



# **Information and Communication Technology**

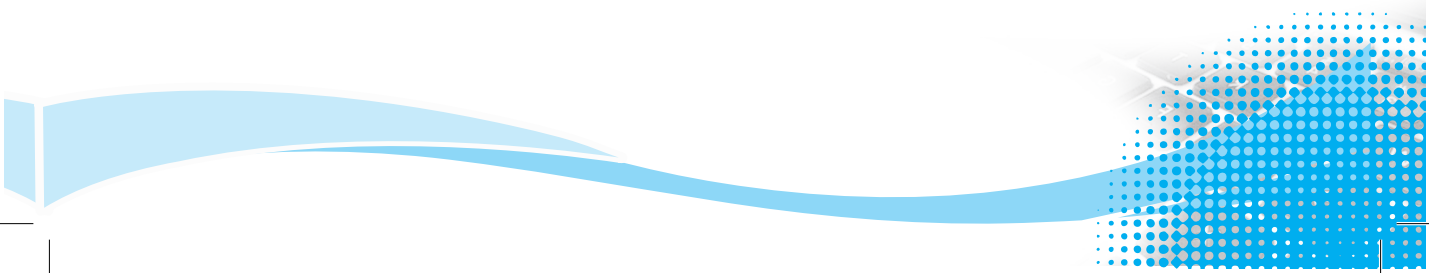
**for Rwandan Schools**

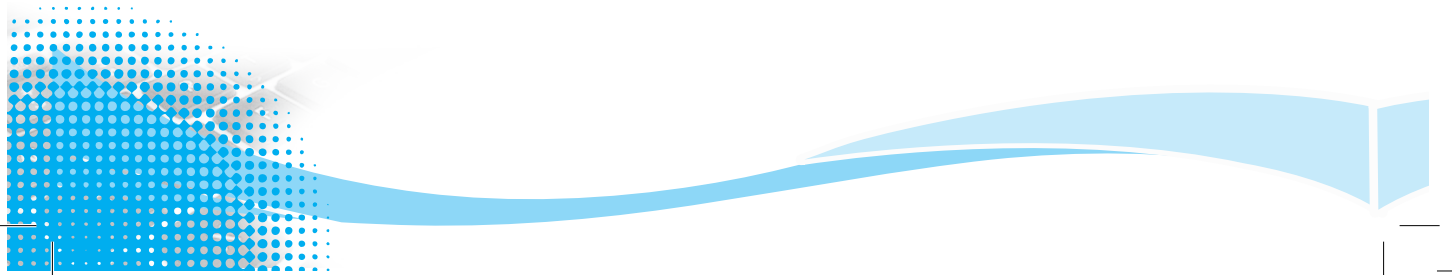
**Secondary 2**

**Student's Book**



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# **Information and Communication Technology**

**for Rwandan Schools**

**Secondary 2**

**Student's Book**





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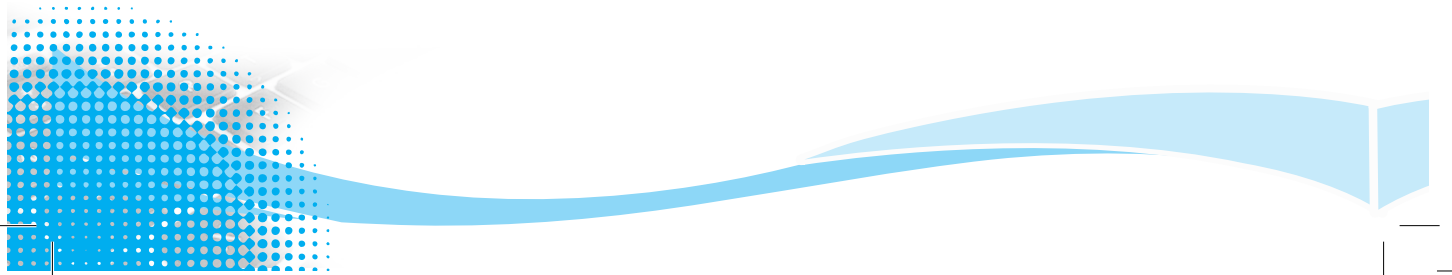
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# Unit 1



## Data Protection

**Key Unit Competency: By the end of this unit, you should be able to:**

Use computers safely and securely to ensure that data is protected.

### Introduction

**Data** is the plural form of the word **datum**. In modern usage, the word data is accepted when expressed either in singular and plural form. Data refers to a collection of numbers, characters, and symbols which are held in a computer. Data are usually represented in units of eight **bits**, which are called **bytes**.

**Data protection** is defined as the process of safeguarding data from corruption, loss, or unauthorised access. All forms of data are considered assets for an organisation or an institution.

### 1.1 Protect the Computer

In any organisation or institution, it is always necessary to think about the security of computers, as well as the data and information stored in them. Security should be ensured for both computer software and hardware.

It is essential to take measures to protect the computer from threats such as unauthorised access. Persons who gain unauthorised access to a computer system pose a great threat to any institution.

A computer system can be protected from security threats by assigning every authorised person **user privileges** or **passwords** in order to access it. In this case, every authorised user would have to log into the system. Every user's history of activities can be tracked if the system is carefully inspected.

#### 1.1.1 User Privilege

A computer requires the configuration of certain control measures to ensure that privacy is maintained. This also ensures that personal data or information in the computer is secured.

Every user of the computer can have an account created for their use, each account with different privileges. **User privilege** is the permission given to a user to perform an action. It is used to regulate who can view or use the resources in a computer.

In order to access a computer, the user requires some form of **identification** and **authentication**. **Identification** refers to the process of a proving one's identity. **Authentication** refers to the process of verifying the identity of a user.

For the identification process, the computer system first verifies that the user has a valid user account. The process then requires a confirmation of the validity by use of a password if one had been set. The computer maintains an internal list of valid user accounts and a corresponding set of access privileges for each account.

An account can either be an **Administrator** or **Standard user (Guest)** in Windows operating system.

- **Administrator:** This is a user that has superior privileges. Administrators can make changes to the accounts of other users such as changing the security settings, installing software and hardware, as well as accessing and modifying all files on the computer.
- **Standard user (Guest):** This is a user account that allows people to have temporary or limited access to a computer. People with this type of account can use most of the software installed. They can also change the system settings that do not affect other users or the security of the computer. Standard users cannot, however, install software or hardware, or create passwords.

### Procedure for creating a user account

#### Practice Activity 1.1: Creating a user account

- (i) Click the **Start** button.
- (ii) Select **All Apps** from the **Start menu**.
- (iii) Click on **Settings** then select **Accounts** icon. A dialog box appears.
- (iv) Click on **Family & other users** in the left pane.
- (v) Select **Add someone else to this PC** in the right pane as shown in Figure. 1.1.
- (vi) Type the details of the user in the window displayed then click the **Next** button as shown in Figure 1.2.
- (vii) The account is automatically created. The account is given a default account type of **Standard**. To change to Administrator account type do the following:
- (viii) Click on the account in the right pane of the **Accounts** window. A dialog box is displayed as shown in Figure 1.3.

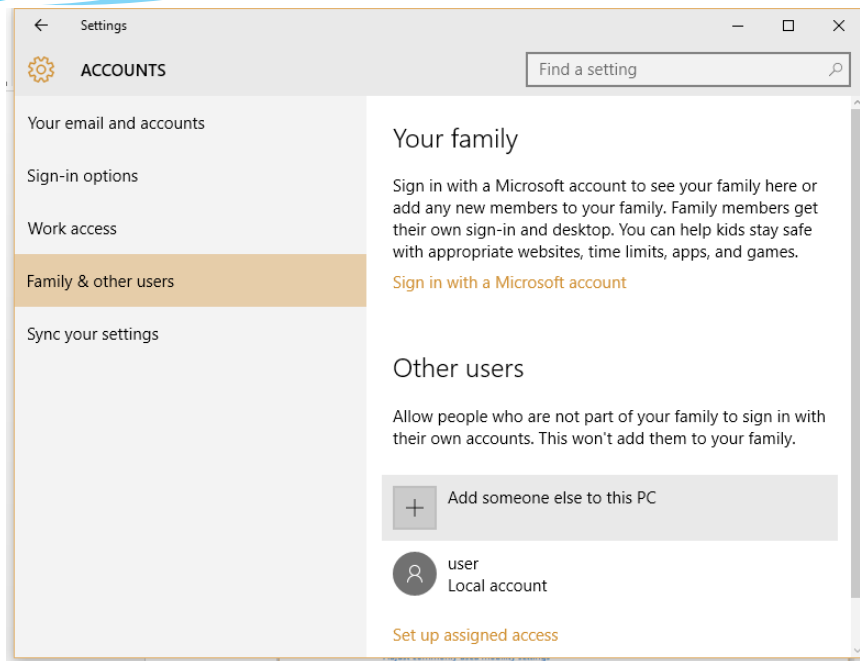


Figure 1.1: Accounts window

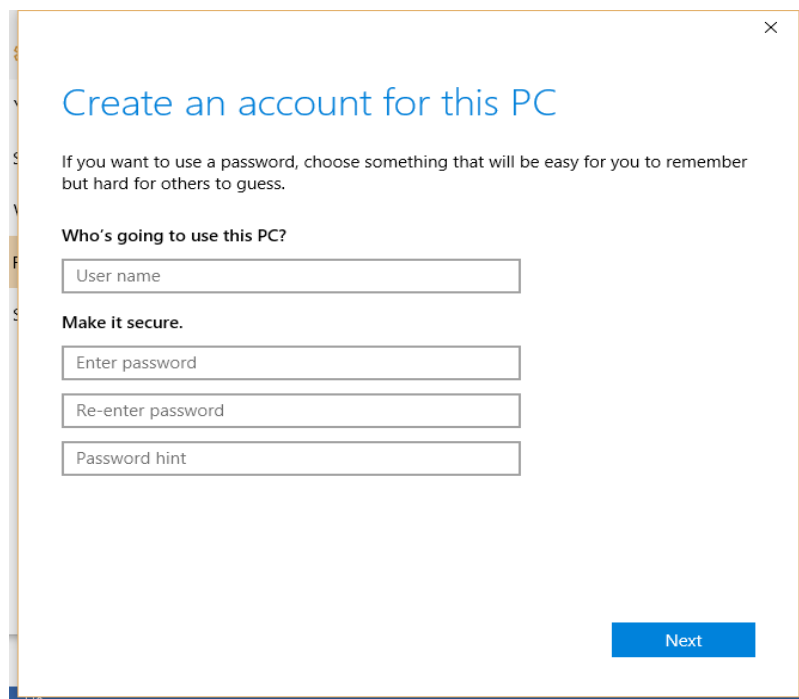


Figure 1.2: User Accounts window

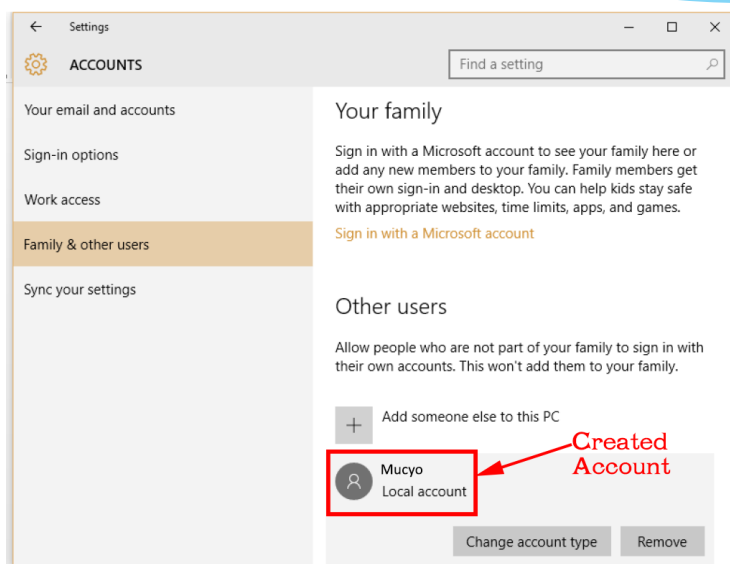


Figure 1.3: The Manage Account dialog box

- (ix) Select **Change account type** button. The dialog box in Figure 1.4 appears.

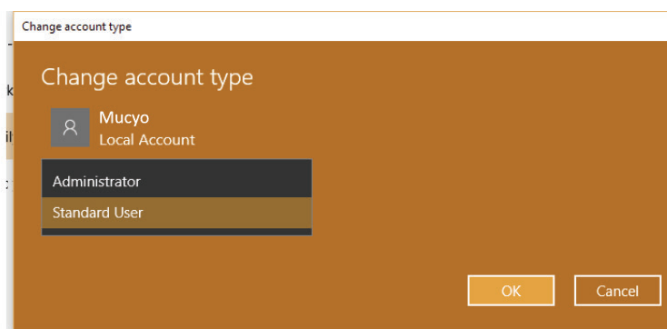


Figure 1.4: The Change account type dialog box

- (x) Click on the box written **Standard User**. Select **Administrator**. Click **OK**.

### Switch between users without logging off

If a computer has more than one user account, it is possible to change from one user account to another without logging off the **Active user account**. To switch between users, do the following:

#### Method 1: Using the Start Menu

- (i) Click the **Start Menu** and then click on **Switch User** command.
- (ii) Select the desired user account.

#### Method 2: Using the Keyboard Shortcut

- (i) Press **Ctrl+Alt+Delete** and then click on **Switch User** command.
- (ii) Select the desired user account.



### Method 3: Using the Shut Down dialogue box

- (i) Open the **Shut Down** Windows dialogue by pressing **Alt+F4**.
- (ii) Click the down arrow. Choose **Switch user** in the list and click **OK**.

Note: You can also use a shortcut to switch user through the **Ctrl+Alt+Delete** options.

Press **Ctrl+Alt+Delete** on the keyboard, and then select **Switch user** in the options.

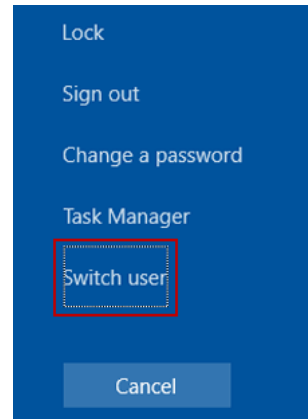


Figure 1.5: Switching user dialog box

### Method 4: Using the User Icon

- (i) Click the **Start** button on the desktop.
- (ii) Click the **User** icon on the top-left corner in the **Start Menu**.
- (iii) Select the desired user **account** such as **Guest** from the menu displayed.

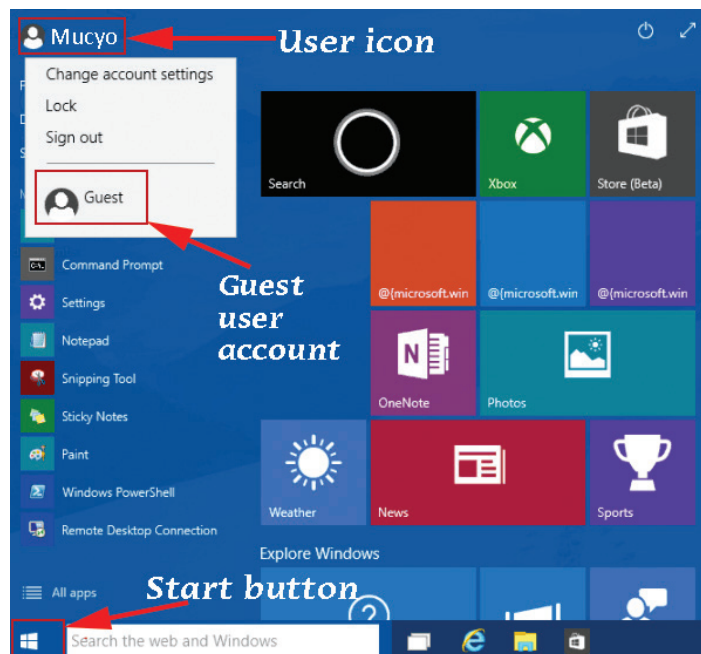


Figure 1.6: Switching the user account icon

### Practice Activity 1.2: Switching the user account

Practise how to switch accounts using various methods.

### 1.1.2 Passwords

The most common method of protecting a computer against any intruder is to set up user accounts with usernames and passwords. Access to the computer is, therefore, denied to anyone who does not have the username and the password.

A **password** is a secret code used to prevent unauthorised access to a computer hardware, software, as well as the data and information stored in the computer. A password provides the user with authority to access information in a computer.

A good password should be strong and easy to remember; but it should be difficult for a **hacker** to guess. A hacker tries to access an account in a computer without permission. The following are characteristics of a strong password:

- (i) It should have at least eight (8) characters.
- (ii) It should contain a combination of uppercase and lowercase letters. It should also have numbers and symbols if they are allowed. An example of a strong password is: **Nkosi%88#**
- (i) It should be changed frequently, for example, after every one month.

#### Tips for creating a strong password

A good and easy method of creating a strong password is as follows:

- (i) Think of a **phrase** that you can easily remember. To create a strong password, the phrase should have at least eight words.

For example: **I Am Smart And I Work Very Hard.**

#### Practice Activity 1.3(a)

Write down a phrase that you can easily remember. The phrase should have at least eight words.

- (ii) Take the **first letter** of each word. In our example (**I Am Smart And I Work Very Hard**) the letters are **IASAIWVH**.

#### Practice Activity 1.3(b)

Now write down the first letters of each of the words in the phrase you wrote down in Part (i) above.

- (iii) Choose some **letters** and change them to numbers that match in shape. For example, you could change the letter I to number 1, and the letter S to number 5. In our example, this change will result in: **1A5A1WVH**.

#### Practice Activity 1.3(c)

Now change some letters to numbers that you consider to be similar in shape as we have done in Part (iii) above.

- (iv) Change some **letters to lowercase**. For example, the letters that are the same, and the last letter. In our example it is letters A and H. The resulting password is: **1a5a1WVh**

### Practice Activity 1.3(d)

Now change some letters to lower case and write down your resulting password.

#### Procedure for creating a password using windows

- (i) Click the **Start** button. Select **All Apps** from the **Start** menu.
- (ii) Click on **Settings** then select **Accounts** icon. A dialog box appears.
- (iii) Click on **Sign-in options** in the left pane.
- (iv) Click on **Change** button in the right pane under Password as shown below.

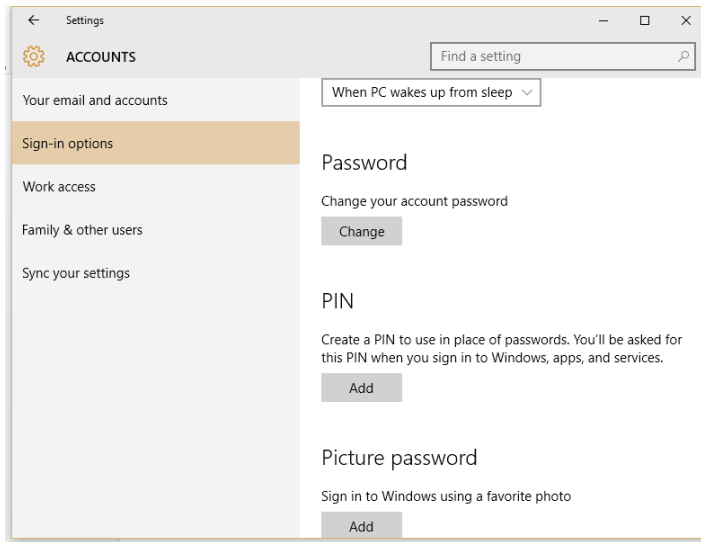


Figure 1.7: Managing sign-in options

Note that not every computer user has privileges for creating accounts and passwords.

#### Procedure for changing the password

- (i) Type the current password in the window provided as shown in Figure 1.8, then click **Next**.

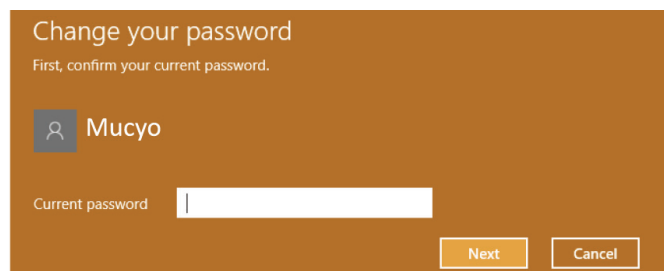
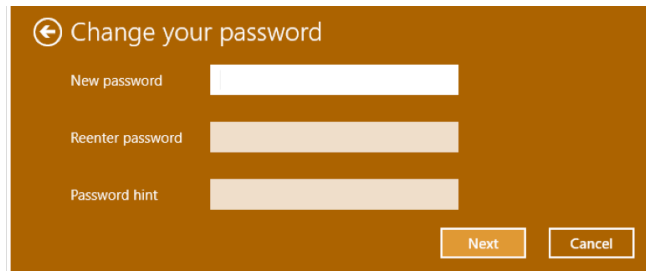


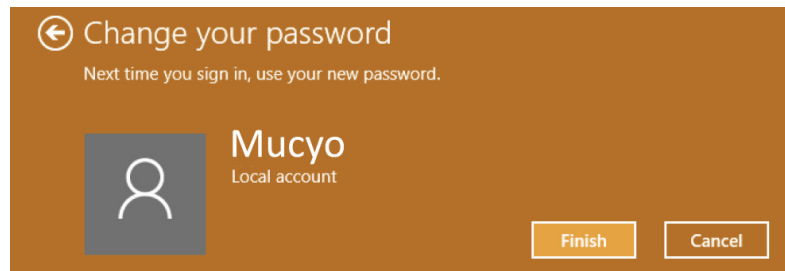
Figure 1.8: The dialog box used for changing the user's password.

- (ii) Type the new password and re-type it again in the window provided as shown in Figure 1.9, then click **Next**.



*Figure 1.9: Make changes to your password.*

- (iii) Enter a new password in the **New Password** box. Re-type the password in the **Reenter password** box.
- (iv) Type a hint in the **Password hint** box. The hint is displayed when you cannot remember the password.
- (v) Click the **Next** command. A final dialog box is displayed. Click on **Finish** as shown in Figure 1.10.



*Figure 1.10: The final step in changing the password*

### **Why do you need to change your password?**

- It is advisable to change one's password every few months for security reasons. Sometimes you may forget to log out of your account in a computer that is used by several people. In this case, someone may find your account open and gain access to your data.
- If someone gets to know your username and password, he or she could log into your computer and change, delete, or corrupt your files.
- If someone gets to know your username and password, he or she could log into your computer and share your files with other users.

#### **Practice Activity 1.4: Creating and changing passwords**

Practise to do the following on your PC:

- (i) Create three possible strong passwords.
- (ii) Change the passwords.

## Setting user privileges

- (i) Click the **Start Menu**. Select **Settings**. Click **Accounts**.
- (ii) Select **Family & other users**. Click “Add someone else to this PC.”
- (iii) Select “I don’t have this person’s sign-in information.” Select “Add a user without a Microsoft account.” Enter a username.
- (iv) Type the account’s password twice, enter a clue, and select **Next**.

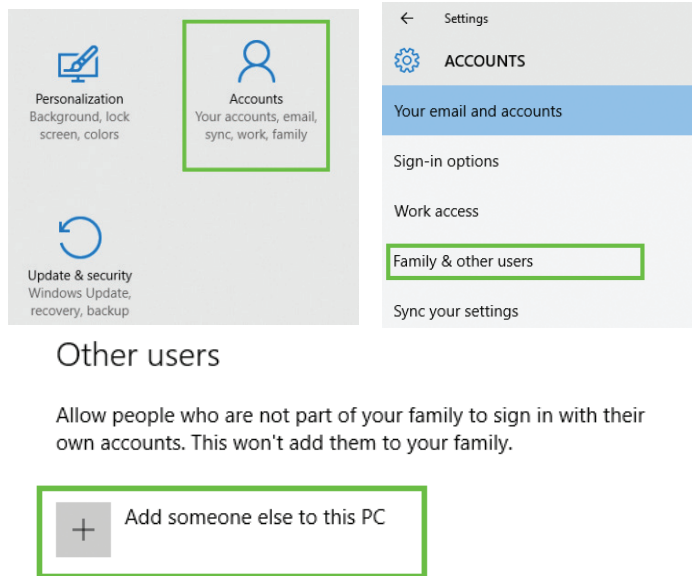


Figure 1.11: Setting user privileges

## Allow and block specific programs in Windows 10

When an account is created in Windows 10, the user privileges are automatically defined with the type of account that has been created. It could either be a standard or an administrator’s account.

The administrator account has more privileges than the standard account. The administrator is able to allow and block specific programs.

To do this, follow these steps:

- (i) Double click on **This PC** icon on the desktop.
- (ii) Open the drive where the application files are located, for example, **C:**
- (iii) Open the **Program** files folder.
- (iv) Right-click on the specific application file and select **Properties**.
- (v) Click on the **Security** tab of the window.
- (vi) Click on the **User profile** name to allow or deny access to the user under **Group or User names**.
- (vii) Click on the **Edit** button and give permissions to the user profile accordingly.

- (viii) Click **Apply** then **OK**.
- (ix) Close the window and check if the changes are effective.

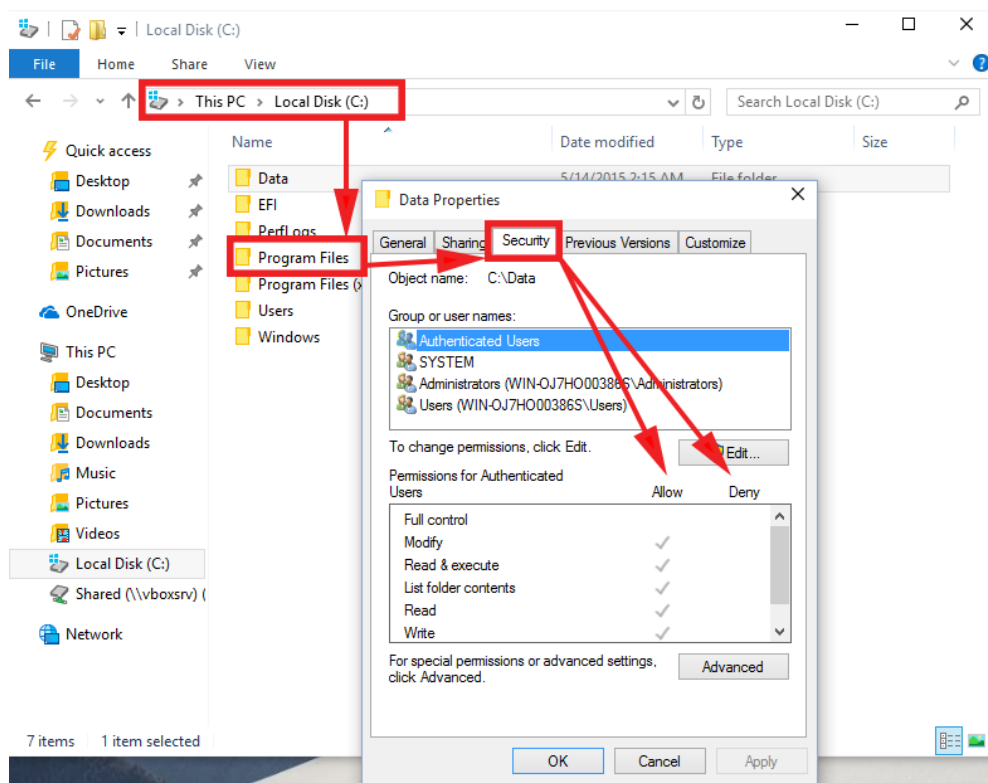


Figure 1.12: Allowing and blocking users from accessing specific programs

### Practice Activity 1.5: Setting user privilege accounts

Practise to allow and block users from using specific programs in Windows 10.

### Revision Activity 1.1

#### Part A: Fill in the missing words with the correct answers

1. A computer is protected by setting up user accounts with \_\_\_\_\_ and \_\_\_\_\_.
2. \_\_\_\_\_ is the permission given to a computer user to perform an action.
3. \_\_\_\_\_ is a secret code used to prevent unauthorised access to a computer, data, and software.
4. One who gains unauthorised access to a computer system is a \_\_\_\_\_.
5. A strong password should have at least \_\_\_\_\_ characters.

**Part B: Answer these questions**

1. Define the term “data protection”.
2. Explain the meaning of these terms: (a) User privileges (b) Password
3. Identify the **two** types of password accounts.
4. Outline the procedure for setting up any one of the password accounts named in Question 3 above.

**Part C: Do the following:**

- (i) Create two new user accounts on your computer; one for the Administrator and another for a Standard User.
- (ii) For both accounts, set strong passwords.

## 1.2 Harmful Programs

### 1.2.1 Definition

The term **harmful program** refers to software that interferes or poses security problems to the computer hardware, software, data, and information.

### 1.2.2. Categories of Harmful Programs

Another name for harmful programs is **malware** (**malicious software**), which refers to software which is specifically designed to gain access or damage a computer without the user’s knowledge. Malware (harmful programs) affect the smooth running of a computer system or carry out illegal activities such as collecting information from unknown users.

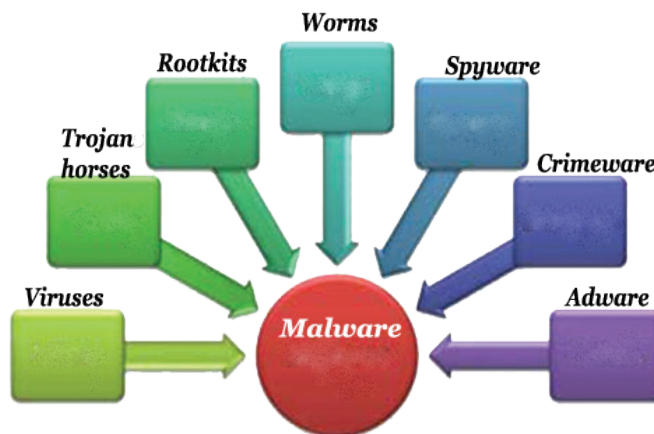



Figure 1.13: Categories of harmful programs

Malware can take the form of forced advertising (**adware**), stealing sensitive data (**spyware**), facilitating illegal activities (**crimeware**), or spreading e-mail (**spam**)



among others. The categories of harmful programs include the following: viruses, worms, Trojan horses, rootkits, spyware, crimeware, and adware. The discussions that follow explain the various types of harmful programs:

### Viruses

- A **virus** is a program that makes a copy of itself over and over again in a computer. This is called **replicating**. Some examples of computer viruses are program viruses, file viruses, boot sector viruses, and hoax viruses.
- A virus is loaded into a computer without the user's knowledge. It can spread from one computer to another.
- It inserts copies of itself into other computer programs, data files, or the boot sector of the hard disk thereby erasing or altering computer files, filling computer memory, or making the computer fail to function.

### Worms

- A **worm** is a malicious program that replicates itself and finally occupies the system memory of the storage media. Worms use the network to duplicate.
- A worm does not alter files. It resides in the active memory and duplicates itself.
- Worms are only noticed when they occupy a lot of space in memory, thereby slowing or halting tasks during processing.


### Trojan Horses

- A **Trojan horse** is a harmful program that disguises itself as genuine software. An unsuspecting user is tricked into downloading and running it on his or her computer system.
- After it is activated, it can irritate the user by popping up windows or changing the desktop, deleting files, stealing data, or activating and spreading other malware.
- Trojan horses are also known for creating back doors to give malicious users access to the computer system.
- Trojan horses do not replicate like worms and viruses; instead they spread through user interaction such as opening an e-mail attachment or downloading and running a file from the Internet.
- Trojan horses can be used to gain access to a computer system. For example, a user can be tricked to download what he or she thinks is a game. Once it is downloaded and runs on the computer, it deletes files in the hard disk. It can also copy and send the saved password to another person through an email.

### Rootkit

- A **rootkit** is a collection of malicious programs designed to a computer or areas of its software and hide there. It may also hide the existence of other malicious





programs. A rootkit hides the fact that an operating system of a computer has been compromised. It does so sometimes by replacing important executable files in the system.

- A rootkit is activated even before an operating system boots up therefore it is difficult to detect.
- Rootkits themselves are not harmful. They are used to hide viruses, worms and other harmful programs by disguising them as necessary files that your anti-virus will overlook.

### Spyware

- Spyware is a program that monitors or tracks personal information or Internet activity and sends such information to someone else.
- Spyware can also gather information about e-mail addresses and even passwords or credit card numbers by recording the key strokes entered into a web form.
- Since spyware exists as an independent program, it has the ability to do the following:
  - monitor keystrokes;
  - scan files on the hard disk;
  - spy on other applications such as chat programs or word processors;
  - install other spyware;
  - read cookies; and
  - change the default home page on the web browser.
- Spyware then relays the collected information to the author who uses it for marketing or advertising purposes. Some malicious authors sell the gathered information to another party.
- Sometimes spyware is included along with genuine software. Sometimes it may come from a malicious website.

### Crimeware

- **Crimeware** is a type of harmful software that is designed to carry out or facilitate illegal online activities.

### Adware

- **Adware** is software that automatically displays or downloads advertising material (often unwanted) when the user is browsing the Internet.

#### Revision Activity 1.2

Research on examples of names of malware. You could present the examples in a table as shown below. Some examples are given.

Examples of viruses	Examples of Trojan horses	Examples of Rootkit	Examples of worms	Examples of spyware
ILoveYou Code Red Melissa Sasser			Michelangelo Blaster Brontok Bagle	

### 1.3 Sources of Viruses

There are many sources of computer viruses. They include the **Internet** and **storage devices or media**.

#### 1.3.1 Internet

The following are some sources of computer malware:

- **E-mail attachments:** A virus can come as a file attached to an e-mail message. This type of virus is known as a **hoax**. When the file is opened, the virus is activated. This causes damage such as destroying files on the hard disk. It may also get forwarded to every contact listed in the address book.
- **File sharing:** Internet users are able to share or exchange files that are in their individual computers. This, therefore, makes it possible for such computers to be vulnerable to virus infection risks. This is because viruses can be transmitted along with the file to be shared.
- **Malicious websites:** These are sites that trick the user into giving away information or downloading a virus. They may have a code that finds and exploits weak security points in a computer. If such a site finds a security weakness, it downloads a virus to the computer and installs it without the user knowing. Malicious websites may be associated with malware, viruses, and misleading applications such as antivirus, computer games, or fake codes.

#### 1.3.2 Storage Devices or Media

A common way of spreading viruses among computers is the use of removable storage media. These devices are connected to a computer system through a port or drive. Examples of such devices are flash disks and external hard drives.

**Windows Autorun** in a computer is a feature that runs automatically when Windows starts. Windows Autorun triggers the virus to run and get transferred to the computer system when a storage device is inserted.

When copying data, the data together with the malware are transferred to the storage medium, for example, a flash disk. When the medium is connected to another computer, the malware is automatically copied to the next computer.

### Symptoms of a computer infected by viruses

- (i) A computer system takes longer than usual to load programs and carry out other operations.
- (ii) Unfamiliar graphics appear on a computer file.
- (iii) The drive light of a non-referenced drive comes on without a reason.
- (iv) The computer unexpectedly restarts without instruction.
- (v) The file size in the computer becomes unusually large.
- (vi) The size of Random Access Memory (RAM) may become smaller.

#### Revision Activity 1.3

##### Part A: Fill in the missing words to complete the sentences

1. Rootkit are harmful programs. They are used to hide \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
2. \_\_\_\_\_ refers to viruses whose source is e-mail attachments.
3. \_\_\_\_\_ are sites that trick one into giving away information or downloading viruses.
4. A Trojan is a harmful program that disguises itself as \_\_\_\_\_ software.
5. Drive light of a non-referenced drive coming on without a reason is an indication of \_\_\_\_\_.

##### Part B: Study these questions carefully and give the correct answers

1. What is the meaning of the term harmful program?
2. Apart from viruses, identify other categories of harmful programs.
3. A lab technician found out that some of the computers in a school were infected with a computer virus.
  - (a) Give the symptoms of a virus-infected computer.
  - (b) What are the measures to protect a computer system from virus attacks?

### 1.4 Measures to Prevent Harmful Programs

The following measures can be used to prevent harmful programs:

#### 1. Install an antivirus program

An antivirus refers to computer software that is used to prevent, detect, and remove malicious software. Antivirus software is sometimes abbreviated as **AV**. It is also known as **anti-malware** software. In a computer installed with an antivirus program, always do the following:

- **Keep the antivirus up-to-date** at all times. This ensures that the antivirus is able to detect and remove any emerging viruses.

- **Scan** and detect viruses. To scan means to go through all the parts of the computer system carefully in order to detect the presence of viruses.
- **Quarantine** infected files and programs to prevent the virus from spreading. To quarantine means to separate the infected files on a computer's hard disk. Quarantined files are no longer capable of infecting the computer system.
- Delete or remove the files infected with viruses.
- Notify the user in case a virus is detected.

Antivirus programs can be purchased from seller outlets directly or downloaded from the Internet.

It is advisable to install the latest antivirus software in the computers and regularly have it upgraded so that it is able to deal with any new viruses.

Examples of antivirus programs include Microsoft Essentials, Kaspersky, Norton, Bitdefender, Windows Defender, Avast, Panda, Macfee, and Rising among others. Figure 1.10 shows examples of antivirus programs.



Figure 1.14: Some antivirus programs

#### Practice Activity 1.6: Installing an antivirus program in a computer

Do the following:

- Access the Internet.
- Search for an antivirus software you are familiar with.
- Download the installer of the latest version of the antivirus software by clicking the **Free Download** button. The installer icon will be displayed.
- Right-click the installer and click **Run as Administrator**.
- Click **Install**.
- The progress bar will indicate when the installation is complete.
- You can now run the antivirus program to protect your computer.

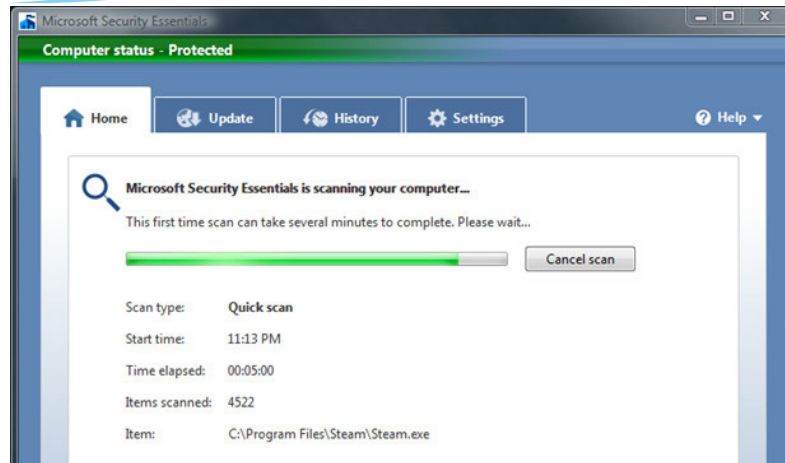


Figure 1.15: Scanning the computer for malicious software

### Steps for scanning a flash disk for viruses

A flash disk is an example of a secondary storage medium. Viruses can easily be spread across computers through the use of secondary storage media such as flash disks. It is advisable to always scan a flash disk or any other secondary storage medium for viruses before use. Most antivirus programs automatically run when a medium, for example, the flash disk is inserted in the USB port in the computer.

#### Practice Activity 1.7: Scanning a flash disk for viruses

To scan a flash disk for viruses, do the following:

- (i) Insert the flash disk into the USB port.
- (ii) Run the antivirus program installed in the computer.
- (iii) If there are any security threats, the antivirus displays their details.

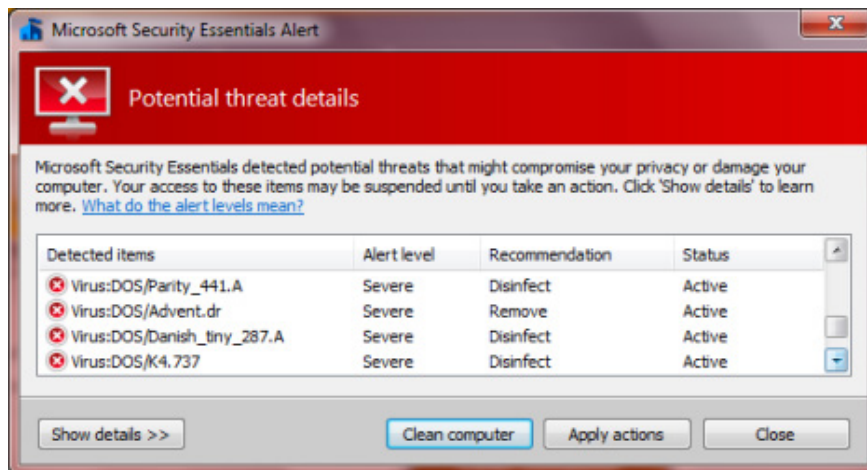


Figure 1.16: Scanning the computer for malicious software

### Practice Activity 1.8: Scanning a flash disk for viruses

Do the following:

- Identify the antivirus program installed in your computer.
- Use it to scan a flash disk for viruses.

**Note:** The use of **cloud-based storage service** to store and share files and folders is a safe way to avoid the spread of computer viruses through secondary storage devices. Cloud-based services refer to data storage services where data are stored, maintained, managed, and backed up over the Internet.

Examples of cloud-based storage services are Onedrive by Microsoft, Dropbox, and Google Drive by Google. Documents stored in the cloud service can be retrieved from a computer located anywhere in the world as long as there is Internet connectivity.



Figure 1.17: Cloud-based storage services

## 2. Keep the antivirus software updated

Companies that sell antivirus programs keep updating them. It is important to always keep the antivirus program installed updated at all times. Microsoft always releases security updates that can help protect one's computer. Always ensure that your operating system is always updated by turning on Windows Automatic update.

## 3. Install anti-spyware software

This is a type of program designed to prevent and detect unwanted spyware program installations. It also removes those programs that have been installed.

## 4. Scan emails for viruses

**Do not open email attachments** unless you are sure of the source. Since computer viruses are often contained in email attachments, scan the attachments for viruses before opening them. Most email services, for example, Google and Yahoo automatically scan emails for viruses before downloading any attachments.

## 5. Avoiding non-secure sites

The following are some control measures to be observed when dealing with non-secure websites:

- Avoid visiting sites you are not familiar with. These may be unsecured sites. Such sites promise to have free downloads of games and books.

- Block sites that you do not want the computer to connect to through the browser. Examples are sites that may contain indecent information and graphics.
- Google Chrome tells you if the site you're trying to visit is dangerous or deceptive.

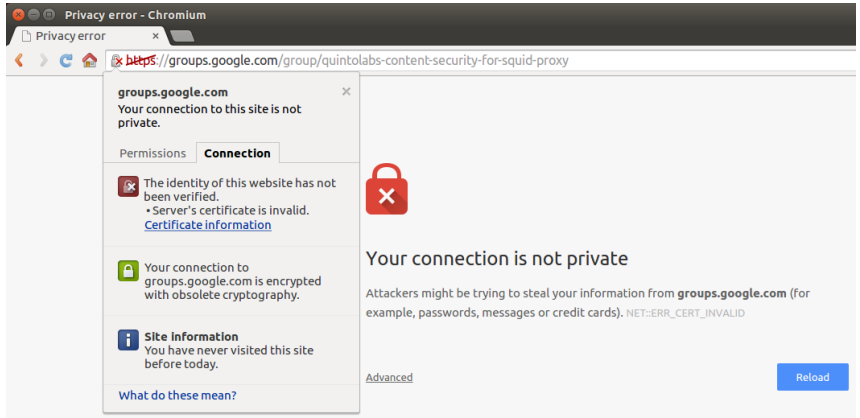


Figure 1.18: Warning on dangerous sites

This is how you turn on warnings about dangerous sites: On your computer, open Chrome. At the top right, click the Chrome button and then Settings.

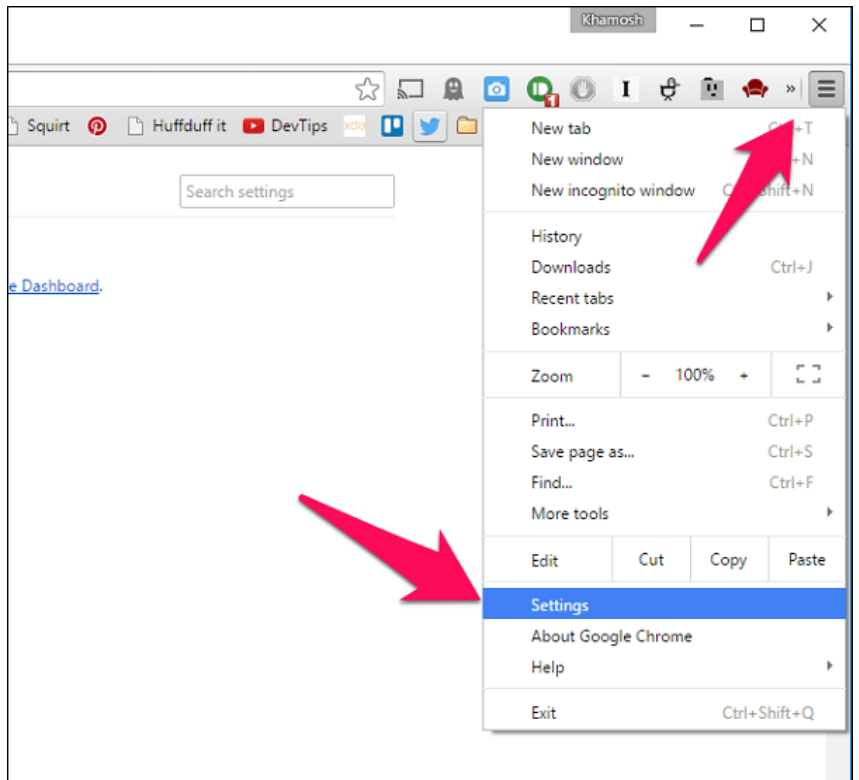
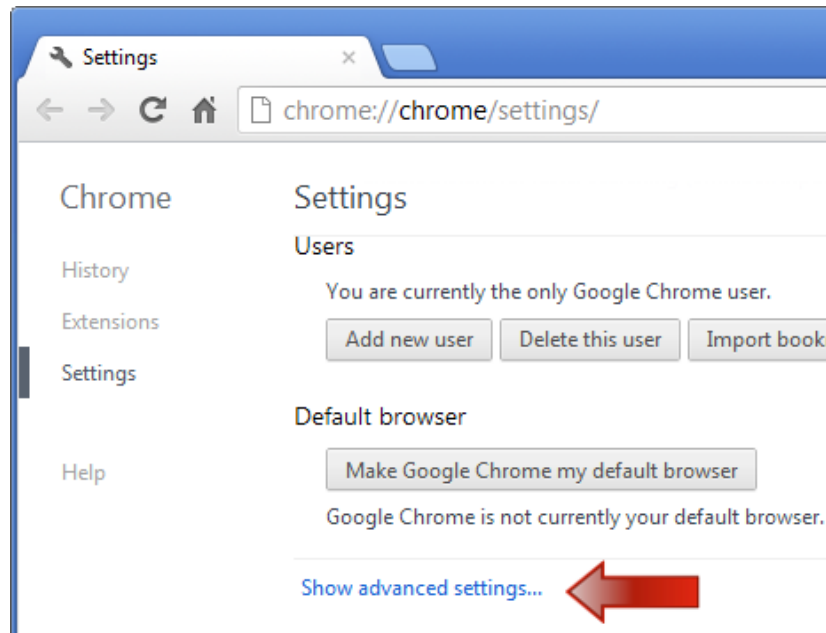


Figure 1.19: Settings in Chrome

At the bottom, click **Show advanced settings.**



*Figure 1.20: Advanced settings in Chrome*

Under “**Privacy**,” check the box next to “**Protect you and your device from dangerous sites.**” It is recommended that you ensure that the alerts are turned ON at all times.

#### Privacy

[Content settings...](#) [Clear browsing data...](#)

Google Chrome may use web services to improve your browsing experience. You may optionally disable these services. [Learn more](#)

- Use a web service to help resolve navigation errors
- Use a prediction service to help complete searches and URLs typed in the address bar or the app launcher search box
- Prefetch resources to load pages more quickly
- Automatically report details of possible security incidents to Google
- Protect you and your device from dangerous sites**
- Use a web service to help resolve spelling errors
- Automatically send usage statistics and crash reports to Google
- Send a "Do Not Track" request with your browsing traffic

*Figure 1.21: Settings for protecting the computer from harmful sites*



- Use **Windows firewall** to block unsecured sites. A firewall is a software program or a piece of hardware that helps to detect and keep out hackers, viruses, and worms that try to reach your computer over the Internet.
- Always avoid sites that have **warning of certification**. A site's certificate allows your browser to establish a secure connection with the site. If your browser warns you of a certification error, it is likely that the website could pose a threat to your computer system.
- Avoid clicking on pop-up sites that appear on the Internet.

## 6. Other precautionary measures

Other ways of ensuring safety of the data are as follows:

- Use proper cleaning agents to clean the computer hardware including the screen and the keyboard, for example, soft cotton cloth and cleaning solvents available in the market.
- Prepare backups for all the data and documents held on the computer. A back up is a copy of a file or any other item of data made in case the original is lost or damaged.
- Compressing files, folders, and programs decreases their size. This then reduces the amount of space they use on the computer drive or removable storage devices. Files that have been stored in a zipped compressed folder can be protected with a password.

### Revision Activity 1.4

**Part A: Fill in the missing words to complete the sentences:**

1. An antivirus software \_\_\_\_\_ infected files to prevent virus spread.
2. Computer viruses are mainly spread through secondary storage devices. \_\_\_\_\_ and \_\_\_\_\_ are examples of secondary storage devices.
3. A \_\_\_\_\_ is a set of hardware and or software equipment that is used to prevent hackers from invading private networks.
4. List some examples of antivirus programs:
  - (a) \_\_\_\_\_
  - (b) \_\_\_\_\_
  - (c) \_\_\_\_\_.

**Part B: Do this exercise**

Viruses are a major problem for a computer user. Explain the possible measures to protect computer systems from virus attacks.

**Part C: Do the following:**

- Install an antivirus in the computer system.
- Use the antivirus software installed in the computer to scan the computer and a flash disk for viruses.

## 1.5 Definition of Key Words in this Unit

### Revision Activity 1.5

**Find out the meaning of the words given below. Share your findings with the rest of the students in a class presentation. Check the meanings you find against those provided in the glossary at the end of this course book:**

Data Protection	User privileges	Passwords	Viruses	Worm
Spyware	Trojan	Rootkit	Malware	Internet
Antivirus	Scan	Restore	Firewall	Piracy
Cleaning agent	Antispyware	Backup	Compressing files	

### Revision Exercise 1

1. State **two** reasons why data protection is necessary in an organisation.
2. Differentiate between standard and administrator accounts.
3. State **three** ways in which an antivirus software can protect a computer system from virus attacks.
4. Differentiate between spyware and adware.
5. Give **two** sources of computer viruses.
6. State **two** characteristics of a strong password.
7. State **three** preventive measures that could be taken to avoid infection from a virus through a secondary storage medium.
8. State **one** function of a password.
9. While using your e-mail, a pop-up menu could be displayed that could contain a virus. State **one** method of preventing pop-ups in your web browser.

## Unit 2



# ICT in Financial Transactions

**Key Unit Competency: By the end of this unit, you should be able to:**

1. Analyze and criticise the role and impact of computing tools in financial transactions.
2. Use computing tools in financial transactions.

### Introduction

To **transact** means to conduct or carry out business. **Financial transaction** refers to an agreement or communication between a buyer and a seller on how to carry out business. They agree on the terms of exchanging goods or services for payment.

ICT as a tool in financial transactions enables the smooth and efficient running of the agreements and payments made between the buyer and the seller.

### Practice Activity 2.1: Role of computers in society

Research on the role of computer use in society. Compile a report. Make a presentation in class.

## 2.1 The Role of Computers in Financial Transactions

Computers are important tools in all financial transactions. Computers are used to **automate business operations**, for **record keeping**, and for the **stock exchange**.

### 2.1.1 Automated Operations

**Automation** is the process of using computers and information technology to produce products and offer services with minimal human involvement.

Some examples of automated operations include **automated accounting**, **automated mailing**, and **Electronic Data Interchange (EDI)**.

#### 1. Automated Accounting

- **Automated accounting** refers to the process of maintaining up-to-date accounting records using accounting software.
- Accounting software allows easy cross-posting of accounting records.
- Most of the readily available automated accounting systems can be customised to suit the needs of the company that purchases the software. This makes it possible to create customised reports.

- Many organisations in Rwanda use accounting software. With this type of software, an organisation is able to administer and manage the income, expenses, and assets, as well as maximize the profits and ensure sustainability.
- The Unstructured Supplementary Service Data (USSD). **USSD** is the short for **Unstructured Supplementary Service Data**. This is a technology that is used for communication.
  - ➔ The USSD is a system for mobile telephony that enables a mobile user to send text between a mobile phone and an application program in the computer network of the service provider.
  - ➔ Examples of USSD applications may include prepaid call back services, mobile money services, and mobile chatting.
  - ➔ USSD services allow a two-way exchange of data
  - ➔ When the mobile user sends a message to the phone company network, it is received by a computer that gives USSD services. The computer gives a response that is sent back to the phone. The message is displayed on the phone screen. The service provider determines the format of the messages that are sent over USSD to their customers.

### Using the USSD

- (i) The user sends a request to the network via USSD by dialing the number such as \*182# or \*131#.
- (ii) This message is received by the computer in the service provider's network that processes USSD requests.
- (iii) The USSD may have a reply for the user with a number of options and ask the user to select, for example, \*182#. The USSD may reply with acknowledgement message such as: "Thank you for your request. Your message is now being processed. A reply will be sent to your phone."

#### Practice Activity 2.2: Types of financial technologies and their use

1. Identify USSD codes available locally and frequently used in Rwanda. Practise to use each USSD code.
2. Find out some examples of software in financial transactions commonly used in Rwanda. Write down their trade names. Find out some of the functions that the identified software offer. Share your findings with the rest of the students.

## 2. Automated mail

- **Automated mail** refers to a business tool that makes it easy to process a large volume of mail.
- The sender uses electronic methods to address, sort, and prepare the information for mailing. The mails are then automatically sent to the users.

- Automated mail software can be configured to automatically send a reminder to customers about a planned event. The message sent will remind the customers about the date, the venue, and the time of the event.
- Institutions that send mails in bulk use automated mail. The Rwanda Education Board (REB) is an institution that uses automated mail to send bulk mails to stakeholders in the education sector.

### 3. Electronic Data Interchange (EDI)

- EDI is a computer-to-computer exchange of business documents.
- It is a process that allows business partners to trade without the need for humans and paper work.
- EDI replaces postal mail, fax, and email. Though email is also an electronic approach, the documents exchanged via the email must still be handled by people rather than computers.
- EDI documents flow straight through the receiver's computer. The processing of the business transaction can begin immediately.
- With EDI, an organisation receives and processes an order electronically. EDI reduces the number of days that the process takes to complete.
- Rwanda became the first country in sub-Saharan Africa to launch a one-stop electronic clearing system. This is an example of an electronic data interchange system where cross-border trade procedures are automated. This reduces the cost of doing business.

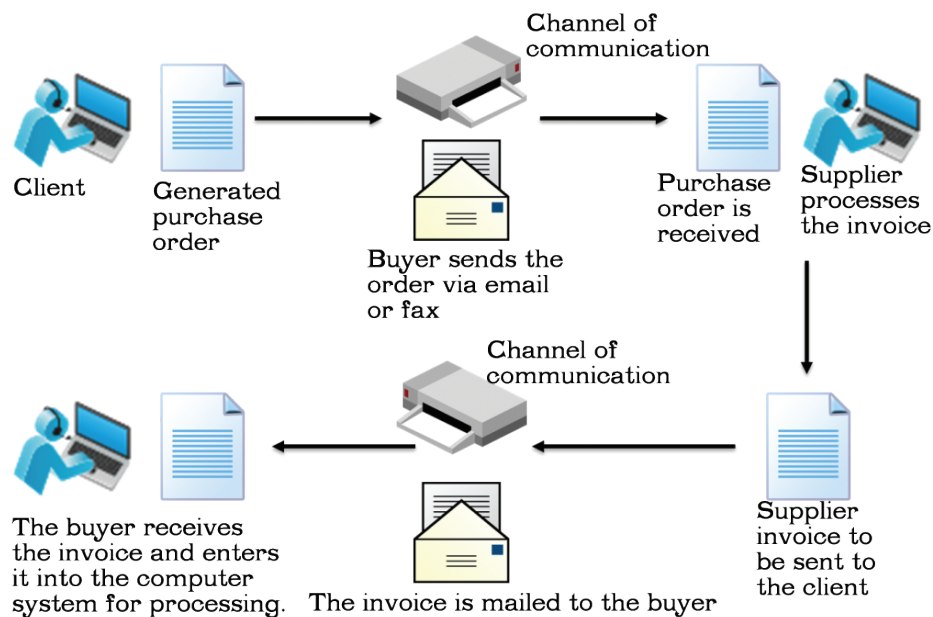


Figure 2.1: Processing a purchase order using an electronic data interchange (EDI)

### 2.1.2 Record Keeping

A **record** is something that represents proof of existence. A record can also be used to recreate or prove evidence about the past. Records are usually in writing or any other permanent form.

**Record keeping** is the systematic process of recording, creating, capturing, and maintaining transactions and events in an accounting system.

Record keeping software such as accounting software, databases, and book keeper provide ready-made reports. They also provide the user with a large storage space for files, back-up of records, and security of files through the use of passwords among other things.

#### **Advantages of using computers in record keeping**

- (iv) It is an efficient way to keep financial records.
- (v) It requires less storage space than physical files.
- (vi) It is easy to generate financial reports such as orders, invoices, and debtor reports or other records.
- (vii) Once the separate documents are done, the computer program is able to summarize and prepare the final financial records automatically.
- (viii) Enables the user to back up records faster and keep them safely.

#### **Disadvantages of using computers in record keeping**

- (i) Investing in computers for record keeping requires great amount of money.
- (ii) For people to work with computers, they need to be trained properly. Training requires money.
- (iii) In case there is no backup, one can easily lose data.
- (iv) The quality of instructions issued to the computer by human operator determines the accuracy of content.

### 2.1.3 Stock Exchange

**Stock exchange** is a market where the shares of public listed companies are traded. These shares are in bonds, stocks, and other securities. In this market the shares are issued, bought, and managed.

Other names used to describe the stock exchange are **stock market**, **bourse**, and **equity market**.

**Automated Trading Systems (ATS)** enable the customers to trade in stock without going through **stockbrokers**.

A stockbroker is a professional who buys and sells securities on a stock exchange market on behalf of his or her clients. In using the ATS, the computer in this case acts as the broker. The computer program used is able to create orders and automatically submit them to the ATS.



Figure 2.2: The stock exchange market in Rwanda

### The use of computers in the stock exchange

An **Electronic Communication Network (ECN)** is a type of computerized network that is used in the stock exchange. It allows orders made to be communicated electronically.

To trade with an ECN, one must open an account with a broker. This allows the user direct access trading. To use the ECN, one enters an order into the ECN through a computer to allow one to trade on stock exchange.

Some ECN systems offer additional features such as negotiation. **Negotiation** is the process of making offers and counteroffers, with the aim of finding an acceptable agreement.

### Stock trading

When a person or an institution engages in the buying and selling of stock, he or she is said to be engaging in **stock trading**.

Stock trading can be done online using computers that are connected through the Internet. This is called **online stock trading**.

### Advantages of online stock trading

- (i) Computers ensure that stock trading is faster and more efficient.
- (ii) Investors get more up-to-date information.
- (iii) It allows investors to buy or sell shares quickly.
- (iv) It provides accurate market data. This is important for investors to make informed choices.

### Disadvantages of online stock trading

- (v) Mechanical failures may interrupt the trading process. Back up Internet connection is always required.

#### Revision Activity 2.1

**Part A: Fill in the missing blanks with the correct answers**

1. EDI stand for\_\_\_\_\_.
2. Examples of accounting software are \_\_\_\_\_ and \_\_\_\_\_.

**Part B: Find and highlight terms used in financial transactions**

Identify the following word that related to financial transactions. Circle them in the maze below: Transaction; Trading; Mail; Accounting; Stock; and Broker

A	T	D	R	F	G	K	O	H	D
T	R	A	D	I	N	G	G	U	P
F	A	P	Q	P	I	K	Z	R	D
K	S	T	O	C	K	T	M	W	S
G	A	M	G	C	B	J	A	E	X
A	C	C	O	U	N	T	I	N	G
H	T	X	C	I	D	J	L	B	Y
P	I	M	N	W	C	B	P	C	N
R	O	A	B	R	O	K	E	R	V
O	N	Z	G	X	L	Z	D	X	G

#### Revision Activity 2.2

**Read the following questions carefully and give the correct answers**

1. Define the term 'record keeping'.
2. State the role of computers in record keeping.
3. State **three** advantages of using ICT in the stock exchange.
4. Explain the role of ICT in Automation.
5. Explain automated accounting as used in financial technology.



### Revision Activity 2.3

#### Do this activity:

1. Research the advantages of the automated record keeping system over the manual. Make a class presentation to the other students.
2. Research the Rwanda stock exchange. Find out the stocks available in the market. Research some terms commonly used in the stock market. Find out their meanings. Prepare a report and present it to the teacher for marking.

## 2.2 Financial Technologies in Society

**Financial Technology** also known as **FinTech** refers to the use of software and digital platforms to offer financial services to consumers.

The use of financial technological tools often creates new and efficient means of providing services to consumers. It allows monies to be transferred through mobile devices. Users are able to transact without handling cash.

Most banks now offer a service called **online banking**. This service is also known as **Internet banking**, **e-banking**, or **virtual banking**. It refers to an electronic payment system that enables customers of a bank or other financial institution to perform banking transactions through the financial institution's website. A customer is able to transfer money from one account to another through the use of a computer that is connected to the Internet. The following is a discussion of some technologies related to financial transactions, namely: **E-commerce**, **ATM**, and **mobile banking**.

### 2.2.1 E-Commerce

**E-Commerce** is electronic commerce. It is also known as **eBusiness**. It is the buying and selling of goods and services over the Internet using credit cards in online shops.

- **Credit card:** This is a plastic card normally issued by a financial institution to allow its user to borrow short-term pre-approved funds at the point of sale in order to complete a purchase. The debt does not incur interest until the period given by the bank elapses.
- **Online shopping:** This is a form of electronic commerce which allows consumers to buy goods or services directly from a seller over the Internet.

#### Using a credit card in online shopping

The following are the steps for using a credit card in online shopping:

- (i) Connect to a secure and encrypted network. To encrypt is to convert information or data into a secret code. This process helps to prevent unauthorised access.

- (ii) Enter the online address of the website where you want to purchase the item from in the address box of the browser's window.
- (iii) Select the items to purchase and click the appropriate button used for purchasing the item.
- (iv) Enter the shipping, billing, and credit card details.
- (v) Click the appropriate button to complete the transaction.
- (vi) Print the confirmation screen or proof of purchase received upon completing the transaction. Keep this record until the purchased item arrives.

### **How to Make Online Financial Transactions Secure**

- (i) Do not use the same passwords and usernames for all accounts.
- (ii) Ensure that the password used is strong enough. A strong password contains a combination of numbers, symbols, and lowercase and uppercase letters.
- (iii) Change the passwords frequently, preferably every one to three months.
- (iv) Ensure the antivirus and firewall security programs are up-to-date.
- (v) Consider using debit cards for online shopping transactions.
- (vi) When performing online transactions do not use unsecured WIFI.

### **2.2.2 Automated Teller Machine (ATM)**

An **Automated Teller Machine (ATM)** is an automatic transaction machine. It is used together with an ATM card or a debit card to access, deposit, withdraw, and check the account balances and print mini statements among other things.

#### **Withdrawing money from an ATM**

To withdraw money from an ATM, do the following:

- (i) Insert the card into the ATM machine. A dialog box is displayed.
- (ii) Enter the **Personal Identification Number (PIN)** then press the Enter key. A dialog box is displayed. **PIN** refers to an identifying number. It is assigned to an account holder by the bank or any other organisation. It is used to check the accuracy of the user's details when carrying out an electronic transaction.
- (iii) Choose the type of transaction from the list provided such as withdrawal, deposit, mini statement, or checking account balances.
- (iv) To withdraw money, select the amount from the list by pressing the button next to the desired value. However, if the value is not among the list, press the button labelled **Next** to avail other options. Type the amount in the box provided.
- (v) The machine will automatically confirm if the account has enough money; if the money in the machine is adequate; and if the required money is within the bank withdrawal limit. A dialog box is displayed.
- (vi) Select the button labelled **Yes** for the machine to produce a printed receipt, or **No** if a receipt is not required.

- (vii) The machine dispenses the money, ejects the ATM Card, and finally produces the receipt if it was required.

**Note:** ATMs are primarily used for checking account balances and withdrawing money, but some ATMs enable the user to deposit money.

### Depositing money in an ATM

To deposit money in an ATM, do the following:

- (i) Insert the money in the dispenser.
- (ii) Enter the Personal Identification Number (PIN) then press the Enter key. A dialog box is displayed.
- (iii) Choose the type of transaction from the list provided, in this case deposit.
- (iv) Press Enter button. The machine automatically counts the money and updates your account balance. It then displays a dialog box requesting if another transaction is required.
- (v) Press the button next to **No** to exit. Remove your ATM card.



Figure 2.3: Using an Automated Teller Machine (ATM)

### Checking the account balance in an ATM

To check your balance in an ATM, do the following:

- (i) Insert the ATM card and enter your personal identify number (PIN).
- (ii) Choose the type of transaction from the list provided, in this case balance enquiry.
- (iii) Press the button labelled **Next** then press the **Balance Enquiry** option. The machine automatically checks the account and displays the required information. Press **ESC/Exit** button to remove the ATM card.

#### Practice Activity 2.3: Using an ATM

Visit the nearest bank and ask the information officer to guide you to do the following:

- Use the ATM to withdraw and deposit money.
  - Check the account balance.
  - Understand the advantages and disadvantages of using the ATM.
- You could also perform a library or Internet search on the above topics.

### Some advantages of using the ATM

- Cash can be withdrawn at any time of the day.
- The ATM offers the convenience of transacting in multiple locations.
- The use of PIN ensures that your money is safe in case the card is lost.

### Some disadvantages of using the ATM

- When there is a failure in the network, access to your account is denied.
- The ATM card could be stolen.

- **Be Safe when using an ATM:** It is advisable to use an ATM that is located within a building. The chances are that such an ATM is monitored by closed-circuit television (CCTV).
- CCTV refers to a television monitoring system that uses video and several cameras. Video pictures are transmitted from one or more cameras by cable to a set of monitors. It is also commonly used in supermarkets to capture shoplifters. CCTVs can also be installed in homes for security reasons.

### 2.2.3 Mobile Banking

Mobile banking refers to the use of a mobile application and device to provide banking services to customers.

Most banks nowadays have the mobile banking facility. Some of the mobile banking facilities offered are:

- (i) Buying airtime
- (ii) Sending money to your mobile phone
- (iii) Checking the balance
- (iv) Withdrawing cash
- (v) Transferring funds
- (vi) Getting a mini statement
- (iv) Service requests (Cheque book requests, Forex rates, full statement request, stop cheque)

#### Practice Activity 2.4: Activities on mobile banking

Use mobile devices or visit a mobile banking agent to do the following:

- Use mobile banking services to withdraw and deposit money.
- Check the account balance and get a mini statement.

## Advantages of mobile banking

The following are some advantages of mobile banking:

- (i) It makes life easier since customers can access their accounts from the comfort of their homes.
- (ii) The customer is notified of any transaction carried out on their account.
- (iii) Mobile banking applications are easy to use thus user-friendly.
- (iv) The use of mobile banking reduces cases of fraud.
- (v) The transfer of funds from one account to another is easy.
- (vi) Paying of bills is done more quickly and at the convenience of the customer.

## The process of loading money on a mobile phone account

When money is deposited in an account, it is automatically loaded to that account. To load money in a mobile phone account, do the following:

- (i) Visit an agent shop displaying the sign of a mobile money service provider.
- (ii) Pay the money.
- (iii) Provide your mobile phone number to the agent. Ensure that you do not disclose your PIN details to the agent.
- (iv) Wait for a confirmation of the transaction from your service provider.

Once the money is loaded on the mobile platform, it can now be transferred to the bank account. To transfer money to the bank account, obtain the procedure from the bank.



Figure 2.4: Mobile banking

## The process of sending and receiving money

To send money via mobile banking services, do the following:

- (i) Select **SIM Toolkit** from the phone.
- (ii) Choose the mobile money service provider.
- (iii) Select the **Send Money** option.
- (iv) Enter the phone number of the recipient.
- (v) Enter the amount of money to be sent. Ensure there is enough money to cater for the transaction charges.

- (vi) Enter your PIN details.
- (vii) Confirm the details entered then click **OK**.

### **The process of withdrawing money**

To withdraw money from the account, do the following:

- (i) Visit an agent shop displaying the sign of mobile money service provider.
- (ii) Select **SIM Toolkit** from the phone.
- (iii) Choose the mobile money service provider.
- (iv) Select the **Withdraw Cash** option.
- (v) Select **From Agent** option.
- (vi) Enter the agent number.
- (vii) Enter your PIN details.
- (viii) Enter the amount of money to be withdrawn. Ensure there is enough money to cater for the transaction charges.
- (ix) Confirm the details entered then click **OK**.
- (x) Wait for a message to be sent to the agent's phone and your phone confirming the transaction. The agent provides the money at the end of the transaction.

#### **Practice Activity 2.5: Using mobile telephony to send and withdraw money**

With phones that are enabled for mobile banking, do the following:

- Deposit, withdraw, and send money.
- Use mobile money to buy items and pay for services such as airtime, electricity, water, goods, and television services among other things.

### **Mobile money transfer services have made life easier in Rwanda**

- (i) Users can easily save and withdraw money using their mobile phones.
- (ii) Through mobile money transfers, users can easily buy and sell items without travelling long distances.
- (iii) Some mobile money service providers in Rwanda have collaborated with transport companies that operate various routes. Travellers are able to pay their travel fares using mobile telephony.

### **Mobile money security**

To ensure that your money in the mobile device is secure, do the following:

- (i) Do not share the details of your PIN with anyone.
- (ii) Reset the security details such as the PIN frequently.

### Revision Activity 2.4

Fill in the missing words to complete the sentences:

1. \_\_\_\_\_ is the buying and selling of goods and services over the Internet using credit cards in online shops.
2. \_\_\_\_\_ is a form of electronic commerce which allows consumers to buy goods or services directly from a seller over the Internet.
3. Some of the mobile banking facilities offered by banks are \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

### Revision Activity 2.5

Answer these questions:

1. Define the term “online shops”.
2. What is the negative impact of financial technology in society?
3. Explain the term E-commerce.
4. State the importance of mobile banking.

### Revision Activity 2.6

1. Discuss the use of mobile banking in Rwanda.
2. Compare mobile banking and the use of ATMs.
3. Discuss the use of mobile banking in Rwanda. Summarise your findings and make a class presentation to the rest of the students.

## 2.3 Impact of Financial Technology in Society

Financial technologies can have both positive and negative effects on society.

### 2.3.1 Positive Impact of Financial Technologies

Financial technologies have brought beneficial changes to society. These include the following:

- Quick service delivery
- Security in transactions
- Unlimited access to the users bank account
- Automated billing
- Automation of routine tasks

- Creation of job opportunities
- Communication networks
- Easy management of payroll
- Increased revenue to country
- Solution to bank service problems

### 1. Quick Service Delivery

The use of computers to buy and sell shares on the stock market is an example of a financial technology. It allows the stock exchange to be carried out through Internet connectivity. Customers are able to get the information they require faster. This enables them to make informed decisions very fast.

The Bank of Kigali, for example, has partnered with mobile telephone service providers to offer **online banking**. In this way, service delivery has improved and customer satisfaction is enhanced.

### 2. Security in Transactions

- Every account holder deposits and withdraws money from his or her account. This money must be protected from danger or threat related to financial transactions such as fraud.
- To protect money held in a bank account, customers are advised to take some precautionary measures. For example, one should not share their PIN number with anyone.
- To withdraw money from an Automated Teller Machine (ATM), customers are issued with an electronic card. The card contains the customer's financial details.
- A customer can withdraw and deposit money, pay bills, and shop using it. A customer should report to the bank immediately if his or her electronic bank card gets stolen or lost.



Figure 2.5: Electronic bank cards

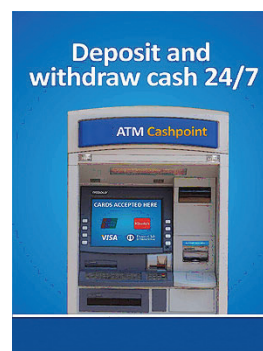


Figure 2.6: An Automated Teller Machine



### 3. Convenience

- Through the use of an ATM, customers have access to banking services from anywhere worldwide.
- Customers are able to access their accounts without going to the main branch.
- Some banks have also expanded online banking to mobile banking. In this way, a customer is able to perform a transaction through a mobile device such as a smart phone or a tablet.



Figure 2.7: Mobile banking

### 4. Unlimited access to the user's bank account

Banks are able to provide their customers unlimited access to their accounts through agency banking, mobile banking, plastic money, and remote banking among other things.

In agency banking, a mobile network operator is able to offer banking services within a locality, for example, in a rural setting or village. In this way, one does not have to travel long distances to the headquarters of the bank in order to carry out a transaction.

Some transactions that one is able to do in agency banking include depositing, withdrawing, and transferring funds, paying bills and requesting the account balance. Banking agents can be situated in drug stores, supermarkets, post offices, and near workplaces.

### 5. Automated system of issuing bills (invoices)

An **invoice** is a list of goods sent or services provided by a company, issued together with a statement of the amount of money owed. Another name for an invoice is a **bill**.

Financial technologies enable businesses to invoice goods and services through computer systems. The bills are then sent to the customers via emails through Internet connectivity. This eliminates the cumbersome manual preparation of invoices.

Billing software is designed to allow the creation of customer accounts. Each account contains all the data about the customer that is needed to accurately prepare the invoice. This data may include the customer's name, the contact address, including the email, and the physical address to allow the efficient delivery of goods.

In Rwanda, billing systems are commonly used by suppliers of goods to supermarkets and other stores.



Figure 2.8: An Automated Billing system

There is also a law that requires every VAT registered taxpayer to use **electronic billing machines (EBMs)**. The transactions on the billing machines enable the Rwanda Revenue Authority (RRA) to monitor payment of taxes by business operators.

#### Practice Activity 2.6: Using billing machines

Visit a supermarket or a shop where they are using billing machines to see how billing machines are used to do the following:

- Record items.
- Generate bills for a given request.

You could also perform a library or Internet search on the above topics.

### 6. Automation of routine tasks to increase efficiency

Computers and computerised systems have replaced human labour in performing some activities, especially routine tasks. The following are some benefits of automating routine tasks:

- The quality of products is improved. This is because tasks are performed with accuracy and with speed. The level of accuracy that is achieved by automation is higher than that which is achieved by human labour.
- An automated system works at a constant speed without pausing for frequent breaks, sleep, and holidays. In this way higher productivity is achieved.

- Automation increases safety in the workplace. Workers are moved to supervisory roles where they no longer have to perform hazardous tasks.

## 7. Creation of job opportunities

New job opportunities are created by the introduction of financial technology. In Rwanda and other countries across the world, new job opportunities have been created. Examples include the following: ICT manager, bank agents, data entry clerks, and systems analysts among others.

## 8. Communication networks

Communication networks have improved financial services by bringing the services nearer to the people, making it cheaper, faster, and more reliable. The following are communication networks that are used to offer financial services:


- **Internet:** Communication of information on financial transactions through emails has led to improvement in business operations. The Internet banking has improved operations in the banking sector. Customers are able to access their bank accounts and perform transactions any time of the day and from anywhere. Financial institutions also use the Internet to send statements of accounts to their customers.
- **Social Networks:** Financial institutions have embraced the use of social networks as communication tools. These platforms are used by financial institutions to share information with their clients, as well as to market their services to potential customers. Some examples of common social networks include Twitter, Facebook, and Instagram among others.
- **Short Message Service (SMS):** These are short text messages sent via a mobile phone for communication. Financial institutions use these services to communicate with their customers.

## 9. Easy management of the payroll

In most organisations in Rwanda, salaries are paid through **electronic funds transfer (EFT)**. This is a financial system by which money is transferred from one bank account to another. This transfer can either be within a single financial institution or across other institutions. EFT does not require the direct involvement of bank staff. The use of EFT simplifies the process of preparing the payroll and reduces the costs associated with the process.

## 10. Solution to bank service problems

Banking institutions have been experiencing huge challenges when serving large numbers of customers. Some of these challenges include long waiting times, limited time for customer servicing, transaction errors due to the bank



personnel and excessive bureaucracy. Financial technologies have been used to provide solutions to these challenges in several ways. A discussion on some of these follows.

- **Long waiting times:** Long queues of customers waiting for services in the banking hall have been reduced. This has been achieved through:
  - ✓ **Electronic Funds Transfer (EFT):** Customers use debit cards, credit cards, and smart cards to transfer money without visiting the bank either by use of ATM or online banking.
  - ✓ **Mobile banking:** The customer is able to access banking facilities by the use of mobile phones and applications that support all services offered by the bank.
  - ✓ **Internet banking:** This is made possible through online banking facilities available on the Internet. Clients can carry out banking transactions without physically visiting the bank.
- **Limited time for customer servicing:** Before the introduction of technology, the banks were not able to provide services to their customers beyond their operational hours. The introduction of ATM means that the user can access his or her account any time and from anywhere without limitation of time or place. Also through the use of Agency and online banking, a customer can access banking services from anywhere.
- **Transaction errors by the bank personnel:** Transaction errors caused by banking personnel have been reduced through automation of most of the bank services, for example, counting of currency notes is now done by currency counting machine, withdrawals are done by use of the ATM, funds can be transferred electronically, deposits can be done using the ATM, and bills can be paid using a credit card. All these processes help to reduce errors.
- **Excessive bureaucracy:** This happens when management takes too long to make decisions on issues such as approval of bank loans. Customers wait for a long time trying to get feedback. Automation of loan processing and approval has reduced excessive bureaucracy and made the process quicker.

### 2.3.2 Negative Impact

These are the problems that society experiences related to financial technology. Examples include fraud and unemployment.

#### 1. Online financial fraud

Online fraud is an intentional act of dishonesty that is committed using Internet connectivity that may lead to loss of funds or financial data. A bank may, for example, lose personal information of the customers. This information may then be used to commit theft or other unlawful activities.

In other online financial fraud, victims may be misled to transfer money to the accounts of those committing fraud.

For example, an offender may send an email to a victim pretending to be an officer in the bank. The victim may be led to give his or her bank account information.

If the victim unwittingly releases his or her information, the offender may use the stolen identity to withdraw money from the victim's bank account and transfer it to his or her own account. In this case, a financial fraud is committed.

## 2. Loss of jobs causing unemployment

Technological unemployment is a situation where job losses are caused by the development of technologies.

Financial institutions have automated certain services such as counting of money. They have also automated services such as deposits and withdrawals through the use of automated teller machines. This automation has led to loss of jobs for tellers and cashiers.

### Revision Activity 2.7

#### Fill in the missing words

- \_\_\_\_\_ is a combination of letters, numbers or special symbols that are used to gain access to information in an account during financial transactions.
- \_\_\_\_\_ is an electronic card that contains customer's financial details.
- Write the following abbreviations in full:  
(i) SMS (ii) EFT (iii) ATM (iv) CCTV

#### Fill in the missing words to complete the sentences

- The term given to an intentional act of dishonesty that involves financial dealings for purpose of personal gain is \_\_\_\_\_.
- \_\_\_\_\_ is an authentication method used to measure unique physical characteristics of a person, such as voice pattern, the iris or retina pattern of the eye or finger print patterns.
- \_\_\_\_\_ is a facility that enables customers to access banking facilities anywhere using a remote device such as a mobile phone or a tablet.
- Long queues of customers in the banking hall have been reduced through \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.

### Revision Activity 2.8

Answer these questions:

1. Define automated billing.
2. State how financial technology has positively enhanced quick service delivery in our society.
3. Explain how fraud is carried out using computer tools.
4. Explain how users can have unlimited access to their accounts.
5. Explain how the problem of long lines in banks has been solved.

## 2.5 Definition of the key words in this unit

### Revision Activity 2.9

Find out the meaning of the words given below. Share your findings with the rest of the students in a class presentation. Check the meanings you find against those provided in the glossary at the end of this course book.

Record keeping	Receivables	Payables
Debtor	Biometrics	Credit cards
Stock exchange	Password	ATM
Plastic Money	Fraud	Agency banking
Mobile banking	Automated operations	Data Interchange

### Revision Exercise 2

1. Explain **three** points to illustrate the positive impact of financial technology in society today.
2. State **two** advantages of mobile banking.
3. Explain how fraud can be carried out using computer tools.
4. Explain the impact of mobile and agency banking on society.

# Unit 3



## Objects in a Document

**Key Unit Competency: By the end of this unit, you should be able to:**

1. Insert symbols, pictures, tables, and objects in a document.

### Introduction

This unit deals with insertion and manipulation of graphics in a word document. The term graphics refers to anything in the form of images or pictures. The graphical objects could be in form of textboxes, tables, pictures, equations, symbols, word art and tables.

### 3.1 Objects: Insert and Format Text Boxes

The word processing program allows the user to insert a text box in a document. A **text box** also known as a **text field** or a **text entry box** is a graphic that is intended to enable the user to input textual information to be used by the program.

A text box may contain simple text, a quote, or any other information that the creator may wish to use. Text boxes may be used in the following situations:

- Drawing attention to a piece of text.
- Enhancing the layout of a document.
- Inserting a label on an object or in the margin.

#### 3.1.1 Inserting a Text box in a Document

##### Method 1: Using the Insert Tab to insert a text box in a document

To add a text box in a document, do the following:

- (i) Click on **Insert** tab from the menu bar, select **Text box** from the **Text** group. A drop down menu appears as shown in Figures 3.1(a and b).
- (ii) Click on the desired text box in the **Built-In** section or click on **Draw text box** to insert a customised one.
- (iii) If **Draw text box** option is selected, the cursor changes to a plus sign in the document. Click and drag it in the desired location. Otherwise, begin typing in the box and the content in it will automatically be deleted.
- (iii) Type the desired text.

- (iv) The keyboard shortcut is as follows: **Long press ALT**, press **N** then **X** and finally **D**. Then insert the customised text box or use the arrow keys to select the desired option.

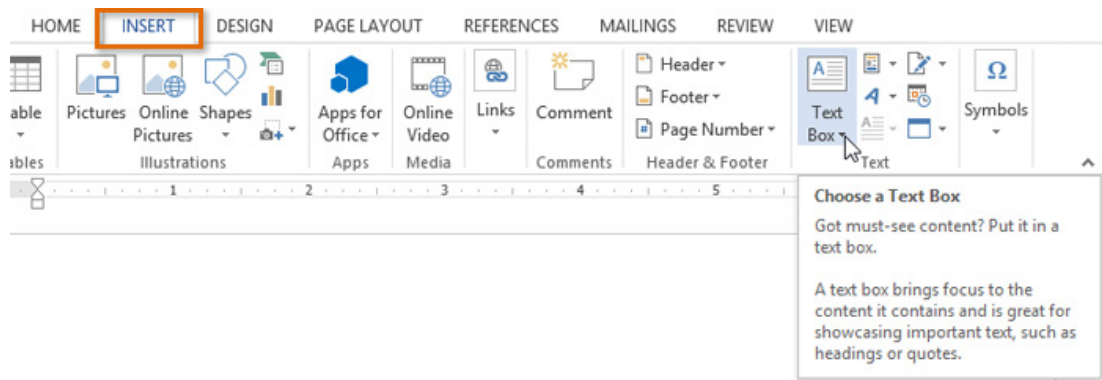


Figure 3.1(a): Selecting Text box from the Insert menu

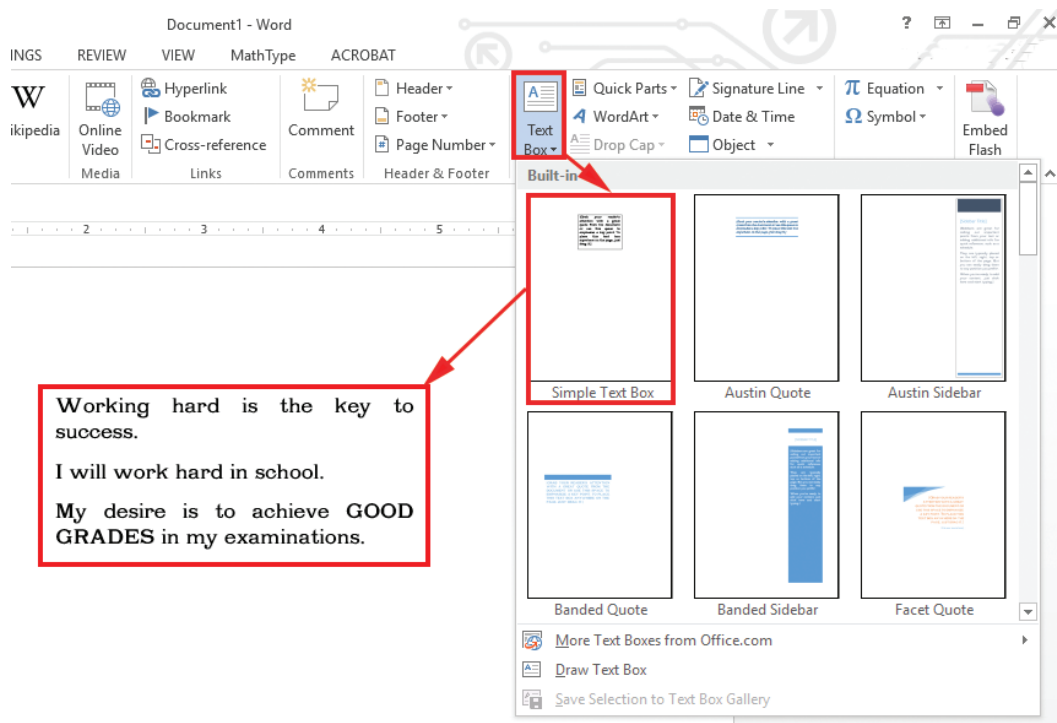


Figure 3.1(b): Inserting a simple text box

## Method 2: Using the Shapes Feature to insert a text box in a document

You can use the **Shapes** feature to add a text box in a document. The steps are as follows:

- (i) Click on **Insert** tab from the menu bar.



- (ii) Select **Shapes** from the **Illustrations** group. A drop down menu appears as shown in Figure 3.2(a).

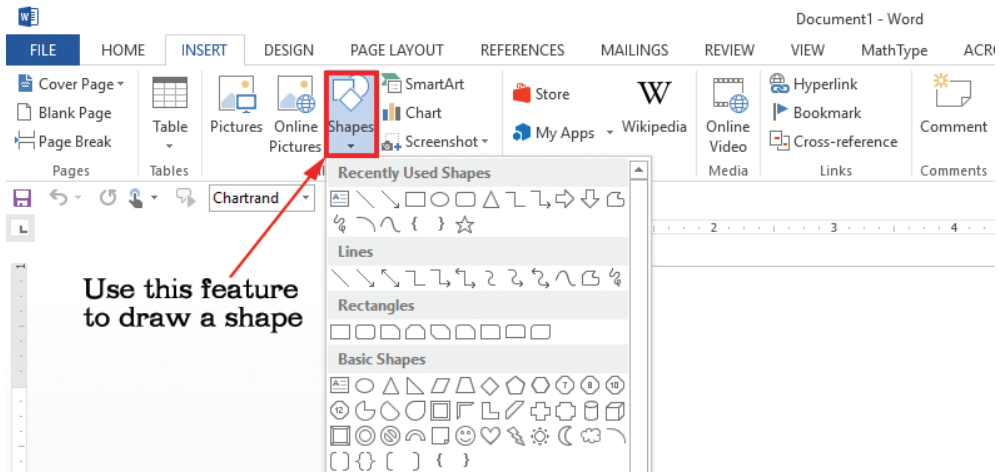


Figure 3.2(a): Using the shapes feature to draw a text box.

- (ii) Click on the desired text box in the **Built-In** section use it to draw the desired shape.
- (iii) Right-click the drawn **Shape** and choose **Add Text** from the pop-up menu.

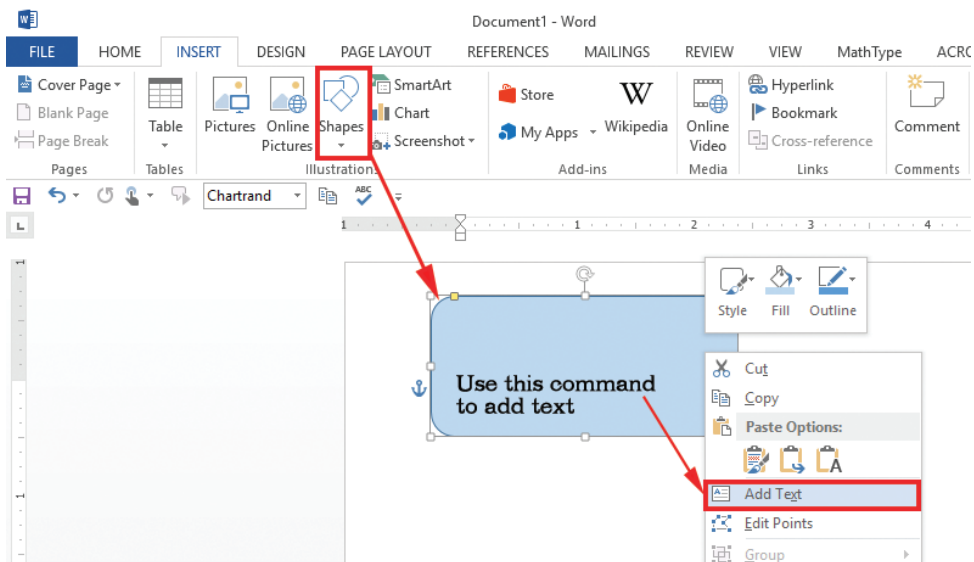


Figure 3.2(b): Inserting text into a shape.

### Practice Activity 3.1: Inserting text boxes

Draw text boxes of different shapes and add text as shown in Figure 3.2(c) on page 46.

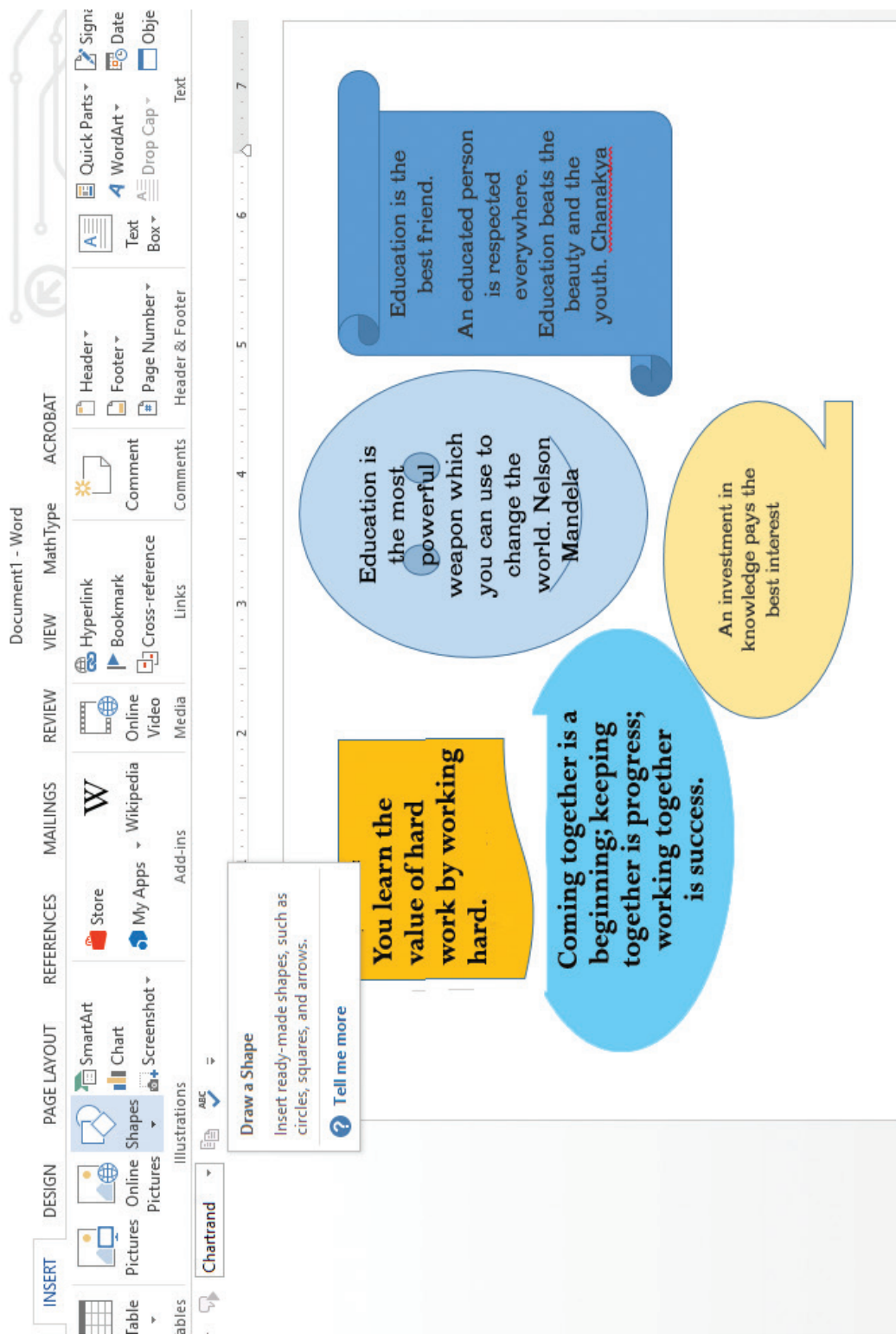


Figure 3.2(c): Inserting text into a different shapes

### 3.1.2 Formatting a text box

When a text box is highlighted in a document, the **Drawing Tools** tab which comes along with the **Format** tab in the menu bar is activated.

There are various formatting features available some of which include: editing the text box shape, creating a link, and changing text direction.

### 3.1.3 Editing the shape of a text box

The editing feature is used to change the shape of a drawing. To use this feature to change the shape of a text box, do the following:

- (i) Click on the text box to select it.
- (ii) Click on **Format** tab under **Drawing Tools** tab in the menu bar.
- (iii) Select **Edit Shape** under **Insert Shapes** group. A drop down menu appears.
- (iv) To change the shape of the text box, select the desired shape from **Change Shape** option as shown in Figure 3.3(a) on page 48.

The keyboard shortcut is as follows: **Long press ALT**, press **JD** then **E** and finally press the **right arrow key**.

- (v) To edit points of a text box, click on the **Edit Points** option. The points are selected and the shape changes to red colour.
- (vi) Once you select the points, you can drag them to the desired shape. In this case, the points were dragged to achieve the shape shown in Figure 3.3(c) on page 49.

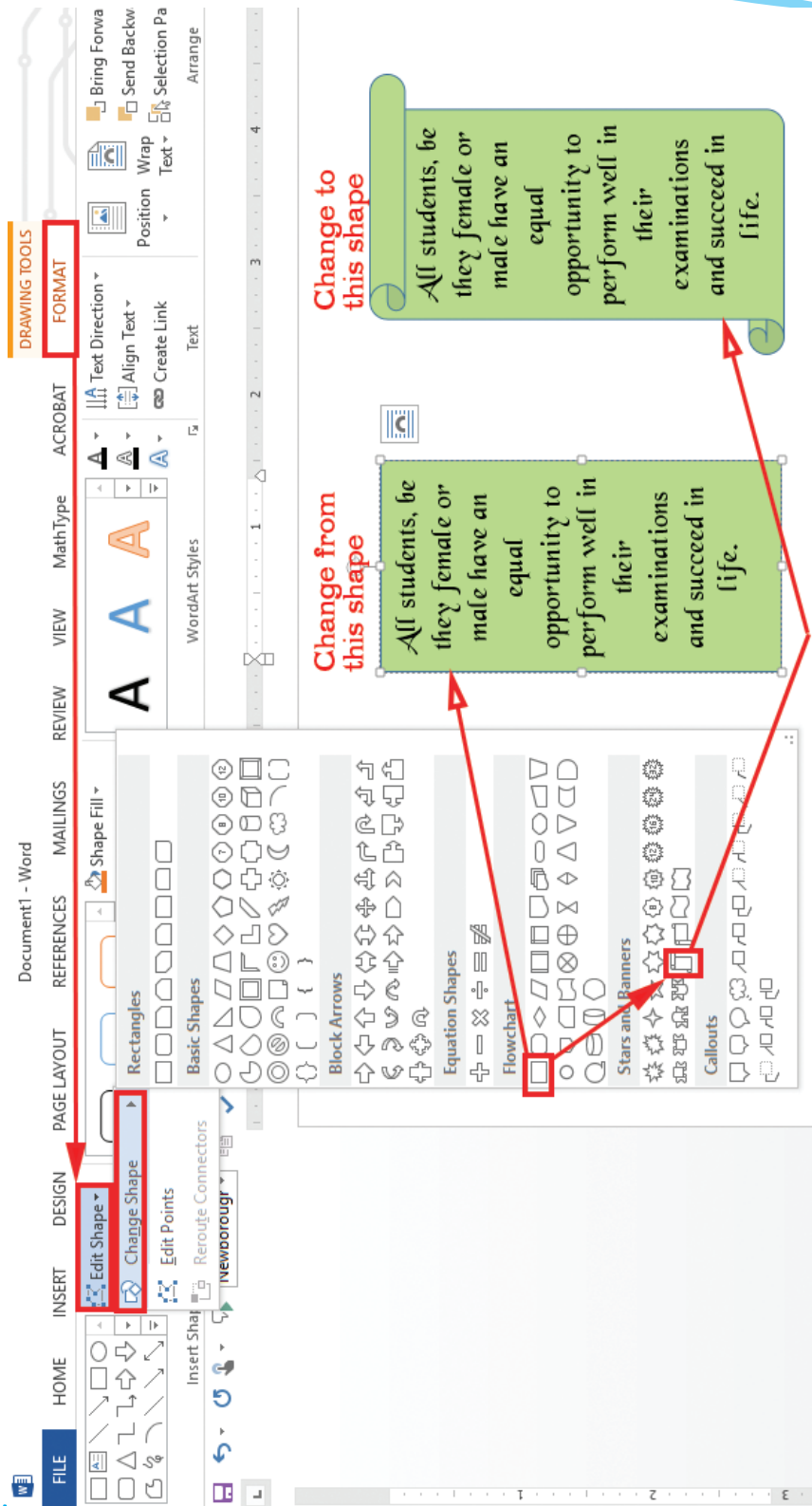


Figure 3-3(a): Changing the shape of a text box

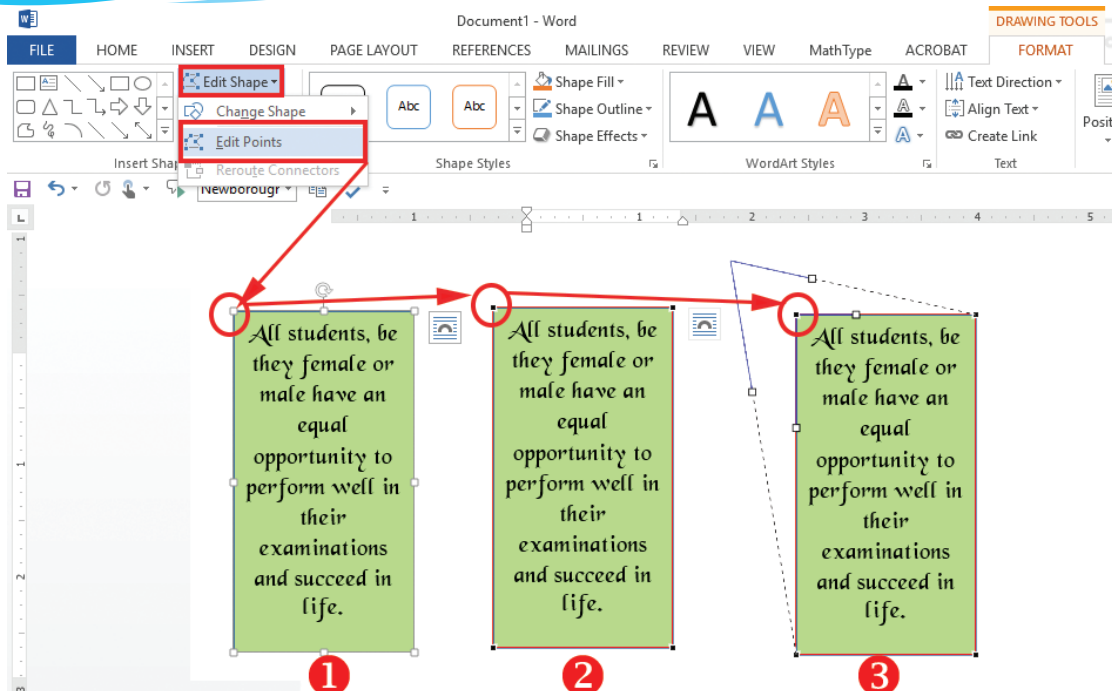


Figure 3.3(b): Editing the points of a text box

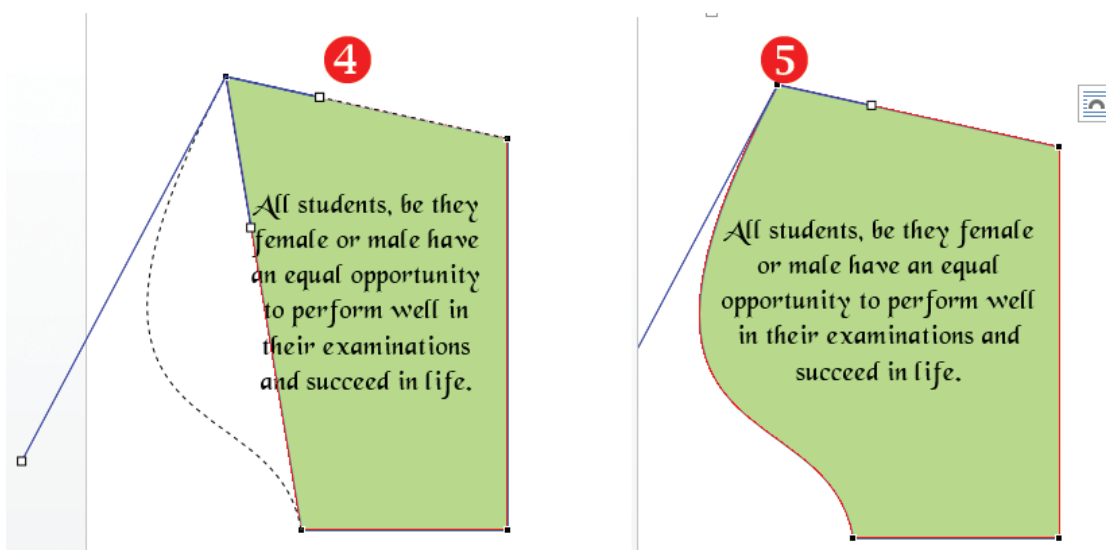


Figure 3.3(c): Editing the points of a text box and dragging them to a desired shape

### Practice Activity 3.2: Editing the shape of text boxes

Draw the text boxes labelled 1 and 3. Change their shapes to the ones shown by arrows and labelled 2 and 4.

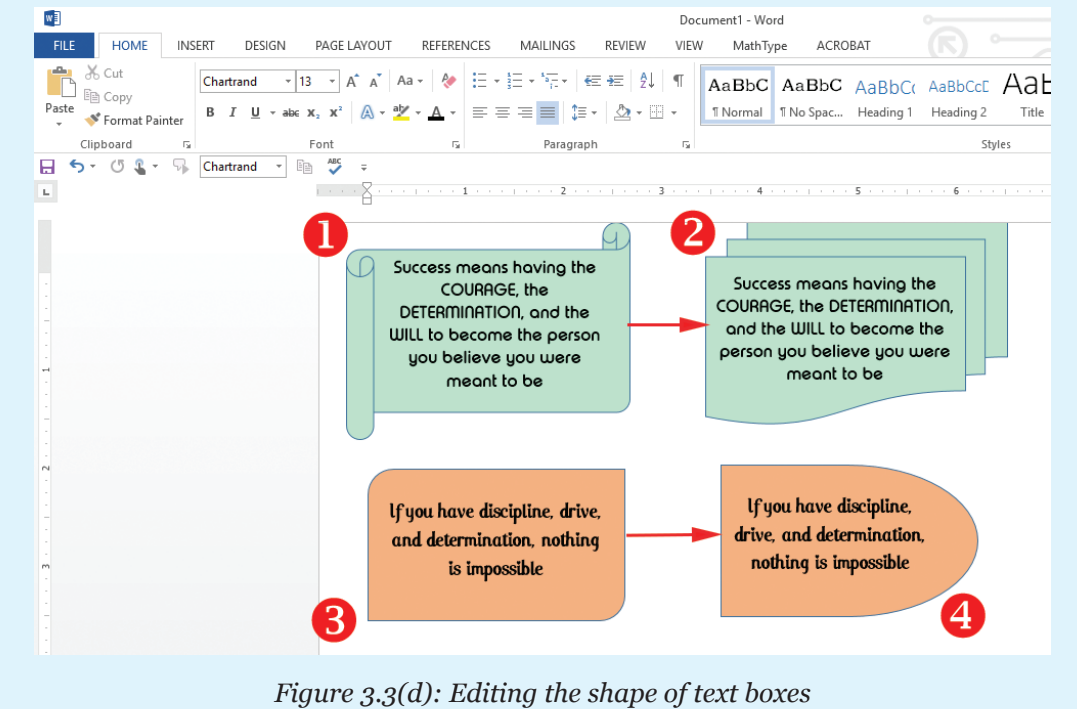


Figure 3.3(d): Editing the shape of text boxes

### 3.1.4 Modifying colours and lines for text boxes

The default colour for lines is black. To change this colour to a desired one, do the following:

- (i) Click on the text box.
- (ii) Click on **Format** tab under **Drawing Tools** tab in the menu bar.
- (iii) Select **Shape Outline** in the **Shape Styles** group. A drop down menu appears as shown in Figure 3.4(a).
- (iv) Click on the desired colour under **Theme Colours** to change the border colours.
- (v) To remove the borders, click on **No Outline**.

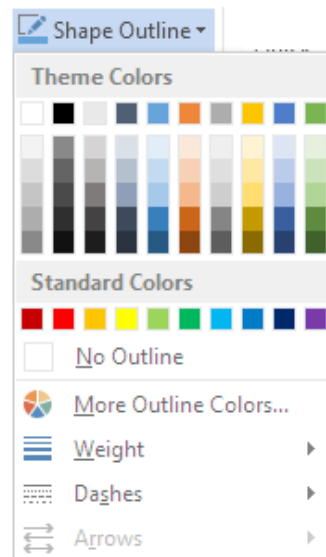


Figure 3.4(a): Changing the colour of lines

- (vi) Click on **Weight** and select the desired line to change the line thickness or to change the line style.
- (vii) Click on **Dashes** and select an option in the side kick menu. See Figure 3.4(b).

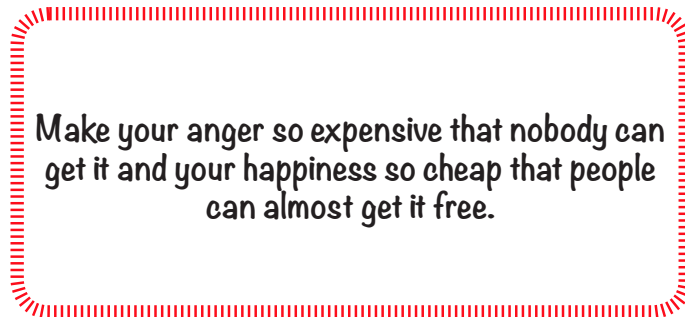


Figure 3.4(b): The weight and colour of the line have been changed to dashes style.

**Practice Activity 3.3: Modifying the lines and colours for text boxes**

Draw the text box labelled 1 as shown in Figure 3.5. Change its colour and lines to match those in the text box labelled 2.

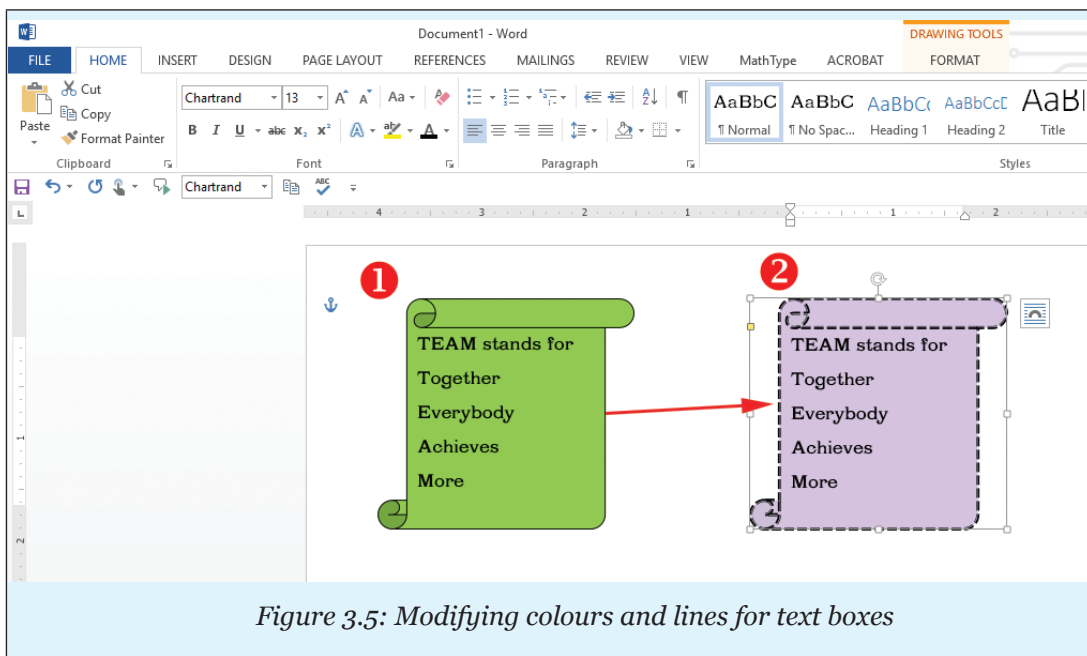


Figure 3.5: Modifying colours and lines for text boxes

### 3.1.5 Creating Links between Text Boxes

You may have text that you would like to run in a series of text boxes. You want the text to flow from one text box to the next and ensure that the reader will be able to follow the text.

This feature of creating links allows you to insert text that will flow from one text box to another. When the first text box is full, this feature allows the text to be inserted automatically to the next text box and fills it.

If you add or delete text in one text box, **Create Link** will adjust the text in the rest of the text boxes accordingly.

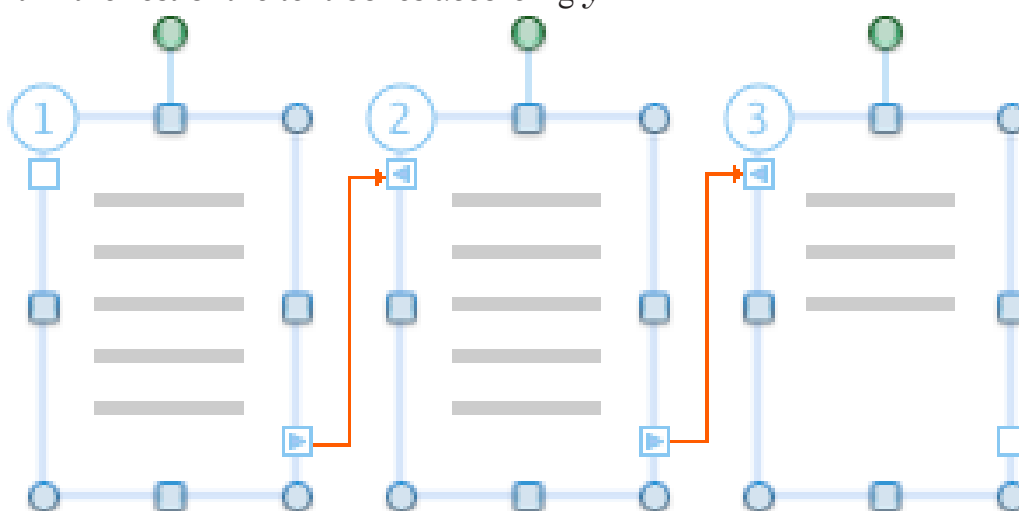


Figure 3.6: Text in linked boxes flows from one box to the next

To create a link between two text boxes, do the following:

- (i) Add two text boxes and ensure that they are empty.
- (ii) Click on the first text box.
- (iii) Click on **Format** tab under **Drawing Tools** tab in the menu bar.
- (iv) Select **Create Link** icon under **Text** group.
- (v) Click on the next text box to automatically create the link.

#### Practice Activity 3.4: Creating links between text boxes

Do the following:

- (i) Create three text boxes.
- (ii) Type the poem titled, Don't Quit.
- (iii) Link the three text boxes as shown in Figure 3.7 shown on page 53.



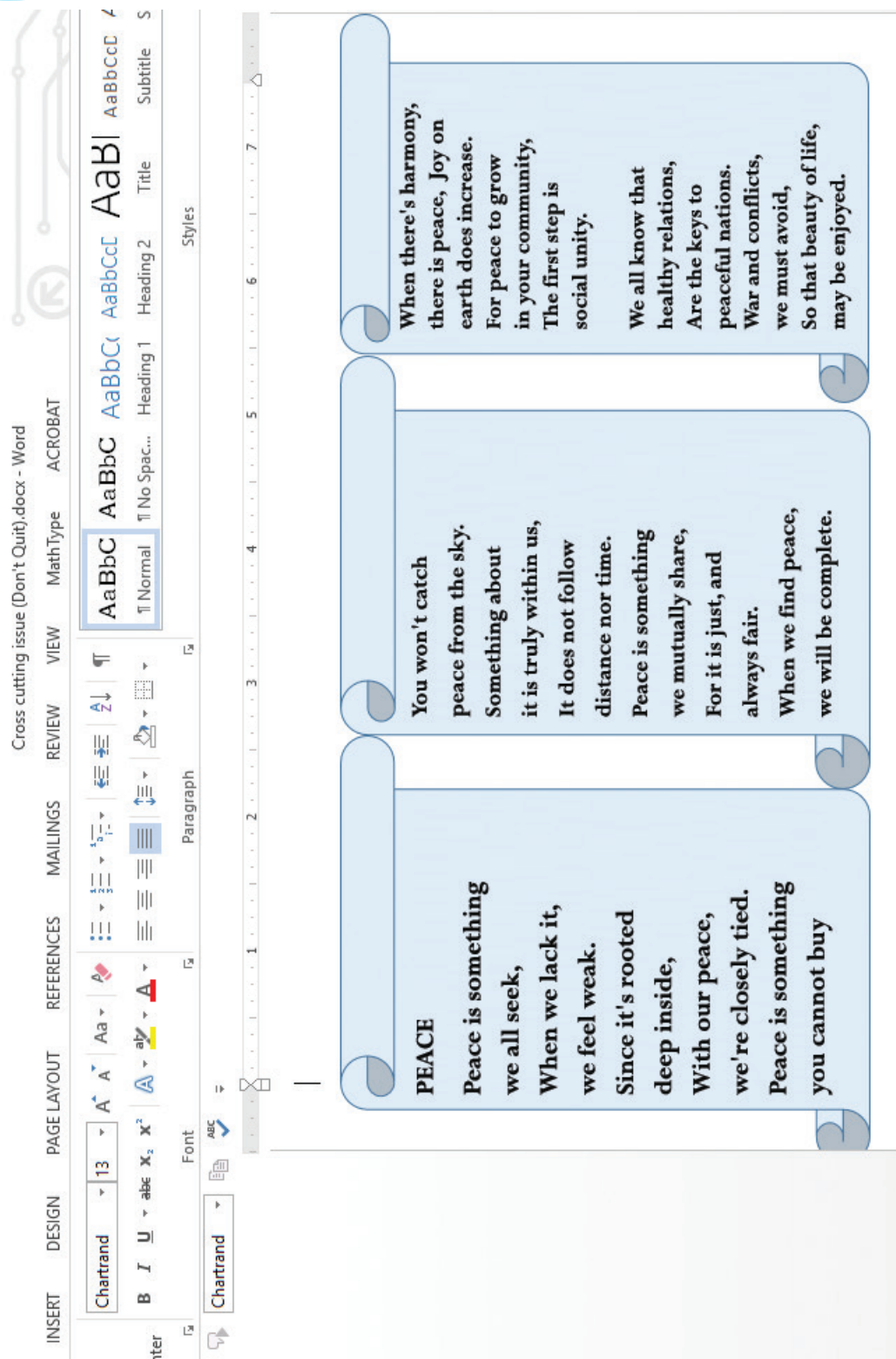


Figure 3.7: Linking text boxes

### 3.1.6 Text Direction in Text Boxes

The direction of text in a text box can be changed to the desired orientation using the following procedure:

- (i) Highlight the content in the text box.
- (ii) Click on **Format** tab under **Drawing Tools** tab in the menu bar.
- (iii) Select **Text Direction** icon under **Text** group.
- (iv) Click on the desired direction from the resulting drop down menu.
- (v) If the desired option is not in the list, click on **Text Direction Options**. A dialog box appears as shown in Figure 3.8.
- (vi) Select the desired orientation and click **OK**. **Note:** The keyboard shortcut is as follows: **Long press ALT**, press **JD** then **AX** and finally **X**.

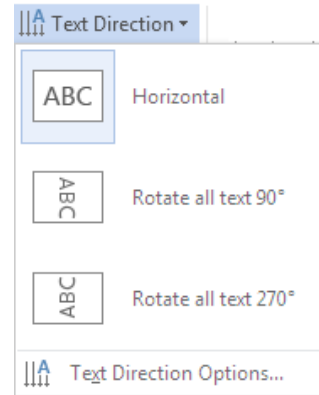


Figure 3.8: Changing the text direction.

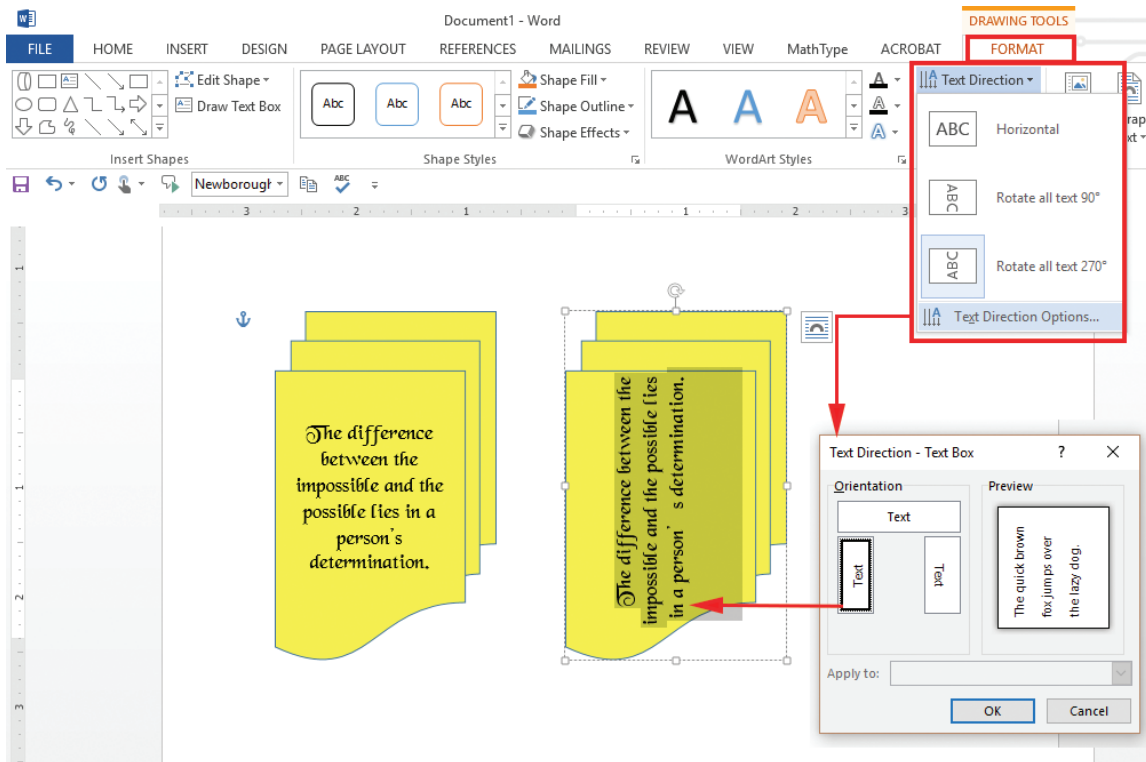


Figure 3.9: Other options available for changing text direction

### 3.1.7 Applying Fill Effects to a Text Box

The feature of **Fill Effects** adds colour inside the text box. To apply it, do the following:

- (i) Click on the text box.
- (ii) Click on **Format** tab under **Drawing Tools** tab in the menu bar.
- (iii) Select **Shape Fill** in the **Shape Styles** group. A drop down menu appears as shown in Figure 3.10(a).
- (iv) Click on the desired colour under **Theme Colours** to fill the shape.
- (v) To remove fill added, click on **No Fill** box.
- (vi) Click on **Gradient** and select the desired fill style, click on **Texture** and select an option in the side kick menu.

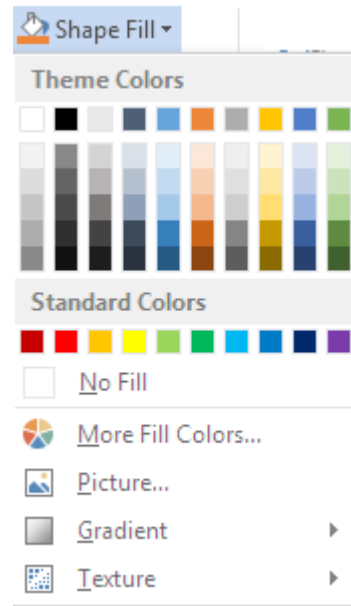


Figure 3.10(a): Filling a shape with colour

**Note:** The keyboard shortcut is as follows: Long press ALT, press JD then SF.

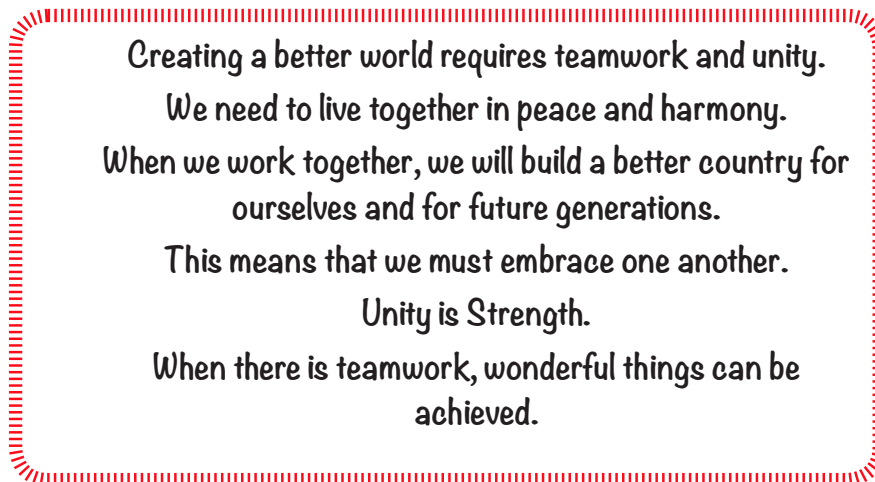


Figure 3.10(b): A shape with coloured borderline

### Revision Activity 3.1

#### Part A: Re-arrange the letters to form proper words

- The letters below can be re-arranged to form a formatting feature in a text box. Give the feature in each case:
  - ESDSAH \_\_\_\_\_
  - RTUXETE \_\_\_\_\_
  - NDIEARGT \_\_\_\_\_

#### Part B: Fill in the missing words to complete the sentences

- The term graphics refers to anything in form of \_\_\_\_\_ or \_\_\_\_\_.
- A \_\_\_\_\_ is an object created to contain text.
- Two text boxes can be connected to allow \_\_\_\_\_ from one to another.
- The direction of text in a text box could be changed to the desired \_\_\_\_\_.

#### Part C: Answer these questions

- Define the term text box.
- State **two** ways in which a text box can be used.
- List **three** ways in which a text box can be added in a document.
- Write the keyboard shortcut for performing the following activities:
  - Activating the shape outline drop down menu.
  - Changing the text direction.
- A student inserted a text box in a document. The student however, did not want the border lines of the text box to appear. Advise the student on how to remove the text border.

#### Part D: Do this practical activity

- Create a new document and insert three text boxes in the document.
- Create a link between the second and the third text box.
- Type the following sentences in the second text box. Ensure that data overflows to the third text box.

***“Ships don’t sink because of the water around them. Ships sink because of the water that gets in them. Don’t let what’s happening around you get inside you and weigh you down.”***

4. Remove borders of the second and third text boxes.
5. Type your first name in the first text box
6. Save the document as **Object 1**.
7. Enhance the appearance of the first text box in the following ways:
  - (i) Change the border colour to blue.
  - (ii) Increase the line weight to 6 points. Change it to suitable dashes.
  - (iii) Rotate all text to 270°.

## 3.2 Adding Shapes

Various shapes can be added in a word document then formatted as required by the user.

### 3.2.1 Inserting Shapes

- (i) Click on **Insert** tab from the menu bar, select **Shapes** icon from **Illustration** group. A drop down menu appears as shown in Figure 3.11(a).
- (ii) Click on the desired shape, the pointer changes to a plus sign.
- (iii) Position the pointer at the desired area of the document and drag it in the desired direction to draw the shape.

**Note:** The keyboard shortcut is as follows: **Long press ALT**, press **N** then **SH**.

### 3.2.2 Formatting Shapes

Once a shape has been inserted in a document, one can format it. To format in this case means to arrange it in the desired way.

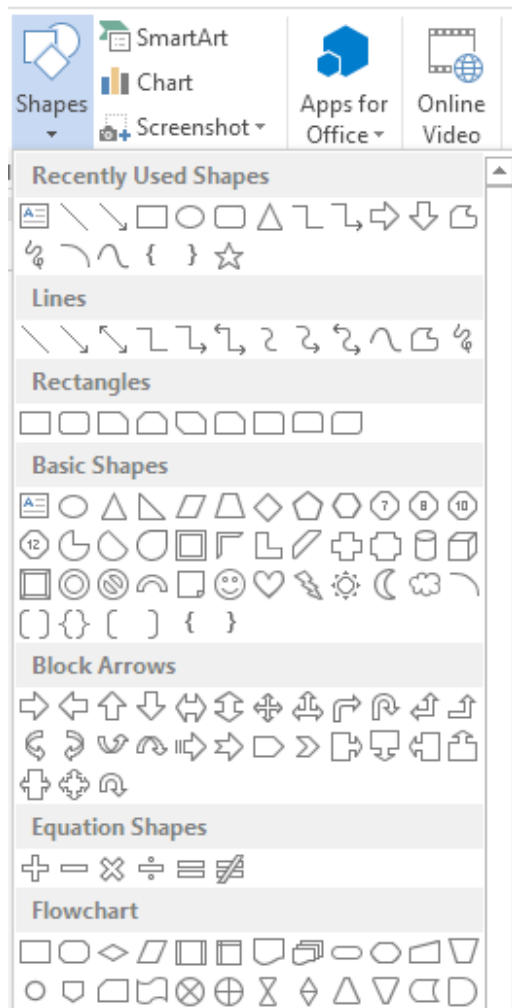


Figure 3.11(a): Adding shapes

Some formatting styles that can be applied on a shape include the following: changing the shape; rotating the shape to an angle; and grouping a number of shapes into one image.

Most of these formatting features are contained in the drawing tool menu that is added on the menu bar anytime an image is inserted.

**Practice Activity 3.5: Inserting shapes**

Create a document and insert the shapes shown below:

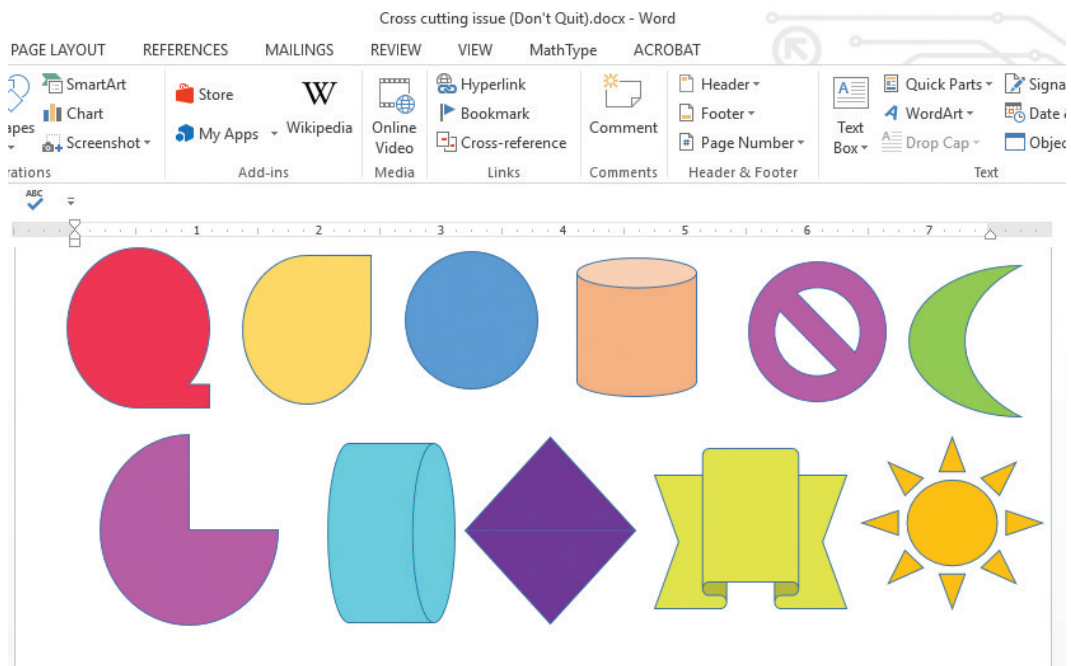


Figure 3.11(b): Inserting shapes

### 3.2.3 Using Drawing Tools

Drawing tools are normally used when another shape or line exists and is highlighted to activate the **Drawing Tools** menu option in a document. This reduces cluttering of options on the ribbon.

Figure 3.12 shows the ribbon displayed when the **Drawing Tools** tab is selected.

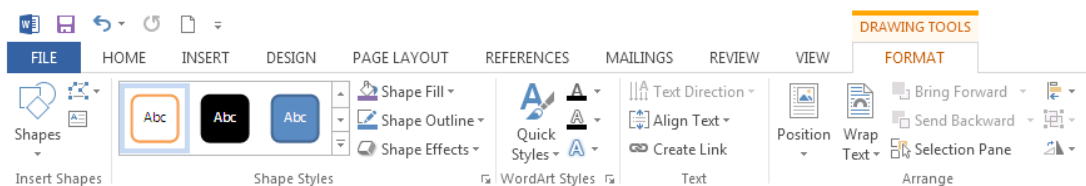


Figure 3.12: The drawing tools tab

### 3.2.4 Inserting Shapes

Insert shapes group is normally used for drawing different shapes according to the user's preference. Examples of shapes that one can insert include lines, rectangles, basic shapes, arrows, flow charts, stars, banners, and speech bubbles as shown in Figure 3.13.

### 3.2.5 Shape Styles Group

Shape styles are used for formatting the shapes using fill colour, outline, or effects. Figure 3.14 shows insert shapes styles group.

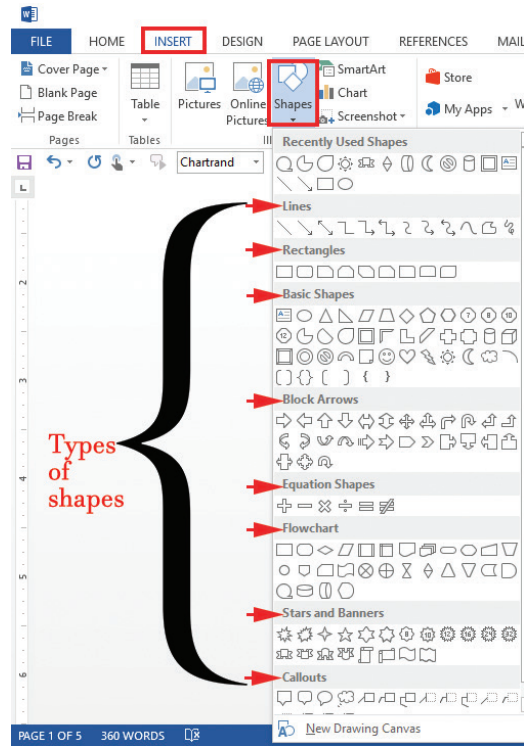


Figure 3.13: Inserting shapes

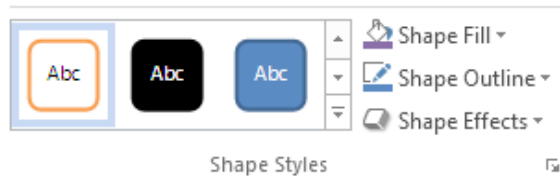


Figure 3.14: Shape formatting styles

### 3.2.6 WordArt Styles Group

WordArt style is used for formatting text found in shapes using text fill, text outline, and text effects. WordArt enables you to create special text effects such as shadowed, rotated, stretched, and multicoloured text.

#### Method 1: Inserting WordArt

- (i) On the **Insert tab**, click the **Insert WordArt** button.
- (ii) In the **WordArt gallery**, click the **WordArt style** that you desire.
- (iii) Replace the placeholder text with the text you want to format using **WordArt**.

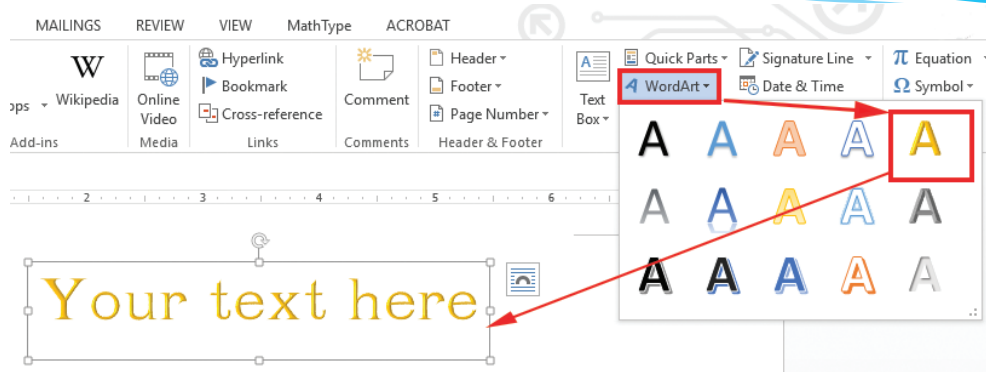


Figure 3.15: Inserting WordArt styles

### Method 2: Converting regular text to WordArt

To convert regular text to WordArt, do the following:

- (i) Select the text you want to convert, then click the **Insert** tab.
- (ii) Click the **WordArt** drop-down arrow in the **Text** group.
- (iii) Word will automatically create a text box for the text, and the text will appear in the selected style.



Figure 3.16: Converting text to a WordArt style

**Practice Activity 3.6: Creating WordArt**

Using any of the two methods discussed above, create WordArt that reads:  
**Successful people are not gifted. They just work hard. They purpose to succeed.**



### 3.2.7 Text Group

It is usually used when formatting text in a shape by changing the direction, or alignment of the text, or when creating a link in text found in two shapes.

### 3.2.8 Arrange Group

It is used when arranging text and shapes in a document. It can also be used for changing position and rotating a shape.

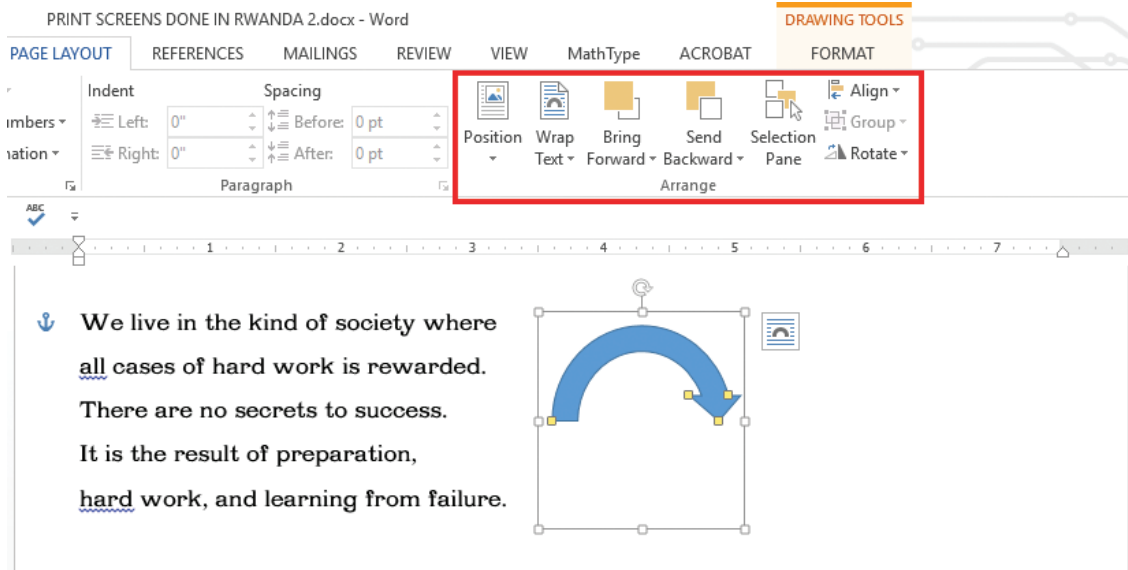


Figure 3.17: Arranging text and shapes in a document

#### Practice Activity 3.7: Using Text Group and Arrange Group

Create text and also arrange text and shapes on how to protect the environment.

### 3.2.9 Formatting Features

#### Changing shape

To change a shape that has already been inserted, do the following:

- (i) Select the shape.
- (ii) Click on the adjustment handle which is normally a yellow diamond and drag it either inward or outward.
- (iii) Release the mouse button once the desired shape is realized.

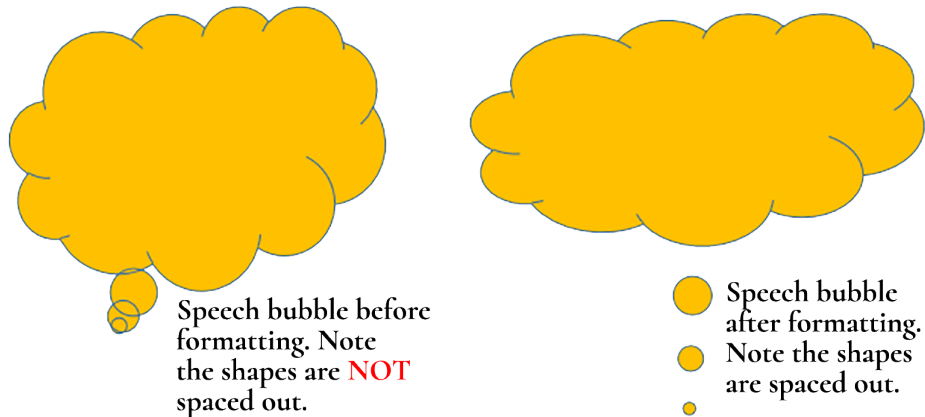


Figure 3.18: Using the formatting features to change a shape

### Rotating (Method 1)

A shape can be rotated to a desired angle. Rotating is done to change the orientation of the shape. To rotate a shape, do the following:

- (i) Click on the shape to be rotated.
- (ii) Click on the handle and drag the picture to the desired direction.

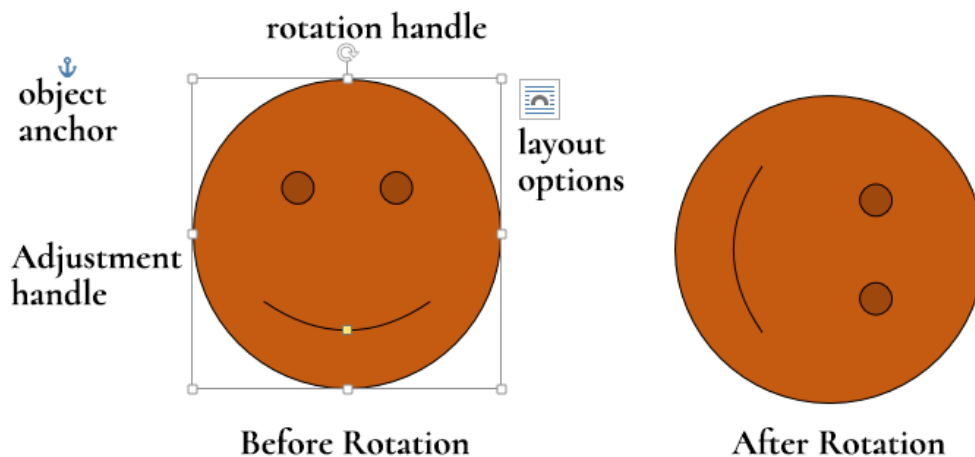


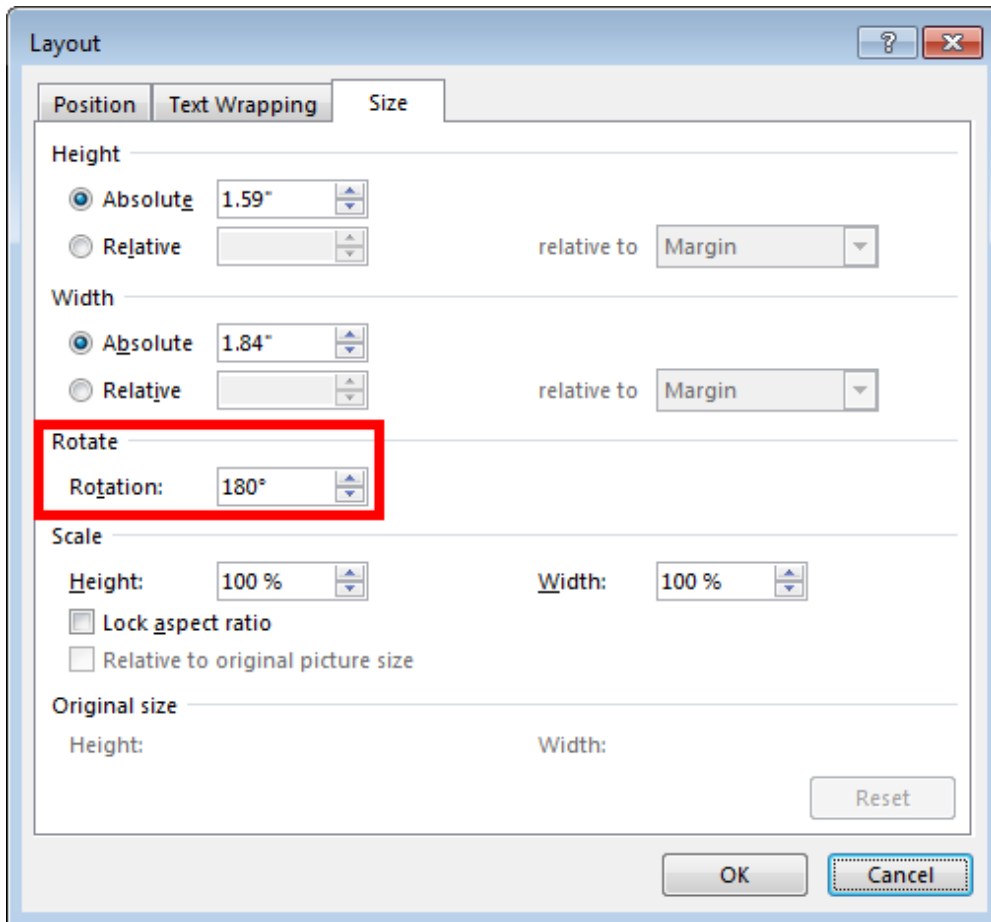
Figure 3.19: Rotating is done to change the orientation of the shape

### Rotating (Method 2)

- (i) Click on **Format** menu in the **Drawing Tools** menu.
- (ii) Select the dialog box launcher in the **Size group**. A dialog box is displayed with the **Size** tab activated as shown in Figure 3.20

- (iii) Type or select the degree of rotation in the **Rotation** box.
- (iv) Click **OK** to apply.

The keyboard shortcut for the above process is as follows: **Long press ALT** then **JD** and finally **SZ**.



*Figure 3.20: Changing the degree of rotation*

### Grouping

More than one shape can be grouped in one so that they are moved or formatted as a unit. To group shapes, do the following:

- (i) Select the shapes by clicking on them as you hold the shift key down.
- (ii) Right-click on the selected shapes. A pop-up menu appears as shown in Figure 3.21.
- (iii) Select **Group** then **Group** again from the next pop-up menu. A canvas is automatically inserted around all the shapes and hence making it easier to format all the shapes at once.

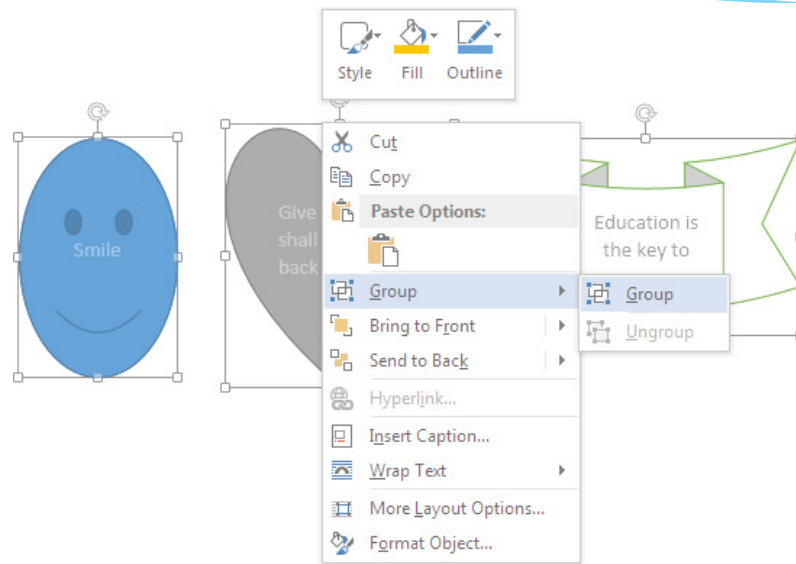


Figure 3.21: Grouping objects



Figure 3.22: Grouped objects

### Shape effects

The following are some examples of effects that can be added on a shape: shadow, reflection, glow, soft edges, bevel and 3-D rotation. To add a shape effect, do the following:

- (i) Select the picture.
- (ii) Click on **Format** tab in the **Drawing Tools** tab from the menu bar, select the **Shapes Effects** icon from **Shape Styles** group. A drop down menu appears as shown in Figure 3.23.
- (iii) Click on the desired effect to display other options in a pop-up menu.
- (iv) Select the desired effect to automatically apply it to the shape.

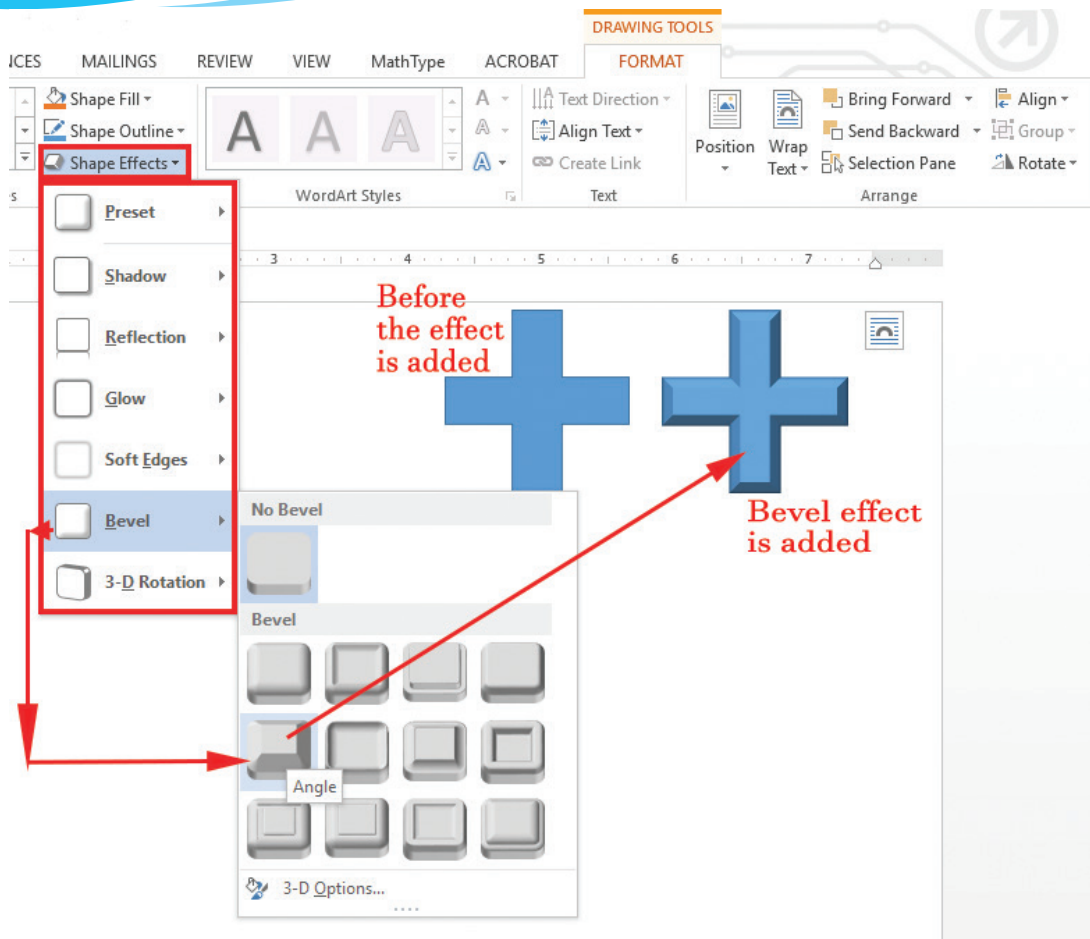


Figure 3.23: Shape effects options

**Practice Activity 3.8: Using shape effects options**

Draw different shapes. Apply different effects to achieve the desired shapes. Examples are shown in Figure 3.24.

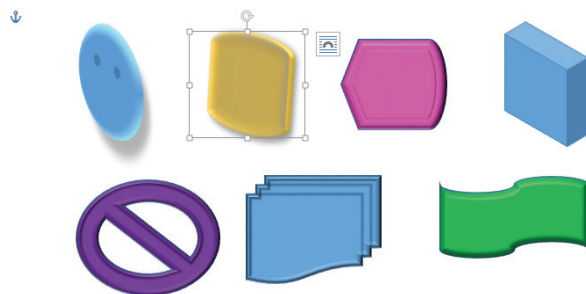


Figure 3.24: Shape effects options

### Adding text in shapes

Text can be added in a document using the following procedure:

- (i) Right-click on the shape and select **Add Text** option from the pop-up menu as shown in Figure 3.25.
- (ii) Type the desired text.
- (iii) Click away from the shape. Figure 3.26 shows a cloud shape containing text, which is a message on peace.

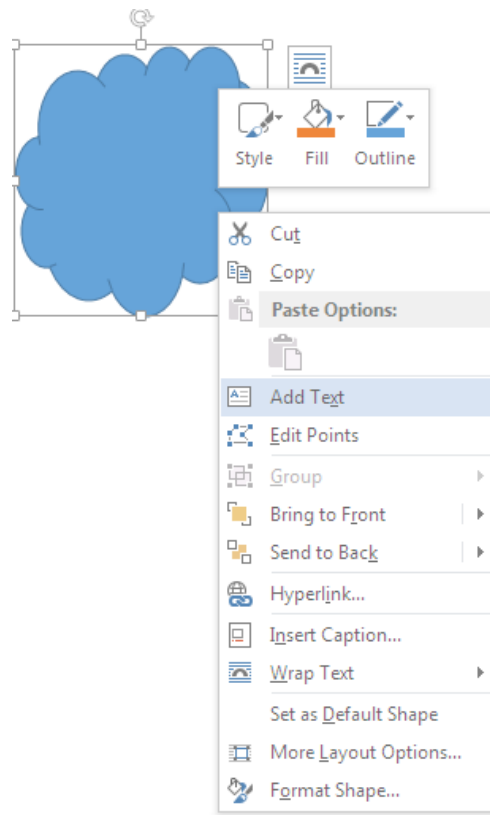


Figure 3.25: Adding text to a shape

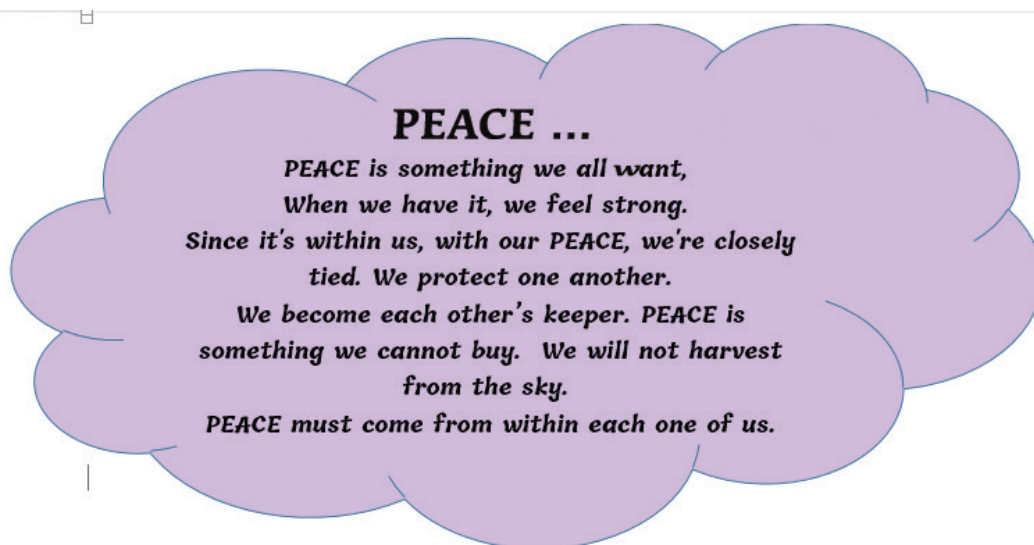


Figure 3.26: A cloud shape with a peace message

### Revision Activity 3.2

#### Part A: Give the correct answers

1. The letters below can be re-arranged to form words describing formatting features in a shape. Give the feature in each case:  
(i) OPUGR            (ii) RETOAT        (iii) VELBE
2. More than one shape can be \_\_\_\_\_ into one so that they are moved or formatted as a unit.
3. \_\_\_\_\_ feature is used when arranging text and shapes in a document.
4. A \_\_\_\_\_ is automatically inserted around all the shapes.
5. Shadow, reflection, glow, soft edges, bevel and 3-D rotation are examples of \_\_\_\_\_.

#### Part B: Do this practical activity

1. Outline the procedure of inserting a parallelogram in a document.
2. List **three** formatting features that can be applied to a shape.
3. Differentiate between the function of the rotating handle and the adjustment handle found with a shape placeholder.
4. List **three** shape effects available in Microsoft Word 2013.
5. State the purpose of grouping of objects.

#### Part C: Do this practical activity

1. Create a new document and insert a speech bubble, a round corner rectangle, and a 16-sided star.
2. Save the document as **Shapes**.
3. Rotate the speech bubble to 180°.
4. Format the star to have a relaxed inset bevel.
5. Using the adjustment handle, change the round corner rectangle to a circle. Save the changes as **Shapes 1**.
6. Type the following message in the speech bubble: "Do not litter. Always keep your environment clean."
7. Insert the following message in the circle: "Life is an echo, what you send out comes back. What you sow you reap."
8. Save the changes as **Shapes 2**.
9. Group the three images.

### 3.3 Inserting Pictures and WordArt Objects

A picture can be inserted from the Internet or from an existing file.

#### 3.3.1 Inserting pictures from the Internet

- (i) Position the insertion point where the picture is to be inserted.
- (ii) Click **Insert** tab from the menu bar in the **Illustrations** group and click **Online Pictures** icon. If there is Internet connection, a dialog box is displayed as shown in Figure 3.27.
- (iii) Type the name of the image to be located in the box provided. Click on **Go** button to display the result on the window as shown in Figure 3.28.
- (iv) Click on the desired image then select **Insert** button.

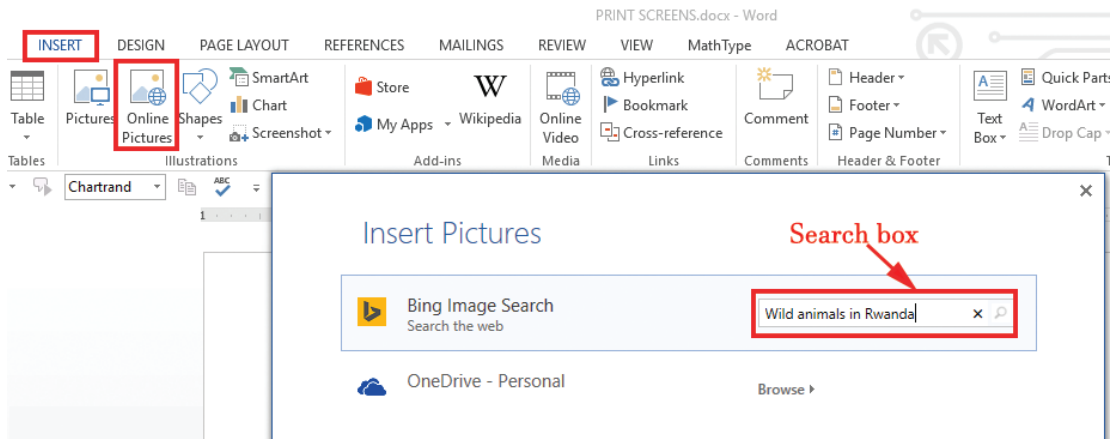


Figure 3.27: Inserting Picture dialog box

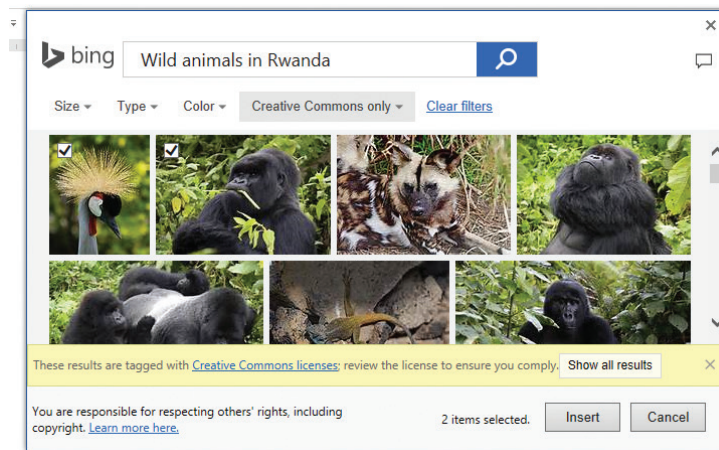


Figure 3.28: Images displayed based on the search result



### Practice Activity 3.9: Inserting pictures from the Internet

Create a document and insert online pictures in the document.

#### 3.3.2 Inserting pictures from an existing file

- (i) Position the insertion point where the picture is to be inserted.
- (ii) Click **Insert** tab from the menu bar.
- (iii) Under **Illustrations** group, click **Pictures** icon. A dialog box appears as shown in Figure 3.29.
- (iv) Select the location where the picture is stored.
- (v) Select the picture then click **Insert** command.

**Note:** The keyboard shortcut for the above process is as follows: **Long press ALT**, press **N**, then **P**.

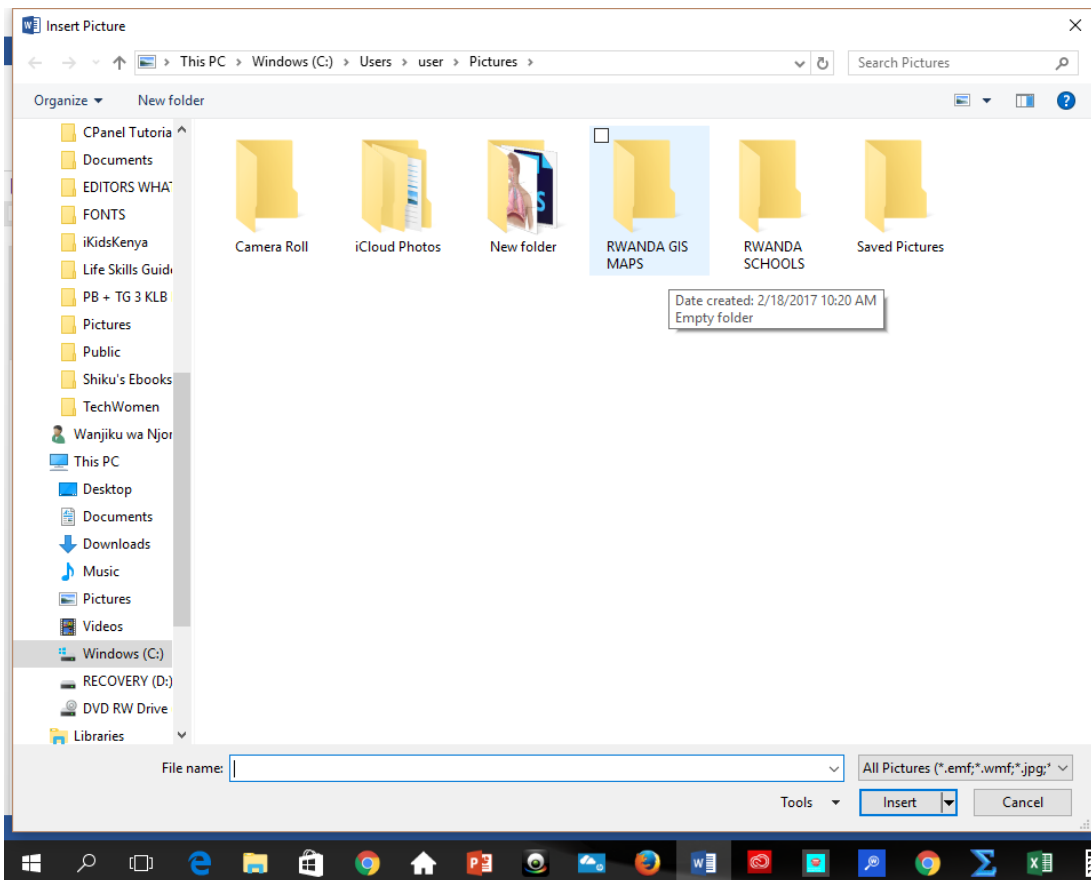


Figure 3.29: Inserting a picture from file

### 3.3.3 Inserting WordArt objects

- (i) Position the insertion point where the WordArt is to be inserted.
- (ii) Click **Insert** tab from the menu bar. Under **Text** group, click **WordArt** icon. A drop down menu appears containing a list of WordArt options as shown in Figure 3.30. The keyboard shortcut for the above process is as follows: **Long press ALT, press N then W.**
- (iii) Select the desired WordArt option. It is automatically inserted in the document with the words, “**Your text here**” as shown in Figure 3.30.

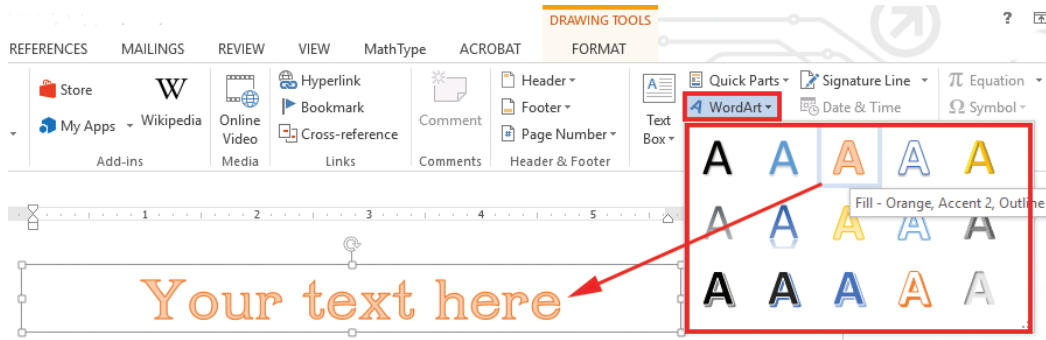


Figure 3.30: Word Art text box

- (iv) Click inside the text box. The words in it will automatically be deleted. Type the desired text.

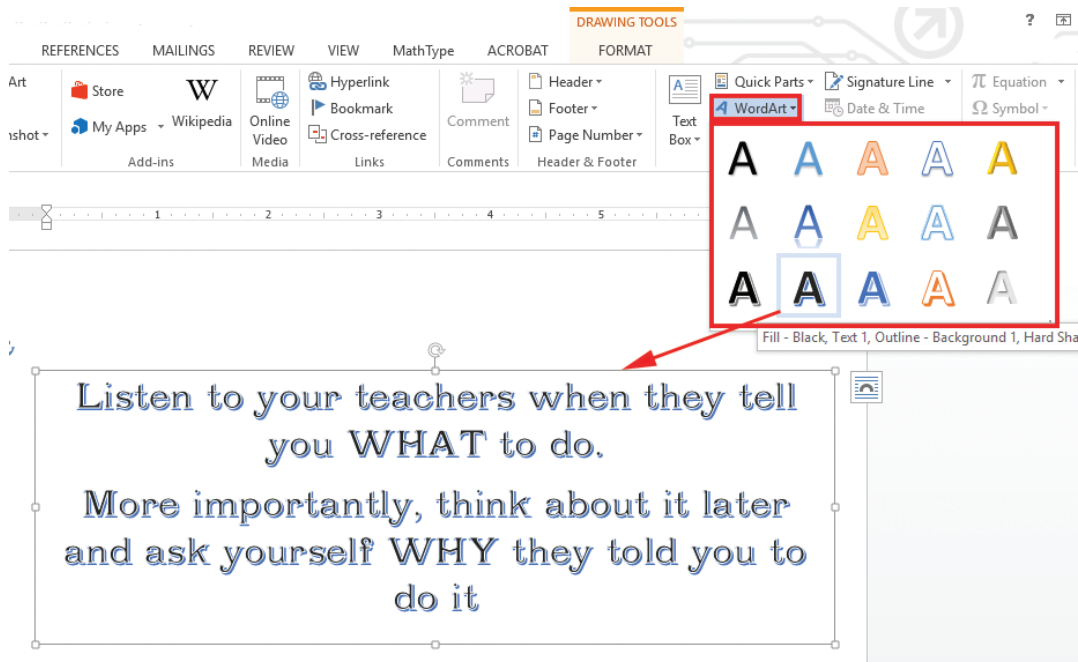


Figure 3.31: Inserting a WordArt object

### Practice Activity 3.10: Creating a document

#### Do the following:

Research on inspiring messages intended for students. Create a document. Draw text boxes of different shapes. Insert the inspiring messages you have gathered from your research. Your result should be similar to Figure 3.32. Save the document as **MyStudies**.



Figure 3.32: Creating a document with text boxes

### Revision Activity 3.3

**Part A: Fill in the dashes with the correct words. Choose your answers from these words: Textbox, Insert Tab, Text, Illustrations, WordArt.**

1. The tab in the menu bar where the online pictures icon is found: \_\_\_\_\_.
2. Words written in artistic formats: \_\_\_\_\_.
3. A group in the ribbon where the WordArt icon is found: \_\_\_\_\_.
4. A group in the ribbon where the online pictures icon is found: \_\_\_\_\_.
5. A box in which a WordArt object is inserted: \_\_\_\_\_.

## 3.4 Equations and Symbols

The equations available in Microsoft Word 2013 are mathematical. Symbols and special characters are also available.

### 3.4.1 Inserting Symbols and Special Characters

#### Inserting symbols

Symbols are non-alphabetical signs that have specific meaning when used in a particular context. An example is the © symbol, which is a copyright symbol. To insert a symbol, use the following procedure:

- (i) Position the insertion point where the symbol or the special character is to be inserted.
- (ii) Click **Insert** tab from the menu bar. Under **Symbol** group, click **Symbol** icon. A drop down menu appears containing a list of symbols as shown in Figure 3.33. The keyboard shortcut for the above process is as follows: **Long press ALT**, press **N** then **U**. Select the desired symbol option to automatically insert it in the document.
- (iii) However, if the desired symbol is not in the list, click on **More Symbols** command to display a dialog box as shown in Figure 3.33.
- (iv) Select the desired symbol, then click the **Insert** button.

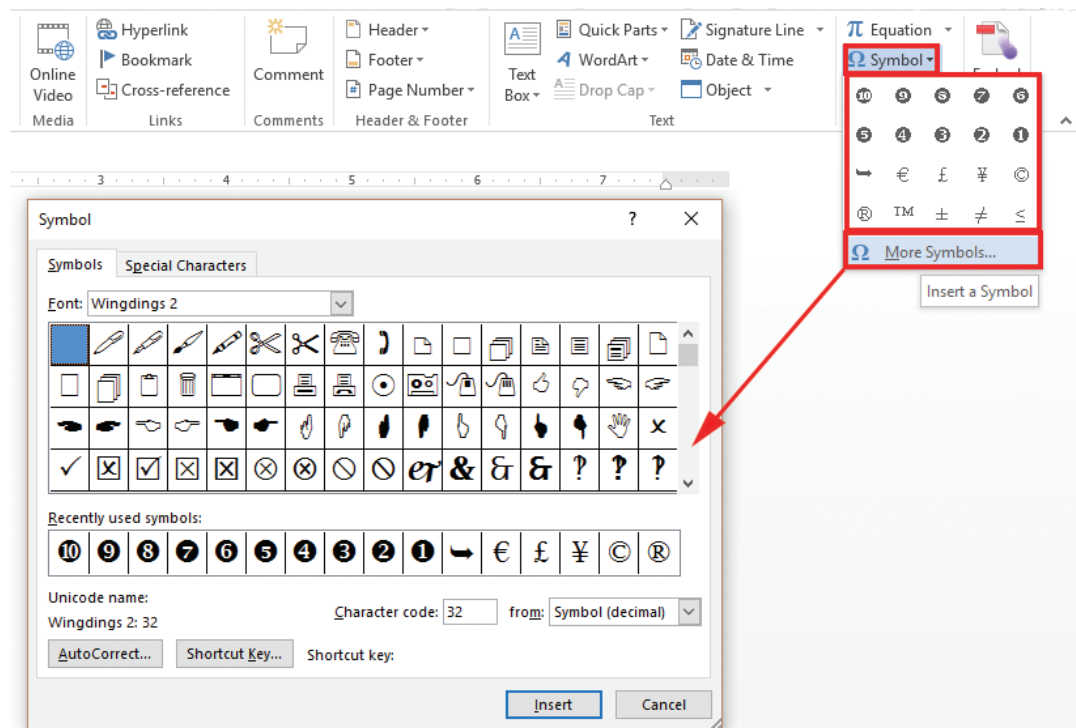


Figure 3.33: Inserting symbols

## Inserting special characters

To insert a special character, use the following procedure:

- (i) Position the insertion point where the special character is to be inserted.
- (ii) Click **Insert** tab from the menu bar. Under **Symbol** group, click **Symbol** icon. A drop down menu appears containing a list of symbols and a **More Symbols** command as shown in Figure 3.33.
- (iii) Click on **More Symbols** command, select **Special Characters** tab to display a dialog box as shown in Figure 3.34.
- (iv) Choose the desired character then click the **Insert** button.

**Note:** The keyboard shortcut for the above process is as follows: **Long press ALT**, press **N** then **U** and finally **M**.

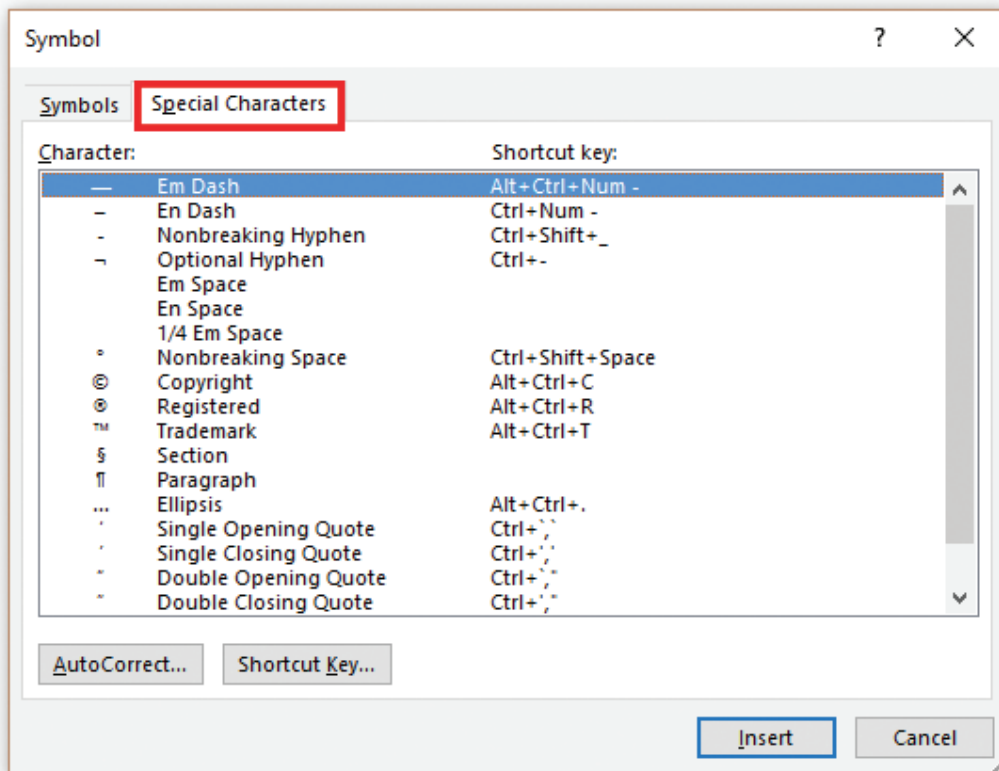


Figure 3.34: Inserting special characters.

### Practice Activity 3.11: Inserting symbols

#### Do the following:

Create a document. Insert different symbols and special characters of your choice in the document. Save the document as **MySymbolsDocument**.

### 3.4.2 Writing Equations

An **equation** is a mathematical statement that has two expressions, usually separated by equals sign. Equations comprise numbers, letters, operators, and symbols. To insert an equation in a document, do the following:

- (i) Position the cursor where the equation is to be inserted.
- (ii) Click **Insert** tab from the menu bar.
- (iii) Under **Symbol** group, click **Equation** icon. The **Equation Tools** menu is added along with **Design** in the menu bar.
- (iv) Click on **Design** to reveal the ribbon under it as shown in Figure 3.35(a).

**Note:** The keyboard shortcut for the above process is as follows: **Long press ALT**, press **N** then **E**.

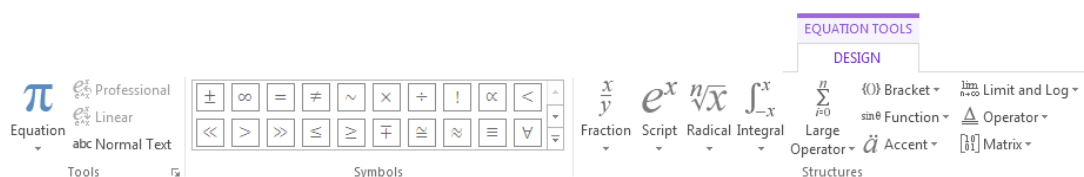


Figure 3.35(a): Writing equations

- (v) Select the desired equation from the **Symbols** group or **Structures** group to automatically insert it in the document. For example, to insert a quadratic equation, click on the equation in the **Radical** icon from the **Structures** group. Figure 3.35(b) shows a sample of a quadratic equation.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Figure 3.35(b): A mathematical expression used for calculating the value of  $x$

#### Revision Activity 3.4

**Part A: Fill in the dashes with the correct words. Choose your answers from these words: Symbol, Equation, Radical, Structures, Symbols.**

1. Non-alphabetical signs that have specific meaning when used in a particular context: \_\_\_\_\_
2. A mathematical statement that has two expressions separated by equal sign: \_\_\_\_\_
3. It is an icon that is used when inserting a quadratic equation: \_\_\_\_\_
4. A group in the ribbon containing equations: \_\_\_\_\_
5. A command button clicked on when inserting a symbol: \_\_\_\_\_

### Practice Activity 3.12: Inserting equations

Create the document shown in the figure below as it appears:  
Save the document using the name: **MyEquations**.

The screenshot shows the Microsoft Word interface with the Equation ribbon selected. The ribbon includes options like Quick Parts, Signature Line, Equation, and Text Box. A dropdown menu is open under the Equation button, showing 'Built-In' and 'Area of Circle'. The document content consists of five numbered items:

1. The area of a circle:  $A = \pi r^2$
2. The Binomial Theorem is given by:  $(x + a)^n = \sum_{k=0}^n \binom{n}{k} x^k a^{n-k}$
3. The formula for expanding a sum is:  $(1 + x)^n = 1 + \frac{nx}{1!} + \frac{n(n-1)x^2}{2!} + \dots$
4. The following are examples of  $2 \times 2$  matrices:  $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$   $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$
5. Evaluate the following integrals:  $\int_1^2 (4x^2 - 3^x) dx$

The right-hand side of the screenshot shows a gallery of equations with categories: Area of Circle, Binomial Theorem, Expansion of a Sum, and Fourier Series. At the bottom, there are links for 'More Equations from Office.com', 'Insert New Equation', and 'Save Selection to Equation Gallery...'.

Figure 3.36: Creating an equations document

## 3.5 Tables

A **table** is a feature that is used to present information in an organised layout. It consists of rows and columns intersecting to form cells where data is entered and manipulated. A **cell** is a box formed by the intersection of a row and a column in a table.

### 3.5.1 Inserting a Table

There are three ways of creating a table namely:

- Using the **Graphic Grid**.
- Using the **Insert Table** feature.
- Using the **Draw Table** tool.

#### Using the Graphic Grid

- Position the cursor where the table is to be inserted.
- Click on **Insert** tab from the menu bar and select **Table** command under the **Tables** group.

A drop down menu appears as shown in Figure 3.37.

- (iii) Select the desired number of rows and columns from the grid.

### Using the Insert Table

- (i) Position the cursor where the table is to be inserted.
- (ii) Click on **Insert** tab from the menu bar and select **Table** command under the **Tables** group.
- (iii) Select **Insert Table**. A dialog box appears as shown in Figure 3.38.

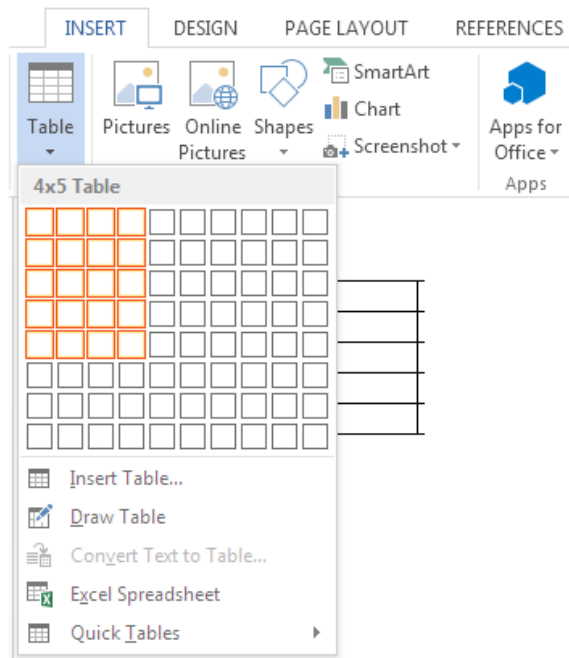


Figure 3.37: Using the graphic grid to insert a table

- (iv) Type the number of columns required in the **Number of columns** box.
- (v) Type the number of rows required in the **Number of rows** box.
- (vi) Select the desired option under **AutoFit behavior**.
- (vii) Click **OK** to apply.

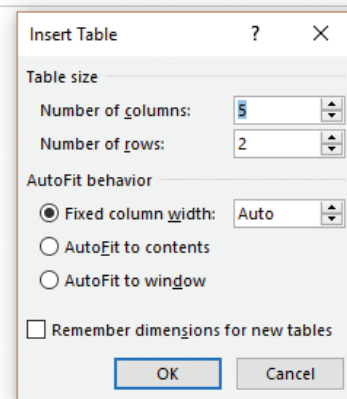


Figure 3.38: Inserting a table dialog box

### Using the Draw Table Tool

- (i) Position the cursor where the table is to be inserted.
- (ii) Click on **Insert** tab from the menu bar and select **Table** command under the **Tables** group.
- (iii) Click **Draw Table** to display a pencil. Start drawing the table by dragging the pencil in the direction where the table is to be displayed. Release the mouse button once the required cell size is realized.



### Practice Activity 3.13: Inserting a table

#### Do the following:

- (i) Create a document.
- (ii) Use the **Graphic Grid** to insert a table of 5 columns and 4 rows.
- (iii) Use **Insert Table** to draw a table of 6 columns and 6 rows.
- (iv) Save the document using the name: **MyTables**.

### 3.5.2 Formatting a Table

When a table is created, the **Table Tools** is added on the menu bar together with **Design** and **Layout** tabs. Most formatting features of a table are found in the **Layout** tab.

The following are some of the formatting features: Inserting rows, inserting columns, deleting (row, column and table), merging cells, splitting cells and formulas among others. Figure 3.39 shows the ribbon containing the different formatting icons.

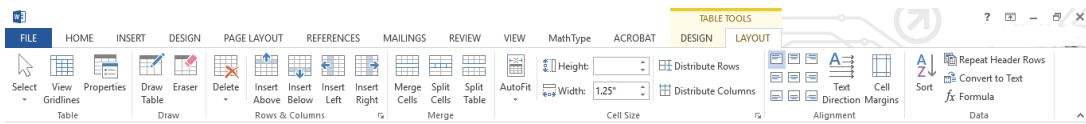


Figure 3.39: Tools for formatting tables

#### Inserting columns and rows in a table

##### Method 1

##### Inserting columns

To add a new column(s) in an already created table do the following:

- (i) Place the cursor in any cell within the column to precede or succeed the new one.
- (ii) Click **Layout** tab from the menu bar and select **Insert Left** or **Insert Right** command under the **Rows & Columns** group.

##### Inserting rows

To add a new row(s) in an already created table do the following:

- (i) Place the cursor in any cell within the row to precede or succeed the new one.
- (ii) Click **Layout** tab from the menu bar and select **Insert Below** or **Insert Above** command under the **Rows & Columns** group.

##### Deleting a row, table and column

To delete a row(s) in an already created table do the following:

- (i) Select a cell in the respective table.

- (ii) Click **Layout** tab from the menu bar and select **Delete** command under the **Rows & Columns** group. A drop down menu appears as shown in Figure 3.40. Click on the desired option. **Note:** The keyboard shortcut for deleting rows, tables, and columns is as follows: **Long press ALT, press JL then D.**

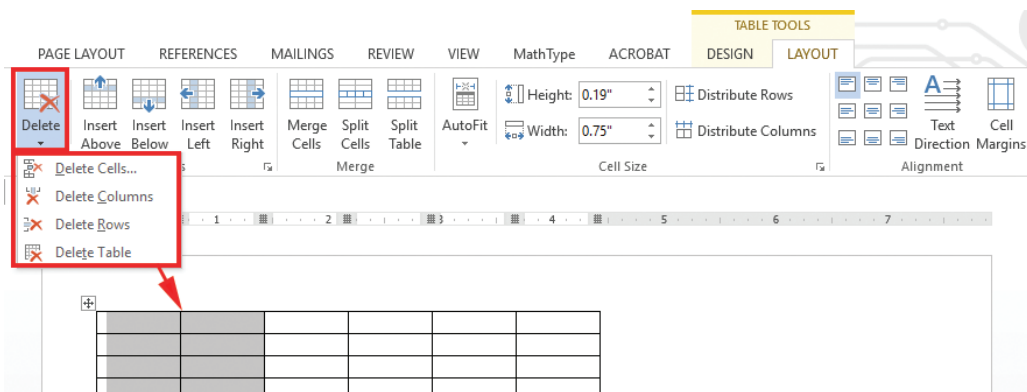


Figure 3.40: Deleting cells, rows, tables, and columns

Options	Functions
Delete Columns	Erases an entire column.
Delete Rows	Erases an entire row.
Delete Table	Erases a table.
Delete Cells...	Erases the selected cells.

Figure 3.41: Options available in delete command

### Method 2

Place the insertion point in the row or column next to which you want to insert a row or column.

- (i) **To insert rows:** Right-click the mouse, then select **Insert Row Below** or **Insert Row Above** from the pop-up menu that appears. Your choice is dependent on what you desire.
- (ii) **To insert columns:** Right-click the mouse, then select **Insert Column to the Right** or **Insert Column to the Left** from the pop-up menu that appears. Your choice is dependent on what you desire. See Figure 3.41 on page 78.

Place the insertion point in the row or column you want to delete.

- (i) Right-click the mouse, then select **Delete Cells...** from the menu that appears.
- (ii) Select **Delete Cells**.

### Practice Activity 3.14: Deleting cells, columns, rows, and tables

Open the document you saved as: **MyTables**.

- (i) Save a copy of it and name the new document as: **MyEditedTables**.
- (ii) Use the newly saved version to practise deleting cells, columns, and rows.

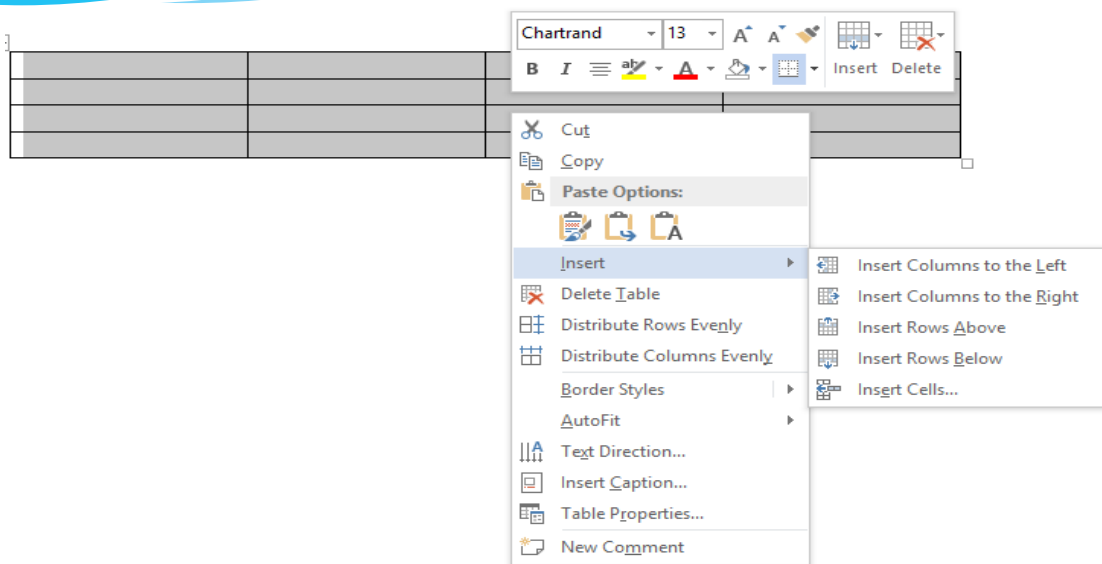


Figure 3.42: Inserting rows and columns by right-clicking

### 3.5.3 Merging Cells and Splitting Cells

Merge cells command is used to combine more than one cells to appear as one large cell while split cells command is used to divide a cell to more than one section hence appearing as many different cells.

#### Merging cells

The following is the procedure for merging cells:

- (i) Select the cells to be merged.
- (ii) Click **Layout** tab from the menu bar and select **Merge Cells** icon under the **Merge** group. The cells are automatically combined.

#### Splitting cells

The following is the procedure for splitting cells:

- (i) Position the cursor in the cell to be split.
- (ii) Click **Layout** tab from the menu bar and select **Split Cells** command under the **Merge** group. The keyboard shortcut is as follows: **Long press ALT**, press **JL**, then **P**.

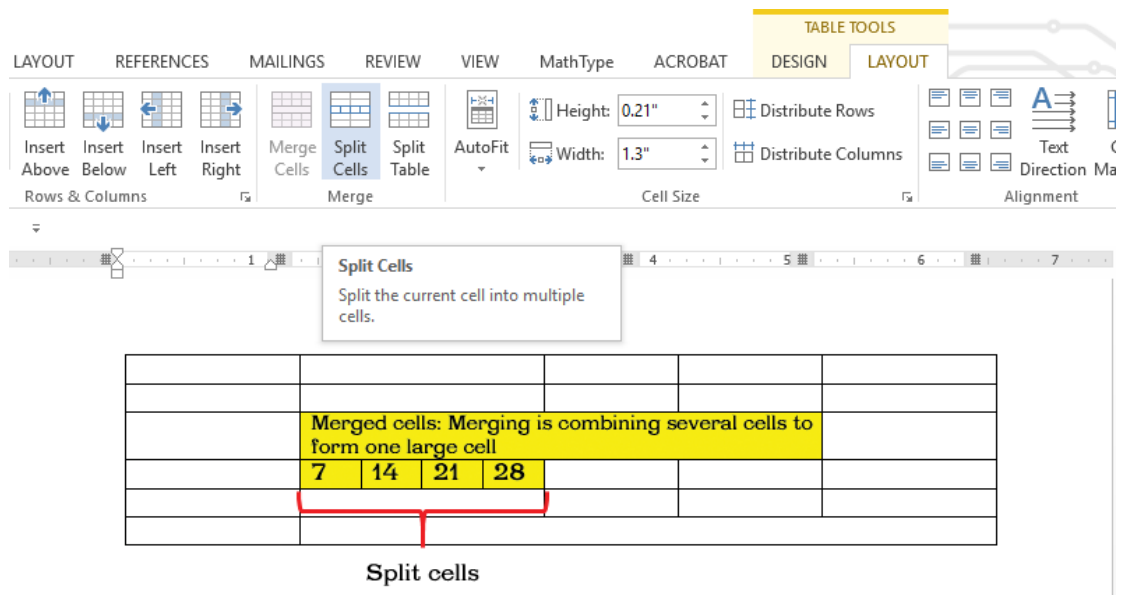


Figure 3.43: Merged and split cells

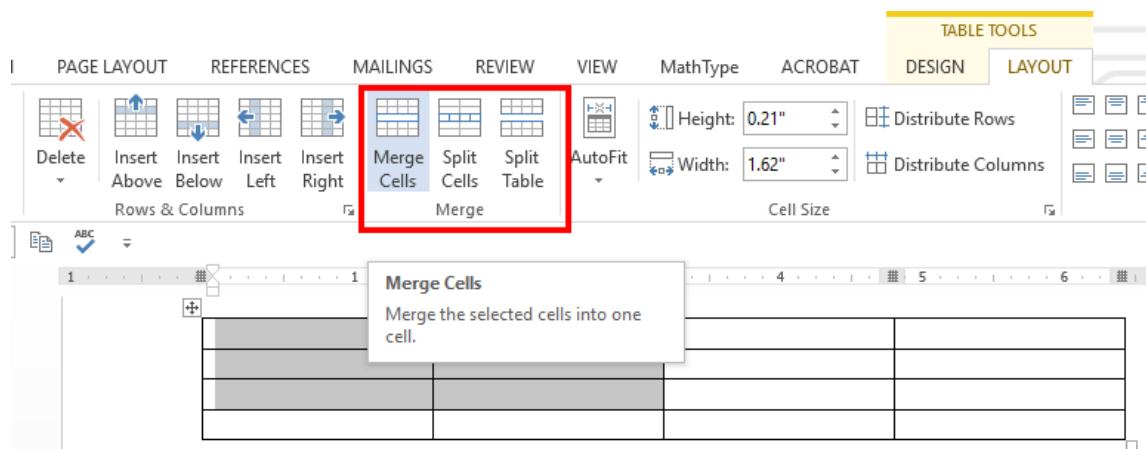


Figure 3.44: Merging and splitting cells

### Practice Activity 3.15: Merging and Splitting Cells

**Do the following:**

- (i) Open the document you saved as: **MyTables**.
- (ii) Save a copy of it and name the new document as: **MyMergedCellsTable**.
- (iii) Use the newly saved version to practise merging and splitting cells.

### Revision Activity 3.5

#### Part A: Fill in the dashes with the correct answers

- The letters below can be re-arranged to form a formatting feature in a table. Give the feature in each case:
  - ERMGE \_\_\_\_\_
  - LTISP \_\_\_\_\_
  - REINST \_\_\_\_\_
- A table is a feature that consist of \_\_\_\_\_ and \_\_\_\_\_.
- A box formed by the intersection of a row and column in a table is known as \_\_\_\_\_.
- Delete columns command is used to erase \_\_\_\_\_.
- \_\_\_\_\_ command is used to combine more than one cells to appear as one large cell.

#### Part B: Follow the instructions given carefully

- Create the following table and save it as **Table 1**.

Name	Class	House
Habimana	2a	Muhanga
Muteteli	2b	Huye
Sebahire	2a	Rubavu
Nyamahoro	2b	Gatsibo

- Insert three columns to the right of the column containing house.
- Add two rows after the row containing Nyamahoro details.
- Add another row on top and include the title "Examination Analysis"
- Save it as **Table 2**.
- Delete Nyamahoro's details.
- Add the following details in the three columns added: Column 1(History, 67, 89, 98), Column 2 (Business, 77, 56, 34) and column 3 (English, 74, 87, 65).
- Merge the cells containing the title.
- Split the cell containing the name Habimana into two.
- Save it as **Table 3**.

### 3.5.4 Table Auto Format and Formulas

#### Table Auto format

This option provides in-built table formats that enable the user to quickly design tables with a professional look. To apply this feature, do the following:

- (i) Position the cursor where the table is to be inserted.
- (ii) Click on **Insert** tab from the menu bar and select **Table** command under the **Tables** group.
- (iii) Select **Quick Tables**. A dialog box appears as shown in Figure 3.45.

The keyboard shortcut is as follows: **Long press ALT**, press **N** then **T** and finally **T**.

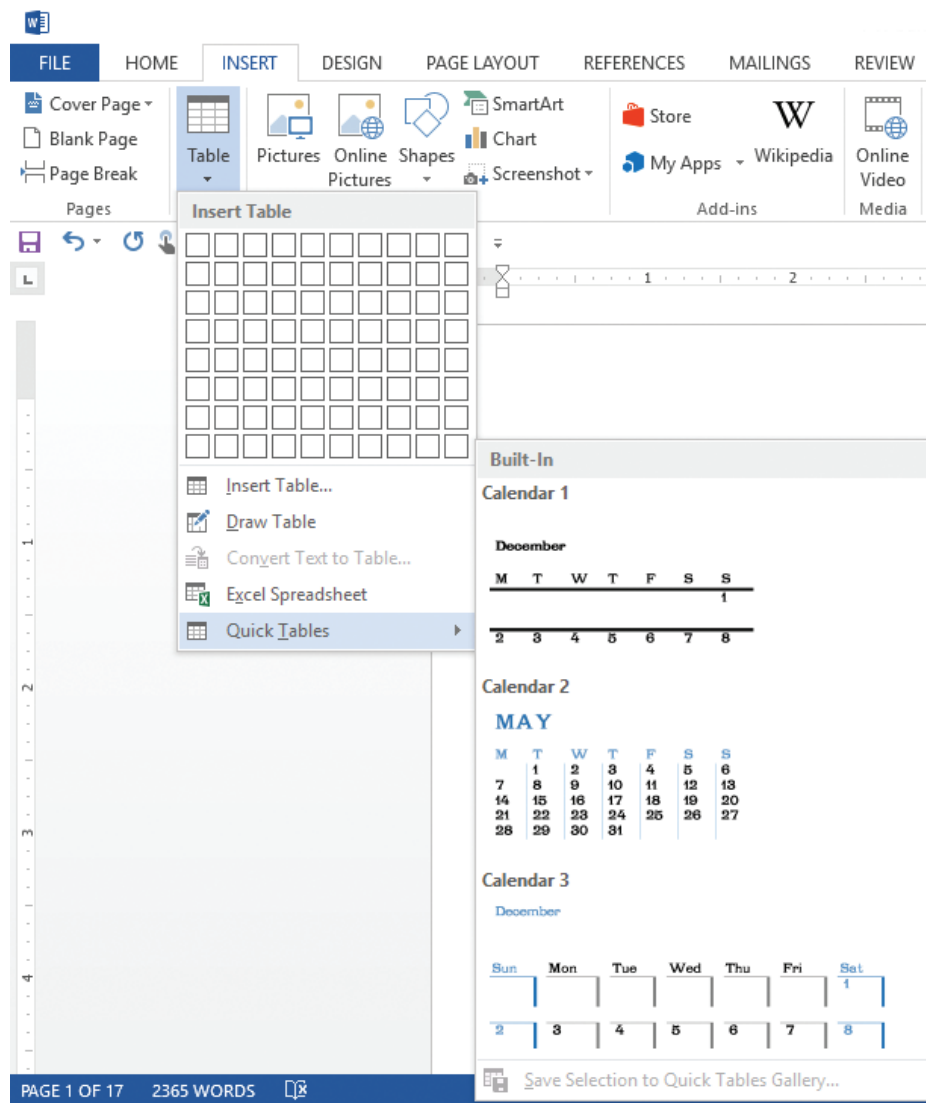


Figure 3.45: A dialog box for auto formatting a table

## Formulas

Formulas are used to perform calculations in a table. Microsoft Word 2013 enables the user to add formulas in a document in order to perform simple calculations. The user can do the following:

- (i) Total numbers in a row or column.
- (ii) Perform other calculations.

### Total numbers in a row or column

- (i) Click the cell in which the sum is to be displayed.
- (ii) Click Layout tab from the menu bar and select  $\Sigma$  command under the Data group. The formula dialog box is displayed as shown in Figure 3.46. The keyboard shortcut is **Long press ALT, press JL then UL**.

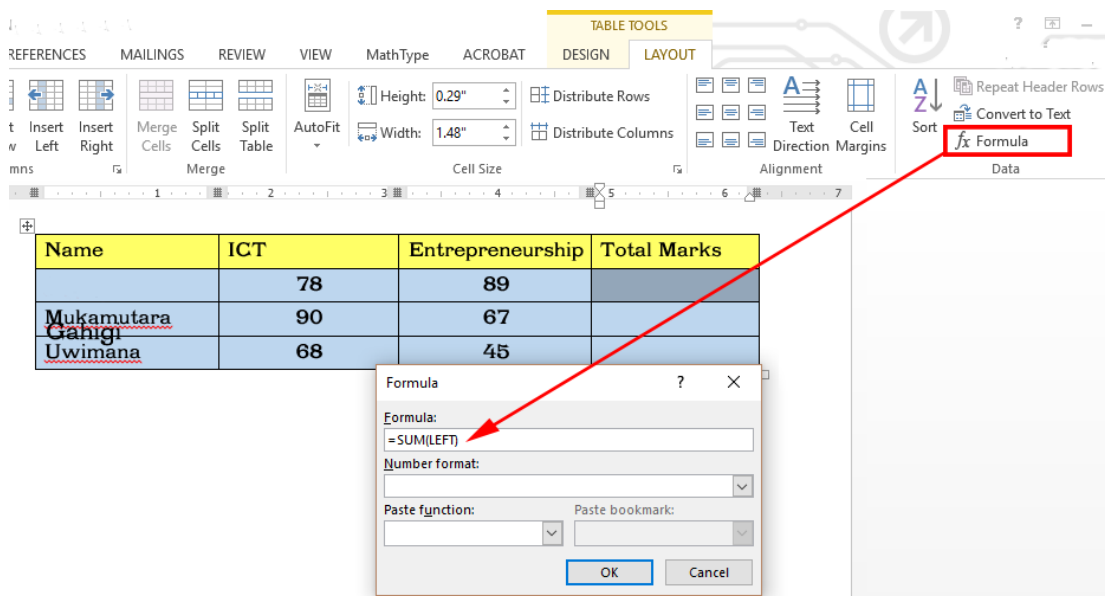


Figure 3.46: Formula dialog box

- (iii) If the selected cell is at the bottom of a column of numbers, Microsoft Word proposes the formula =SUM (ABOVE).  
If the selected cell is at the right end of a row of numbers, the formula =SUM (LEFT) is proposed by Microsoft Word.
- (iv) Click **OK** to apply if the proposal displayed is correct.

Name	ICT	General	Total Marks
Gahigi	78	89	167
Mukamutara	90	67	157
Uwimana	68	45	113

Figure 3.47: Total marks calculated

## Notes

- If a column or a row contains any blank cells, Microsoft Word will not total the entire column or row. To total the entire row or column, type a zero in the blank cell.
- If a column or a row selected for totalling does not contain a value, Microsoft Word will not display any proposal in the formula box.
- Microsoft Word inserts the result of the calculation automatically in the selected cell. If the values in the referenced cells are changed, select the cell containing the result and then press F9 to update the value.

## Perform other calculations in a table

The user can perform other calculations by selecting a function from the **Paste** function.

- Click the cell where the formula is to be typed.
- Click **Layout** tab from the menu bar and select **fx** command under the **Data** group.
- Delete the proposed formula from the **Formula** box if it is not desired except the equal sign.
- Select a function from the **Paste function** box. For instance, to obtain average, click **Average**. The formula dialog box is displayed as shown in Figure 3.48.

Paste function contains inbuilt formulae

Name	ICT	Entrepreneurship	Average
Gahigi	78	89	
Mukamutara	90		
Uwimana	68		

Formula dialog box details:

- Formula: =SUM(LEFT)
- Number format: (dropdown)
- Paste function: (dropdown menu showing ABS, AND, AVERAGE, COUNT, DEFINED, FALSE, IF, INT)
- Paste bookmark: (dropdown)
- Buttons: OK, Cancel

Figure 3.48: The Formula dialog box



- (v) Click in the parenthesis and type “Left” or “Above” depending on where the cells are located. See Figure 3.49.

The screenshot shows the Microsoft Word interface with the Table Tools Layout tab selected. The Formula button is highlighted with a red box. A red arrow points from this button to the Formula dialog box. The dialog box displays the formula `=AVERAGE(LEFT)` in the Formula field. The Number format field is empty, and the Paste function and Paste bookmark fields are also empty. The OK and Cancel buttons are visible at the bottom of the dialog box.

Name	ICT	Entrepreneurship	Average
Gahigi	78	89	83.5
Mukamutara	90	67	78.5
Uwimana	68	45	

Figure 3.49: Average is used to display the mean of selected cell

- (vi) In the **Number Format** box, enter a format for the numbers. For example, to display the numbers as a decimal percentage, click **0.00%**.

### 3.5.5 Writing a Formula

You can sum numbers in a column or a row in a table. To add up a column or row numbers in a table, use the **Formula** command.

- Click the table cell where you want your result.
- Click the **Table Tools Layout** tab and click **Formula**.
- Check between the parentheses to make sure the selected formula includes the cells you want in the sum. In this case, the sum required is of the cells to the left. The formula to use is `=SUM(LEFT)`
- Other formulas available are:

`=SUM(ABOVE)` adds the numbers in the column above the current cell.

`=SUM(LEFT)` adds the numbers in the row to the left of the current cell.

=SUM(BELOW) adds the numbers in the column below the current cell.

=SUM(RIGHT) adds the numbers in the row to the right of the current cell.

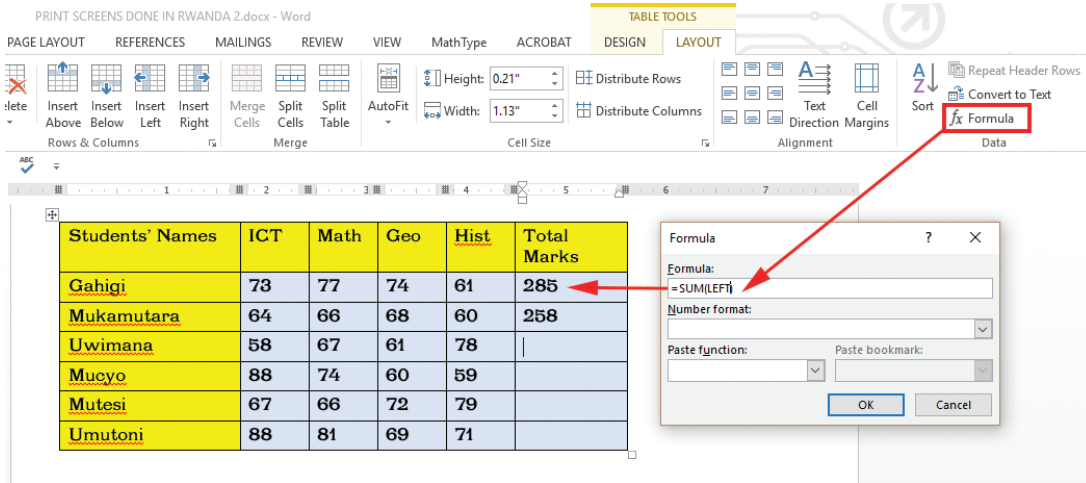


Figure 3.50: Summing numbers in rows and columns

**Practice Activity 3.16: Summing numbers in rows and columns of tables**

**Do the following:**

- Create a document and save it as: **SummingRowsAndColumns**
- Create the table shown in Figure 3.51.
- Use the Formula feature to add the totals of the numbers in rows and columns.

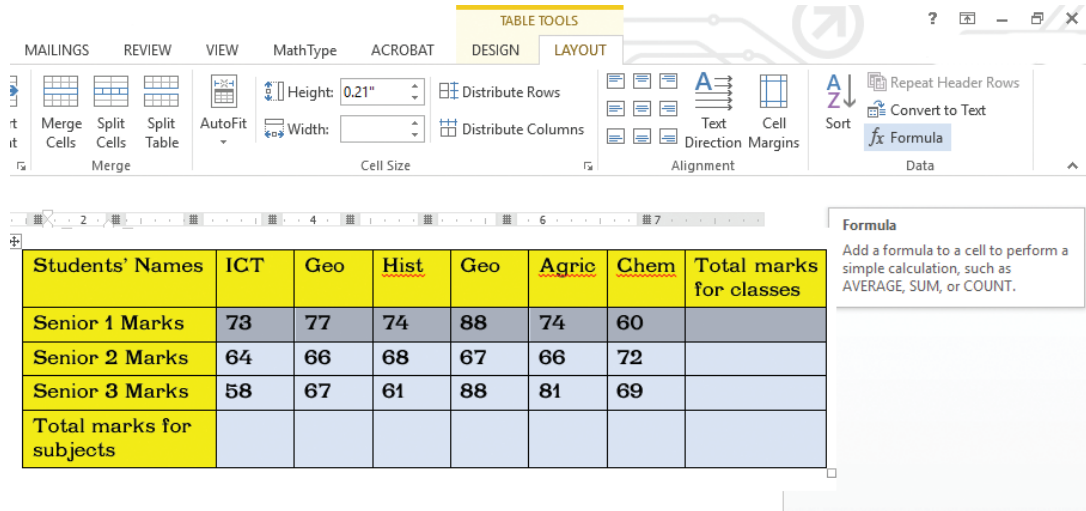


Figure 3.51: Summing numbers in rows and columns

### 3.5.6 Writing in a Table and Text Direction

To write data in a table, click on a cell then type the information.

To change the direction of text in a cell, do the following:

- (i) Click on the cell where the data is to be displayed.
- (ii) Click **Layout** Tab from the menu bar. Select **Text direction** icon in the **Alignment** group. The text direction is automatically changed. Keep clicking on **Text direction** command until the desired direction is reached. See Figure 3.52.

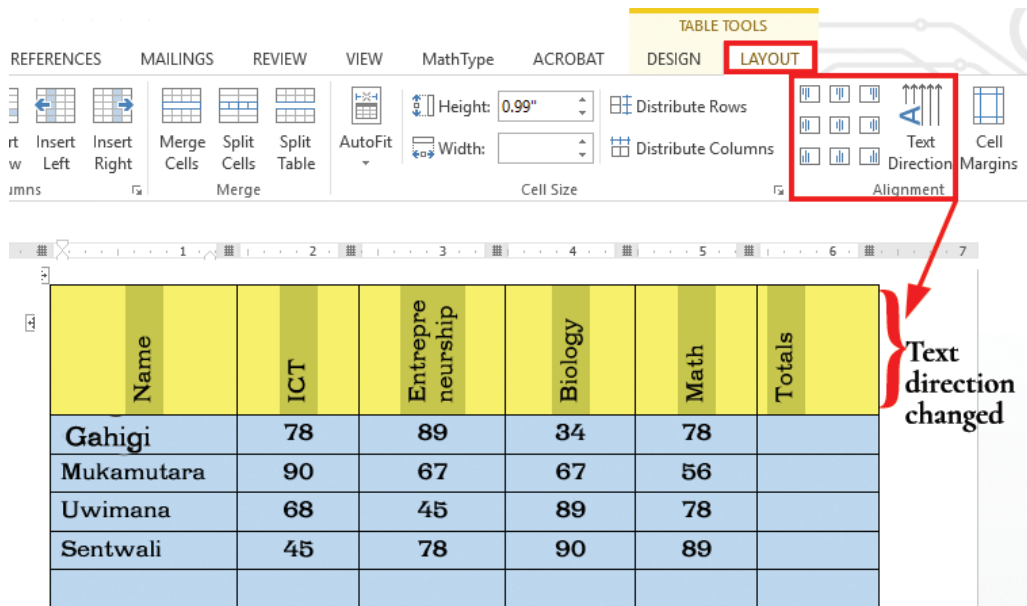


Figure 3.52: Changing of text direction

#### Revision Activity 3.6

##### Part A: Fill in the dashes with the correct answers

1. A table option that provides in-built formats is known as \_\_\_\_\_.
2. \_\_\_\_\_ are used in order to perform calculations in a table.
3. Microsoft Word will not total the entire column or row if it contains any \_\_\_\_\_ cells.
4. \_\_\_\_\_ formula adds the numbers in the row to the left of the current cell.
5. The \_\_\_\_\_ contains inbuilt functions in Microsoft Word.

##### Part B: Read the questions carefully and answer them

1. Define the term symbols as used in word processing.
2. List three ways in which a table can be created.

3. Define the term equation as used in word processing.
4. Differentiate between a row and column.
5. What is a table?

**Part C: Follow the instructions in this activity carefully**

1. Open **Table 3**.
2. Add a column at the far right, label it **Total**.
3. Write a formula to calculate the total marks for each student.
4. Add a row after the last record, label it **Average**.
5. Write a formula to calculate the average for each subject.
6. Add another column after total column, label it **Number**.
7. Write a formula to calculate the number of subjects done by each student.
8. Change the text direction of the row containing labels to vertical.
9. Save changes as **Table 4**.

### 3.5.7 Table Properties, Layout, and Design

To change the properties of a table, do the following:

- (i) Right-click on the table. A pop-up menu appears as shown in Figure 3.53.
- (ii) Select **Table Properties...** option. A dialog box appears as shown in Figure 3.54.
- (iii) The **Table** Tab is active by default. Make the desired changes such as indentation, alignment, border and shading, text wrapping, and indentation.
- (iv) Click **OK** to apply.

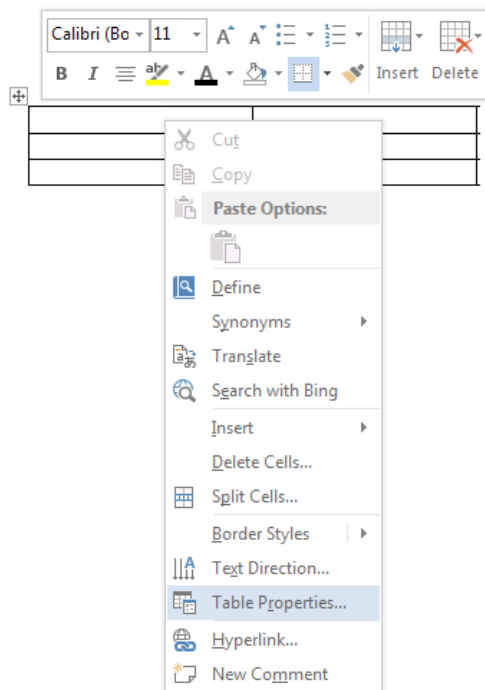


Figure 3.53: Table properties options

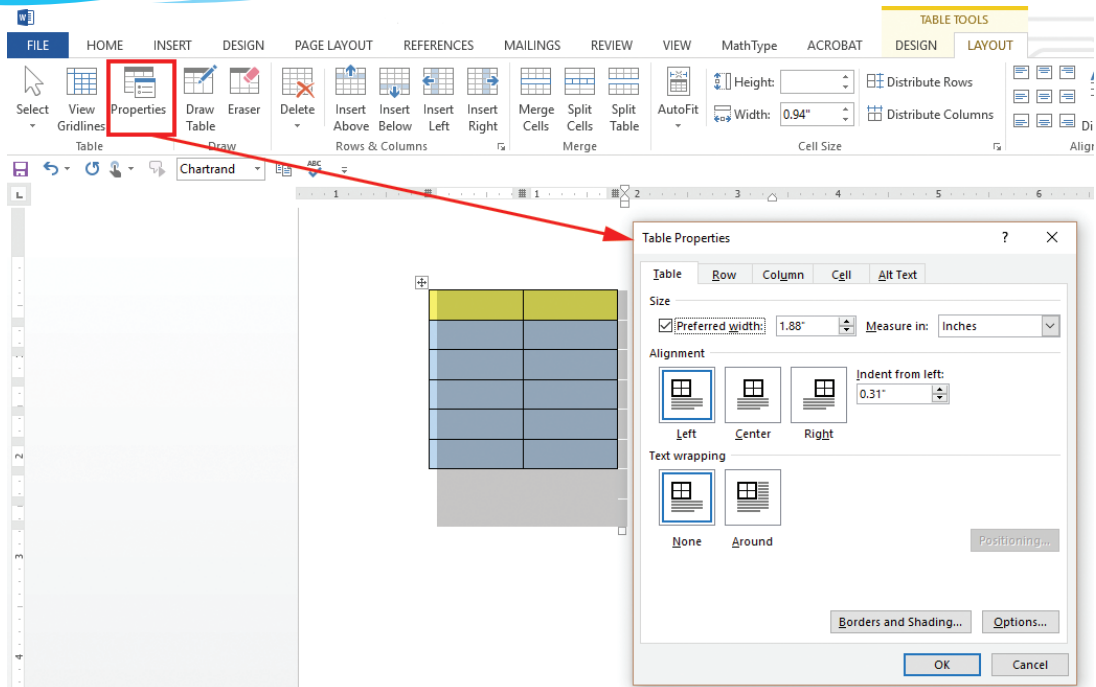


Figure 3.54: Table Properties dialog box

### Borders and Shading

To change borders and shading style of a table, do the following:

- (i) Right-click on the table. A pop-up menu appears as shown in Figure 3.55.
- (ii) Select **Table Properties...** option. A dialog box for **Borders and Shading** appears as shown in Figure 3.56.
- (iii) Click on **Borders and Shading** button. A dialog box appears as shown in Figure 3.57.

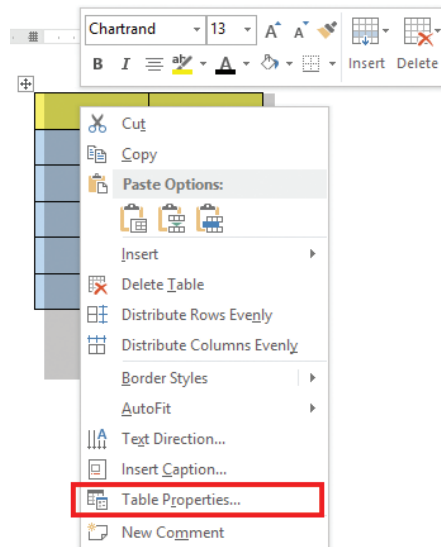


Figure 3.55: Table Properties in the pop-up menu

- (iv) **Borders** tab is selected by default. Click on the desired line **Style**, **Colour**, and **Width**.
- (v) To apply a shading style, click on **Shading** tab and select the desired option.

(vi) Under **Apply to**, select **Table**. Click **OK** to apply.

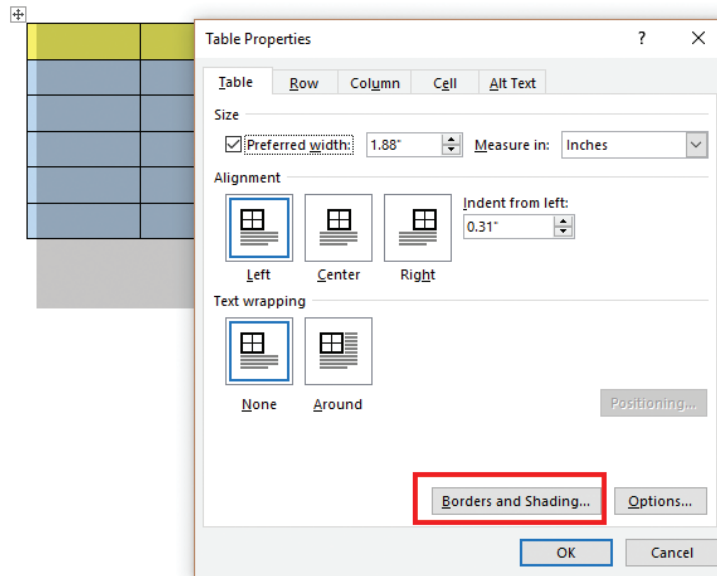


Figure 3.56: Borders and shading dialog box

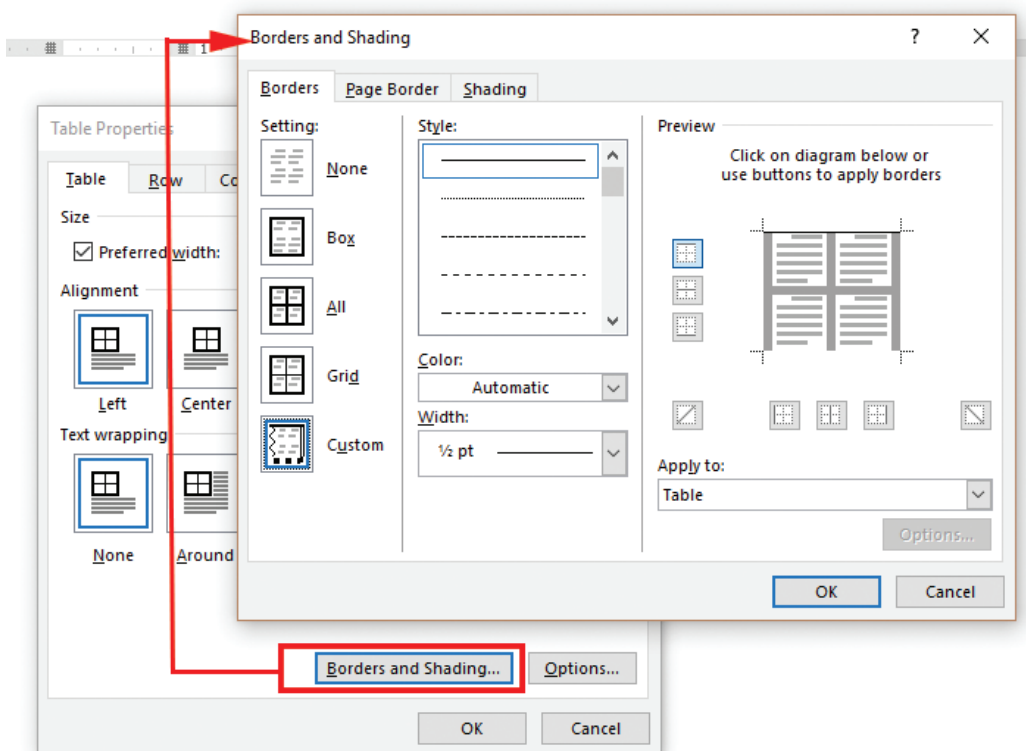


Figure 3.56: Borders and Shading dialog box

### Revision Activity 3.7

#### Part A

Search for the words given below in the puzzle: Border, Shading, Layout, Table, Symbol, Paste, Function, Formula, Shapes, Equations, Picture

P	A	S	T	E	W	F	U	N	C	T	I	O	N	E	S
I	L	H	J	A	J	K	O	B	O	R	D	A	R	Y	H
C	Y	A	X	D	B	N	Q	R	E	Q	U	E	M	T	A
T	O	D	O	W	T	L	S	P	M	I	G	B	I	A	P
U	U	I	R	S	H	A	E	X	V	U	O	A	T	B	E
R	T	N	B	A	T	U	O	Y	A	L	L	T	O	L	S
E	Z	G	I	P	I	C	T	C	P	E	S	A	R	Y	N
B	O	R	D	E	R	F	E	Q	U	A	T	I	O	N	S

#### Part B

Create this table as it appears and save it as **Trial**. Format the borders as shown.

Name	ICT	General	Total Marks
Hakizimana	76	81	157
Dukuzumuremyi	45	65	110
Kamali	88	54	142

### Revision Activity 3.8

Type the essay given below on money management. As you type it, practise to do the following:

- Insert, format, and edit text boxes
- Add shapes and add text in those shapes.
- Insert pictures
- Use drawing tools

## Money Management

### Tips on how to manage your pocket money in Senior School

#### 1 Always prepare a budget

A budget is a plan to show how much money can be spent and how it will be spent. When preparing a budget there are important facts you need to have which include:

- (i) Amount of money you have to spend.
- (ii) Period of time to be covered.
- (iii) Item list.

#### Why Make a Budget

- It helps one to list the items needed and prioritise them.
- A budget helps one to know how much money is available to spend.
- It helps one to know how much money has been spent in a given period of time.
- It helps in planning to save for unforeseen expenses.
- It helps one make decisions about money, both today and in the future.

#### 2 Be Frugal

To be frugal means to spend money carefully. To attain financial discipline one needs to know the difference between wants and needs and be able to prioritise them.

As a Senior School student, you know that the modern world does not favour frugality because of advertisements, latest technology, and fashion among others. However financial discipline enables one to live within their means and learn how to make the most of what one has and also get the best value on items that one purchases.

#### 3 Save

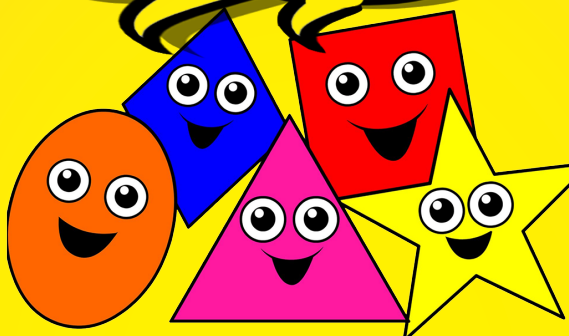
Saving helps one to build a culture of proper financial management.

The little savings act as a financial security in case of an emergency





Let's Sing About Money  
 Let's learn how .... to . save ... save ..  
 Amafaranga ... Amafaranga ....  
 Prepare the budget ... tururruru  
 Be frugal .... tururu tururu  
 Save ... save ... save ... Amafaranga ..



Let's sing about money

**4** Invest

It is important for students to understand the **time value of money** principle that money available at the present time (today) is worth more than the same amount in the future. This is because of its potential earning capacity. It is important to begin saving and investing money as soon as possible so that it has more time to accrue interest.



Learn to save money.

**The earlier you learn about personal financial management, the better prepared you will be in your future endeavours.**

**End of Revision Activity 3.8**

### 3.6 Definition of key words in this unit

#### Revision Activity 3.9

Find out the meaning of the words given below. Share your findings with the rest of the students in a class presentation. Check the meanings you find against those provided in the glossary at the end of this course book.

Table	Shadow effect	Symbols
Equations	Shapes	Pictures
Merge cells	Auto format	Split cells
Text box	Fill effect	WordArt

#### Revision Exercise 3

1. Differentiate between merge cells and split cells.
2. The Table below contains details of students. Use it to answer the questions that follow:

Name	ICT	General	Total Marks
Hakizimana	78	81	159
Dukuzumuremyi	90	65	155
Kamali	68	54	122

Write down the formula that was used to:

- (i) Calculate the total marks for Hakizimana.
  - (ii) Calculate the mean for ICT.
  - (iii) Give the name of the cell containing ICT marks for Dukuzumuremyi given that A1 is the cell containing Name.
3. What is the purpose of writing formulas?
  4. What is a cell as used with tables?
  5. State the purpose of creating links between text boxes.
  6. A student wrote a formula in Microsoft Word 2013. However, the result was not displayed.
    - (i) Give a reason why this happened.
    - (ii) State a solution to the problem.
  7. Differentiate between an equation and a symbol.
  8. List two ways in which a picture can be inserted in a document.

# Unit 4



## Spreadsheet Basics

**Key Unit Competency: By the end of this unit, you should be able to:**

1. Work with spreadsheets and apply basic manipulation of cell content using arithmetic operations.

### Introduction

A spreadsheet program is an interactive program that enables the user to layout and organise numerical data tabular form. Spreadsheets contain rows and columns that intersect to form cells into which data are entered.

Examples of spreadsheet programs include the following: Microsoft (MS) Excel, Lotus 1-2-3, Quattro Pro, Multiplan, and Super Calc among others. The spreadsheet program discussed in this unit is **Microsoft Excel 2013 (Ms Excel 2013)**.

### 4.1 Definition and Role of a Spreadsheet

A **spreadsheet** is a software that enables the user to organise numerical data on the screen in a tabular form. The program is made up of rows and columns used to present and analyse numerical data.

The word spreadsheet is also used to describe an electronic document in which data is arranged in the rows and columns of a grid. A spreadsheet can be manipulated and used in calculations

Spreadsheets enable the user to enter data, edit and perform calculations, as well as present data in graphic form.

#### 4.1.1 Features of Spreadsheets

- (a) They consist of a workbook and worksheets.
- (b) Every worksheet consists of cells where data is entered.
- (c) Every individual cell has a unique cell address used for identification.
- (d) It contains inbuilt formulas known as **functions** that enable the user to perform calculations quickly.
- (e) It allows presentation of information using charts.

#### 4.1.2 Create, Save, and Open a Workbook

A **workbook** refers to a file that can contain one or more worksheets used to organise different kinds of related data.

A worksheet is a form containing cells that are organised in rows and columns. A worksheet on a computer screen resembles a sheet of paper with multiple columns that are used to analyse numerical data.

### Opening Microsoft Excel Program

When you open Microsoft Excel 2013, the first window that is displayed is as shown in Figure 4.1 below:

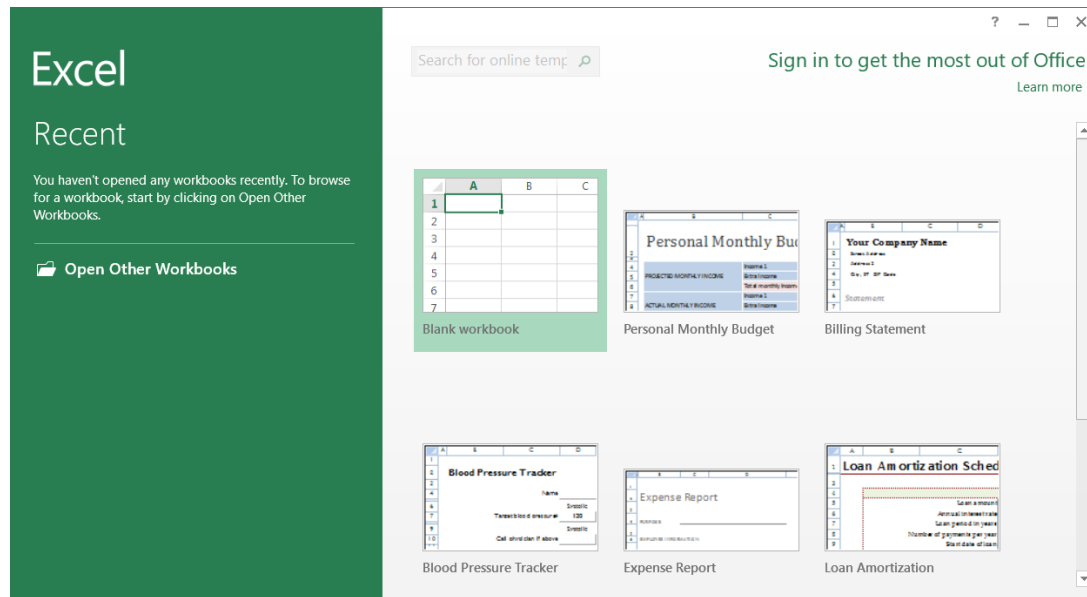


Figure 4.1: Opening Microsoft Excel 2013

There are **four** possible ways of starting Microsoft Excel program. These are:

- (i) Click **START** button, select **All Apps** then Click on **Microsoft Office** to display a list of programs contained in the office suite. Click on **Excel 2013**.
- (ii) Type the word **RUN** in the Search the web and Windows box next to the start button then press Enter key. Type **excel** in the dialog box that appears and click **OK**, or Press **ENTER** on the keyboard.
- (iii) Click **START** button then select **Microsoft Excel 2013** if it was pinned on the start menu.
- (iv) Click **Microsoft Excel 2013** icon if it was pinned on the task bar.

**Note:** Any of the options above will display a window as shown in Figure 4.1. Click on the blank workbook icon to launch Excel and open a workbook window.

### Creating a workbook

When Excel is launched, it automatically opens a workbook containing a worksheet with a default name of **Sheet1**.

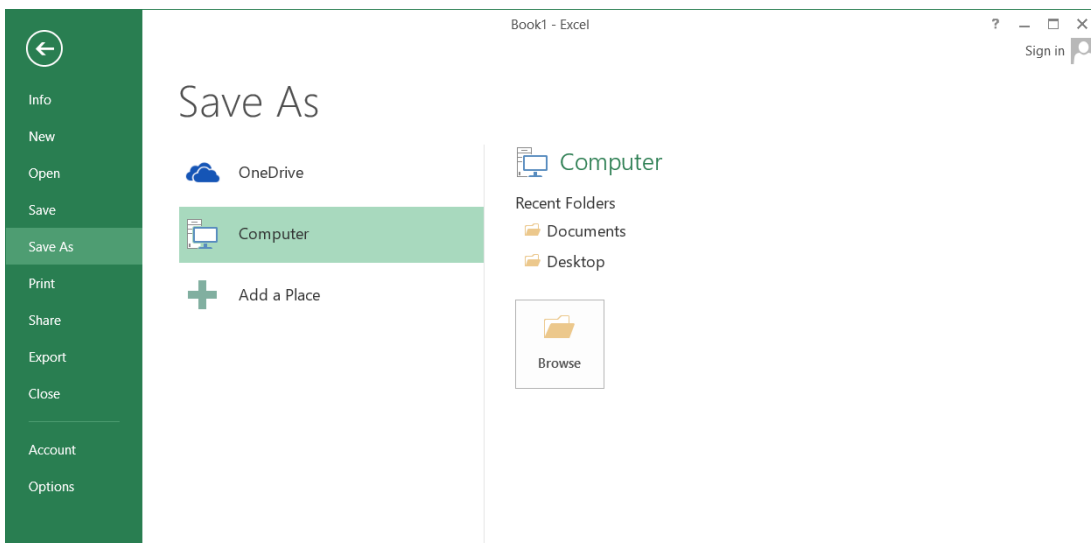
After the program is opened, the following steps can be used to create a new workbook:

- (i) Click on the **File** tab from the menu bar.
- (ii) Select **New** from the pull down menu.
- (iii) Click on the desired template from the right pane. For example, to create a new blank workbook, click on the **Blank workbook** option.

### **Saving a workbook**

To save a workbook for the first time, do the following:

- (i) Click on the **File** Tab in the menu bar.
- (ii) Click the **Save As** option from the pull down menu that appears. The Save As window appears on the right as shown in Figure 4.2.



*Figure 4.2: Saving a workbook*

- (iii) Click on the location where the workbook is to be stored if it displayed on the Save As window. Otherwise click on Browse or Computer icon to display the **Save As** dialog box as shown in Figure 4.3. The keyboard shortcut for saving a document in Excel is as follows: **Long press ALT** then select **F** then **A** and finally press **1**.
- (iv) Type the name of the workbook in the **File name** box. To select another storage location click on it on the left pane of the window.
- (v) Click **Save** button.

Once a workbook has been saved, a user can make changes to it and save it under the same name or a different name. To save changes on an existing workbook, do one of the following:

- (i) Press **Ctrl + S** on the keyboard.

- (ii) Click the **File** tab, then select **Save** command.
- (iii) Click the **Save** icon on the **Quick Access Tool bar**.

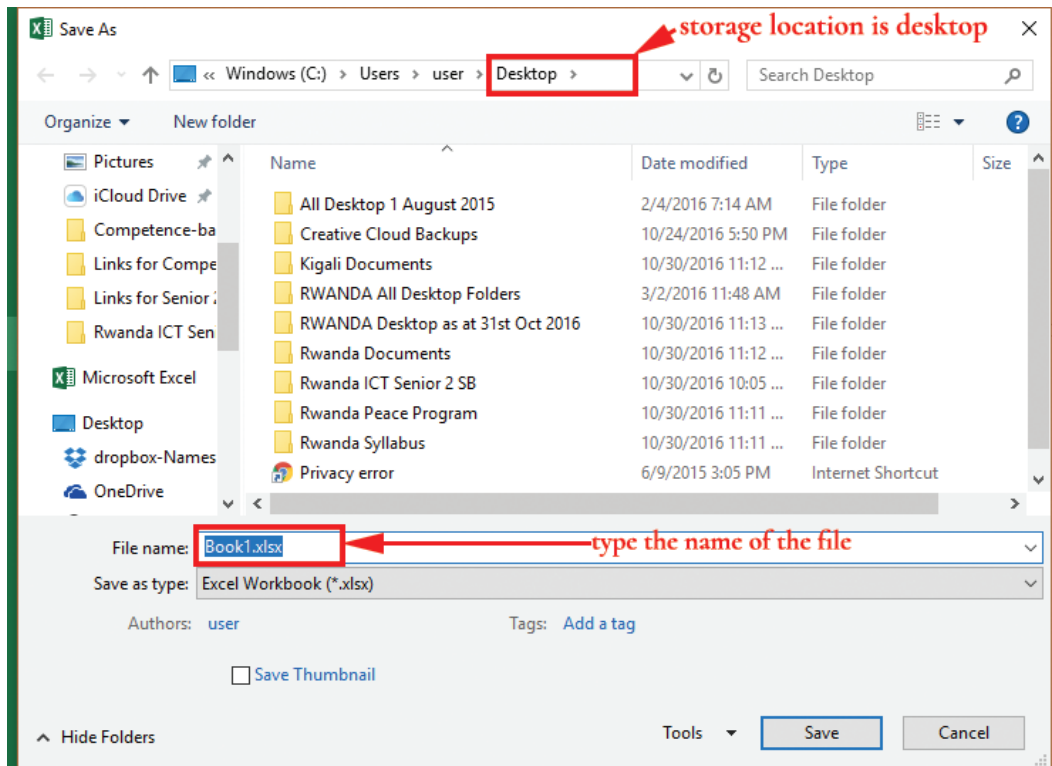


Figure 4.3: Choosing the location for saving a document

### Closing a workbook


To close an active workbook, do one of the following:

- (i) Click **Close** button on the title bar of the active worksheet.
- (ii) Press **ALT + F4** on the keyboard.
- (iii) Click the **File** Tab then select **Close** command.

### Opening an existing workbook

It is also known as retrieving a saved workbook. To open an already saved workbook, do one of the following:

- (i) Click the **File** tab then select **Open** command. Select the location where the workbook was stored then click on the name of the workbook from the list displayed or click **Browse** to locate the file and finally click **Open**.
- (ii) If the file was among the ones that were recently created or modified, click on the **File** tab, select **Open** command then finally click on the name of the file in the **Recent Workbooks** pane.

- 
- (iii) Click **Open** icon on the **Quick Access Toolbar**. The open window appears. Proceed as in option (i) or (ii) above.
  - (iv) Press **CTRL + O** on the keyboard and proceed as option (i) or (ii) above.
  - (v) Open the location where the workbook was saved then double click on the workbook.

## 4.2 Spreadsheet Environment

---

The spreadsheet package used in this case is Microsoft Excel (Ms-excel) 2013. It contains the following parts:

- **Title bar:** It displays the name of the application currently in use as well as the name of the active workbook. When a new spreadsheet is opened, Ms Excel allocates default names such as Book1, Book2 and so on. The default name changes any time the workbook is saved using a new name.
- **Buttons:** The title bar also contains three buttons which are: Minimise, Restore Down/Maximise and Close buttons at the top right corner.
- **Menu bar:** This bar displays the following tabs: File, Home, Insert, Page Layout, Formulas, Data, Review and View. Additional tabs appear when a chart is inserted or selected.
- **Ribbon:** The ribbon consists of icons of commands organised and classified into groups. Clicking on any tab on the menu bar displays a ribbon unique to it. For example, clicking on **Page Layout** tab displays a ribbon with 5 groups namely Themes, Page Setup, Scale to Fit, Sheet Options and Arrange.
- **The Quick Access Toolbar:** It is a small customisable toolbar of the most commonly used commands located at the top left corner of the workbook window. By default, this bar contains Save, Undo and Redo commands. See Figure 4.4 on page 100.

It can be customised in the following ways:

- (i) It can be made to appear above or below the ribbon.
- (ii) Commands can be added or removed from it.
- **Scroll bar:** The scroll bar allows one to move or navigate through a large worksheet. There are two types of scroll bars the vertical scroll bar and horizontal scroll bar. Vertical scroll bar allows upward or downward movement on the worksheet while horizontal scroll bar allows movement from left to right and vice versa.
- **Formula bar:** It provides the user with a box for entering or editing data or formula in a cell. It is located below the ribbon by default. It contains the cell naming box and the formula box used for entering a formula or editing data.

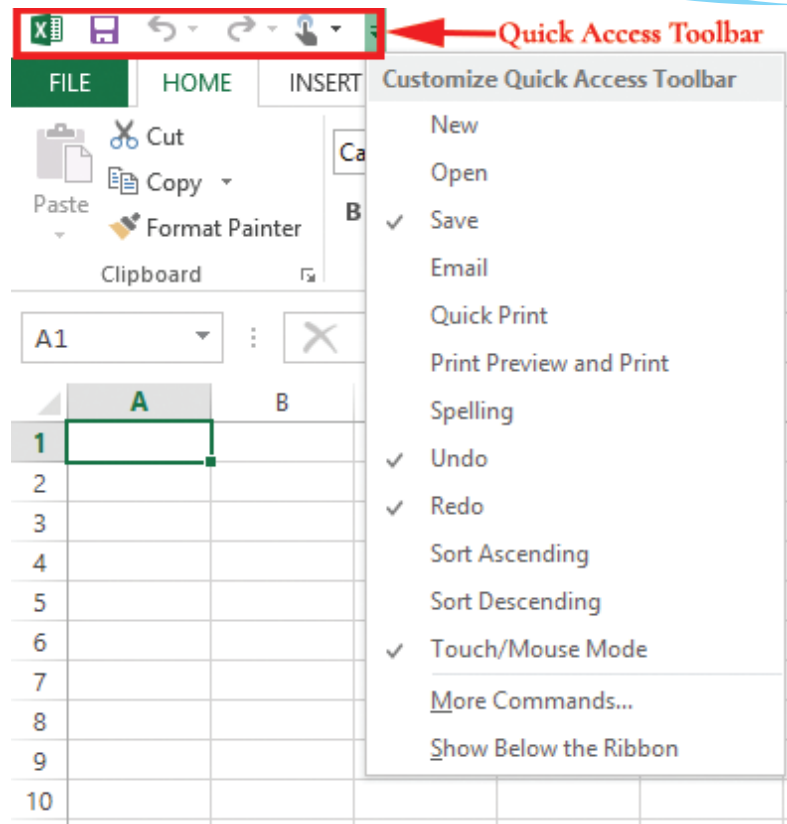


Figure 4.4: Customising the Quick Access Toolbar

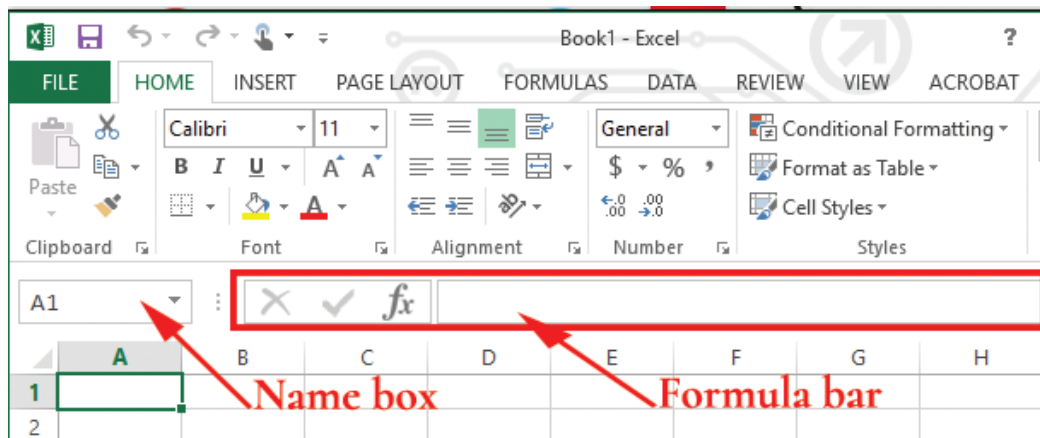


Figure 4.5: The formula bar contains the name box and the formula box

- **Status bar:** It is located at the bottom of the window and it displays status on options that are selected to appear on the status bar. For example, to display average, count, or sum of selected cells is looking at the **status bar**. Figure 4.6 shows a display of the status bar.



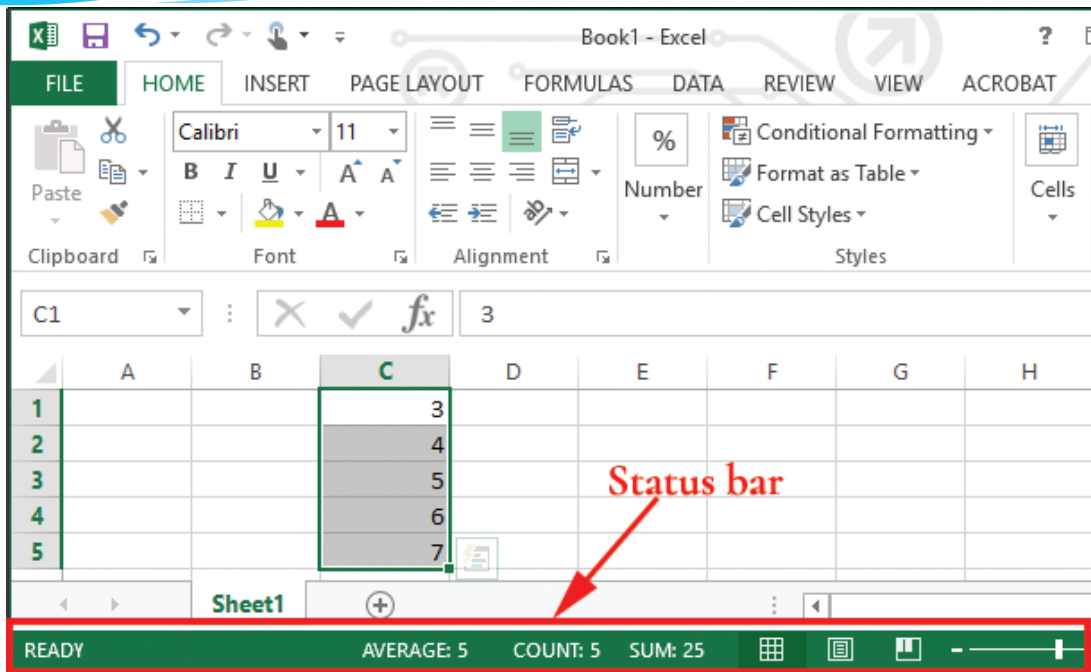


Figure 4.6: The Status Bar

- **Cell:** It is an intersection of a row and a column where data is entered.
- **Active cell:** It is also referred to as **cell pointer** or **selected cell**. It is a rectangular box highlighting the cell being worked with and where data is being entered. By default A1 is usually the active cell. To make a cell active simply click on it.
- **Name box:** It displays the name of the active cell.
- **Column Title:** It is also known as **column heading** and is labelled in letters. This is a row containing the column labels.
- **Sheet Tab:** It contains the name of the worksheets in the workbook.
- **Row Title:** It is also known as **row heading** and is labelled in numbers. This is a column containing the row labels.

## Parts of the Microsoft Excel Window

Figure 4.5 shows the parts of Microsoft Excel window.

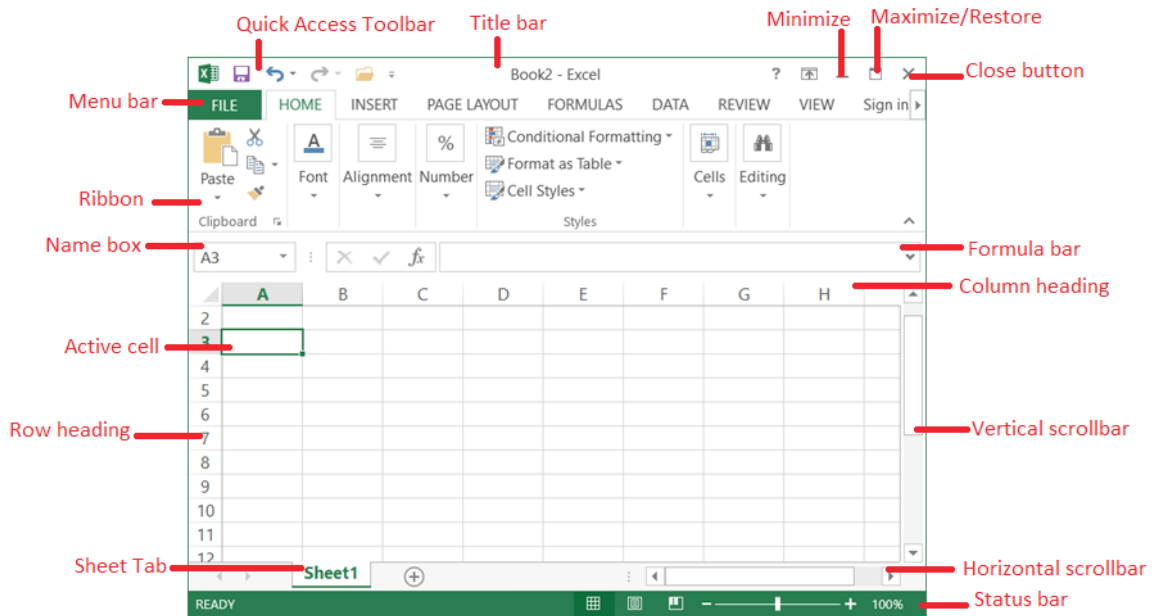


Figure 4.7: The Microsoft-Excel application window

### Revision Activity 4.1

#### Part A: Fill in the dashes with the correct answers

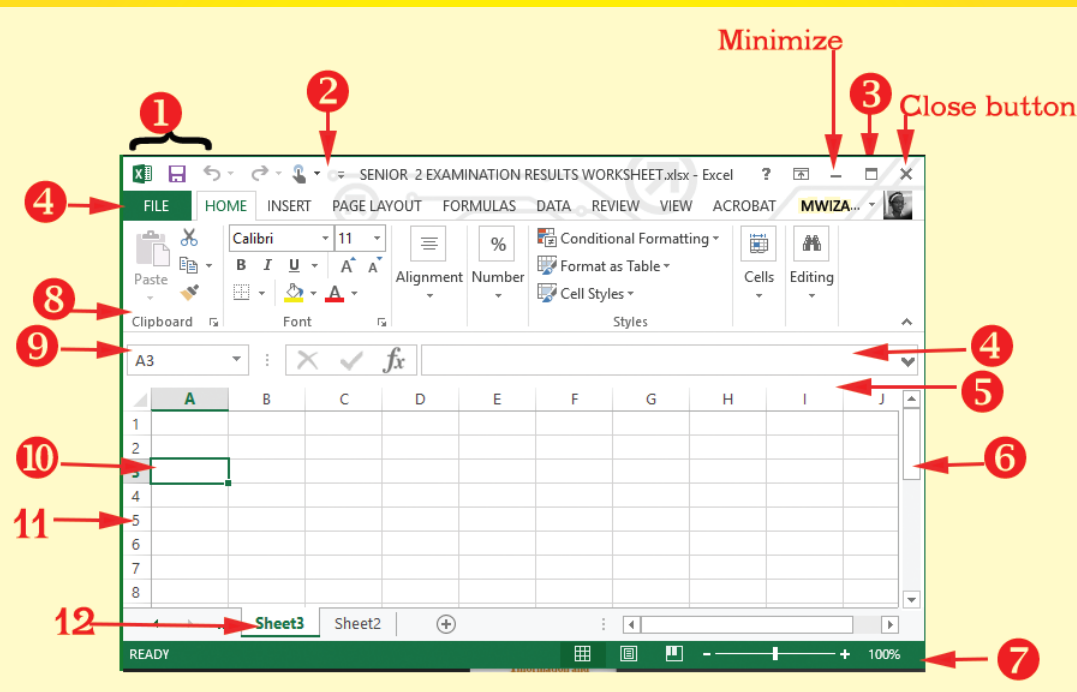
1. The default name of the first sheet in a workbook is \_\_\_\_\_.
2. \_\_\_\_\_ is the keyboard shortcut for saving data.
3. A ribbon consist of \_\_\_\_\_ of commands organised in groups.
4. The intersection of a row and a column where data is entered is known as \_\_\_\_\_.
5. \_\_\_\_\_, \_\_\_\_\_ reduces the Microsoft Excel window to an icon in the task bar.

#### Part B: Read the questions carefully and answer them

1. Define the term spreadsheet.
2. State **two** roles of a spreadsheet program.
3. Give **three** features of a spreadsheet program.
4. Outline **two** possible ways of starting the Microsoft Excel program.
5. Write the keyboard shortcut for performing the following actions:  
(i) Open a worksheet (ii) Close a workbook

**Part C: Label the diagram shown below:**

The diagram below represents the Microsoft Excel application window. Identify and label the parts numbered 1 to 12.



*Figure 4.8: Labelling the Excel Application Window*

## 4.3 Cell, Row, and Column basics

### 4.3.1 Definitions

- **Row:** It is a range of horizontal cells having a unique number. They run vertically on the left side of the worksheet.
- **Column:** It is a range of vertical cells labelled using a unique letter. They run horizontally at the top of the worksheet.

### 4.3.2 Cell Content

In this section we will discuss the different types of data in a cell. These types include: Labels, Values, Functions and Formulas.

#### (a) Labels

They are text or alphanumeric characters that are entered in a cell which cannot be manipulated mathematically. By default, all labels are aligned to the left of a cell.

### Entering a Label

- (i) Click on the cell where the text is to be entered.
- (ii) Type the text.
- (iii) Press the **Enter** key or click on a different cell.

### (b) Values

They are numeric data that can be manipulated mathematically. They include numbers, dates, time and currency among others. A value can be entered as a label if it is preceded by an apostrophe. By default, all values are aligned to the right of a cell.

### Entering Values

- (i) Click on the cell where the value is to be entered.
- (ii) Type the value.
- (iii) Press the **Enter** key or click on a different cell.

### (c) Formulas (or Formulae)

They are mathematical expressions created by the user.

Every formula must have the following components:

- (i) Begin with an equal sign (=).
- (ii) Contain mathematical operation such as +, -, / and \*.
- (iii) Cell addresses that contain values.

### (d) Function

They are in-built formulas in Excel. In-built means that they exist as essential parts of the program that the user can quickly apply to a cell in order to perform mathematical calculations. Every function must have the following components:

- (i) Begin with an equals sign (=).
- (ii) The name of the Function.
- (iii) The cell addresses that contain values.

### Entering formula

Formulae can be typed within a cell in a worksheet but when the enter key is pressed, the actual cell displays the result of the calculation.

To view the formulae, simply click on the cell, it will be automatically displayed on the formula bar.

### Enter data in a cell

When data is typed in a cell, it is displayed in the selected cell as well as in the formula bar. The data enters the cell when the **Enter key** or **Arrow key** is pressed. Text can be wrapped on a cell by pressing **ALT+ Enter** while typing.

## Selecting data

This refers to highlighting a cell containing data that is supposed to be formatted. The table below summarises the different ways of selecting data in a worksheet.

Selecting data in:	Procedure
A single cell	Click on the cell; or use either the arrow or tab key on the keyboard.
Block cells	Do one of the following: <ul style="list-style-type: none"><li>Click on the first cell of the block, hold down the shift key, and press the arrow key to extend the selection in the desired direction.</li><li>Click on the first cell of the block, press and hold down the left mouse button and drag the cursor until the desired number of cells are selected.</li><li>Click on the first cell of the block, hold down the shift key, and click on the last cell of the block.</li></ul>
Entire row/ column	Go to the column title or row title and click on the row number / column letter.
Non-adjacent cells	Hold down the control (CTRL) key as you click on the desired cells.
Entire worksheet	Click on the <b>Select All</b> button as shown in Figure 4.9 on page 103 or press CTRL + A.

## Copy and paste

**Copying** is the process of creating a duplicate of data. The content remains in its original location as a copy of it is stored on the clipboard. A **clipboard** is a temporary storage location for items to be moved or copied. **Pasting** is the process of inserting the current clipboard content to a new location. To copy and paste, do the following:

- (i) Select or highlight the data.
- (ii) Use one of the following options:
  - Right-click on the highlighted data then select **Copy** from the pop-up menu. Press Ctrl + C on the keyboard. From **Home** tab, click **Copy** icon under the Clipboard group. Figure 4.10 on page 103 shows a section of the **Home** tab ribbon showing the clipboard group.
  - The keyboard shortcut is as follows: Long press ALT then H and finally C key.

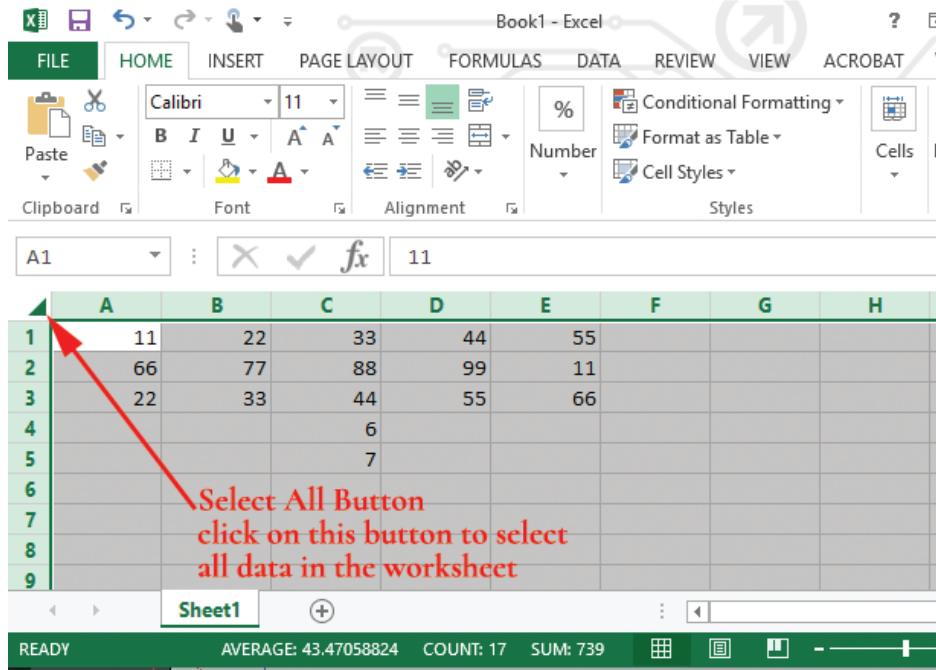


Figure 4.9: Using the Select All Data button

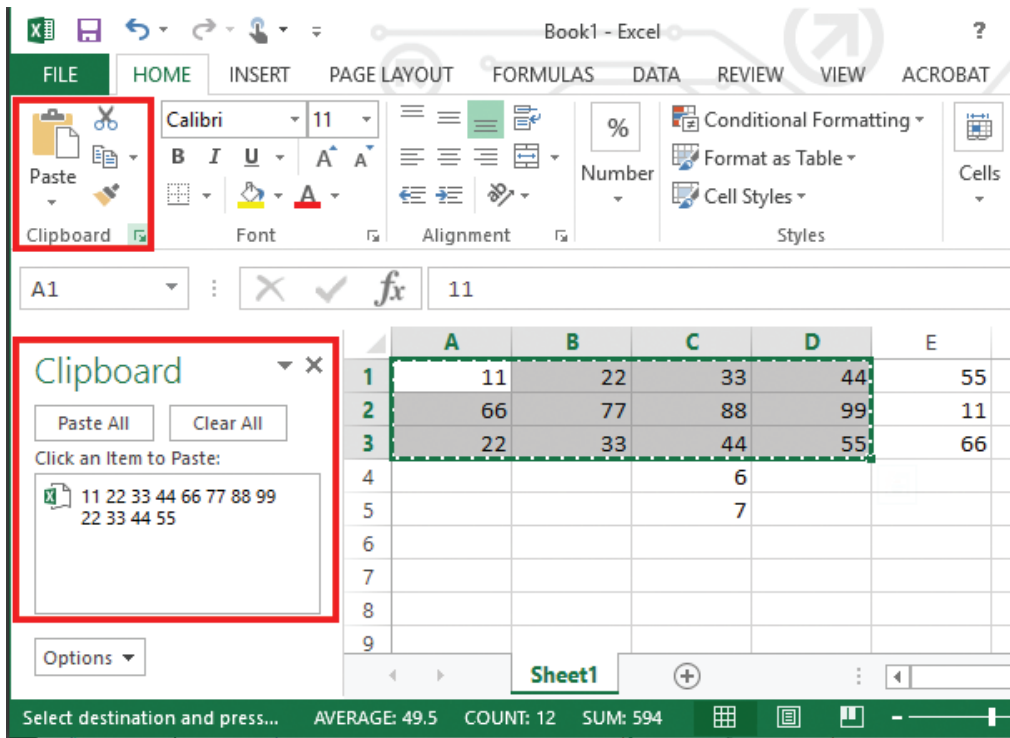



Figure 4.10: Copying and pasting

- (iii) Position the cursor where the duplicate is to be placed.
- (iv) Paste it by doing one of the following:
  - From **Home** tab, click **Paste** icon under the **Clipboard** group.
  - Right-click at the cursor position and select **Paste** from the pop-up menu that appears.
  - Press **Ctrl+ V** on the keyboard.

Copying can also be done using **Format Painter** command. This method is used when copying formats which had been previously applied on a cell or a group of cells. To copy formats do the following:

- (i) Select the cells containing the format to copy.
- (ii) Click **Format Painter**  from **clipboard** group in the **Home** tab.
- (iii) Click the cells where the format is to be copied.

**Note:** To copy the formatting in the selected cell or range to several locations, double-click the **Format Painter** button. Click on the first location to apply the format then the second, third all the way to the last one.

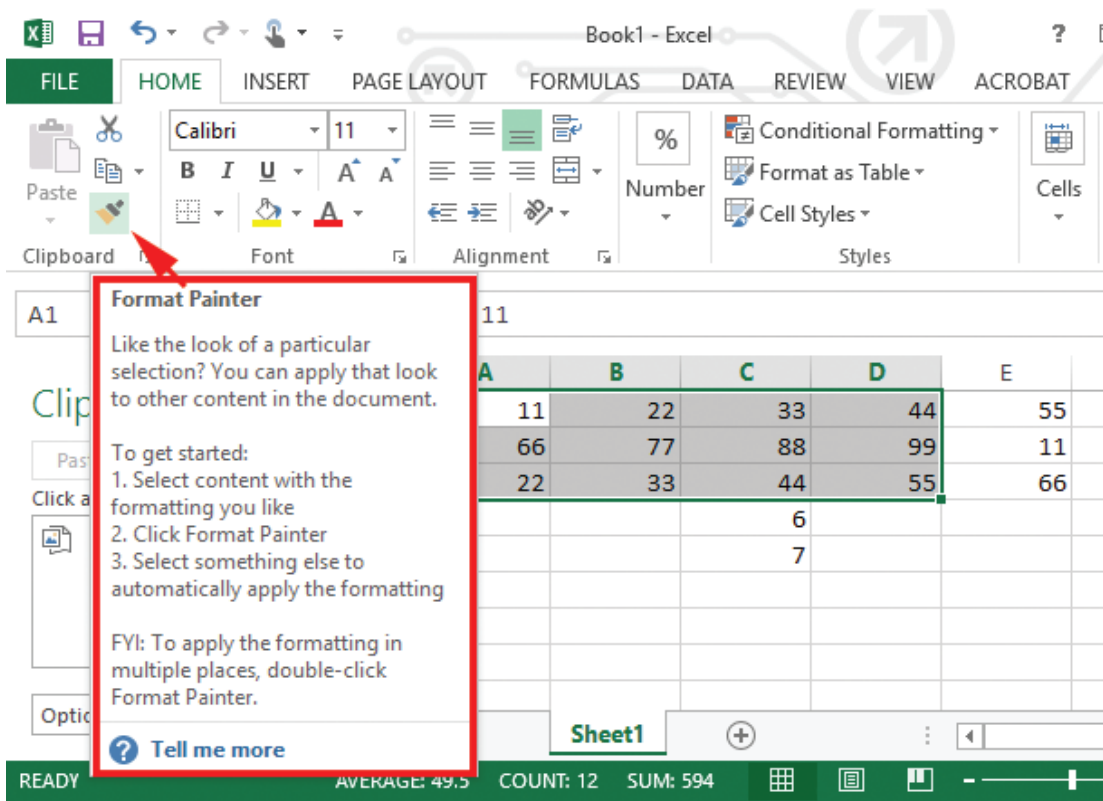


Figure 4.11: Using the Format Painter

## Cut and paste

Cutting is also known as moving. It is the process of changing the position of data to a new location. The data is deleted from its original location.

To move data, do the following:

- (i) Select or highlight the text or object.
- (ii) Use one of the following options:
  - From **Home** tab, click **Cut** icon under the **Clipboard** group.
  - Right-click on the highlighted text or object then select **Copy** from the pop-up menu.
  - Press **Ctrl + X** on the keyboard.
- (iii) Position the cursor where the data is to be transferred.
- (iv) Paste it by doing one of the following options:
  - From **Home** tab, click **Paste** icon under the **Clipboard** group.
  - Right-click at the cursor position and select **Paste** from the pop-up menu that appears.
  - Press **Ctrl + V** on the keyboard.

## Changing row height

The row height can be made smaller or larger than the default. There are two methods of changing a row height.

### Alternative 1

- (i) Place the mouse pointer at the boundary between two rows on the row title.
- (ii) When the mouse pointer changes to a two headed arrow, click and drag to the desired direction.
- (iii) Release the mouse button to apply.

### Alternative 2

- (i) From Home tab, on the Cells group click on Format. A drop down menu appears as shown in Figure 4.12. The keyboard shortcut is: **Long press ALT** key, then **H** followed by **O** to display a drop down menu.



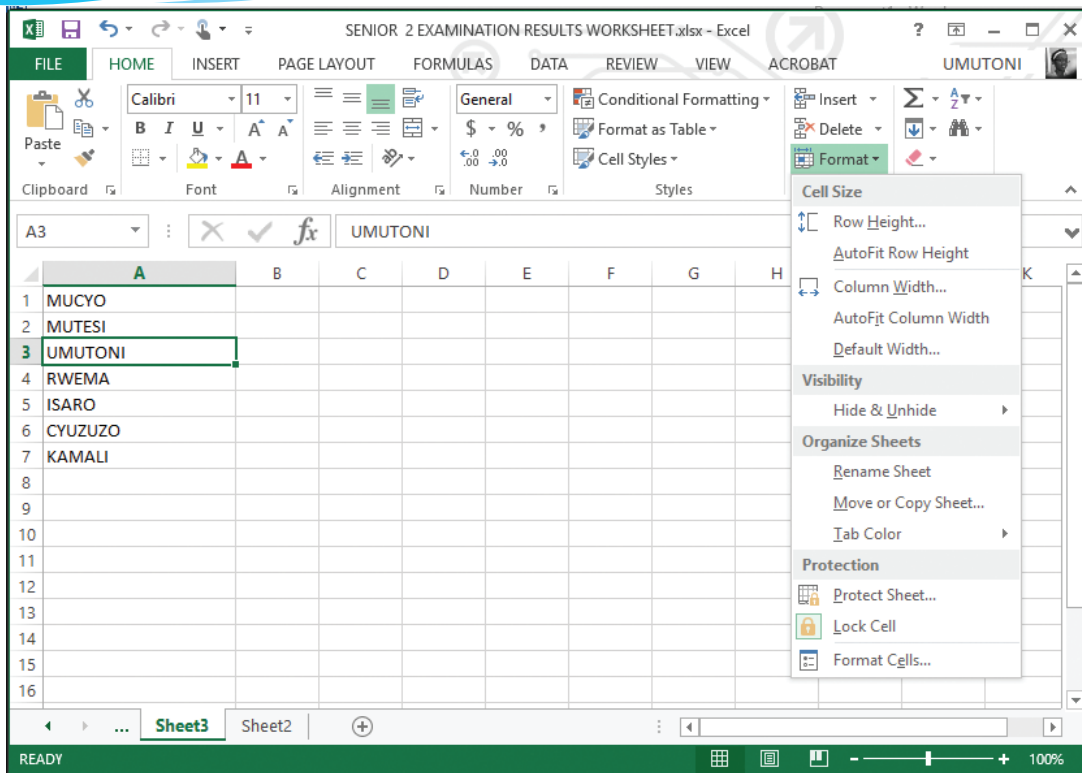


Figure 4.12: Changing the row height

- (ii) From the resulting menu select **Row Height...** A dialog box appears as shown in Figure 4.13.
- (iii) Type the desired value in the **Row height** box.
- (iv) Click **OK**.

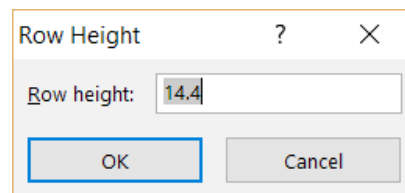


Figure 4.13: Row Height dialog box

### Changing column width

The column width can be made narrow or wider than the default. There are two methods of changing a column width.

#### Alternative 1

- (i) Place the mouse pointer at the boundary between two columns in the column title.
- (ii) When the mouse pointer changes to a two headed arrow, click and drag to the desired column width.
- (iii) Release the mouse button to apply.

## Alternative 2

- (i) From **Home** tab, on the **Cells** group click on **Format**.
- (ii) From the resulting menu select **Column Width...** A dialog box appears as shown in Figure 4.14.

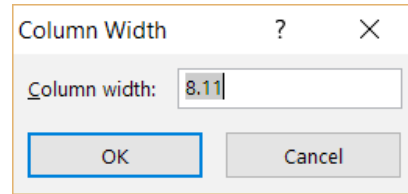


Figure 4.14: Column width dialog box.

- (iii) Type the desired value in the **Column Width** box. Click **OK**.

## Wrap text

**Wrap text** feature enables a cell to contain content that is larger than its size and all the content is displayed in multiple lines. The cell is automatically enlarged as data is entered. To wrap text, do the following:

- (i) Select the cell(s).
- (ii) Click on the **Home** tab then select **Wrap text** icon in the **Alignment** group.

## Alternatively

- (i) Select the cell(s).
- (ii) Click on the **Home** tab then select **Format** icon under the **cells** group.
- (iii) Click on **Format Cells...** from the drop down menu. The format cells dialog box appears as shown in Figure 4.15. The keyboard shortcut is: **Long press ALT** key, then **H** followed by **O** and finally **E**.

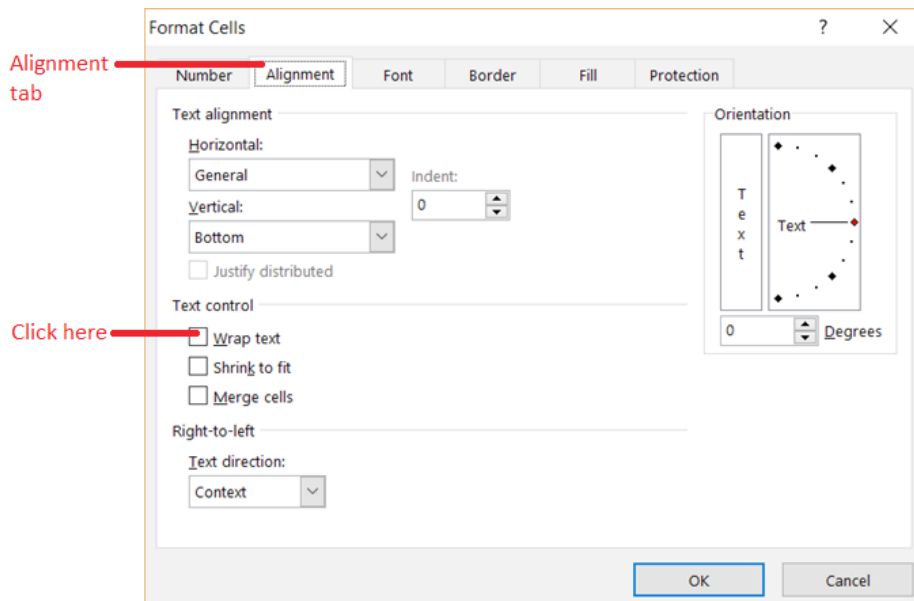


Figure 4.15: Wrapping text

- (iv) Click on the **Wrap text** under the **Text control** section.
- (v) Click **OK** to apply and close the dialog box.

Figure 4.16 shows how the wrapped text will appear in the cell.

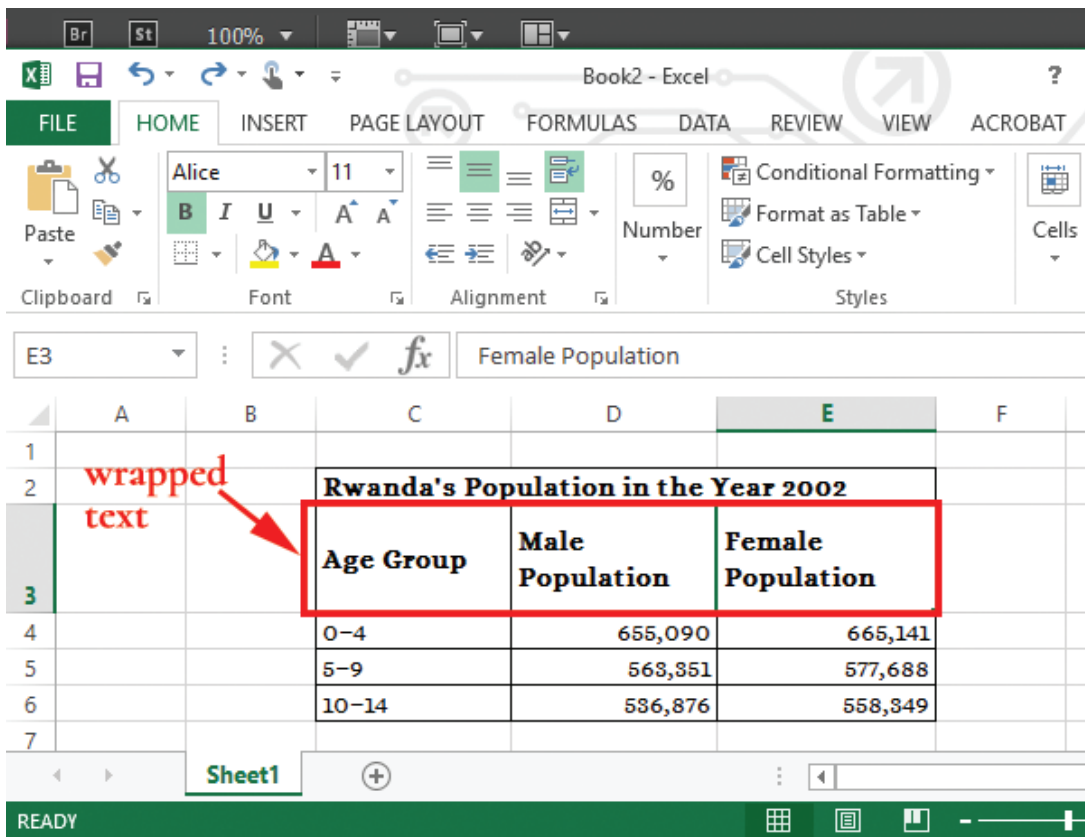


Figure 4.16: Cells containing wrapped text

### Merge cells

Merge cells refers to the combination of two or more horizontally or vertically adjacent cells to become one large cell that is displayed across multiple columns or rows.

The content of the first highlighted cell appears in the merged cell. A single cell that is created by combining two or more selected cells.

The cell reference for a merged cell is the upper-left cell in the original selected range. To merge cells, do the following:

- (i) Select the cells to be merged.
- (ii) Click on the **Home** tab then select **Merge & Center** icon in the **Alignment** group. The cells are automatically merged. Figure 4.17 shows how the merged cells will appear.

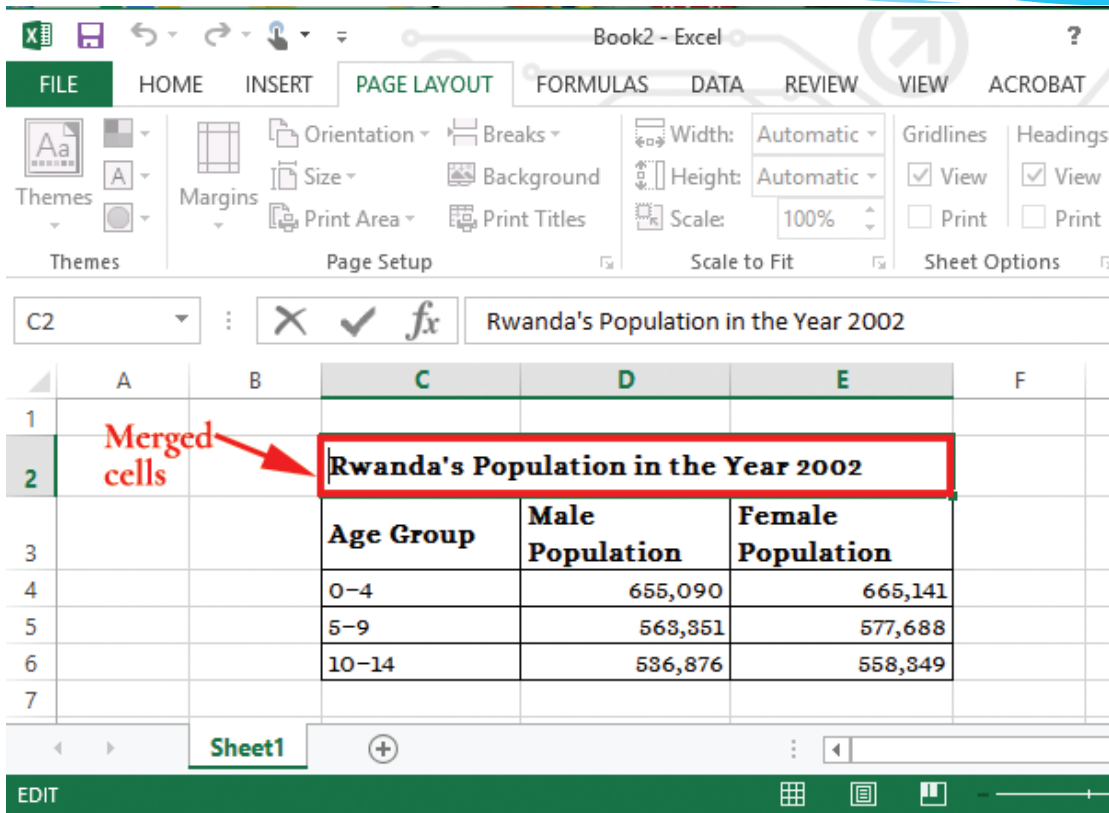


Figure 4.17: Cells that have been merged

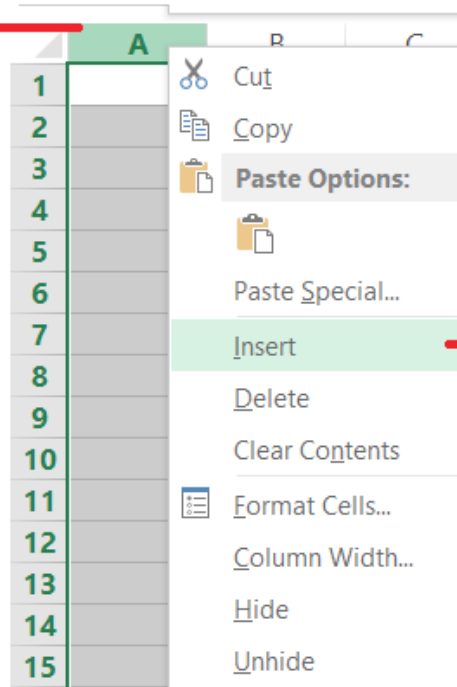
### Inserting a column or a row

It is possible to insert a row or a column between existing rows or columns respectively. To insert a row or a column, do the following:

#### Inserting a column

- (i) Click on the column heading to select it.
- (ii) Right-click on the selected column, and then click **Insert** from the resulting pop-up menu to automatically add a new column to the left of the selected column.

Column heading  
for the first  
column



Insert command

Figure 4.18: Click insert to add a column to the left

### Inserting a Row

- (i) Click on the row heading to select it.
- (ii) Right-click on the selected row, and then click **Insert** from the resulting pop-up menu to automatically add a new row above the selected row.

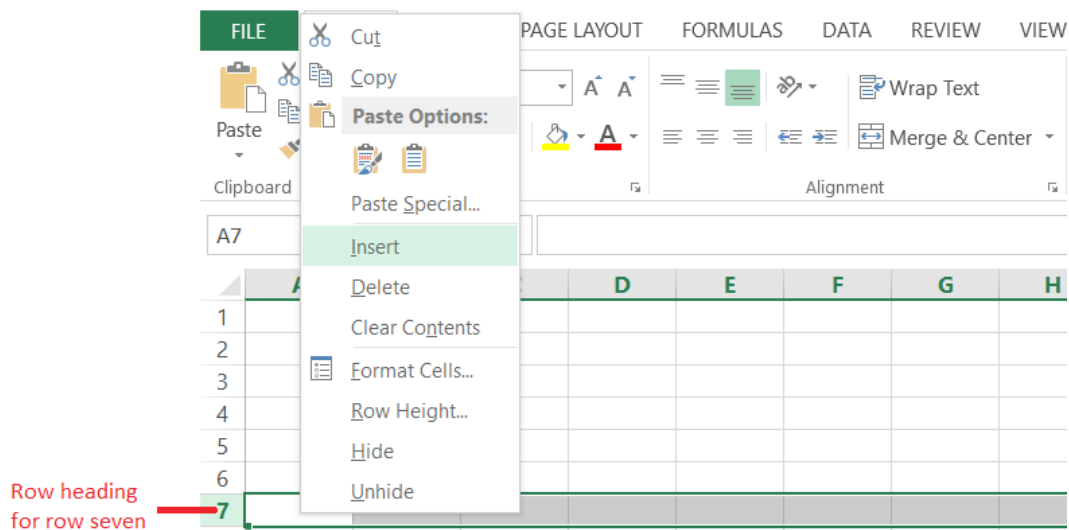


Figure 4.19: Click insert to add a row above row seven

## Deleting rows and columns

To delete rows or columns in a worksheet do the following:

- (i) Highlight a cell or cells to be deleted.
- (ii) Right-click on the selected cell(s) then select **Delete...** option from the pop-up. A dialog box appears as shown in Figure 4.20.
- (iii) Select on **Entire row** option to delete the selected row(s) or **Entire column** option to delete the selected column(s).
- (iv) Click **OK** to apply.

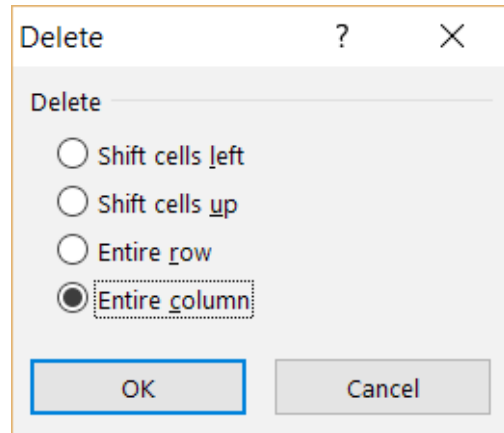


Figure 4.20: Delete dialog box

## Moving rows and columns

To move a row or column in a worksheet, do the following:

- (i) Select the row or column to be moved.
- (ii) Move the mouse pointer to the edge of the selection until it changes from a regular cross to a four-sided arrow cursor.
- (iii) Then drag the column or row to a new location.
- (iv) Release the mouse button to place the row or column to its new location.

## Hide and unhide row/columns

This feature is used to temporarily hide rows and columns from view in order to prevent certain data from being changed or deleted. It is also used to simplify the appearance of a spreadsheet. To hide or unhide a row or a column; do the following:

- (i) From **Home** tab, on the **Cells** group click on **Format**.
- (ii) From the resulting drop down menu, point to **Hide & Unhide** then select the desired option from the side kick menu as shown in Figure 4.21 on page 112. The keyboard shortcut is: **Long press ALT** key, then **H** followed by **O** and finally **U**.

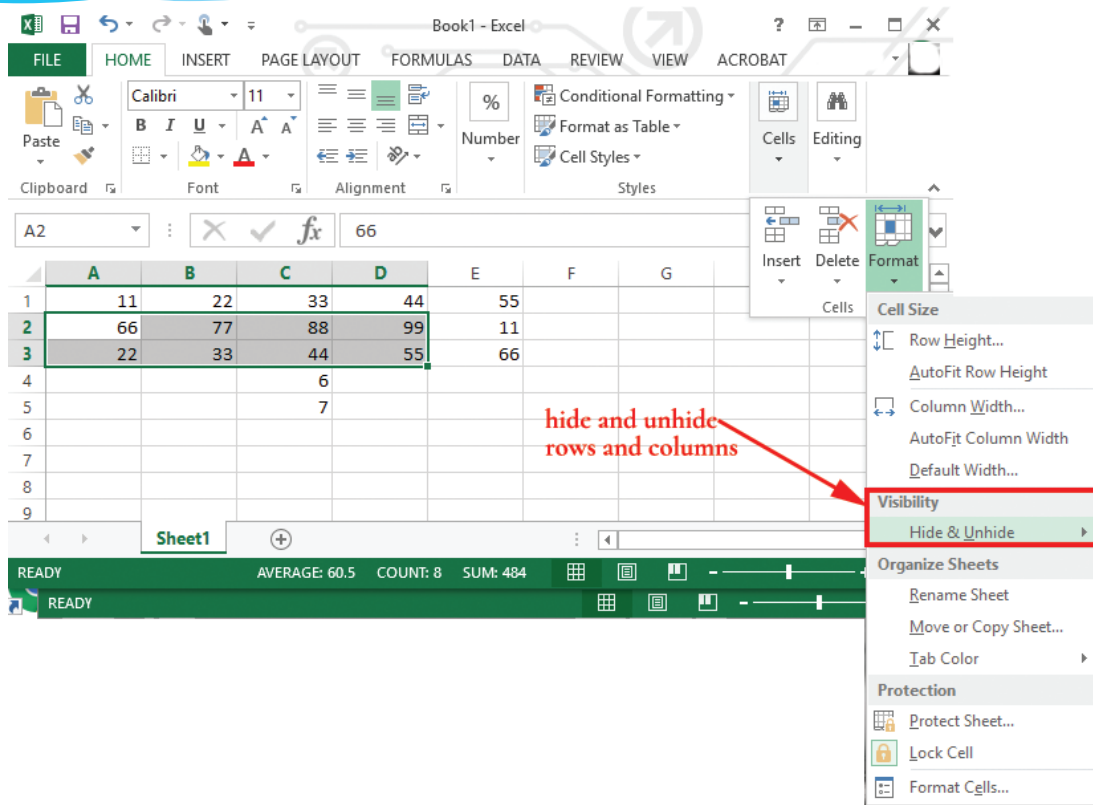


Figure 4.21: Hiding and un hiding columns

### Revision Activity 4.2

#### Part A: Fill in the dashes with the correct answers

- The letters given below could be re-arranged to give a words that are used in spreadsheets. Give the correct word in each case:
  - LELC \_\_\_\_\_
  - MUNLOC \_\_\_\_\_
  - CTLESEGN I \_\_\_\_\_
- \_\_\_\_\_ is a feature that combines two or more cells to one large cell.
- A feature used to decrease the apparent size of font characters so that all data in a selected cell fits within the column is called \_\_\_\_\_
- \_\_\_\_\_ is the keyboard shortcut used for selecting contents in an entire worksheet.
- Values are \_\_\_\_\_ data that can be manipulated mathematically.

**Part B: Read the questions carefully and answer them correctly**

1. Differentiate between a row and a column.
2. Define the term label.
3. Differentiate between a function and a formula.
4. A student created a spreadsheet document for analysis. The student wanted a duplicate of the same file in another location. Outline the procedure the student could have used.
5. An organisation had a large spreadsheet document. The data in the cells was large and part of it could not be displayed. Advise the organisation of the feature they could use to ensure that all the data is visible in the cell.

**Part C: Read the questions carefully and answer them correctly**

1. The following are data that can be entered in a cell. Categorise each one of them as either formula, label, or value.  
(i) 45      (ii) Obey      (iii) 34+56      (iv) =56+50
2. Create a workbook with one worksheet and enter the following details:

No.	Name	Maths	Science	English
1	Umutoni	56	64	93
2	Rwema	78	76	45
3	Kamali	90	88	90
4	Mulisa	45	34	46
5	Mwiza	67	78	77

3. Insert two rows on top and type the title Final Analysis on the second row.
4. Merge the cells containing the title.
5. Hide the column labelled No.
6. Save the document as **Analysis**.

#### 4.4 Formatting a Cell

**Formatting** is the process of improving the appearance of a data in a worksheet. The following are some of the formatting options available in Microsoft Excel: font, text alignment and orientation, cell borders and fill colours, and formatting numbers and text.



## 4.4.1 Font

There are different ways of changing the font of text in a worksheet:

### (a) Using icons in the Home tab ribbon.

To format font in cells using this option, do the following:

- (i) Select the cells.
- (ii) Click on the arrow on the **Font** list box as shown in Figure 4.22.
- (iii) Select the font from the list.

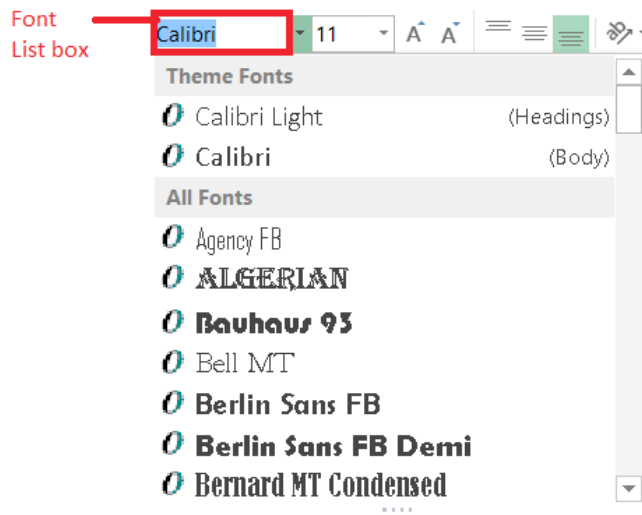


Figure 4.22: The font list box

### (b) Using the dialog box launcher

- (i) Select the cells to apply the format and do the following:
- (ii) From **Home** tab, under the **Font** group, click on the dialog box launcher to get a dialog box as shown in Figure 4.23.
- (iii) Select the desired font attributes.
- (iv) Click **OK** to apply. The keyboard shortcut is: **Long press ALT** key, then **H** followed by **FN**. Use the arrow keys to select a tab.



Figure 4.23: Using the dialog box launcher to change font

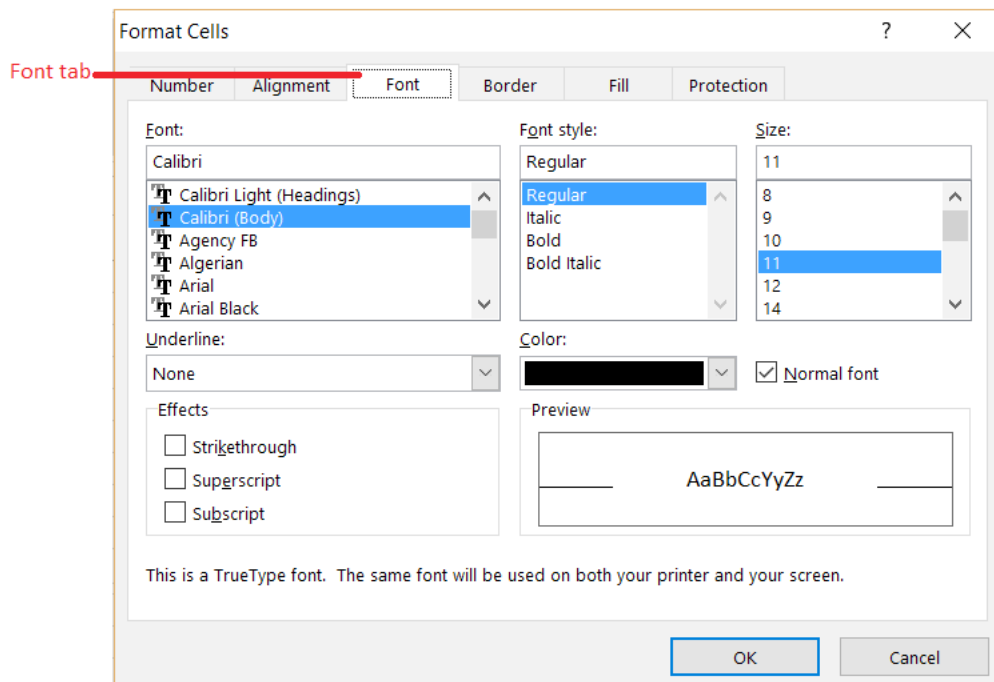


Figure 4.24: Selecting font attributes

#### 4.4.2 Text Alignment and Orientation

To format text alignment, do the following:

- (i) Select the cells to apply the format.
- (ii) From **Home** tab, under the **Alignment** group, click on the dialog box launcher.
- (iii) Select the desired alignment option from the available options in the resulting dialog box shown in Figure 4.25.
- (iv) Click **OK** to apply.

The available options include:

- **Alignment:** This contains the following options:
- **Text Alignment:** It contains three options, namely horizontal, vertical and indent.

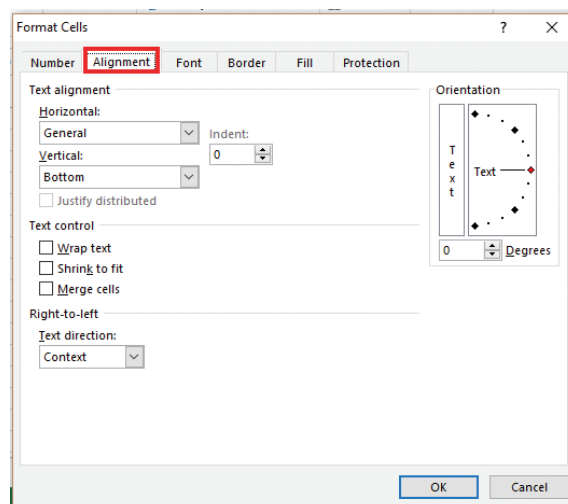


Figure 4.25: Controlling and aligning text

- ✓ **Horizontal:** It is used for changing the horizontal alignment of cell contents. Click on the box to make the desired option.
- ✓ **Vertical:** Used for changing the vertical alignment of cell contents. Click on the box to make the desired option.
- ✓ **Indent:** It indents cell contents from any edge of the cell, depending on the selection made under **Horizontal** or **Vertical** options.
- **Orientation:** Used to change the angle at which the text is inclined in the selected cells.
  - ✓ **Degrees:** Sets the value in which text will be rotated in the selected cell.
- **Text control:** The options under **Text** control are used to adjust how the text should appear in a cell. They include:
  - ✓ **Wrap text:** Wraps text into multiple lines in a cell. The number of wrapped lines is dependent on the width of the column and the length of the cell contents.
  - ✓ **Shrink to fit:** Decreases the apparent size of font characters so that all data in a selected cell fits within the column.
  - ✓ **Merge cells:** Joins two or more selected cells into one large cell.
- **Right-to-left:** Select an option in the **Text direction** box to specify reading order and alignment.
- The keyboard shortcut is: **Long press** ALT key, then **H** followed by **FN**. Use the arrow keys to select a tab.

#### 4.4.3 Cell Borders

The worksheet gridlines do not appear when a worksheet page is printed. The cell border helps in ensuring that the cell outline appears in the print out. They are also used for enhancing the appearance of a document. To apply cell borders, do the following:

- (i) Select the cells to apply the format.
- (ii) From **Home** tab, under the **Font** group click on dialog box launcher.
- (iii) Click on **Border** tab. A dialog box will appear as shown in Figure 4.26.
- (iv) Select the desired border style under **Style** option.
- (v) Click the buttons under **Presets** or **Border** to apply borders to the selected cells. To remove all borders, click the **None** button. It is also possible to click areas in the text box to add or remove borders. To change **Colour**, click on the **Colour** list box and select the desired colour from the colour palette.

(vi) Click **OK** to apply.

The keyboard shortcut is: **Long press ALT** key, then **H** followed by **FN**. Use the arrow keys to select a tab.

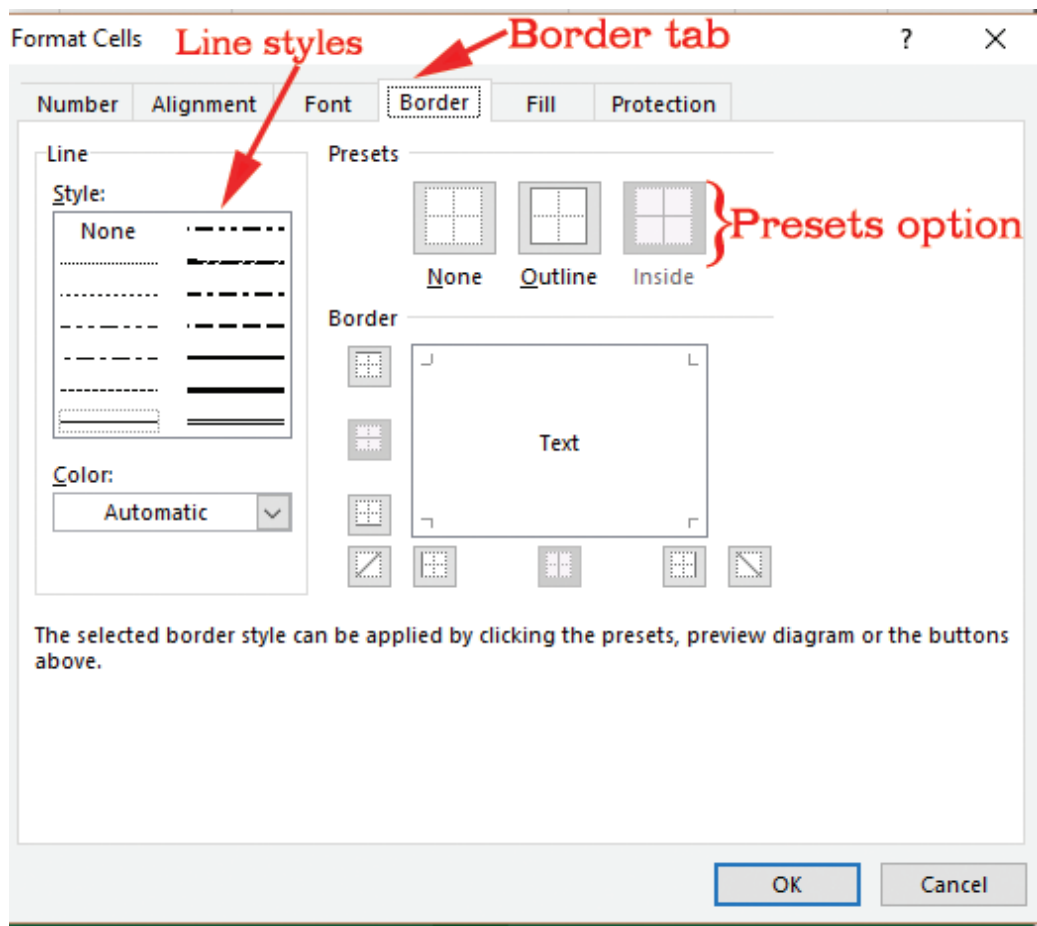


Figure 4.26: Formatting cell borders

#### 4.4.4 Fill Colours

To apply the fill colour command, do the following:

- (i) Select the cells to apply the format.
- (ii) From **Home** tab, under the **Font** group click on dialog box launcher.
- (iii) Click on **Fill** tab. A dialog box will appear as shown in Figure 4.27.
- (iv) Select the desired fill style from the available options, namely background colour, pattern colour, and pattern style and fill effects.
- (v) Click **OK** to apply.

The keyboard shortcut is: **Long press ALT** key, then **H** followed by **FN**. Use the arrow keys to select a tab.

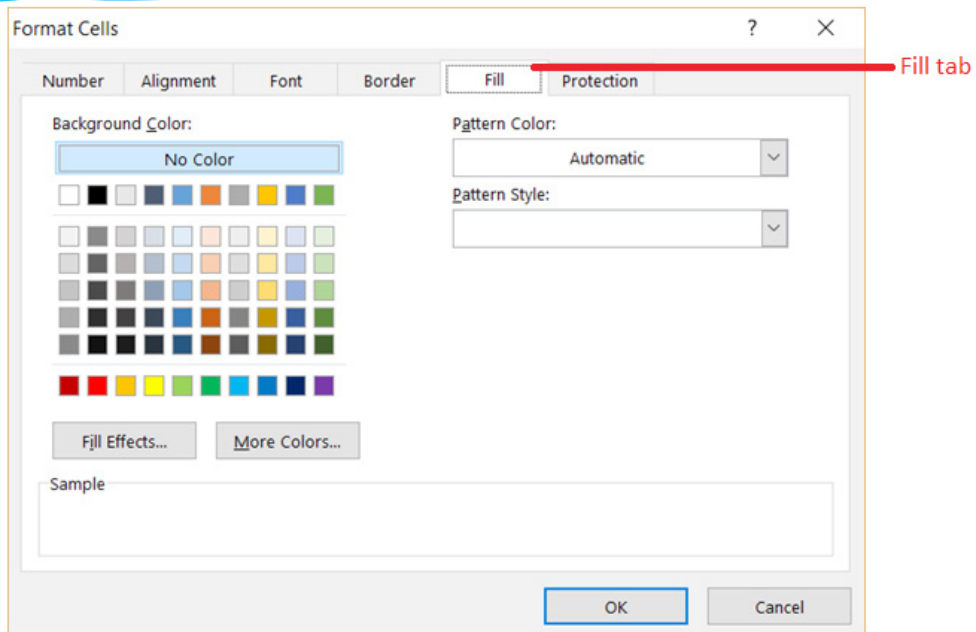


Figure 4.27: Formatting colours

#### 4.4.5 Formatting Number

Select the cells to apply the format and do the following:

- (i) From **Home** tab, under the **Font** group click on dialog box launcher.
- (ii) Click on **Number** tab. A dialog box will appear as shown in Figure 4.28.

The keyboard shortcut is: **Long press ALT** key, then **H** and finally **FN**.

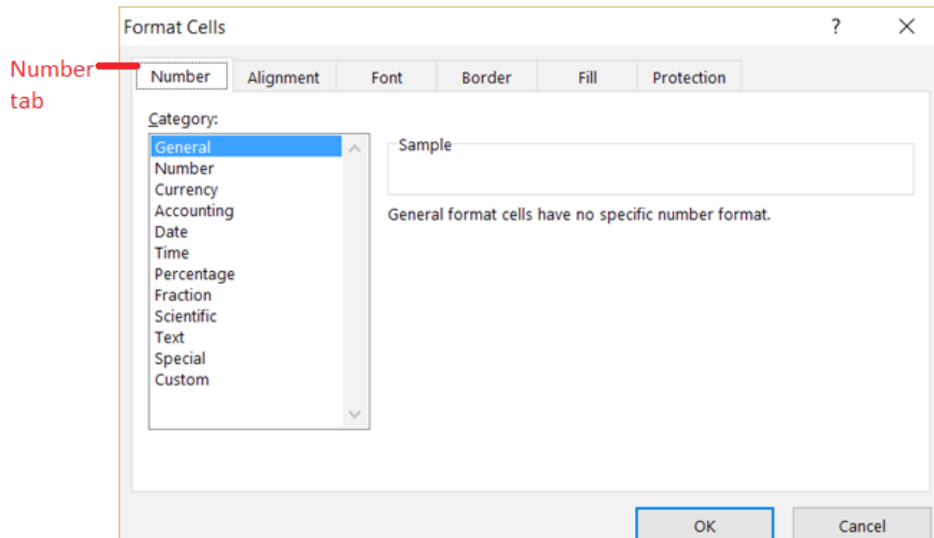


Figure 4.28: Formatting number

- (iii) Under **Category** section, select an option and then select the desired options to specify a number format. The chosen format is shown as it will appear in the **Sample** box.
- (iv) Click **OK** to apply.

## 4.5 Worksheet Basics

When excel is activated, a workbook is launched with a default worksheet. The user can insert, delete, rename, copy and move a worksheet. The following commands can be used when manipulating a worksheet.

### 4.5.1 Inserting a Worksheet

This feature enables the user to add a worksheet in a workbook. By default, the workbook in Microsoft Excel 2013 only comes along with one worksheet. To add another worksheet, do the following:

- (i) Right-click on the name of the sheet. A pull-up menu appears as shown in Figure 4.29.

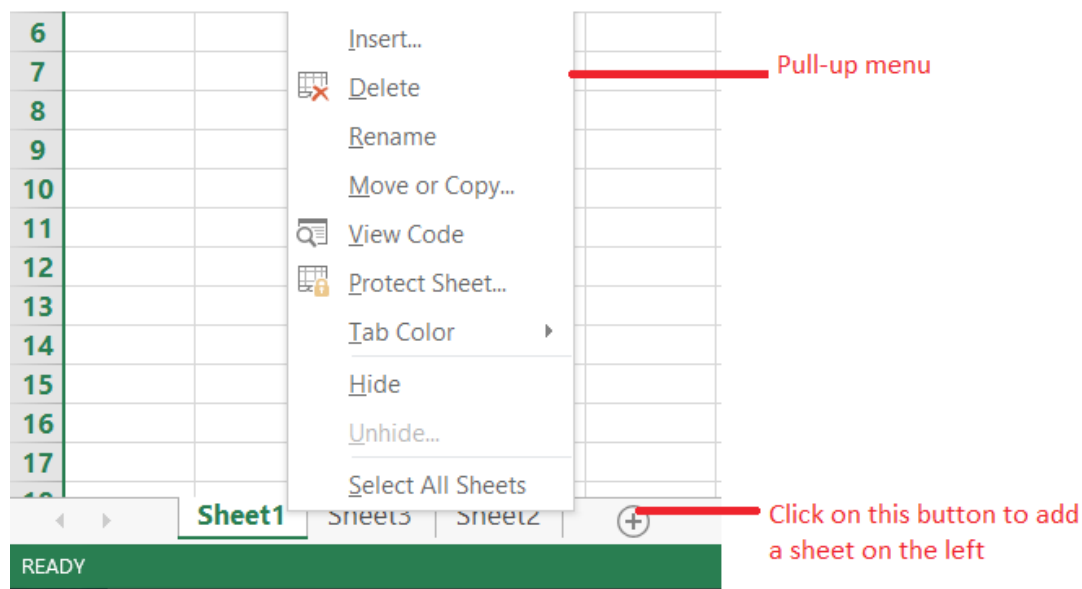


Figure 4.29: Adding a worksheet

- (ii) Select **Insert** option. A dialog box appears as shown in Figure 4.30.
- (iii) Click **OK** to apply. The new worksheet name appears before the current worksheet.

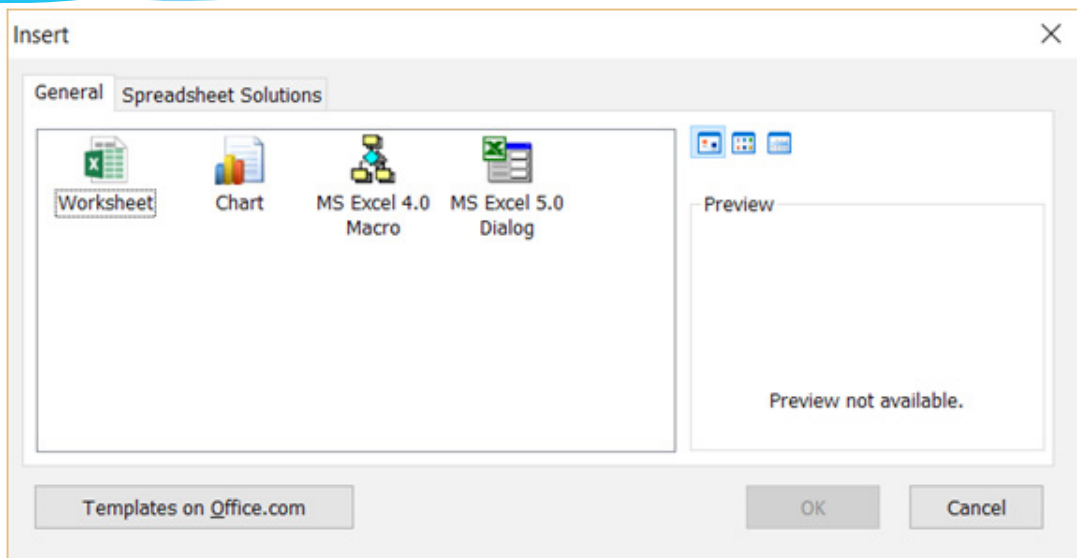


Figure 4.30: Inserting a worksheet

#### 4.5.2 Deleting a Worksheet

This option is used when the entire worksheet is to be deleted. Do the following:

- (i) Right-click on the name of the sheet. A pull-up menu appears as shown in Figure 4.31.
- (ii) Select **Delete** option. The sheet is automatically deleted.

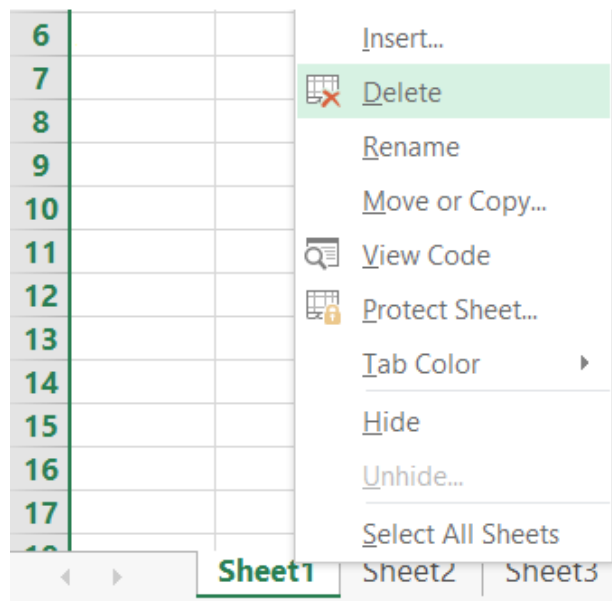


Figure 4.31: Click on Worksheet name then select Delete to apply

### 4.5.3 Renaming a Worksheet

Renaming is the process of assigning a worksheet a different name. To rename a worksheet, do the following;

- (i) Double click on the name of the worksheet. The worksheet is highlighted as shown in Figure 4.32.

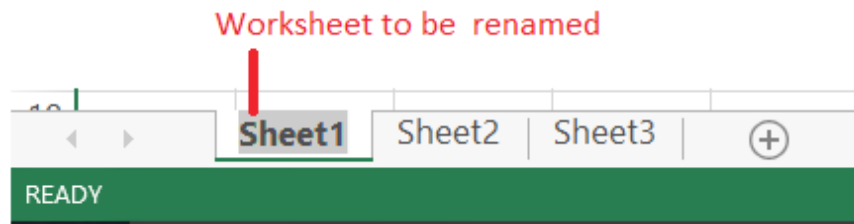


Figure 4.32: Renaming a worksheet.

- (ii) Type the desired name and then press **Enter**.

### 4.5.4 Copying and Moving a worksheet

- (i) Right-click on the name of the sheet. A pull-up menu appears as shown in Figure 4.33.

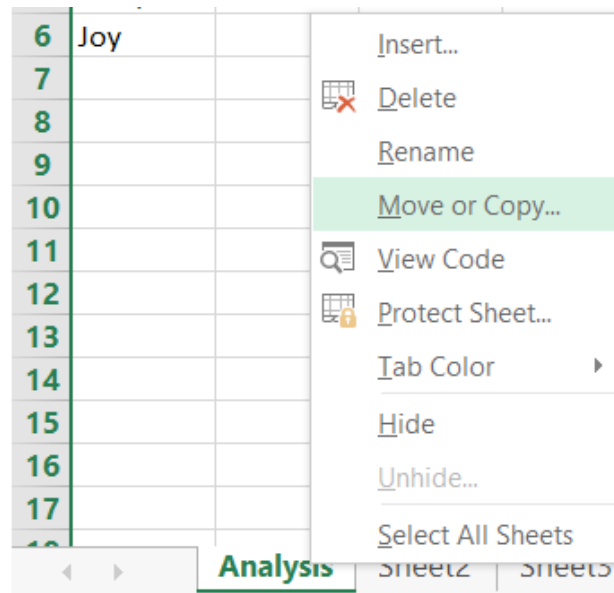
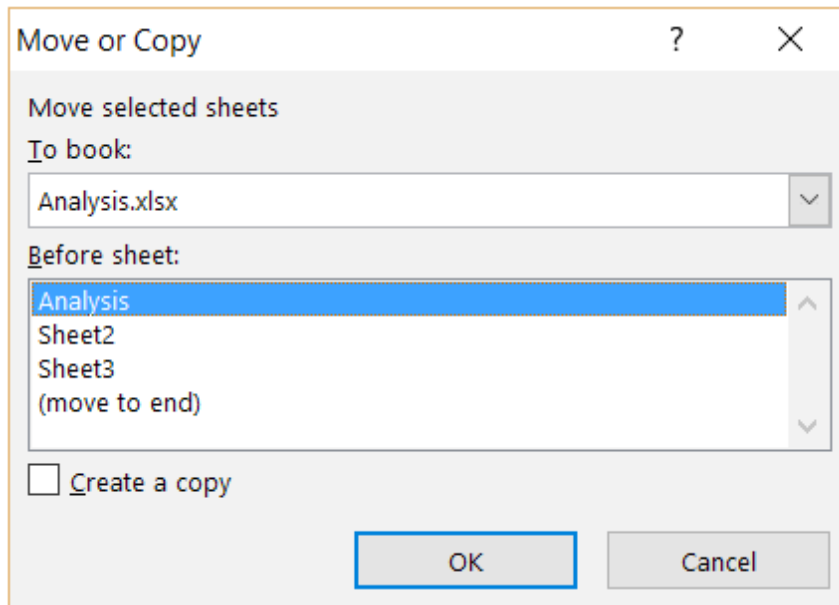


Figure 4.33: Moving or copying a worksheet



- (ii) Select **Move or Copy** option. A dialog box appears as shown in Figure 4.34.



*Figure 4.34: Moving a selected worksheet*

- (iii) Select the book name in the **To book:** list and the worksheet to appear before it in the **Before sheet:** box.
- (iv) When Copying click on the **Create a copy** check box to enable it duplicate the worksheet else it will be moved.
- (v) Click **OK** to apply.

## 4.5.5 Grouping and Ungrouping Worksheets

### Grouping worksheets

- (i) Select the first worksheet to be included in the group.
- (ii) Press and hold the **CTRL** key on your keyboard.
- (iii) Select the next worksheet needed in the group.
- (iv) Release the **CTRL** key.
- (v) Select **Group**.

### Ungrouping worksheets

- (i) Select the grouped worksheets to be ungrouped into separate worksheets.
- (ii) Select **Ungroup**.

### Revision Activity 4.3

#### Part A: Identify words from the word puzzle

Identify the following words related to worksheet basics and formatting in the puzzle given below: Insert, delete, rename, copy, group, move, font, merge, orientation, borders.

O	R	I	E	N	T	A	T	I	O	N	A	M
M	E	W	Y	O	Y	T	E	N	N	I	P	E
E	N	V	T	P	I	Q	X	S	O	A	U	R
R	A	U	O	A	T	A	T	E	D	F	O	E
G	M	C	R	M	E	B	O	R	D	E	R	S
E	E	T	E	L	E	D	A	T	I	O	G	N

#### Part B: Read the questions carefully and provide the correct answers

Open the analysis document and do the following:

1. Add two columns to the right of the column labelled English. Label the first column Total.
2. Calculate the total marks for each student.
3. Copy the content of this worksheet to another worksheet.
4. Hide the column labelled No.
5. Name the second worksheet as Final.
6. Change the orientation of the text in the first row to 90°.
7. Add a border on the worksheet data.
8. Rename the first worksheet to Class.
9. Group the two worksheets.
10. Change the font size to 14 and font type to Arial Black

## 4.6 Mathematical Operators

Operators are symbols used in a formula to define the relationship between two or more values or cell references.

They are symbols or signs that represent arithmetic operations in Excel formula. There are four major mathematical operators that can be used to write an expression.

Figure 4.35 shows different operators as well as their functions.

Operator	Symbol	Function
Plus	+	Adds all the numbers.
Minus	-	Subtracts numbers.
Multiplication	*	Multiplies numbers
Division	/	Divides numbers

Figure 4.35: Mathematical operators and their functions

Figure 4.36 shows data about student's marks of different subjects entered in a worksheet.

#### Revision Activity 4.4

**Part A: Study the figure given below that presents data of students' performance in various subjects:**

Student's Name	Math	ICT Studies	Entrepreneurship	Total
Gahigi	60	50	50	
Mukamutara	38	74	76	
Uwimana	86	48	48	
Sentwali	40	80	90	
Habimana	61	40	39	

Figure 4.36: Sample data of students

**Part B: Use the data in Figure 4.36 to work out the following: Write the answers in your notebook.**

1. Calculate the total mark for Gahigi would be  $=60+50+50$ .
2. Calculate the difference between Maths and ICT marks for Gahigi.
3. Multiply the Maths mark by 5 for Gahigi.
4. Divide the total mark for Gahigi by 5
5. Calculate the percentage Maths marks for Gahigi.

#### 4.7 Definition of Key Words in this Unit

##### Revision Activity 4.5

**Find out the meaning of the words given below. Share your findings with the rest of the students in a class presentation. Check the meanings you find against those provided in the glossary at the end of this course book:**

Spreadsheet	Worksheet	Row
Column	Cell	Workbook
Cell borders	Wrap text	Merge cell

##### Revision Exercise 4

1. Define the term active cell.
2. Differentiate between a workbook and a worksheet.
3. Differentiate between **Save** and **Save As** commands.
4. State the function of the **Paste** command.
5. Define the term label as used in a spreadsheet.
6. List **three** types of mathematical operators that can be used in calculations.
7. Differentiate between a label and a value.
8. Describe how the following selections would be made:
  - (i) Non-adjacent cells
  - (ii) A single cell
9. Differentiate between **Merge cells** and **Wrap text** commands.
10. State **three** components that must be contained in a formula.

# Unit 5



## Worksheet Data Presentation

**Key Unit Competency: By the end of this unit, you should be able to:**

Manage a window, sort and filter data in a spreadsheet.

### Introduction

The Microsoft Excel worksheet is made up of many columns and rows. Information entered in a worksheet may occupy many columns and rows such that it cannot be viewed in one screen.

This topic introduces the learner to ways of dealing with large data and information in a worksheet such as sorting, filtering, freezing, and splitting worksheets.

### 5.1 Freeze panes

If information in the worksheet stretches down or across more than one screen, normally as the user scrolls down or across the worksheet, the information keeps on disappearing to the top or to the left as the ones towards the bottom or right of the screen are displayed.

The freeze command is used to permanently display selected rows or columns.

For example, the column or row titles can be frozen to ensure that the data displayed is viewed with the correct title after scrolling.

#### 5.1.1 Freeze Top Row

If a worksheet contains a large amount of information, the top row containing the titles or column headings could be frozen to keep it visible while scrolling through the rest of the worksheet. To freeze the top row, do the following:

- (i) Select a cell in the top row where the freeze command is to be applied.
- (ii) Click on **View** Tab on the menu bar.
- (iii) Click on the **Freeze Panes** icon under the **Window** Group on the ribbon. A drop down menu appears as shown in Figure 5.1.
- (iv) Select on **Freeze Top Row** option to automatically the freeze command.

The keyboard shortcut for freezing a pane is: **Long press ALT**, press **W** then **F**.

### Practice Activity 5.1: Freezing the top row

Study Figure 5.1 shown below that presents data of students' performance in various subjects:

The screenshot shows an Excel spreadsheet titled 'SENIOR 2 EXAMINATION RESULTS WORKSHEET 2.xlsx'. The 'View' tab is selected on the ribbon, and the 'Freeze Panes' dropdown menu is open. The 'Freeze Top Row' option is highlighted in green. A red arrow points from this option to the first row of the data table. The data table has the following structure:

2	Student's Name	Math	ICT Studies	Entrepreneurship	Total
3	Gahigi	60	50	50	
4	Mukamutara	38	74	76	
5	Uwimana	86	48	48	
6	Sentwali	40	80	90	
7	Habimana	61	40	39	
8	Mucyo	60	50	50	
9	Mutara	38	74	76	
10	Ruterana	86	48	48	
11	Mwiza	40	80	90	
12	Rukundo	61	40	39	
13	Rwigema	60	50	50	
14	Mulisa	38	74	76	
15	Cyuzuzo	86	48	48	
16	Icaro	40	80	90	
17	Umutoni	61	40	39	
18	Mutesi	60	50	50	
19	Mbabazi	38	74	76	

Figure 5.1: Freezing the Top Row

Freeze the top row to allow the top row to be visible while scrolling through the rest of the sheet.

#### 5.1.2 Freeze First Column

The first column containing row headings could be frozen to keep it visible while scrolling through the rest of the worksheet. To freeze the first column, do the following:

- (i) Select a cell in the first column where the freeze command is to be applied.
- (ii) Click on **View** Tab on the menu bar.
- (iii) Click on the **Freeze Panes** icon under the **Window** Group on the ribbon. A drop down menu appears as shown in Figure 5.1.
- (iv) Select on **Freeze First Column** option to automatically activate the freeze command.




Table 5.1 provides a summary of the available freezing options and their functions.

<b>Menu Options</b>	<b>Function</b>
<b>Freeze Panes</b>	Keeps a given block of rows and columns visible while the rest of worksheet scrolls.
<b>Freeze Top Row</b>	It keeps the top row visible while scrolling through the rest of the worksheet.
<b>Freeze First Column</b>	It makes the first column visible while scrolling through the rest of the worksheet.
<b>Unfreeze Panes</b>	It unlocks all rows and columns to scroll through the entire worksheet. It is only visible once one of the freeze pane options has been selected.

*Table 5.1: Freeze menu options*

### Practice Activity 5.2: Freezing the top row

Study Figure 5.2 that presents data of students' performance in various subjects: Freeze the first column to allow the first column to be visible while scrolling through the rest of the sheet.

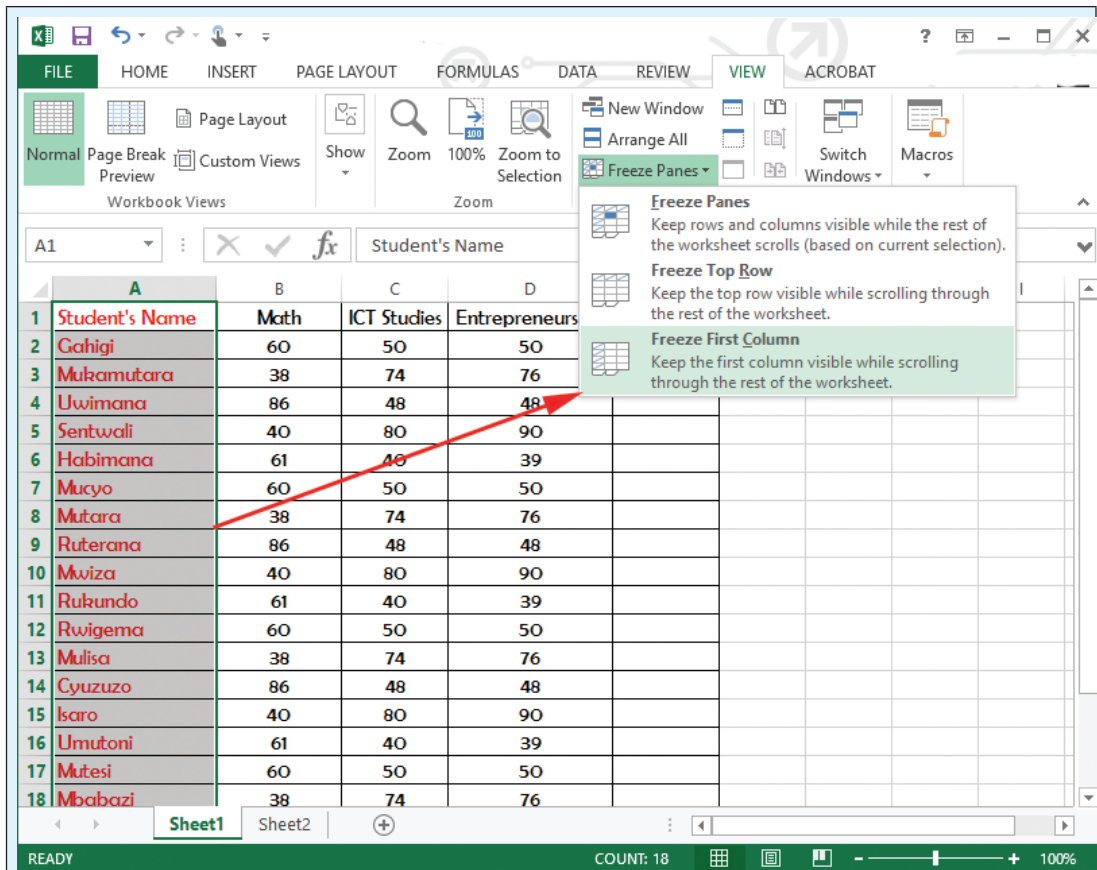


Figure 5.2: Freezing the Top Row

## 5.2 Workbook View

Microsoft Excel provides the following workbook views: **Normal**, **Page break Preview**, **Page Layout**, and **Custom View**. They are found in the **View** tab of the menu bar under the **Workbook Views** group.

### 5.2.1 Normal

It displays the worksheet in normal view. It is the default view. However, if the worksheet was displayed in another view, to change to normal view, select the Normal option from the Workbook Views group. The worksheet appears as shown in Figure 5.3. The keyboard shortcut is as follows: **Long press ALT**, press **W** then **L**.



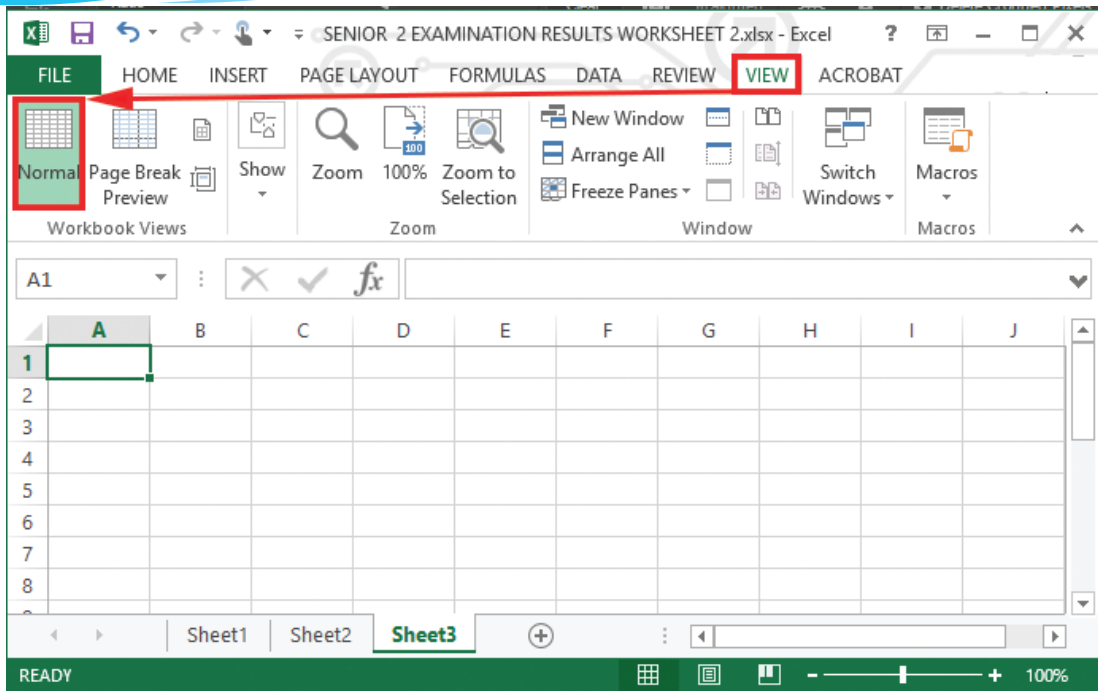


Figure 5.3: The normal workbook view

### 5.2.2 Page Layout

This view displays the worksheet as it will appear on a printed page. It is used to view where pages begin, end and to view or insert footers or headers on the page.

It can only apply if no column or row has been frozen. To display a worksheet in page layout view, select the **Page Layout** option from the **Workbook Views** group.

The worksheet appears as shown in Figure 5.4. The keyboard shortcut is as follows: **Long press ALT**, press **W** then **P**.

### 5.2.3 Page Break Preview

It is used to display a preview of where pages in a document will break when being printed. To display a worksheet in page break preview, select the **Page Break Preview** option from the **Workbook Views** group.

The page numbers appear as water marks. The worksheet appears as shown in Figure 5.5. The keyboard shortcut is as follows: **Long press ALT**, press **W** then **I**.

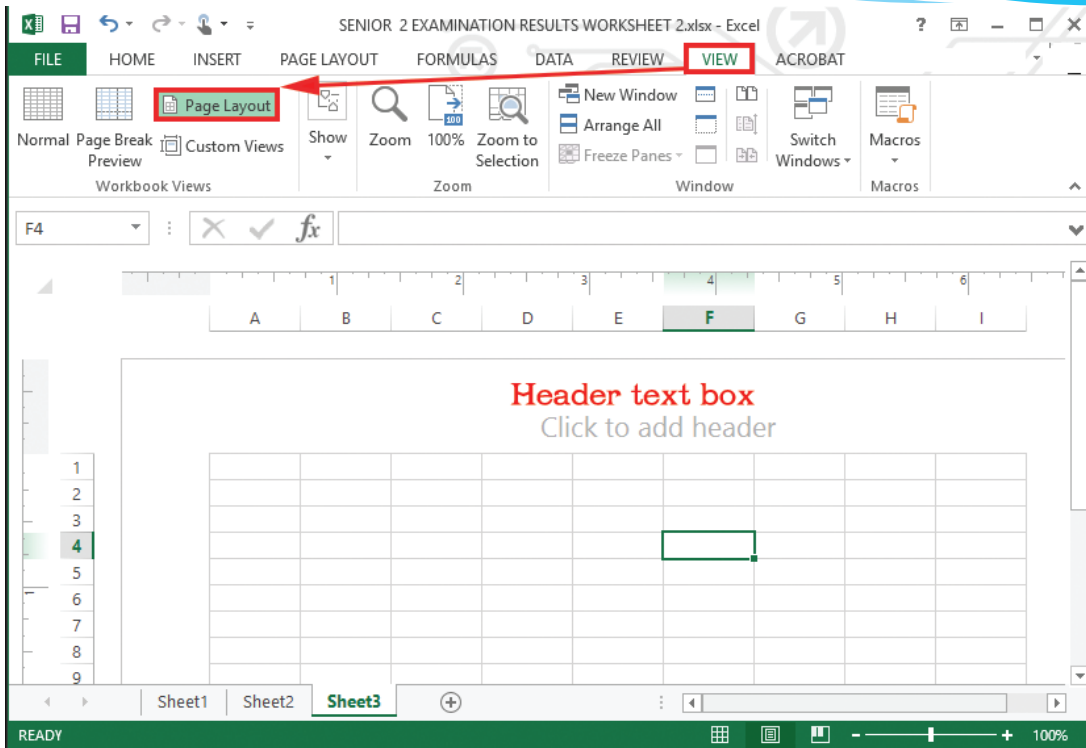


Figure 5.4: The page layout workbook view

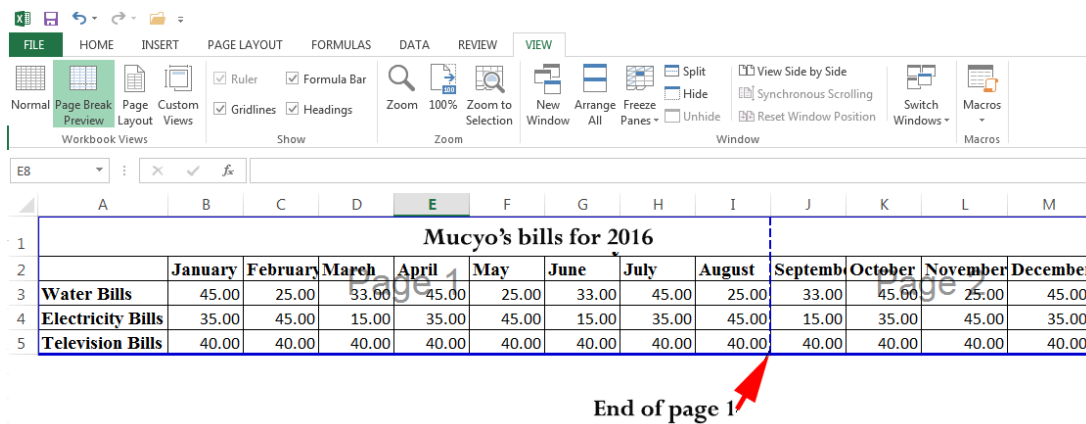


Figure 5.5: The page break workbook view

### 5.2.4 Custom Views

This is a flexible tool that can be used to view the same data in different ways, which is faster than manually changing the settings. This view can retain hidden columns and rows, some filters, zoom and print settings among others.

To create a customised view, do the following:

- (i) Select one of the above views then click on **Custom Views** option from the **Workbook Views** group. A dialog box appears as shown in Figure 5.6. The keyboard shortcut is as follows: **Long press ALT**, press **W** then **C**.

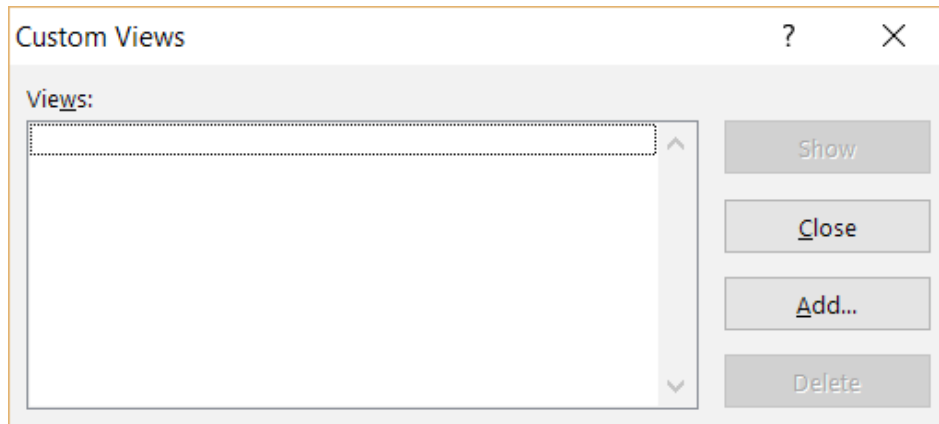


Figure 5.6: Adding a custom workbook view

- (ii) Click **Add...** command. The **Add View** dialog box is displayed as shown in Figure 5.7.

The keyboard shortcut is as follows: **Long press ALT**, press **W** then **C**, press **Tab** key to move to **Add** button then finally press **Enter**.

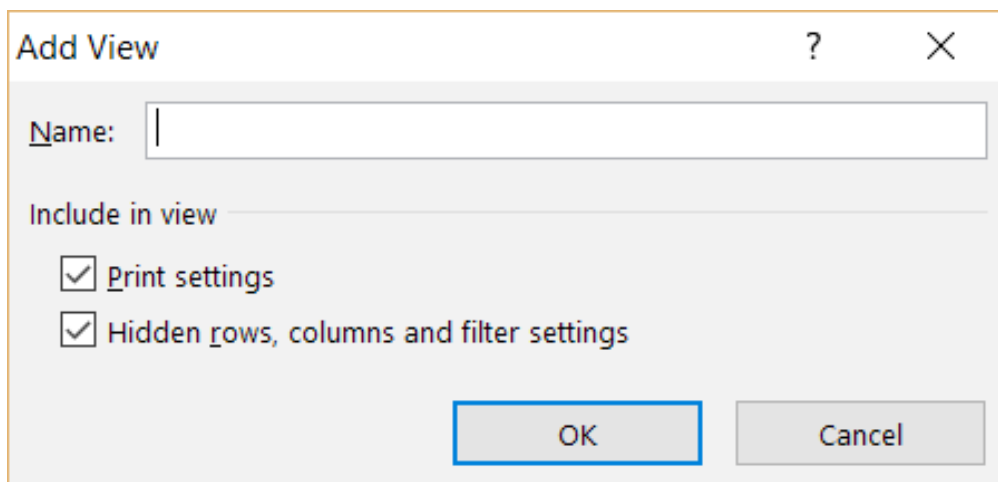


Figure 5.7: Naming a custom workbook view

- (iii) Type the name of the view in the **Name** text box then click **OK**.
- (iv) To display a list of the created customised view, select the **Custom Views** option from the **Workbook Views** group. A dialog box appears as shown in Figure 5.8. To open a worksheet in an already created custom view, select the view from the **Views** list then click **Show**.

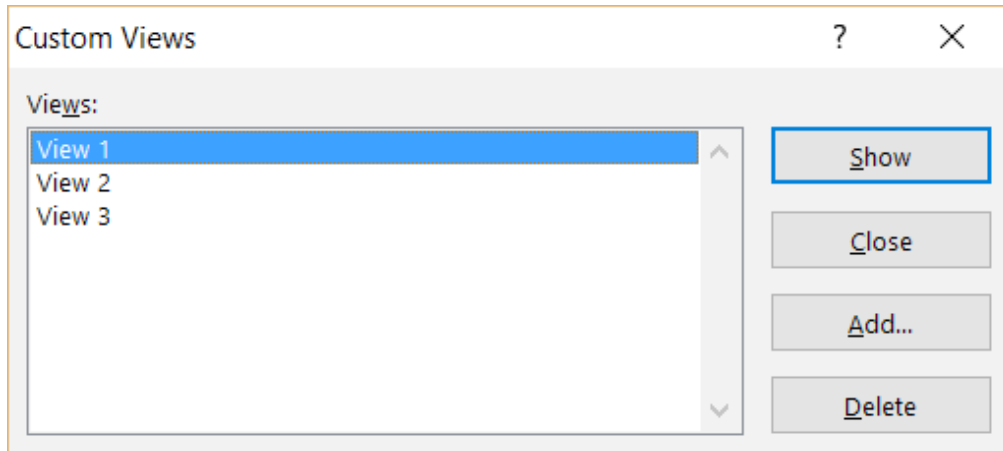


Figure 5.8: Viewing a workbook in a custom view

### 5.2.5 Split Worksheet

Splitting a worksheet is necessary when all the information in it cannot be displayed in one view. This option divides the worksheet into four sections.

The user is able to scroll through a section of the worksheet while keeping other sections visible. The following are the steps followed to split a worksheet:

- (i) Position the cursor at the cell where the split should begin. For example, select **Cell E10**.
- (ii) Click on the **View** tab in the menu bar then select **Split** command on the ribbon from the **Windows** group.

The worksheet is automatically split into four sections vertically at the left edge of the pointer and horizontally along the top edge as shown in Figure 5.9.

The keyboard shortcut is as follows: **Long press ALT**, press **W** then **S**.

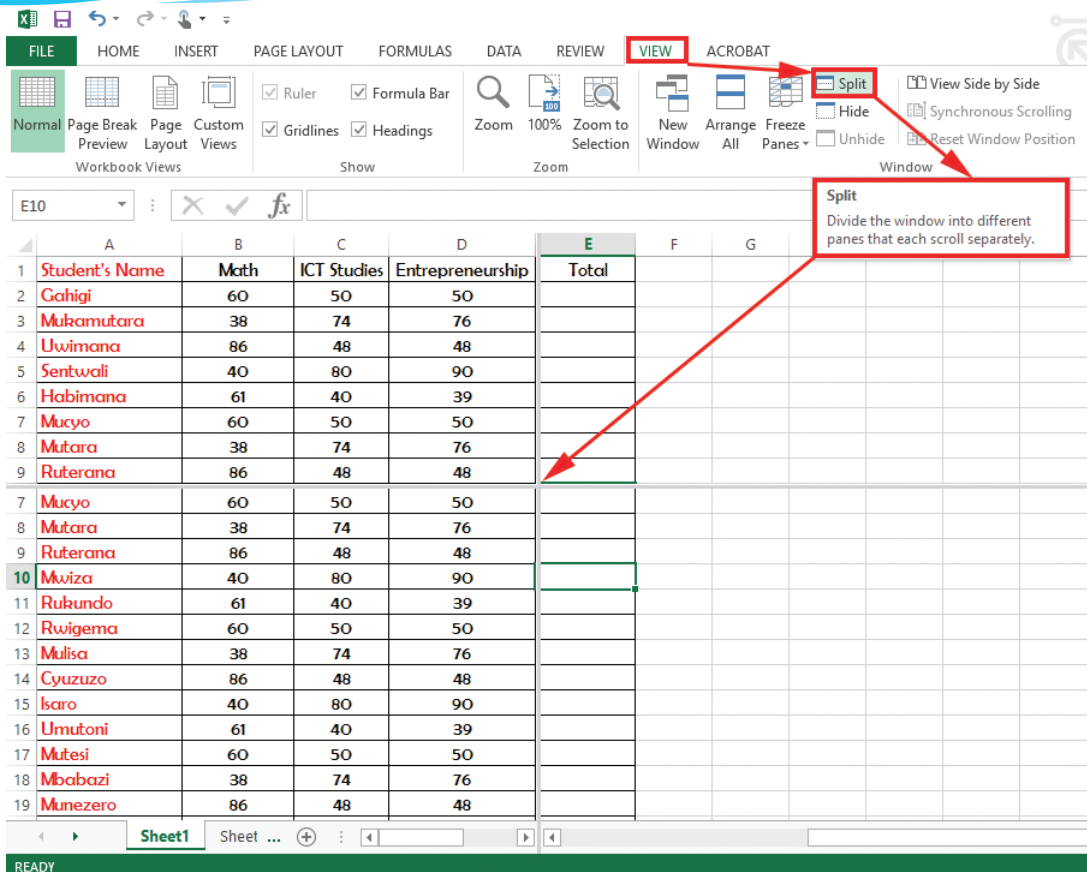


Figure 5.9: Splitting a worksheet

### Revision Activity 5.1

#### Part A: Fill in the dashes with the correct answers

- \_\_\_\_\_ command is used to permanently display selected rows or columns.
- Normal workbook view is used to display the worksheet in \_\_\_\_\_ views.
- \_\_\_\_\_ is a flexible tool that can be used to view the same data in different ways.
- \_\_\_\_\_ is necessary when all the information in a worksheet cannot be displayed in one view.
- \_\_\_\_\_ view shows a document as it will appear on the printed page.

**Part B: Read the following questions carefully and answer them**

1. Explain the use of the **Freeze** command.
2. Outline **three** examples of worksheet views.
3. Differentiate between worksheet **Freeze** and worksheet **Split**.
4. Outline the steps followed when creating a custom view in an Ms Excel worksheet.
5. Describe three freeze pane options.
6. Explain the importance of the page layout view.

**Part C: Read the following instructions carefully. Carry out the activity in pairs**

1. Open Ms Excel program and display the following worksheets in the respective views. Save the workbook as **Views** on the desktop.  

Worksheet	Respective View
Sheet 1	Page Break preview
Sheet 2	Page Layout
2. Using the spreadsheet created in 1 above, insert the following:  
“Integrity is key to success” as a header.
3. Open Sheet 2 and split the worksheet at cell C10.
4. Save the changes as **Exercise 1**.

### 5.3 Sort and Filter

Sort and filter commands are both used to enable the user access the required information faster.

#### 5.3.1 Sort

**Sorting** refers to the process of arranging data in a predefined order. The order could either be ascending or descending.

The ascending order is used when arranging data from the smallest to the largest while descending arranges the data from the largest to the smallest.

The sorting feature is used for managing data in a large worksheet. To sort data, do the following:

- (i) Select the cell range containing the data to be sorted.
- (ii) Click on **Data** tab from the menu bar then select one of the sort option from the **Sort & Filter** group.
- (iii) To sort in ascending order, select the **A to Z** icon. To sort in descending order, select the **Z to A** icon.

Figure 5.10 shows data that is sorted in ascending order (A to Z). Figure 5.11 shows data that is sorted in descending order (Z to A). The keyboard shortcut is: Long press ALT, press A then SA and finally SD.

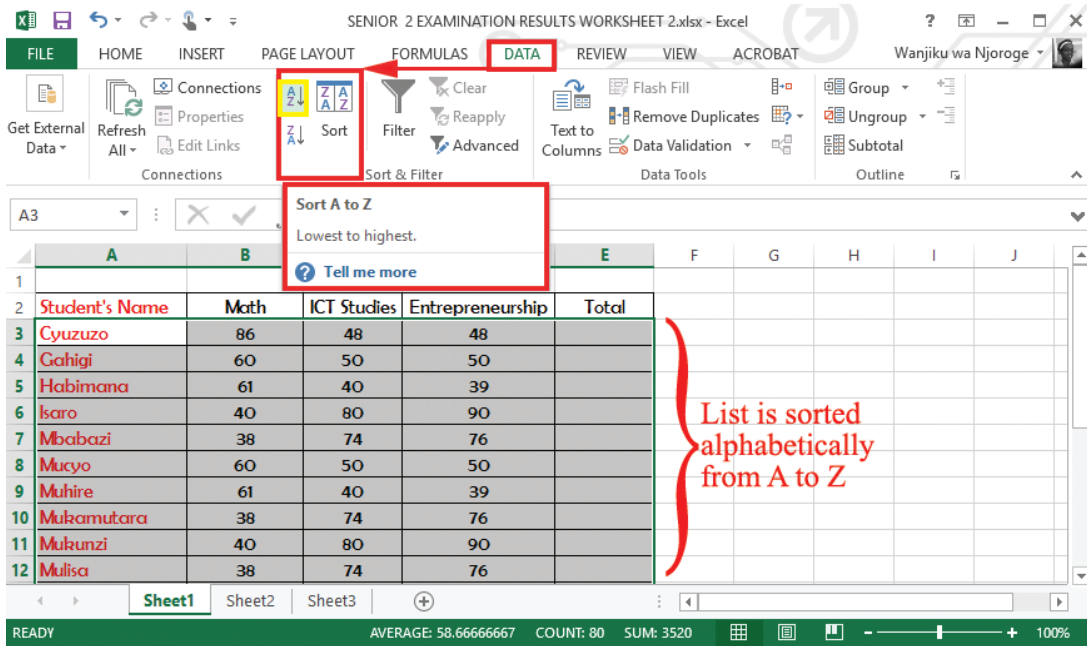


Figure 5.10: A worksheet sorted alphabetically in ascending order (A to Z)

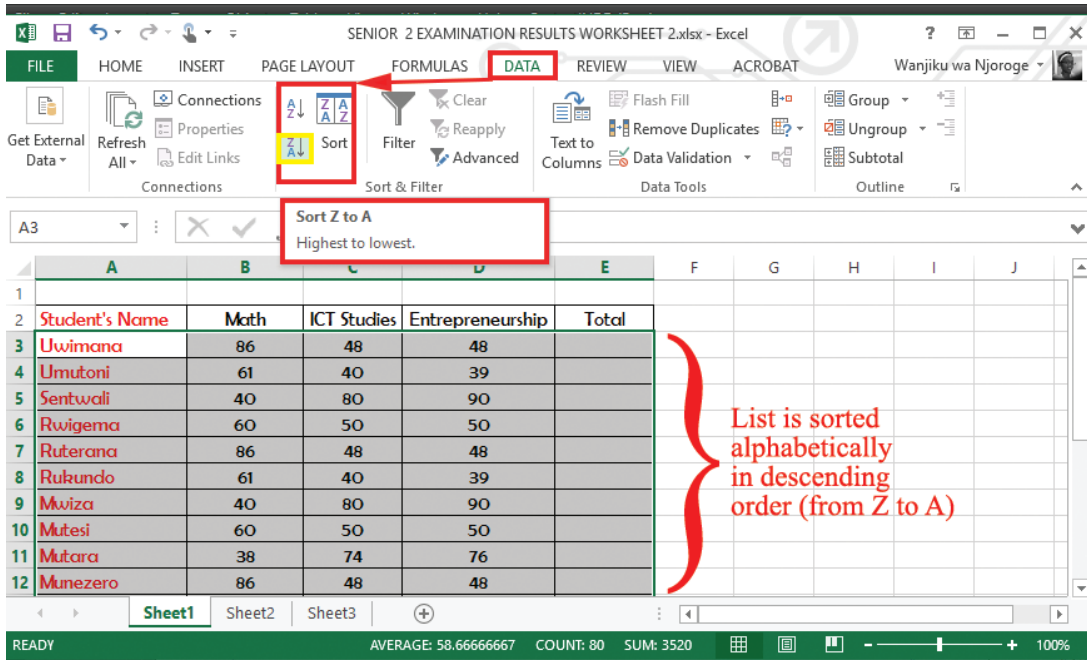


Figure 5.11: A worksheet sorted alphabetically in descending order (Z to A)

- (iv) To customise the sort, select the **Sort** icon. A dialog box is displayed as shown in Figure 5.12. Select the column to use under **Sort by** box, select the sort order in the **Order** box and the data to be sorted on the **Sort On** box then click **OK**. The keyboard shortcut is: **Long press ALT**, press **A** then **SA** and finally **SS**.

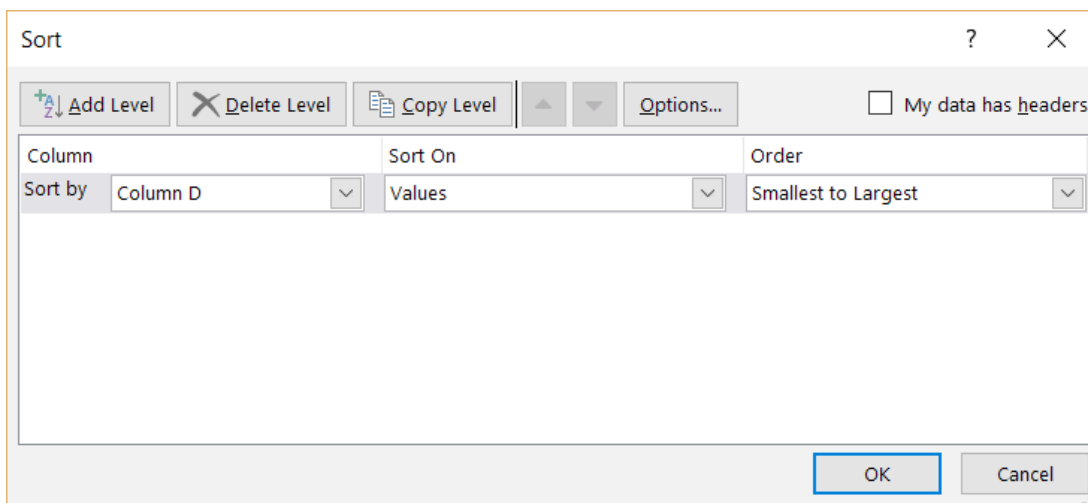


Figure 5.12: Customising the sorting order

### 5.3.2 Filter

It is done to only display records that meet a certain criteria. To filter data, do the following:

- (i) Select the cell range containing the data.
- (ii) Click on **Data** tab from the menu bar then select **Filter** command from the **Sort & Filter** group. The filtering controls are added to the worksheet headers automatically.

Filtering can be done by number, text or colour. Figure 5.13 shows a window having filtering controls. The keyboard shortcut is: **Long press ALT**, press **A** then **SA** and finally **T**.



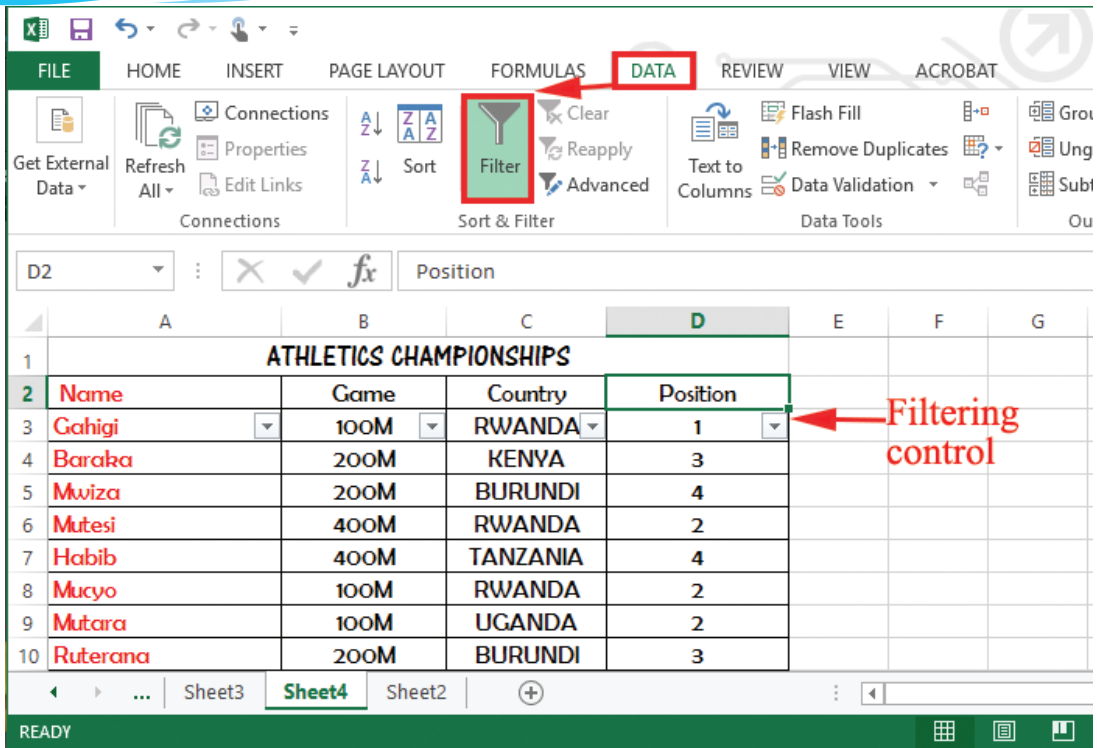


Figure 5.13: Filtering data

### Filter by Number

- (i) Click the filter control of the column header to be filtered. **Number Filters** option is only activated if the column contains numbers.
- (ii) By default all the check boxes next to the numbers are marked (checked). Uncheck the check boxes which do not meet the desired criteria. Figure 5.14 shows **Filter by numbers** menu.

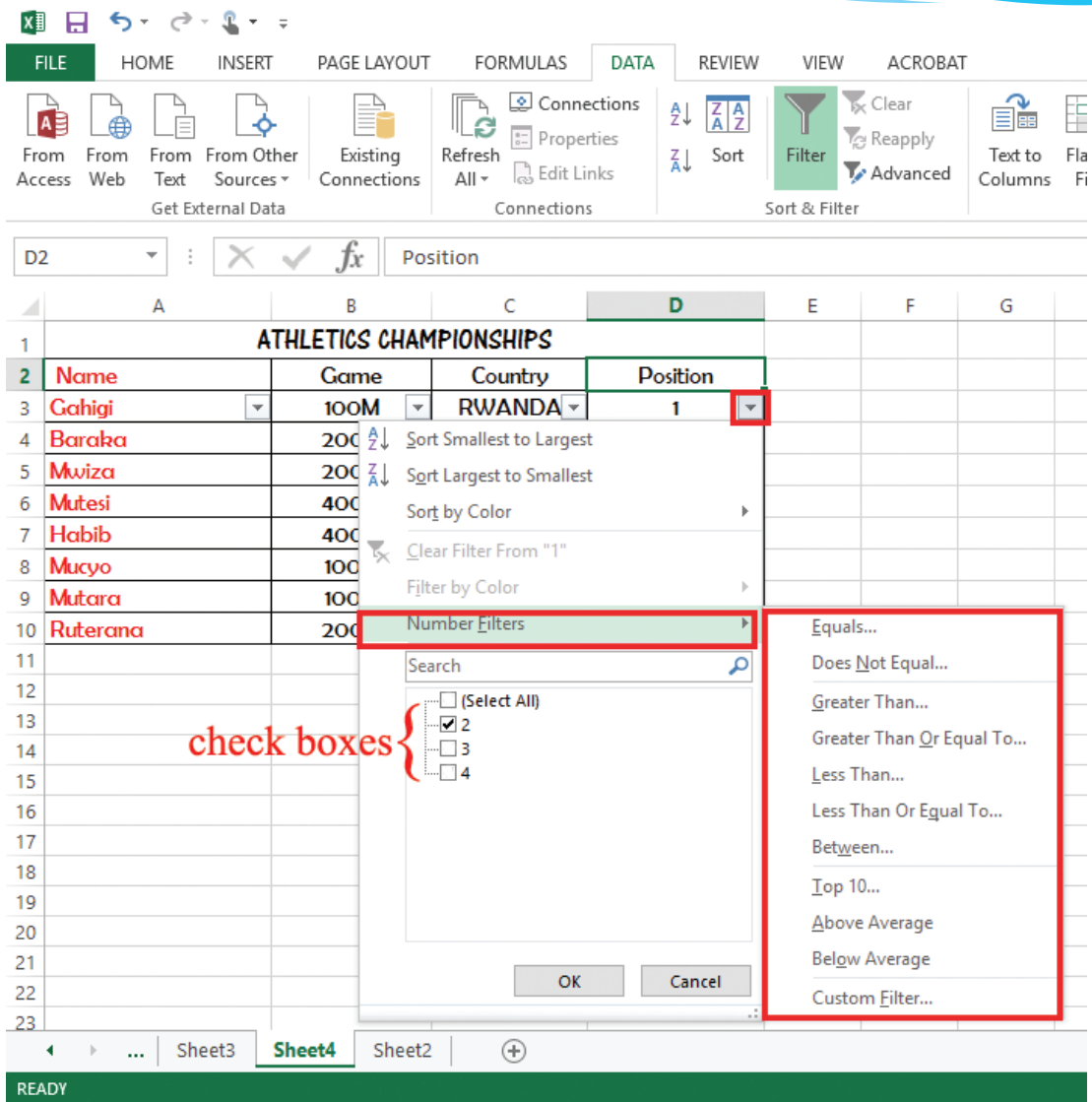


Figure 5.14: Filtering by number

- (iii) Click **OK**. The worksheet will display all the records of people who are position 2. Figure 5.15 shows the filter results of the data.
- (iv) Select the filtering criteria display on the list box to the right, for example, select **Equals ...**

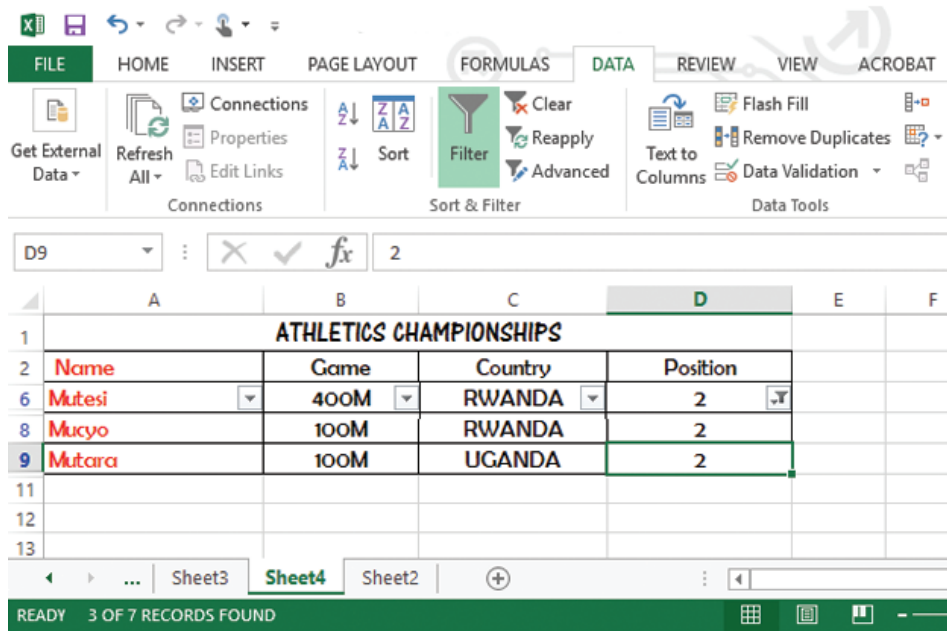


Figure 5.15: Filtered data

**Note:** It is important to copy the data to another worksheet before filtering.

### Filter by Text

- (i) Click the filter control of the column header to be filtered. **Text Filters** option is only activated if the column contains text.
- (ii) By default all the check boxes are marked. Uncheck the check boxes which do not meet the desired criteria. Figure 5.16 shows a worksheet filtered by text.
- (iii) Click **Ok**.

The worksheet will display all the records whose country of origin is Rwanda as shown in Figure 5.17.

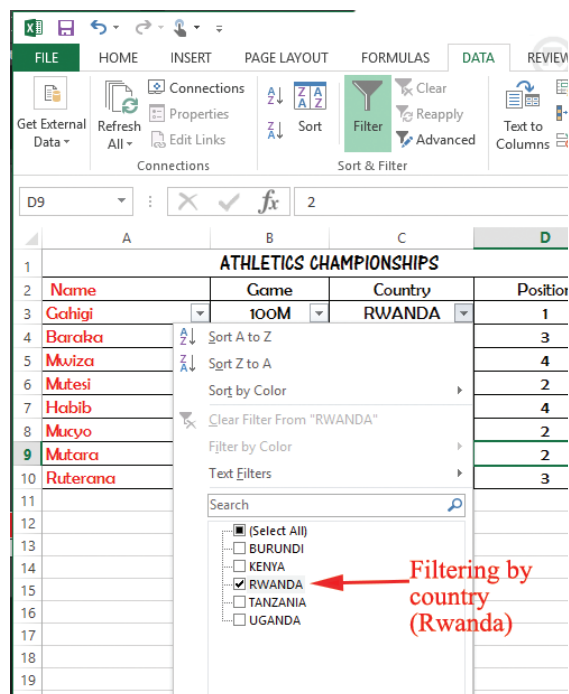


Figure 5.16: Filtering by text

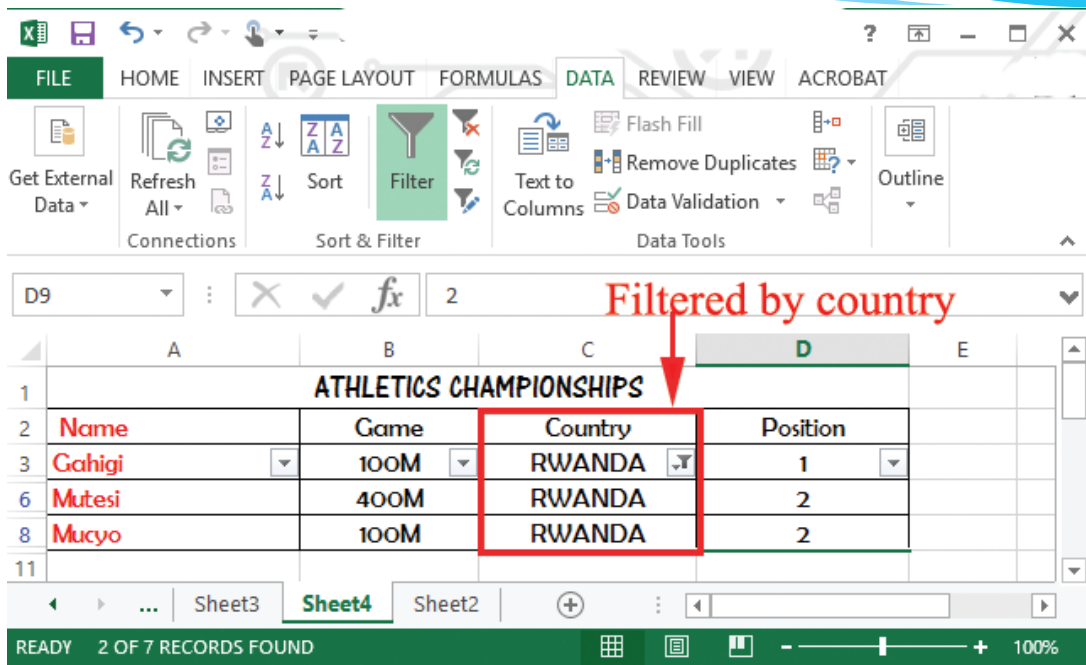


Figure 5.17: Filtered results

### Filter by Colour

- (i) Click the filter control of the column header to be used to filter.
- (ii) Select **Filters by Colour**. This option is only activated if the cells in the worksheet have different colours. A side kick menu is displayed as shown in Figure 5.18.
- (iii) Select the colour to filter by from the side kick menu.
- (iv) Click **OK** to apply.

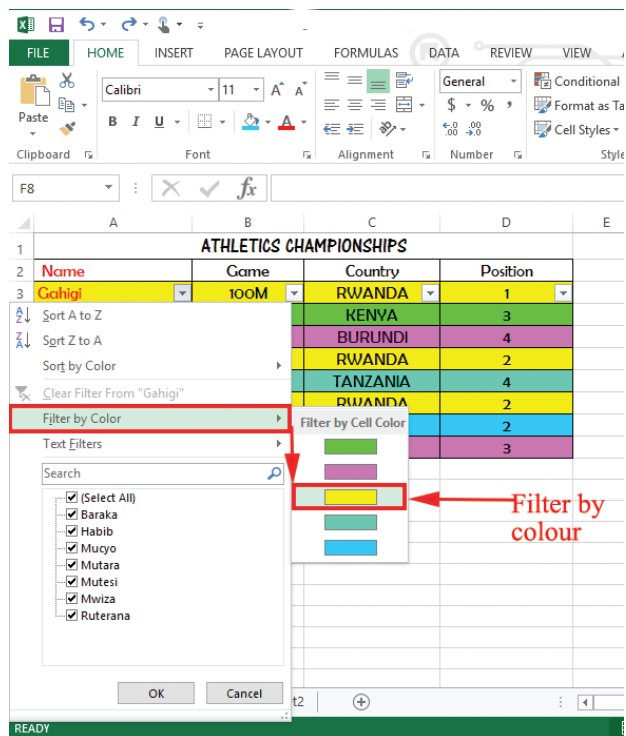


Figure 5.18: Filtering by colour

## Custom filter

This filter option enables the user to specify with great accuracy the records that he or she desires to appear on the filtered list. To custom filter data, do the following:

- (i) Click on the filter control in the table header of the column to be filtered.
- (ii) Select **Numbers Filters** if the column has numbers and if the column has text entries, click **Text Filters** as shown in Figure 5.19.

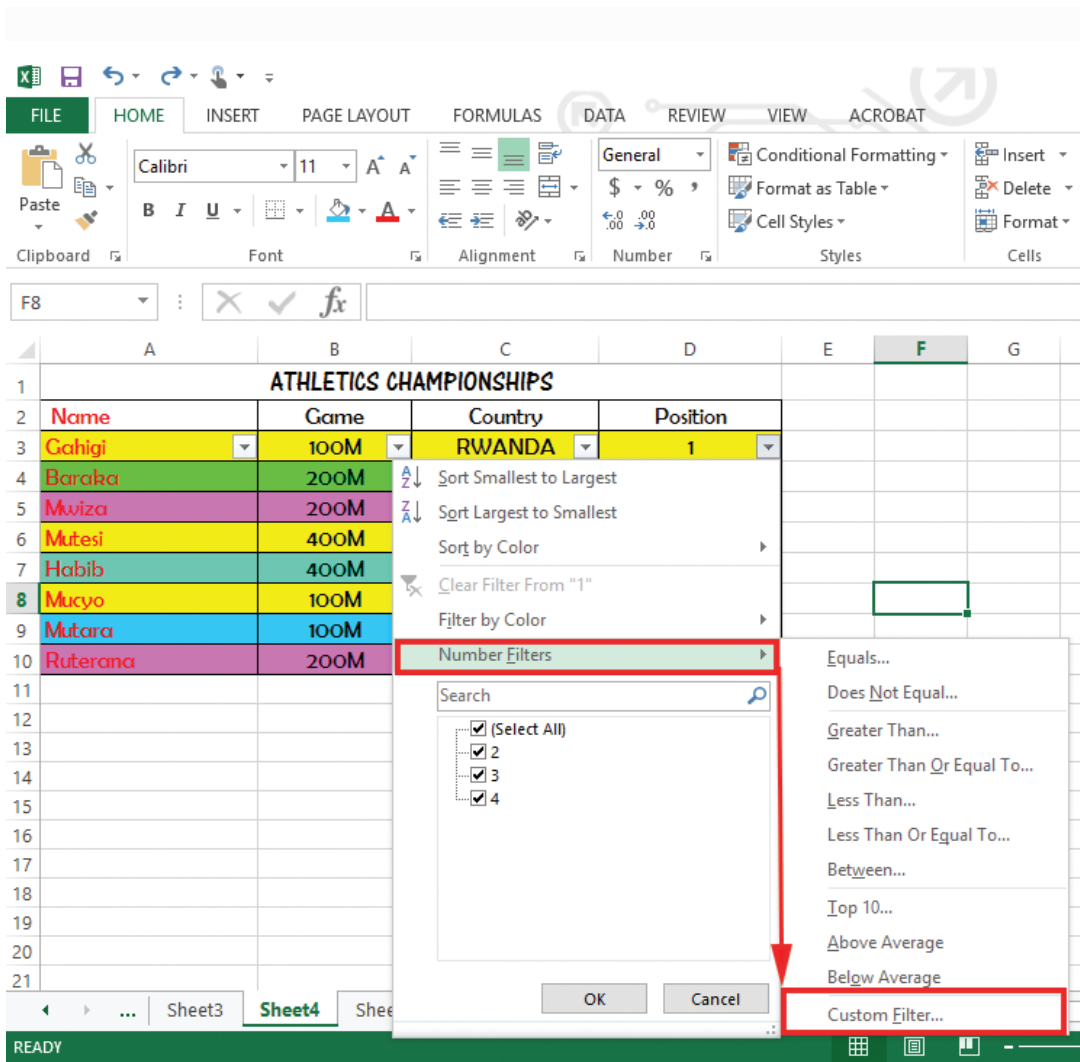


Figure 5.19: Custom filter menu

- (iii) From the side kick menu, select **Custom Filter...** option. A dialog box appears as shown in Figure 5.20.

For example, to show numbers equal to a certain amount, select **Equals** in the first box, then enter the number in the box in the adjacent box.

To filter by two conditions, enter filtering conditions in both sets of boxes, and select **And** for both conditions to be true, and **Or** for either of the conditions to be true.

- (iv) Then click **OK**.

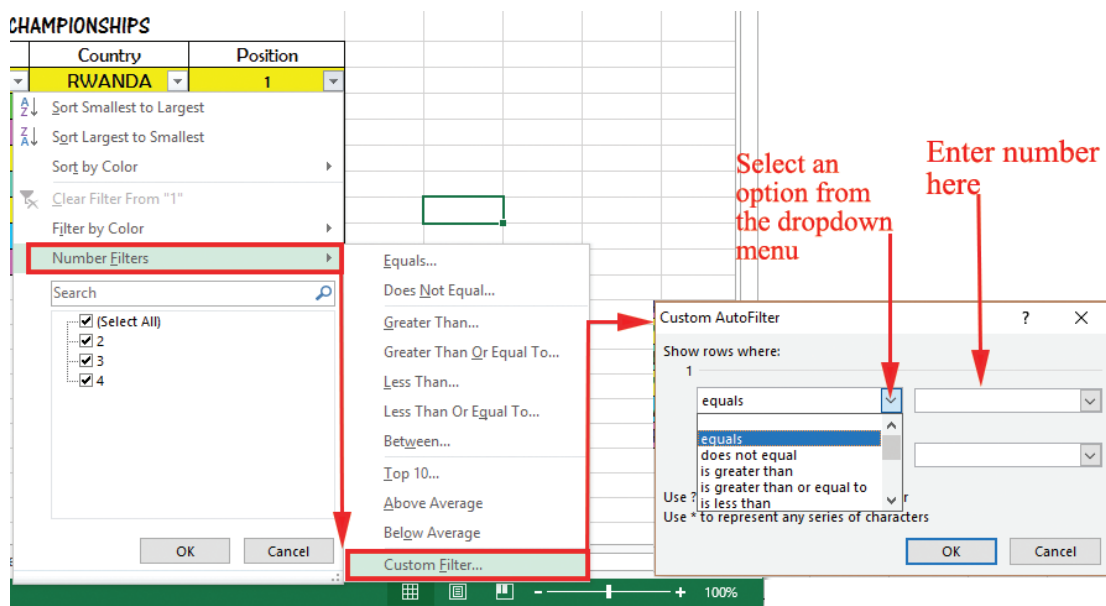


Figure 5.20: Dialog box for custom filter

### Revision Activity 5.2

#### Part A: Fill in the dashes with the correct answers

- \_\_\_\_\_ is the process of arranging data in a predefined order.
- Records in a worksheet can be arranged either in ascending order or \_\_\_\_\_ order.
- The process of displaying records that meet a certain criteria in a worksheet is known as \_\_\_\_\_.

Use the diagram below to answer the questions that follow

The screenshot shows the Microsoft Excel interface with the DATA tab selected. The ribbon includes options for Connections, Refresh, Sort, and Filter. The Filter button is highlighted in green. Below the ribbon, a worksheet titled 'ATHLETICS CHAMPIONSHIPS' is displayed with the following data:

	A	B	C	D	E	F	G
1	<b>ATHLETICS CHAMPIONSHIPS</b>						
2	Name	Game	Country	Position			
3	Gahigi	100M	RWANDA	1			
4	Baraka	200M	KENYA	3			
5	Mwiza	200M	BURUNDI	4			
6	Mutesi	400M	RWANDA	2			
7	Habib	400M	TANZANIA	4			
8	Mucyo	100M	RWANDA	2			
9	Mutara	100M	UGANDA	2			
10	Ruterana	200M	BURUNDI	3			

Figure 5.21: Using the filter feature in a worksheet

4. What is the name given to the part labelled (1).
5. If a column contains numbers only, it cannot be filtered by \_\_\_\_\_.

**Part B: Read the following questions carefully and give the correct answers**

1. Explain the importance of sorting data in a worksheet.
2. Outline the steps followed when sorting data in a worksheet.
3. Outline the steps followed when filtering data in a worksheet.
4. Outline **three** filter options.
5. State the function of the filter command.

**Part C: Read the following questions carefully. Do the activities in pairs**

Figure 5.22 shows a section of a worksheet. Use it to answer the questions that follow.

- (i) Open Microsoft-Excel program and type the information in Sheet 1 as it appears in Figure 5.22. Save it as **Championships** on the desktop.

	A	B	C	D
1	<b>ATHLETICS CHAMPIONSHIPS</b>			
2	<b>Name</b>	<b>Game</b>	<b>Country</b>	<b>Position</b>
3	Cahigi	100M	RWANDA	1
4	Baraka	200M	KENYA	3
5	Mviza	200M	BURUNDI	4
6	Mutesi	400M	RWANDA	2
7	Habib	400M	TANZANIA	4
8	Mucyo	100M	RWANDA	2
9	Mutara	100M	UGANDA	2
10	Ruterana	200M	BURUNDI	3

*Figure 5.22: A section of a spreadsheet*

- (ii) Copy the information in Sheet 1 to Sheets 2 and 3.
- (iii) Select Sheet 2 and filter all the records of the athletes whose Country is Rwanda using filter by text option.
- (iv) Select Sheet 3 and filter all the records of the athletes whose format Colour is blue.
- (v) Save the changes as the **Filtered list**.



## 5.4 Definition of Key Words in this Unit

### Revision Activity 5.3

Find out the meaning of the words given below. Share your findings with the rest of the students in a class presentation. Check the meanings you find against those provided in the glossary at the end of this course book:

Freeze	worksheet	Sort
Filter	Normal view	Page break view
Page Layout	Custom view	Preview
Split worksheet	Freeze panes	Workbook view

### Revision Exercise 5

- The letters below can be re-arranged to form names of different types of workbook views. Give the names.
  - TOCUMS \_\_\_\_\_
  - MOLRAN \_\_\_\_\_
- List **four** types of workbook views available in Microsoft Excel.
- State the function of the Freeze top row option of the freeze panes.
- Differentiate between filtering and sorting.
- Mucyo wanted to filter data in a worksheet so that it only displays values that are greater than 50. Outline the procedure that she should use.
- Outline a circumstance under which each of the following features would be applied in Microsoft Excel:
  - Sort
  - Filter
- Outline the steps followed when splitting a worksheet.
- Gahigi, a Senior 2 student, created a worksheet containing data across many columns. The data could not fit on the screen. Describe a command that he would use to view column labels and the last row in the worksheet at the same time.
- Outline the steps followed when sorting a list of data in descending order in a worksheet.
- Mwiza would like to insert a footer on a worksheet. Give a worksheet view that she would use to achieve her objective.

# Unit 6

## ArcGIS

**Key Unit Competency: By the end of this unit, you should be able to:**

Fill in a new empty map with data, use simple symbols, label features and attributes table, and navigate a map.

### Introduction

Maps are important ways of organising and displaying data.

#### 6.1 Creation of Maps

Maps contain many kinds of data such as world imagery, street maps, topographic data, and base maps. The data on a map is organised into layers, which are drawn on the map in a particular order. Each map is displayed in a **Page Layout view** or window where graphic elements such as legends, North arrows, scale bars, text, and other graphics, are arranged.

Layers give a layout of geographical features added to a map. Layers refer to data that is stored in the **Data folder**. Layers also define how a set of geographical features will be drawn when they are added to a map. They also act as shortcuts to the storage location where the data is stored.

Generally, making maps in **ArcMap** takes the following steps:

- (i) Load **Geospatial data** into **ArcMap**.
- (ii) Identify the features and attributes to present.
- (iii) Define how to show the data.
- (iv) Add map components.
- (v) Export the map.

ArcMap allows one to work with geographic data in maps, regardless of the format or location of the underlying data. With ArcMap, one can assemble a map quickly from predefined layers. Data can also be added from coverages, shapefiles, geodatabases, grids, images, and tables of coordinates or addresses.

**ArcCatalog** is another GIS application that is designed to work with **ArcMap**. It is used to browse, organize, and document geographic data. It is also used to easily drag and drop it onto an existing map in ArcMap.

### 6.1.1 Introducing ArcCatalog

To start the ArcCatalog application, proceed as follows:

- (i) Click the **Start** button on the taskbar.
- (ii) Point to **Programs** to display the **Programs** menu.
- (iii) Point to **ArcGIS**.
- (iv) Click **ArcCatalog**.

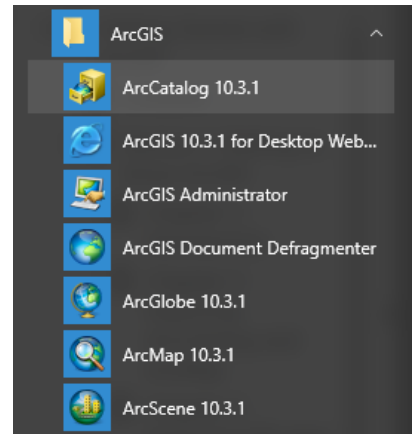


Figure 6.1: Launching ArcCatalog

The ArcCatalog window starts and the two panels in the ArcCatalog window are displayed as shown in Figure 6.2 below.

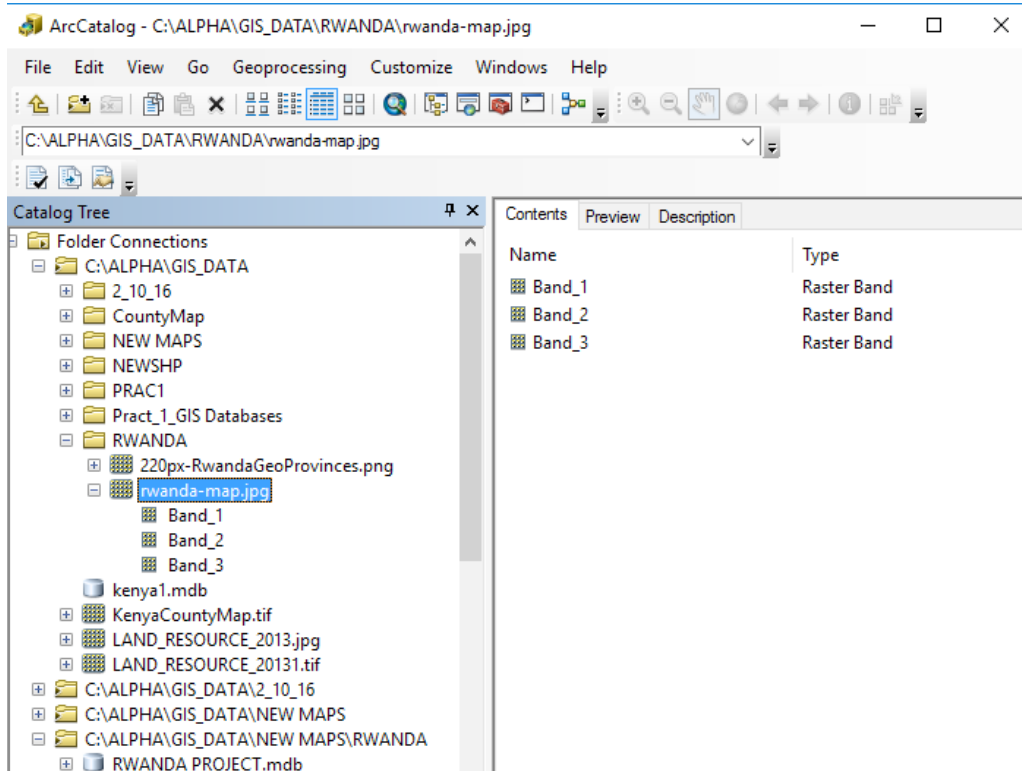


Figure 6.2: The ArcCatalog Window

The **Catalog tree** on the left side of the ArcCatalog window is for browsing and organising the GIS data. The contents of the current branch (**Rwanda-map.jpg**) are displayed on the right side of the Catalog window.

When more information about a branch of the Catalog tree is needed, one can use the **Contents**, **Preview**, and **Description** tabs to view the data in many different ways.

For example, clicking on the Preview tab for the selected branch displays the view shown in Figure 6.3 below.

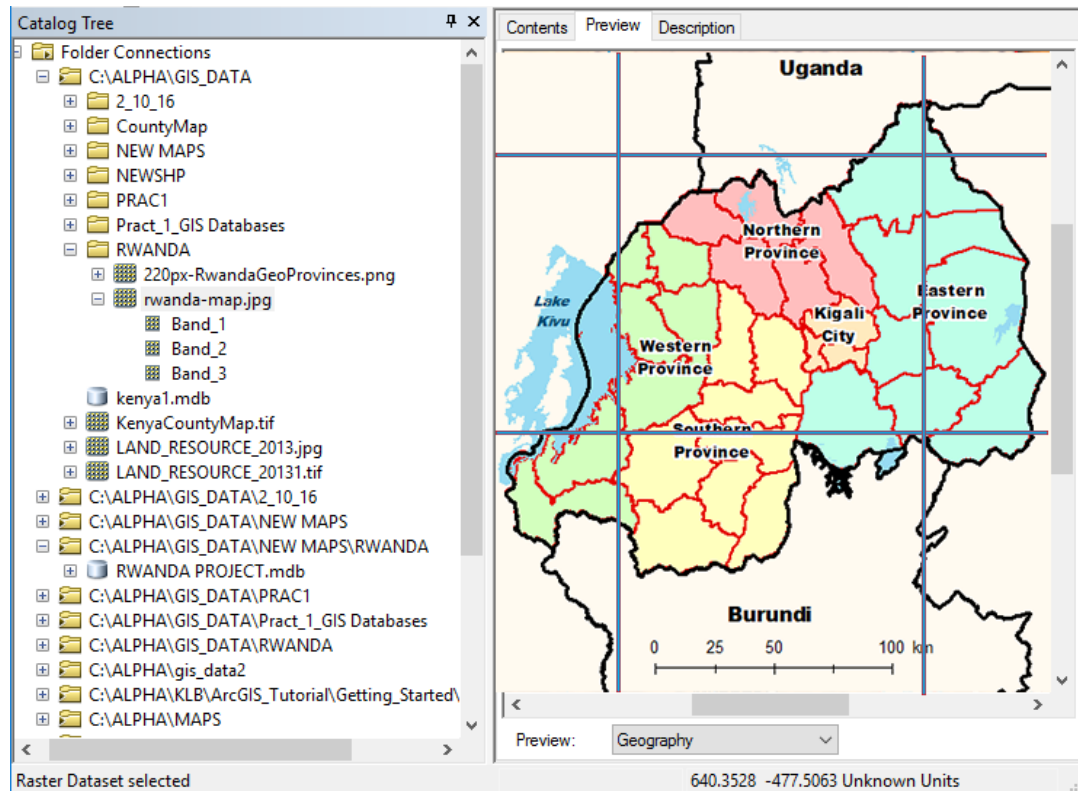


Figure 6.3: Previewing the contents of a Branch

By default, ArcCatalog recognises many different file types as GIS data including shapefiles, coverages, raster images, TINs, geodatabases, projection files, and so on.

If the list of the recognised file types does not include a file type that is being used in GIS analysis, ArcCatalog is customised to recognise additional file types, for example, text files as GIS data.

### 6.1.2 Maps and layers

Maps and layers are the main ways of organising and displaying data in ArcGIS.

Maps, such as printed paper maps, can contain many kinds of data. Data on a map is organised into layers, which are drawn on the map in a particular order.

Each map contains a **Page Layout** where graphic elements, such as legends, North arrows, scale bars, text, and other graphics, are arranged. The layout shows the map page as it will appear in print.

Layers outline how a set of geographic features are drawn when they are added to a map.

If geographic data is stored in a central database, then maps and layers can be created that refer to the database. This makes it easy to share maps and layers with other related users, eliminating the need to make duplicate copies of your data for each user.

ArcGIS has tutorial data which we need to know where it has been installed on the system.

### 6.1.3 Adding Data to a Map

#### Make a connection to the tutorial data

Now we will add a connection to the folder that contains the tutorial data. This new branch in the Catalog tree will remain until it is deleted.

- (i) Click the Connect to Folder button.

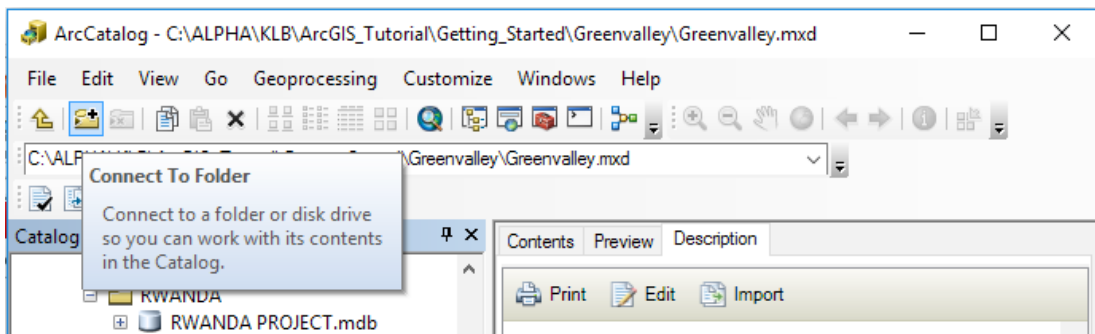


Figure 6.4: Connecting to a Folder from ArcCatalog

After clicking the button, a window opens. It allows one to navigate to a folder in the computer or to a folder in another computer in the network.

- (ii) Navigate to the ArcGIS\ArcTutor\Getting\_Started\Greenvalley folder on the drive where the tutorial data is installed. Click OK.

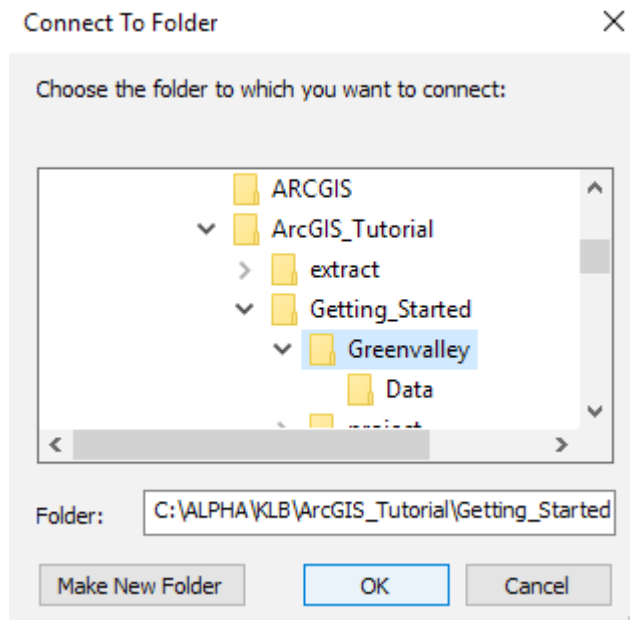


Figure 6.5: Connecting to the Tutorial Data

The new connection is displayed as a branch in ArcCatalog tree as shown in Figure 6.6 below.

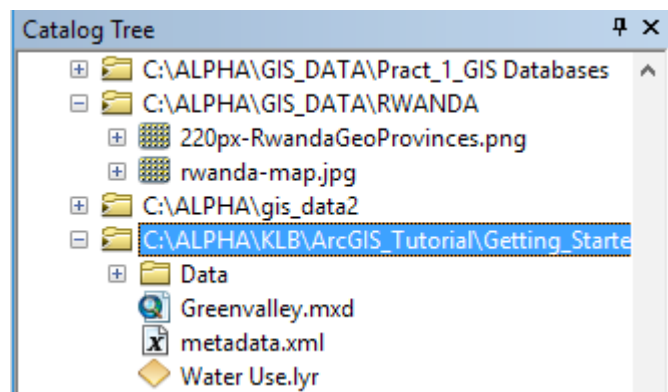


Figure 6.6: The new Connection in the Catalog Tree

The Greenvalley folder has a special icon to show that it contains GIS data.

#### 6.1.4 Open the Greenvalley map

Double-click **Greenvalley** in the Catalog tree. Double-clicking a map in the Catalog tree opens the map in ArcMap.

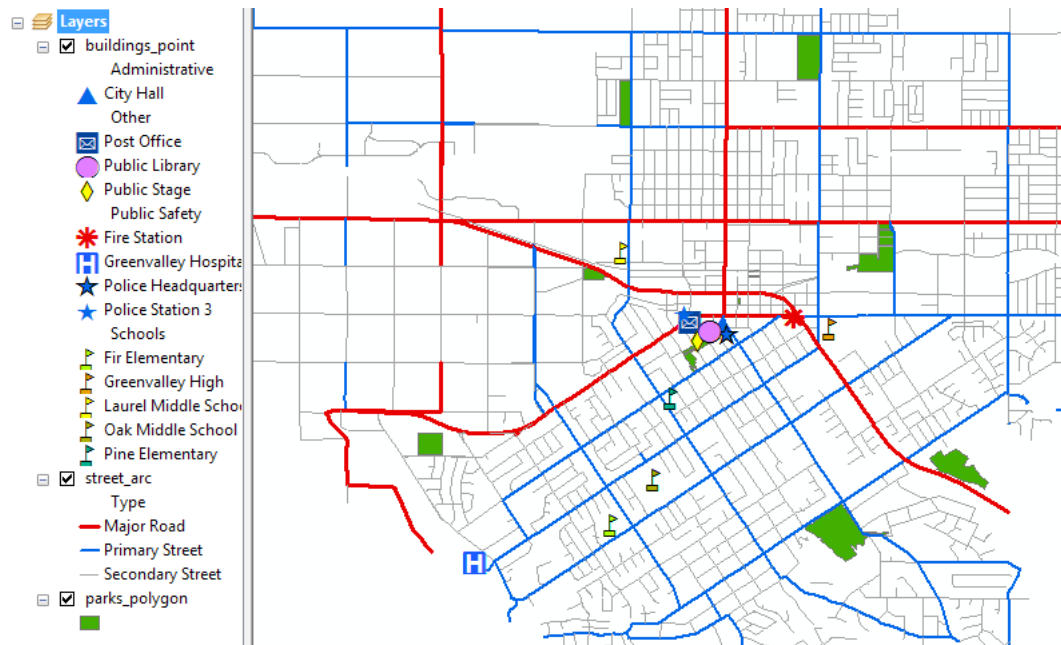
One may also want to start ArcMap without opening an existing map. This is done by clicking the **ArcMap Launch button**  in ArcCatalog. ArcMap can also be launched from the start menu just like ArcCatalog.

## 6.1.5 ArcMap

**ArcCatalog** is used for browsing, organising, distributing, and documenting GIS data. **ArcMap** is the tool for creating, viewing, querying, editing, composing, and publishing maps.

Maps can present several types of information about an area at once. This map of Greenvalley contains three layers that show public buildings, streets, and parks.

The layers in this map are listed in the **table of contents**. Each layer has a check box that lets you turn it on or off.



*Figure 6.7: Layers Displayed in ArcMap*

Within a layer, symbols are used to draw the features. In this case, buildings are represented by points, streets by lines, and parks by areas. Each layer contains two kinds of information.

- (i) **Spatial information**: This kind of information describes the location and shape of the geographic features.
- (ii) **Attribute information**: This kind of information tells you about other characteristics of the features.

In the park layer, all the features are drawn with a single green fill symbol. This single symbol lets one identify areas that are parks, but it does not tell anything about the differences between the parks.

In the street layer, the features are drawn with different line symbols according to the type of street that the lines represent. This symbol scheme lets you differentiate

streets from other types of features and tells you something about the differences between the features as well.

### 6.1.6 Adding a layer to a map

We will start by adding the **Water Use** layer to the in ArcMap map.

- (i) Position the ArcMap and ArcCatalog windows so that both windows can be seen.
- (ii) Click the **Water Use** layer in ArcCatalog and drag it onto the map in ArcMap. One can click and drag any layer from the ArcCatalog tree onto an open map in ArcMap.

The map now shows a new water use layer as shown in Figure 6.8 below.

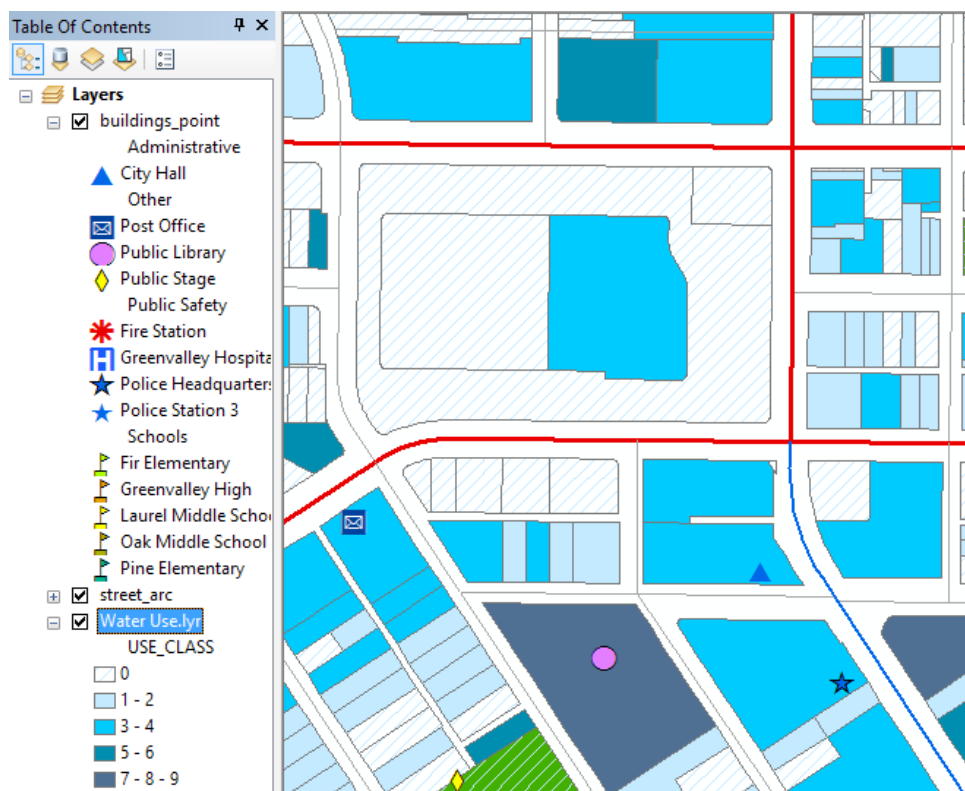


Figure 6.8: Addition of a new water use layer

One can add raw geographic data to a map just as easily as you can add a layer.

## 6.2 Display of a Layer

### 6.2.1 Adding Features and Symbolising Layers

**Symbology** is a set of conventions, rules, or encoding systems that define how geographic information is represented with signs and different colours on a map.



A characteristic of a map feature may influence the size, colour, and shape of the symbol used. Figure 6.9 below shows examples of custom symbols common in maps.



Figure 6.9: Example of Symbols used in Maps.

Symbols can be applied into layers in different ways depending on the type of data. The following are some of the forms used:

- (i) **Single symbol:** All features are represented in the map with a common symbol.
- (ii) **Unique values:** A different symbol is applied to each category of feature within the layer.
- (iii) **Graduated colours:** Variety of colours are used to show differences in feature values.
- (iv) **Dot Density Symbols:** Thematic dot density maps use dots or points to show a comparative density of features over a map based on values stored in the fields. Attribute values determine the number of dots displayed in the polygon feature.
- (iv) **Graduated symbols:** These are common symbols that are used to represent qualitative information of different values using symbols with varying sizes.

Using graduated symbols, the quantitative values for a field are grouped into ordered classes. Within a class, all features are represented with the same symbol.

### 6.2.2 Adding Features

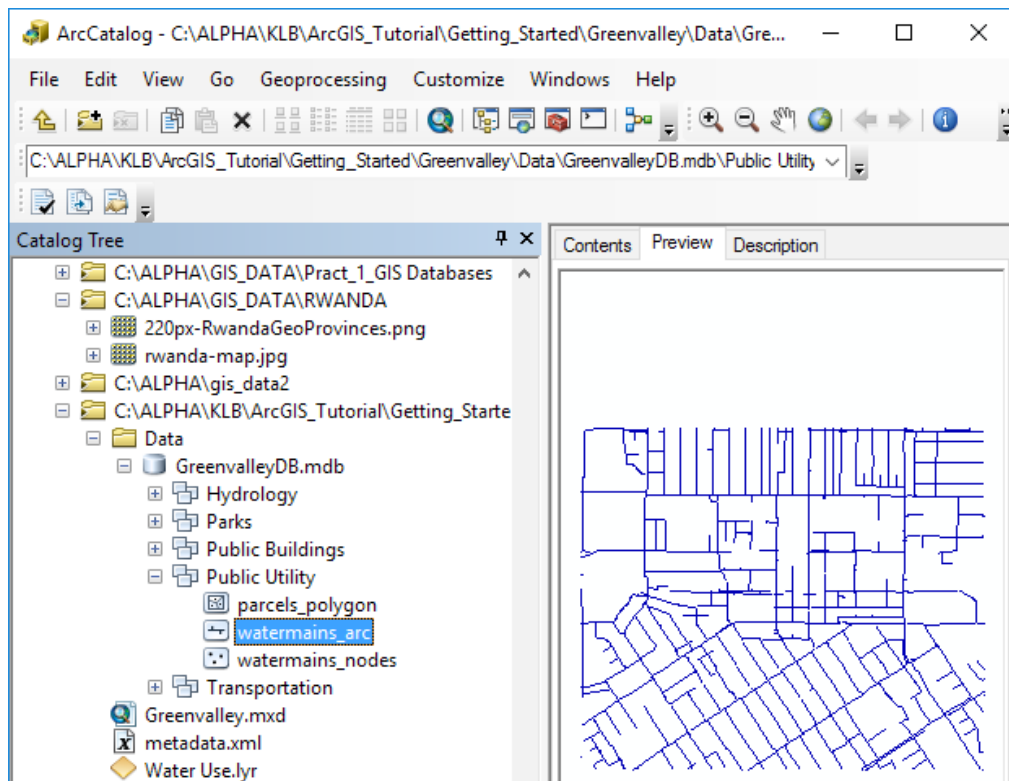
When features are added directly from a coverage, shapefile, or database, they are all drawn with a single symbol.

Let us go back to the Greenvalley example. The data will be added from a database in this case.

- (i) Position the **ArcMap** and **ArcCatalog** windows so that both can be seen.
- (ii) Click the **plus sign (+)** next to the Data folder in the Catalog tree to view the contents of the folder.
- (iii) Click the **plus sign (+)** next to GreenvalleyDB.
- (iv) GreenvalleyDB is a geodatabase that contains the remainder of the data to be used. This data is organised in five feature datasets, namely Hydrology, Parks, Public Buildings, Public Utility, and Transportation.

- (v) Click the **plus sign (+)** next to **Public Utility**.
- (vi) Click **Watermains\_arc** and drag it onto **ArcMap**.

Figure 6.10 below represents the ArcCatalog window showing the steps followed to access the data in the geodatabase.



*Figure 6.10: ArcCatalog Window showing the location of the Greenville Database*

**Watermains\_arc** layer is then dragged and added to the ArcMap window. It appears as shown in Figure 6.11 below.

Notice that, the map now has four layers: **Building\_point**, **Watermains\_arc**, **street\_arc**, and **parcs\_polygon**.

The **Watermains\_arc** layer features are represented using a single symbol which is a uniform line. In this case, the features are polyline shapes that represent the pipes in the water distribution system.

The features in the **Building\_point** layer are represented using unique values, where a different symbol is applied to each category of feature within the layer. The represented features include city hall, post office, public library and schools among others.

Following the steps above, add the water use layer from the catalog tree.

Figure 6.12 below represents the added layer.

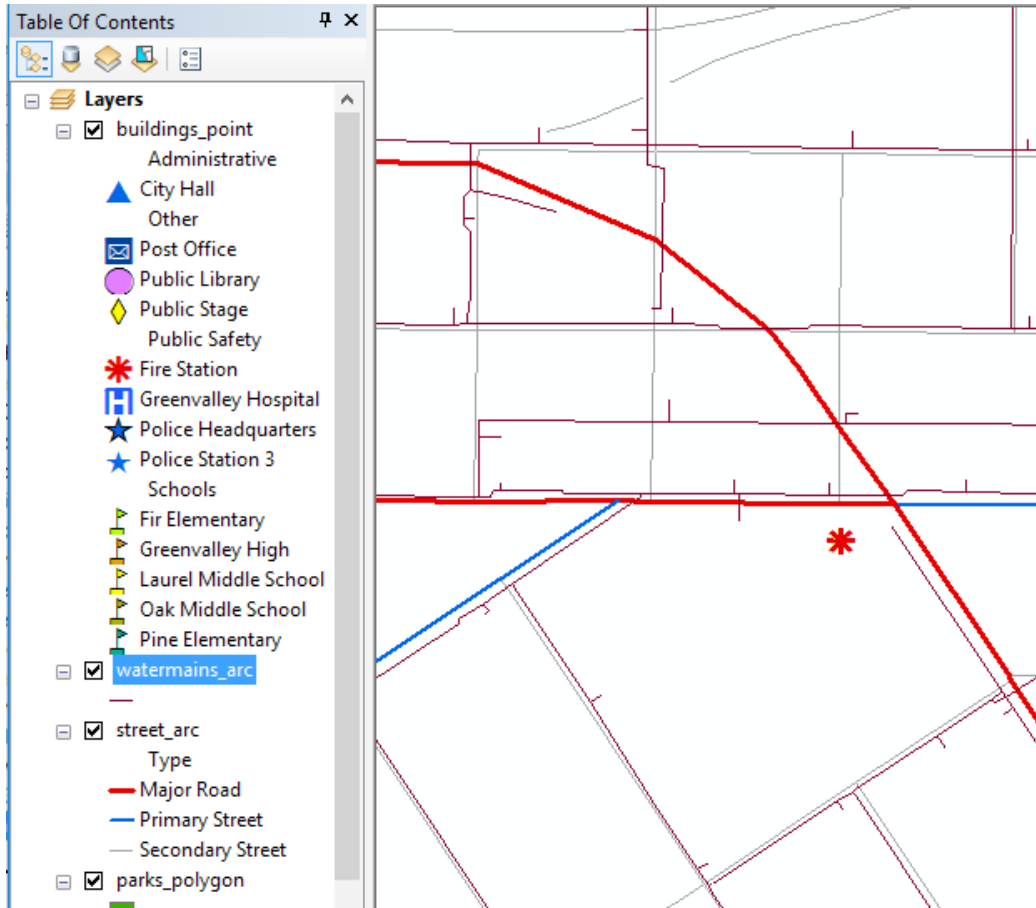


Figure 6.11: ArcMap window showing the added Watermains\_arc layer



Figure 6.12: The water use layer added represented using Graduated colour scheme.

The features in the water use layer are represented using the graduated colour scheme. Zero (0) represents nil water use, 1-2 represents light water use and 7-8-9 represents heavy water use. For example, the school and the fire station are heavy water consumers and they are represented using colour code 7-8-9 as indicated in the table of contents.

The street\_arc layer also represents the different classes of roads using different colours. Figure 6.13 below shows the colour graduated scheme differentiating the countries neighboring Rwanda.

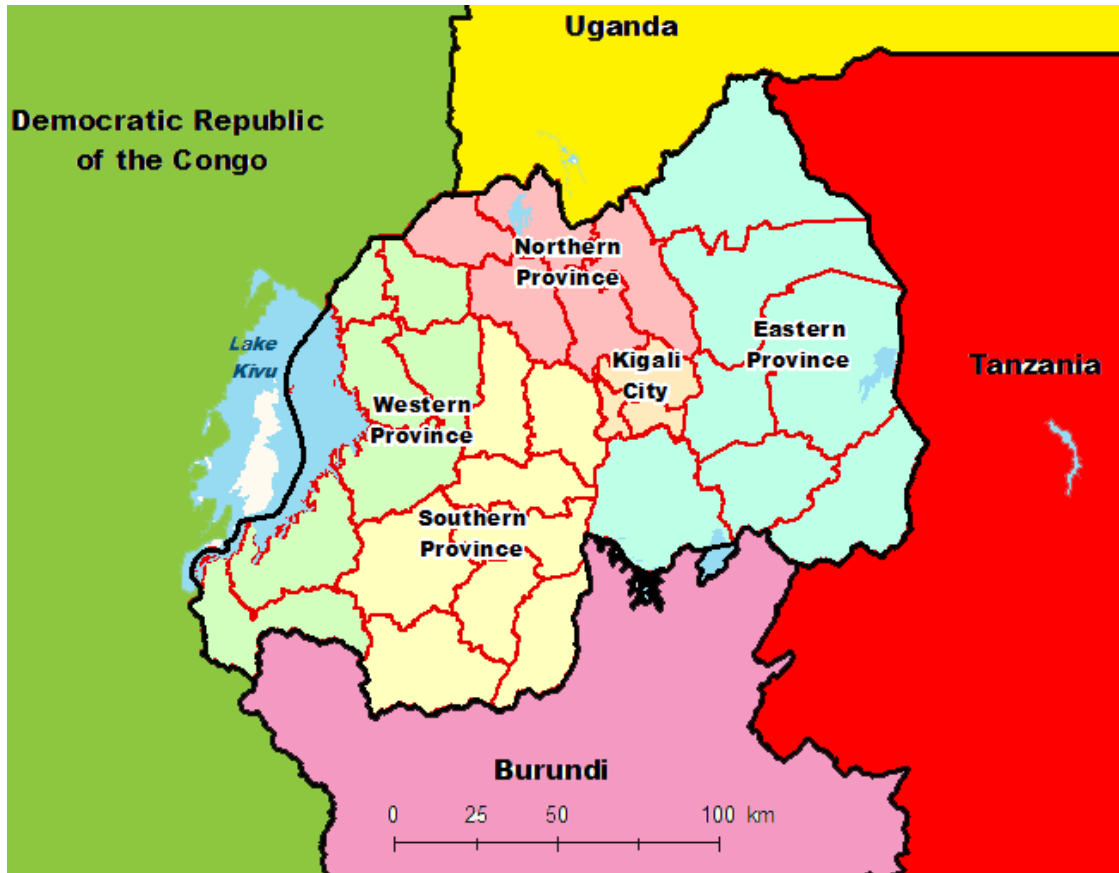


Figure 6.13: Graduated Color Scheme Differentiating Rwanda's Neighboring Countries

### 6.2.3 Editing the feature Symbols

Sometimes, the size, colour and shape of the features need to be changed to give the correct representation. To achieve this, proceed as follows:

- (i) Right-click the **layer title** (for example Watermains\_arc) in the ArcMap table of contents and click Properties. The layer **Properties** dialog box shown

in Figure 6.14 below appears. It can be used to inspect and change a wide variety of layer properties.

- (ii) Click the symbology tab. The symbol scheme for the layer, as well as its appearance in the table of contents can be edited from this tab.

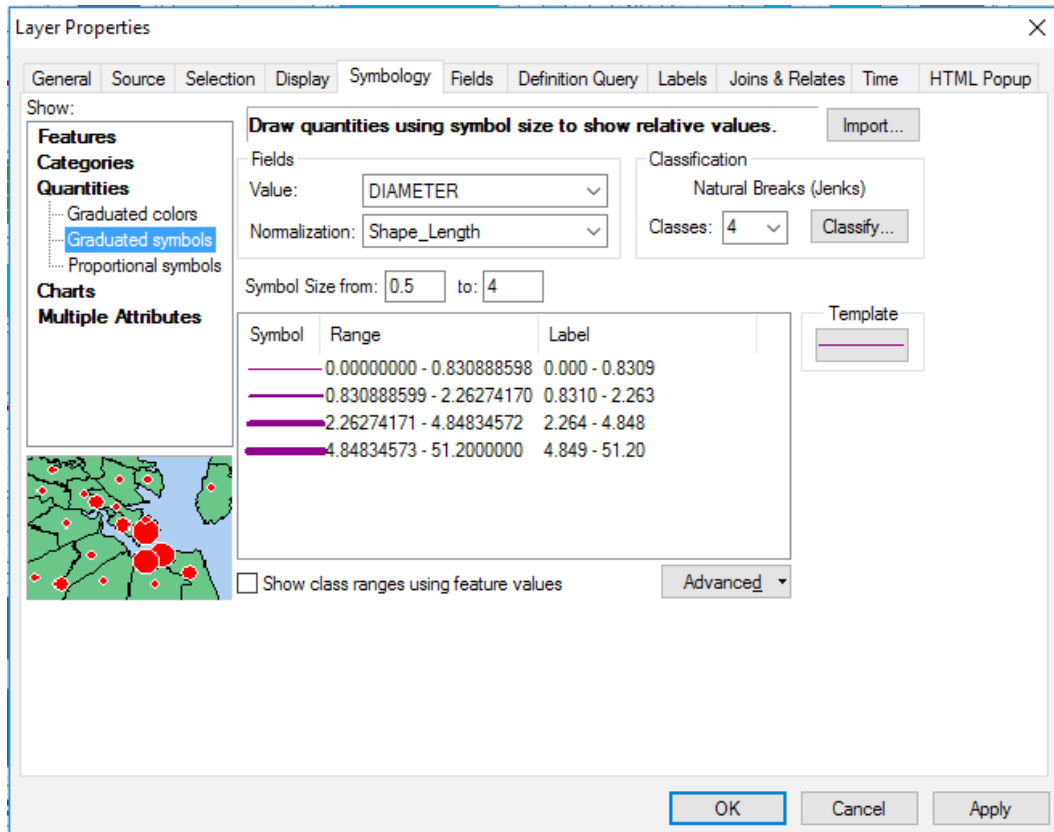


Figure 6.14: Layer Properties Dialog box

- (iii) Click **Quantities**. The panel changes to give controls for drawing with graduated colors, graduated symbols, and proportional symbols.
- (iv) Select **Graduated symbols** option and click the **Value** dropdown arrow and click **DIAMETER**. By default, ArcMap assigns the data to five classes using the Natural Breaks classification (Jenks' method).

The classes can be adjusted to the desired number. Now the width of the line symbols indicates the diameter of the water mains.

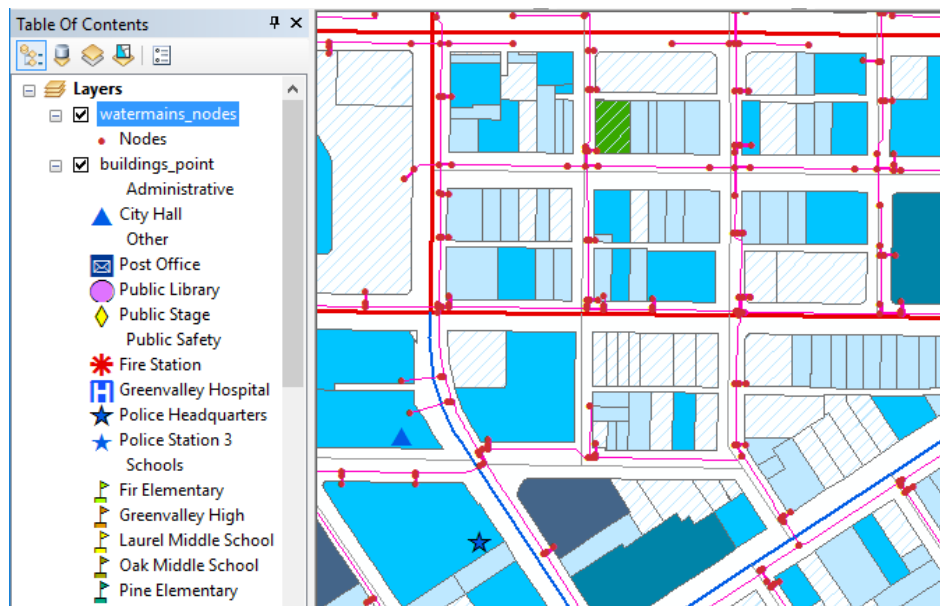
If one wants to change the water mains colour (for example to be ginger pink), click on the template button and select the desired colour.

After clicking, apply and then okay, applies the changes to the selected layer in the map as shown in Figure 6.15.



Figure 6.15: Water main Pipes represented using graduated symbols to show different sizes.

From the geodatabase, add another layer for Watermains\_nodes. This layer will represent the water points. From the layer properties dialog box, edit the colour, shape and size of the nodes and apply the changes. Figure 6.16 below represents the changes.




KEY:  Dot Density Symbols

Figure 6.16: Water nodes represented using the Dot Density Symbols.

## 6.2.4 Add/Remove Labels of a Layer

Progressively, layers have been added to the Greenvalley map as shown in Figure 6.16 above.

The table of contents usually displays the active layers in a map. In a Map, to remove the label of a layer, uncheck the dialogue box, next to the layer label.

Figure 6.17 below shows the label for water use layer unchecked. The map will not display the water use scheme of the town.

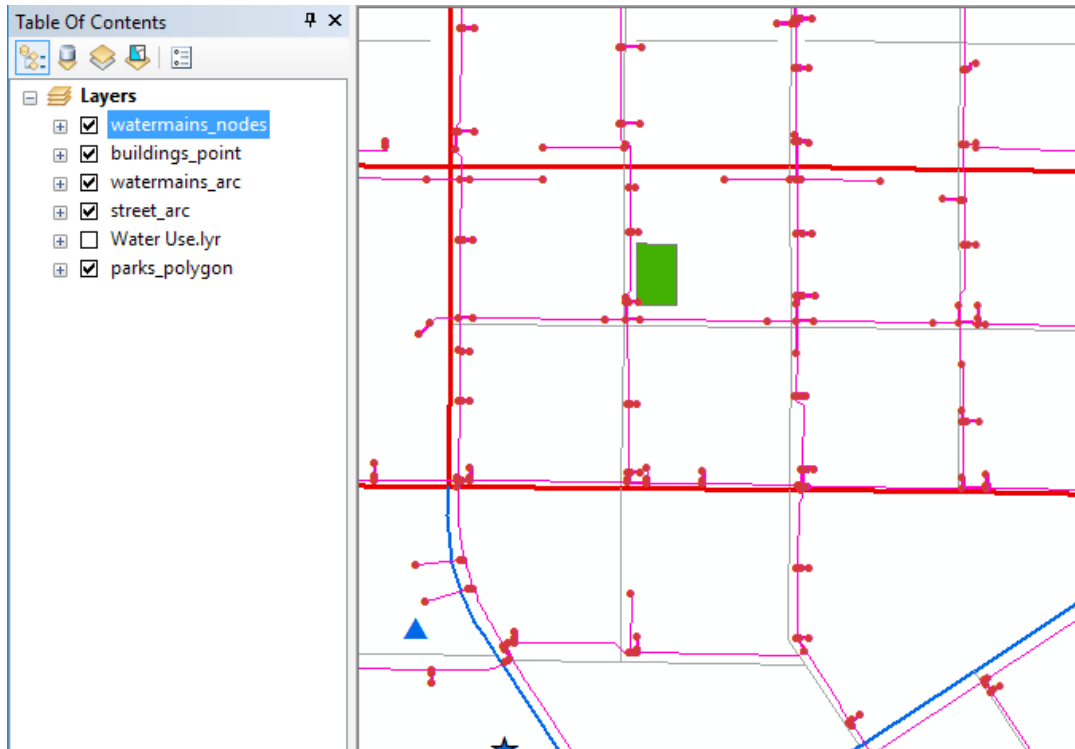


Figure 6.17: Removal of Layers from a Map with layer of Water Use unchecked.

To add the layer for the cities, just check the Checkbox against the layer and the feature appears in the map.

## 6.2.5 Layer Properties

Layer properties usually define the display and feature of a layer. All the aspects of the layers can be controlled through Layers properties. The properties of a layer can be updated and accessed through the layer Properties dialog box.

The properties set are different for different types of geographic data. For example, when designing 3D maps, additional properties, such as elevation of the layer from the surface are set.

To change these settings, select a layer in the **Table of Contents** pane, right-click on it and select properties. The **Layer properties** dialog box in Figure 6.18 appears.

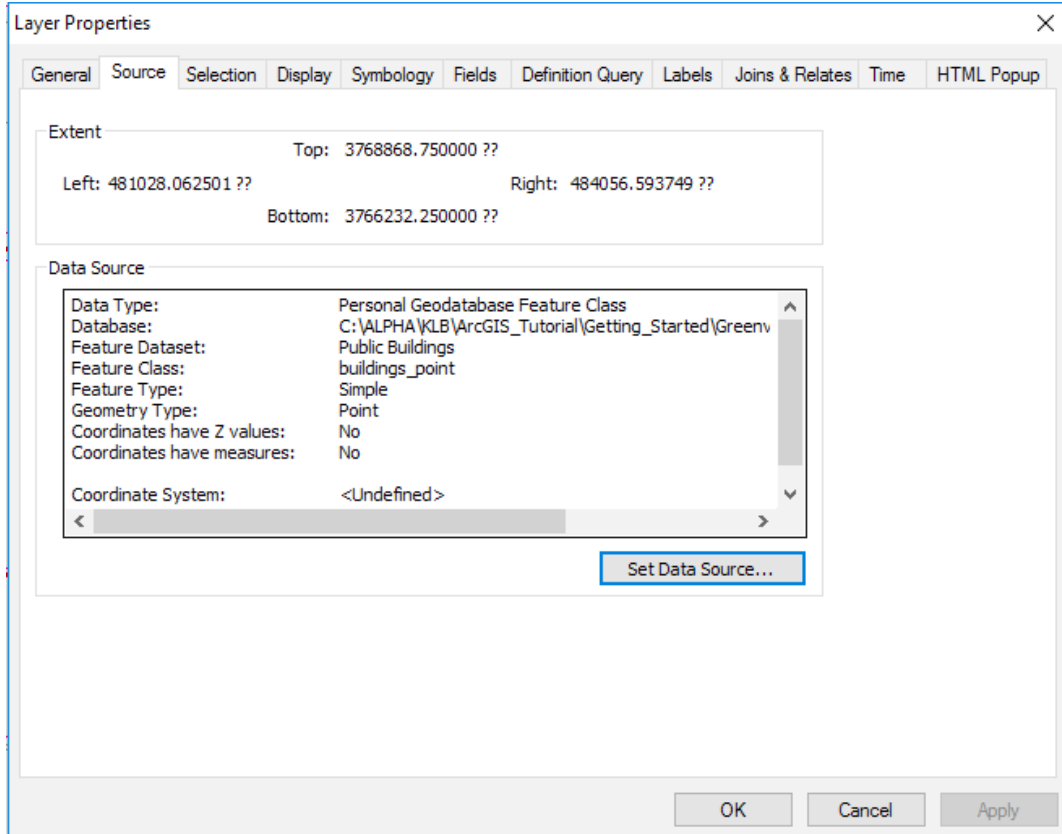


Figure 6.18: The Source tab in the Layer Properties dialog box.

The tabs on this dialog box are specific to the type of layer. The following are some of the properties for feature layers one can set using the **Layer Properties** dialog box. The tabs in the Layer Properties dialog box for Feature layers can be described briefly as follows:

- (i) **General**: This tab allows the recording of layer properties such as layer name, its description, and set credits. It also specifies scale-dependent drawing properties.
- (ii) **Source**: This tab allows viewing of the extent of the data. The source of the data can be viewed and changed from this tab.
- (iii) **Selection**: This tab allows the setting of how features in a specific layer are highlighted when they are selected. The symbol shape and color can be changed in this tab.
- (iv) **Display**: The tab is used for setting the symbol transparency, display field expressions, support hyperlinks using fields, and exclusion of features from the drawing.



- (v) **Symbology:** This tab provides options for assigning map symbols and rendering the data. The tab provides options for drawing all features with one symbol, using proportional symbols, using categories based on attribute values, the use of quantities, colour ramps, or charts based on attributes and the use of representation rules and symbols.

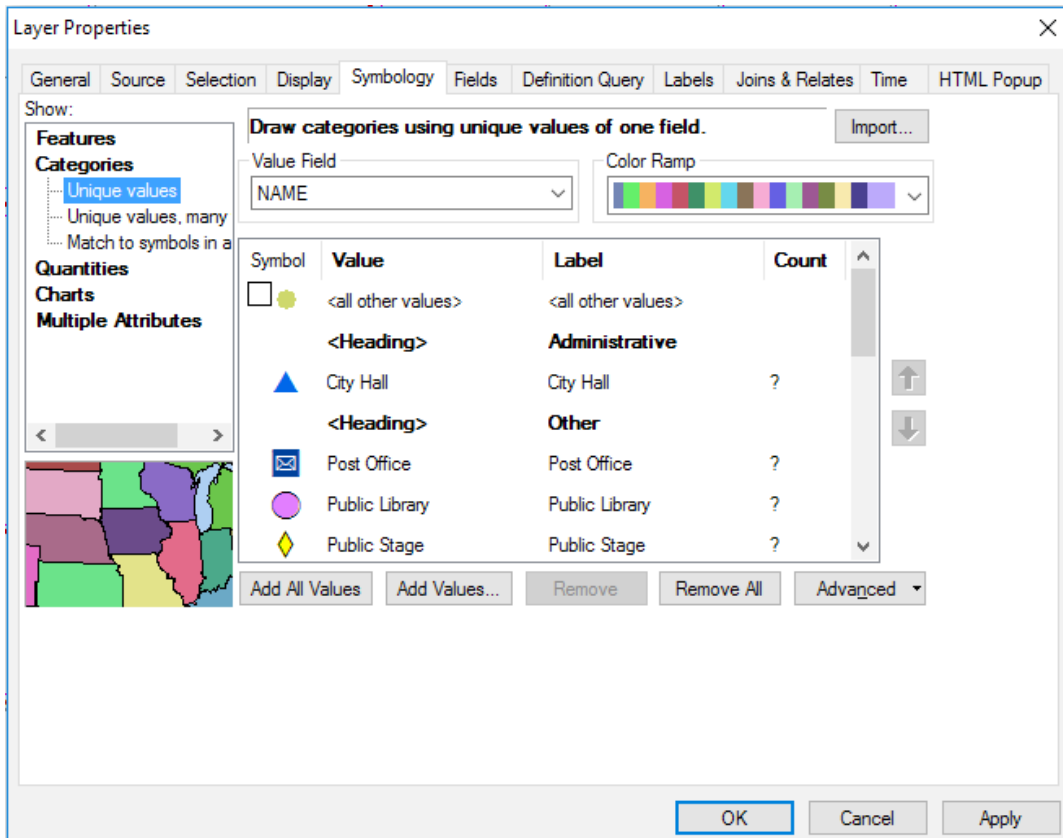


Figure 6.19: Symbology.

- (vi) **Fields:** The tab is used to set characteristics about attribute fields. Other options include creation of aliases. An important aspect is to set alias names for visible fields that make it easier for users to work with feature attributes. One can also format numbers, and make fields invisible.
- (vii) **Definition Query:** This tab allows one to specify that a subset of a feature is used in the layer. With the **Query Builder** dialog box, one can create an expression to select particular features of a dataset to be used in a layer.
- (viii) **Labels:** This tab allows one to turn on a layer's labels, build label expressions, manage label classes, and set up the labelling options for label placement and symbology. Alternatively, one can set labelling properties for all layers within the map using the **Label Manager**.
- (ix) **Joins and Relates:** This tab allows one to join or relate attribute tables to the layer's feature attribute table.

- (x) **Time:** This tab is used to specify the time properties of time-aware layers.
- (xi) **HTML Popup:** This tab is used to specify how pop-up lists are generated when you click a feature to display information about it.

When working with one symbol at a time, any of its properties can be changed and even restructured by adding or removing components.

When more than one symbol is selected, one can only change basic symbol properties, which vary based on symbol type as shown in the table below:

Symbol Type	Basic Property
Line	Line colour, width.
Polygon	Colour, Outline colour, Outline width.
Point	Colour, Size, Angle, Angle alignment, in the context of a 2D map only.

### Revision Activity 6.1

#### Part A: Fill in the dashes with the correct answers

1. A Layer in ArcMap is\_\_\_\_\_.
2. Data can be added into ArcMap using two different ways\_\_\_\_\_ and \_\_\_\_\_.
3. \_\_\_\_\_ method represents all features in a map using a common symbol.
4. The general tab in layer properties allows\_\_\_\_\_.
5. The basic properties of a line in a map are \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.

#### Part B: Read the following questions carefully and give the correct answers

1. Outline the steps followed in making maps.
2. What is symbology?
3. Differentiate between graduated colours and graduated symbols in maps.
4. Explain how a layer can be removed from a map.
5. Give three symbol types used in maps and give their basic properties.


**Part C: Read the following instructions carefully to be able to do this activity**

- (i) Open a shapefile in ArcMap.
- (ii) Identify the various layers used to construct the map.
- (iii) Remove a layer and note down the change in the map.
- (iv) Return the removed layer.
- (v) Change the shape and colour of the symbols representing the layer features.

## 6.3 Attribute Table

### 6.3.1 Adding a Field to a Table

Follow the following procedure to add a field to a table.

- (i) Click the **Add Data** button  and browse to the data to be added.
- (ii) Open the attribute table of this file by right clicking on the layer and choosing the **Open Attribute Table** from the drop down menu as shown in Figure 6.20. Note that when you let the cursor hover on the **Open Attribute Table** from the drop down menu, a **help tip** showing the keyboard shortcut appears as shown in Figure 6.21.

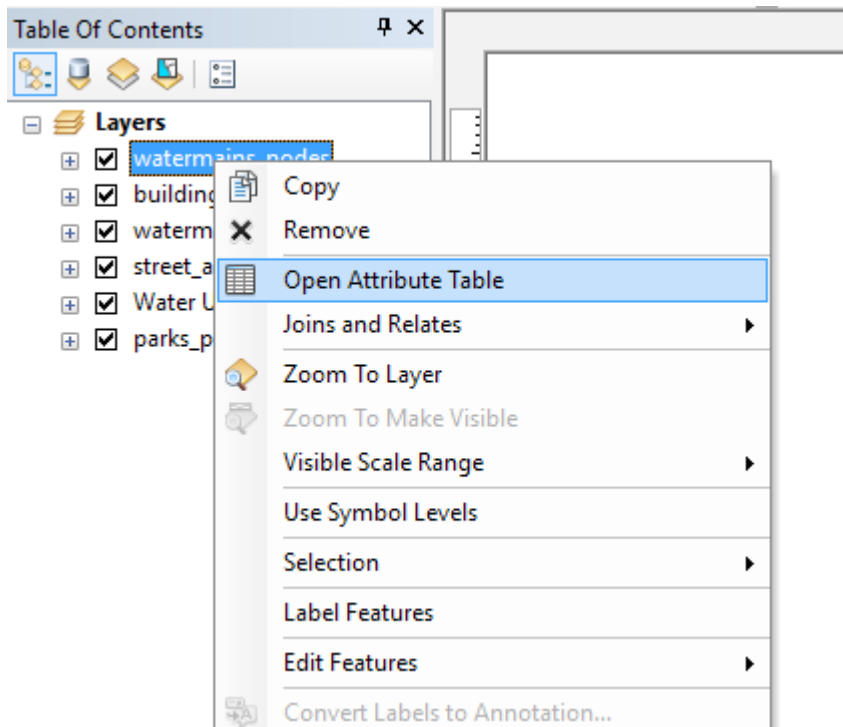


Figure 6.20: The window for opening the Attribute Table.

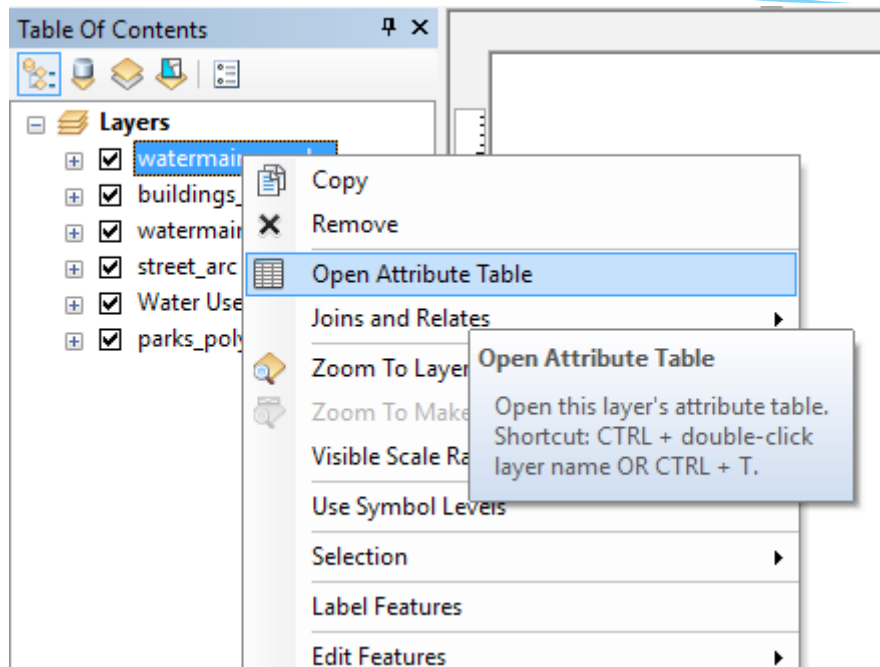


Figure 6.21: The window for opening attribute table showing the help tip.

- (iii) Once you click on **Open Attribute Table**, the window shown in Figure 6.22 appears. In the attribute table, click on the **Table Options** in the top left corner and choose Add Field.

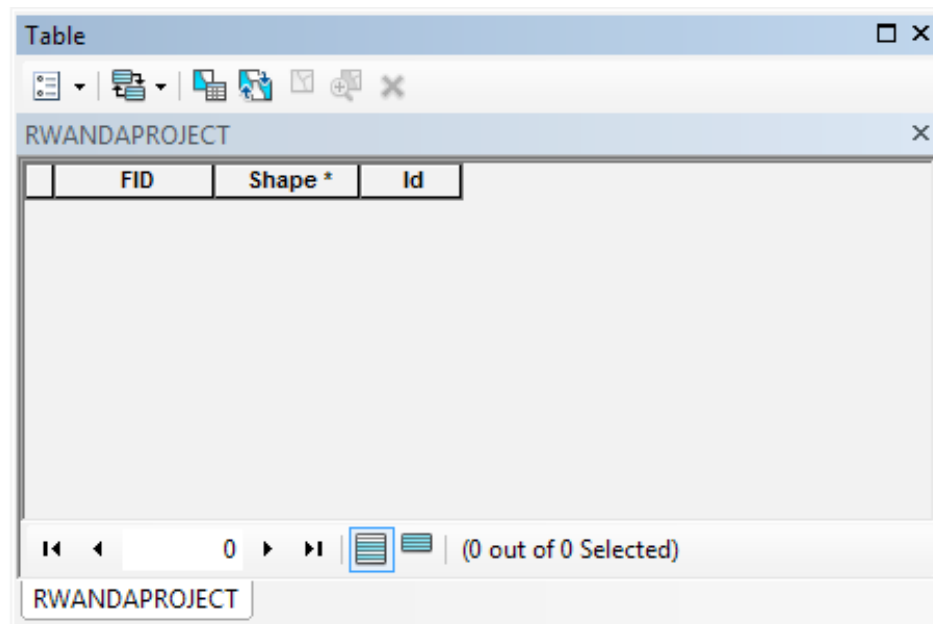


Figure 6.22: The Attribute Table

- (iv) To create a new field called **AREA1**, click on the **Table Options** in the top left corner and choose **Add Field**. Type in the name of the field (**AREA1**) and click **OK**. Figure 6.23 shows how a field is added.

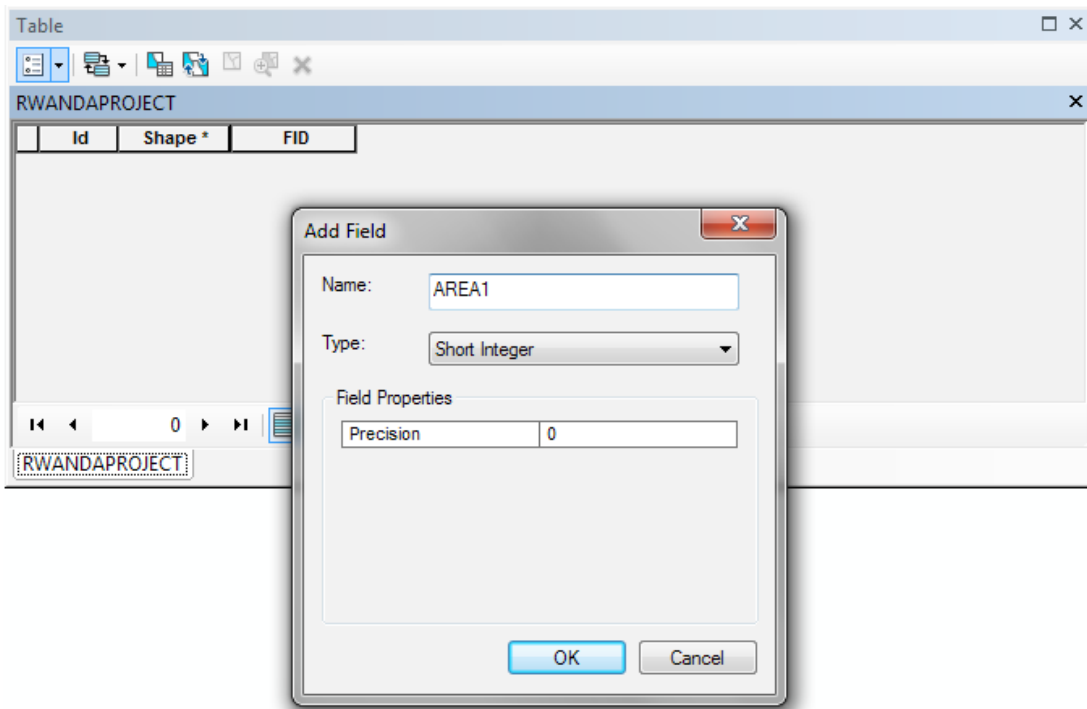


Figure 6.23: Adding a Field to a Table

**Field** is a column in an attribute table that contains information for each feature. Each row in a basic table contains the following:

- FID – Feature ID
- Shape – Point, Polyline, Polygon
- ID – initially 0 but can be reset by user

Field types can be:

- Integers (short or long)
- Decimal numbers (floats or doubles)
- Text
- Date
- Binary Large Objects (BLOB)
- Global Unique Identifier (GUID)

- (v) For the created field called **Area**, use a built-in function to populate this field. Right-click on the field name and choose **Calculate Geometry**.

- For the option to work, populate the values of the field to be geometric values derived from the features that the table represents such as area, perimeter, and length among others.
- The dialog box that appears lets one decide whether the records will be calculated or just the selected records.
- Note that when you let the cursor hover on the **Calculate Geometry** from the drop down menu, a **Help Tip** giving further details appears as shown in Figure 6.24.

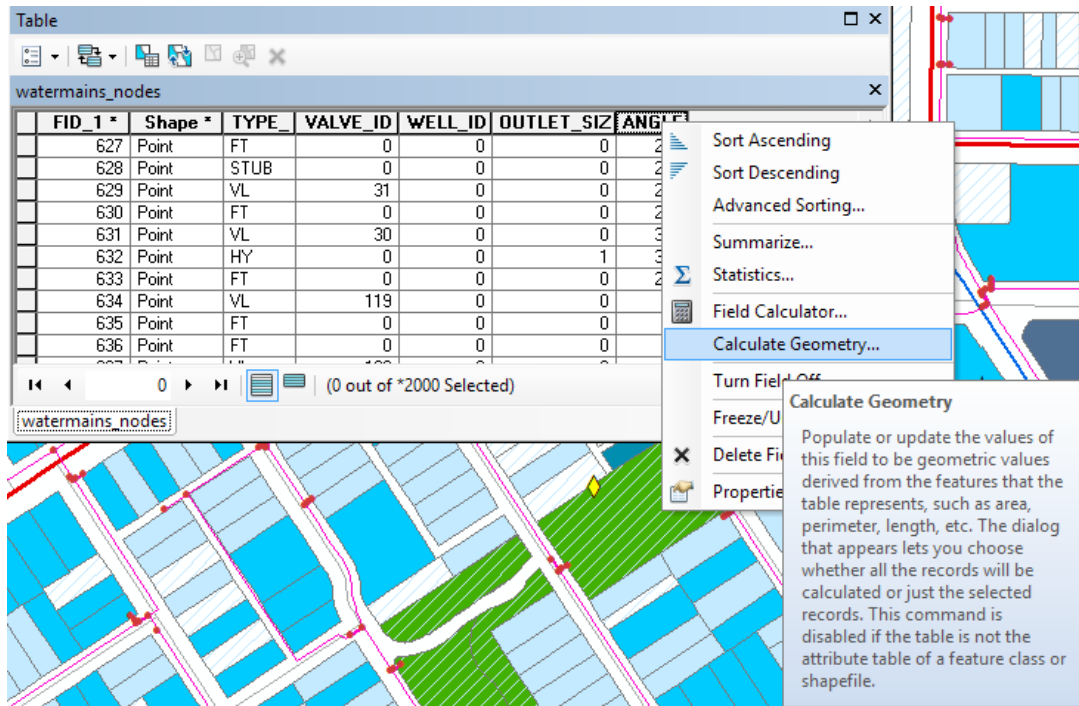


Figure 6.24: Selecting the calculate Geometry feature.

- Probably a warning about calculating outside of an edit session will appear. Click **Yes** to ignore it and continue.
- In the Calculate Geometry dialog box, the area will be calculated.

### 6.3.2 Sorting Records in Attribute Table

Sorting the rows in a table allows information about the contents to be derived more easily.

For example, if the information is about the population of a country in a particular period, after sorting a column's values in ascending order, the values are ordered from A to Z or from 1 to 10.

With descending order, a column's values are arranged from Z to A or from 10 to 1. To sort records:

- (i) Click the heading of the field column whose values are to be used for sorting.
- (ii) Right-click the selected field's heading and click **Sort Ascending** or **Sort Descending**. The drop down menu in Figure 6.25 will appear.

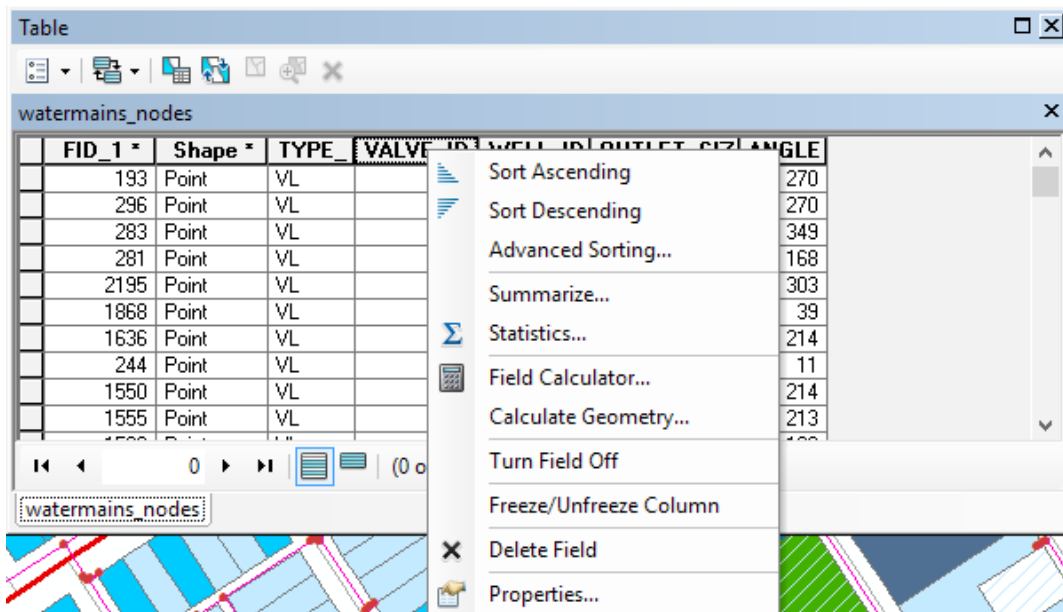


Figure 6.25: Sorting Records

Note that when you let the cursor hover on the Sort Ascending from the drop down menu, a Help Tip giving further details appears as shown in Figure 6.26 below.

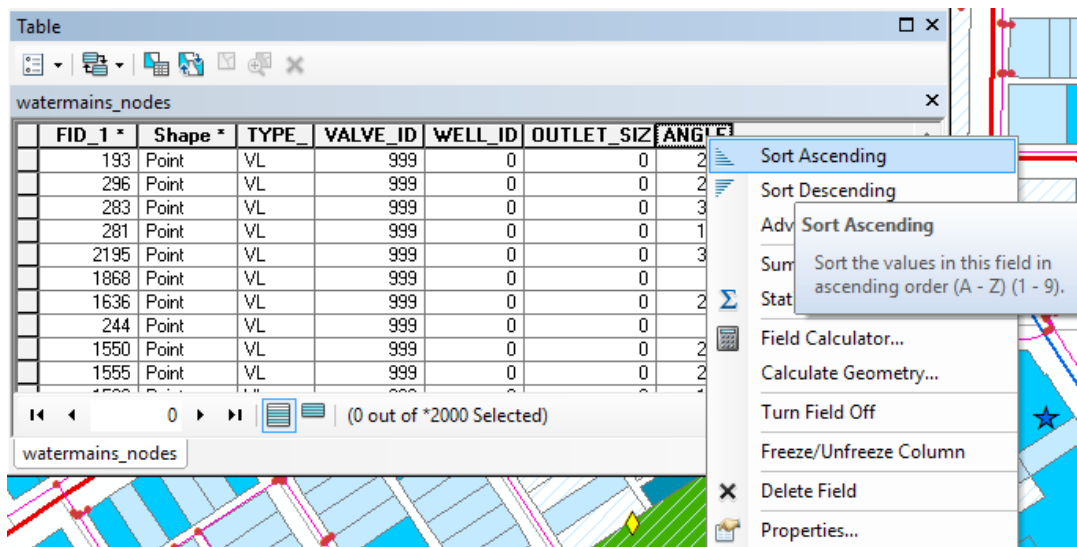


Figure 6.26: Sorting Records by Ascending Order.

- (iii) Sort the values in the field FID\_1 in ascending order (A–Z) (1–9). The data before and after sorting appears as shown in the Figure 6.27 below.

Before Sorting

FID_1 *	Shape *	TYPE_	VALVE_ID	WELL_ID	OUTLET_SIZ	ANGLE
193	Point	VL	999	0	0	270
296	Point	VL	999	0	0	270
283	Point	VL	999	0	0	349
281	Point	VL	999	0	0	168
2195	Point	VL	999	0	0	303
1868	Point	VL	999	0	0	39
1636	Point	VL	999	0	0	214
244	Point	VL	999	0	0	11
1550	Point	VL	999	0	0	214
1555	Point	VL	999	0	0	213

(0 out of \*2000 Selected)

After Sorting

FID_1 *	Shape *	TYPE_	VALVE_ID	WELL_ID	OUTLET_SIZ	ANGLE
214	Point	FT	0	0	0	270
215	Point	VL	136	0	0	0
216	Point	HY	0	0	2	0
217	Point	FT	0	0	0	270
218	Point	VL	164	0	0	0
219	Point	HY	0	0	5	0
220	Point	VL	6	0	0	270
221	Point	HY	0	0	2	180
222	Point	VL	117	0	0	180
223	Point	FT	0	0	0	270
224	Point	VL	173	0	0	270

(0 out of 2236 Selected)

Figure 6.27: Results after Sorting Record

### 6.3.3 Freezing and Unfreezing a Column

Freezing a column helps in showing how attributes for the same feature are related with respect to one or more key fields (that are frozen). When a column gets frozen, it is always displayed even when scrolling horizontally in the table. To freeze a column, do the following:

- (i) Click the heading of the column to freeze.
- (ii) Right-click the selected column's heading and click **Freeze/Unfreeze Column**. The column is frozen.



Figure 6.28 below shows the process of freezing the column named NAME.

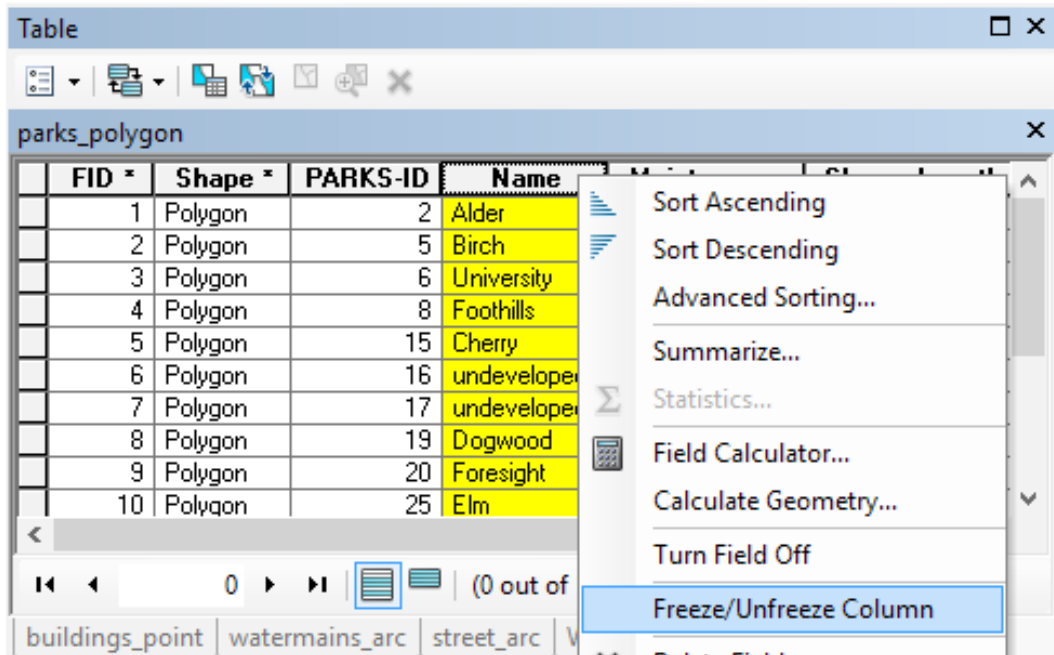


Figure 6.28: Freezing a Column

Figure 6.29 shows the same column after it has been frozen.

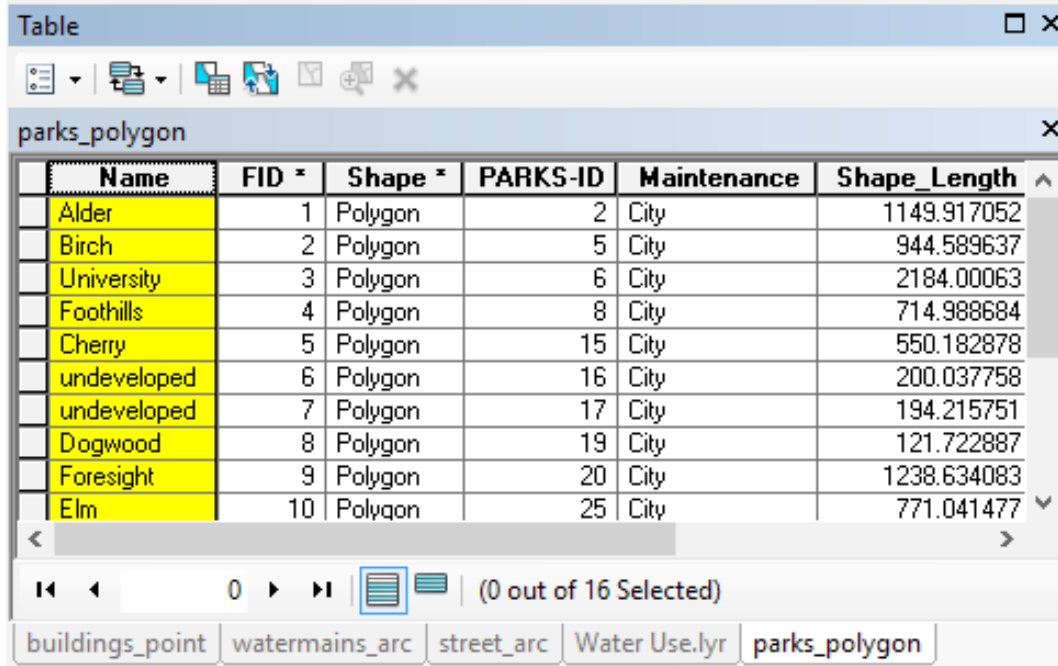


Figure 6.29: Frozen Column

- (iii) Right-click the column heading of the frozen column and click **Freeze/Unfreeze Column** to unfreeze the column.

## 6.4 Querying Data

A request that examines features or tabular attributes based on user-selected criteria and displays only those features or records that satisfy the criteria is called data querying.

Information about features can be retrieved in different ways. Features can be identified by clicking on them to display their attributes.


The user can find features by using known information about the feature in order to search the map for that particular feature.

There are different ways of retrieving information about features in ArcMap. The user can identify features by clicking on them in order to display their attributes.

Alternatively, the user can select features by clicking on them to highlight and then look them up from their records in the layer attribute table. The user can find features by using known information about the feature in order to search the map for that particular feature.

### 6.4.1 Identify

The **identify** tool offers a quick way of getting information about a single feature. To use the Identify tool, proceed as follows:

- (i) Select the Identify tool  from the Tools Toolbar.
- (ii) Within the map, click on the feature of interest in order to view the attribute information for that particular feature.

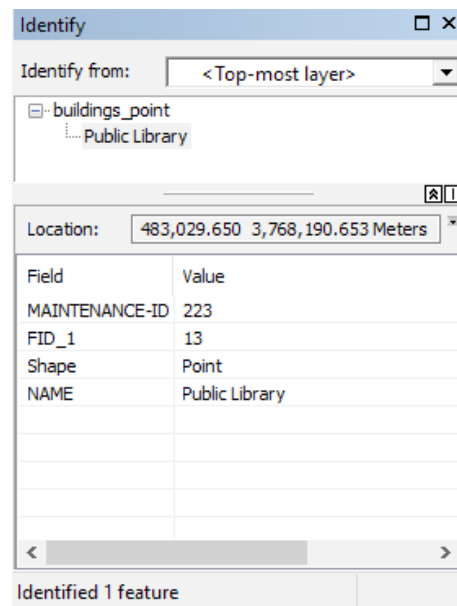


Figure 6.30: Using the Identify Tool

### 6.4.2 Measure


This tool allows distances, areas, and feature locations on a map or scene to be measured. One can draw a line to measure length, a polygon to measure area, or click an individual feature to get measurement information.

Once the user highlights what is to be measured, they click on the map. For example, to measure the distance of a line feature such as a river, the first click begins a line segment, and the next click ends that segment and begins another. Double-click to finish measuring.

One can measure any number of segments in a sequence. That means to measure the distance of the river as it meanders, click each point where the river curves to make a segment.

Downstream the next curve will require another click. A cumulative sum for the distance or area displays as part of the results. The results can be copied and pasted for use in other application.

To measure in a map;

- (i) Click the **Measure**  tool.
- (ii) Choose a measuring tool and click the map to begin measuring.
  - **Distance:** Click the map to measure the straight-line distance between two or more points. Figure 6.31 shows measuring of distance in a map.

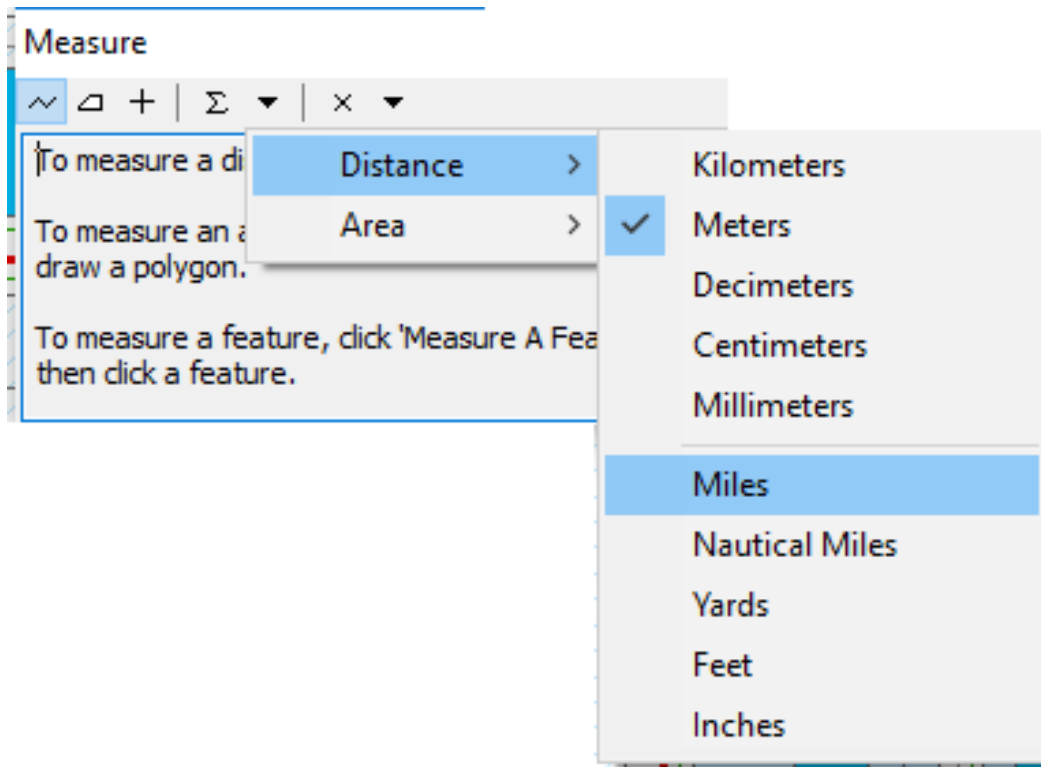


Figure 6.31: The Measure Dialogue Box.

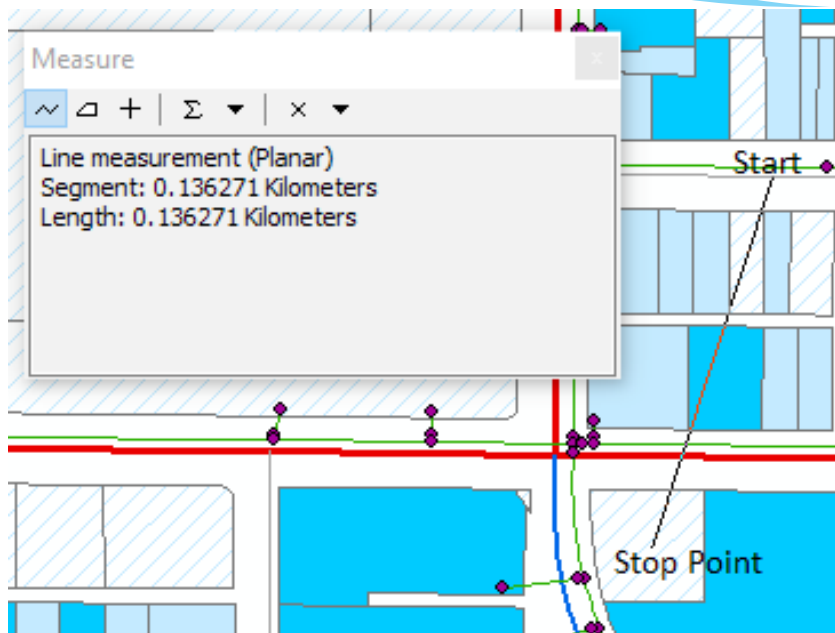


Figure 6.32: Measuring Distance

- Area:** Select the tool for measuring area. Click the map to measure the area of a given locality, for example, a forested area. Identify the starting point on the map, and then successively keep clicking along the edges of the area to be measured until the starting point. The dimensions of the polygon shape will be displayed. Figure 6.33 shows measuring of an area in a map.

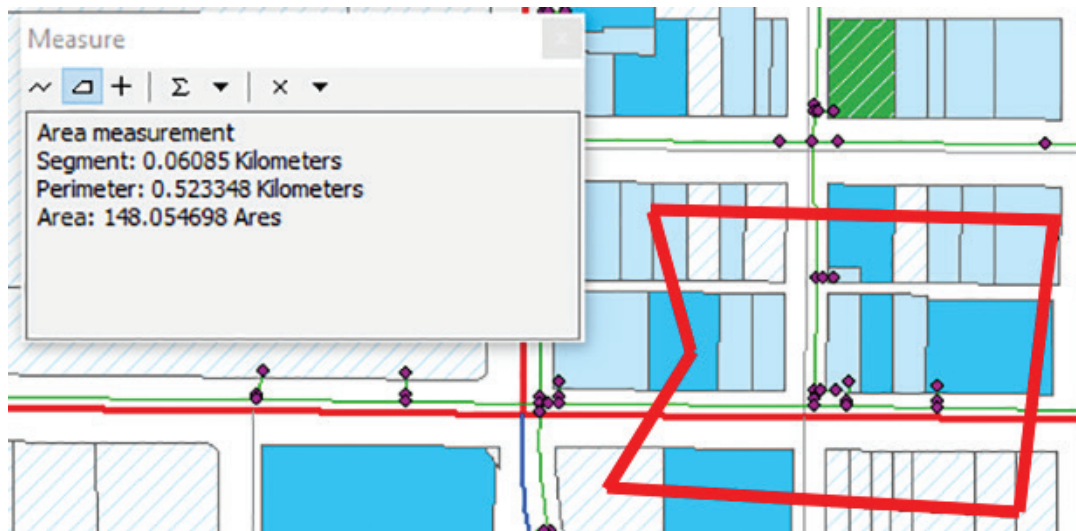


Figure 6.33: Measuring Area in a Map

### 6.4.3 Go to XY

This tool is used for typing in XY coordinates of a location and navigating to them. The coordinates entered can be:

- (i) **Longitude-Latitude:** This is giving the Global Positioning System (GPS) of a given location.
- (ii) **Values** in the map document's coordinate system. These refer to the values of the given location.
- (iii) **Military Grid Reference System (MGRS) coordinates:** The military grid reference system (MGRS) is the geocoordinate standard used by NATO militaries for locating points on the earth.
- (iv) **Universal Transverse Mercator (UTM) coordinate notation:** This is a system that uses a two-dimensional Cartesian coordinate system to give locations on the surface of the Earth. The MGRS is derived from the Universal Transverse Mercator (UTM) grid system.

On the tools toolbar, click the **Go To XY** button  to open the **Go To XY** dialog box, which is shown in Figure 6.34.

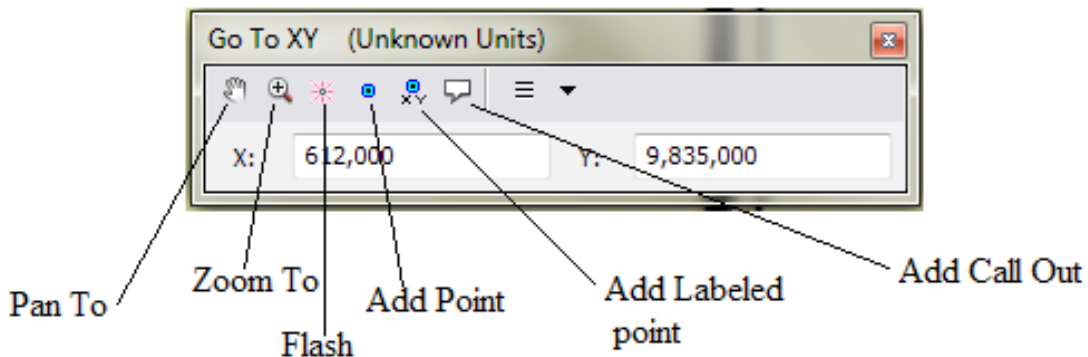


Figure 6.34: Go To XY dialogue Box.

The dialogue box can be used to pan to, zoom to, flash or add call out to a location. Figure 6.35 below is showing a point with coordinates X (612,000) and Y (9,835,000) having a call out.

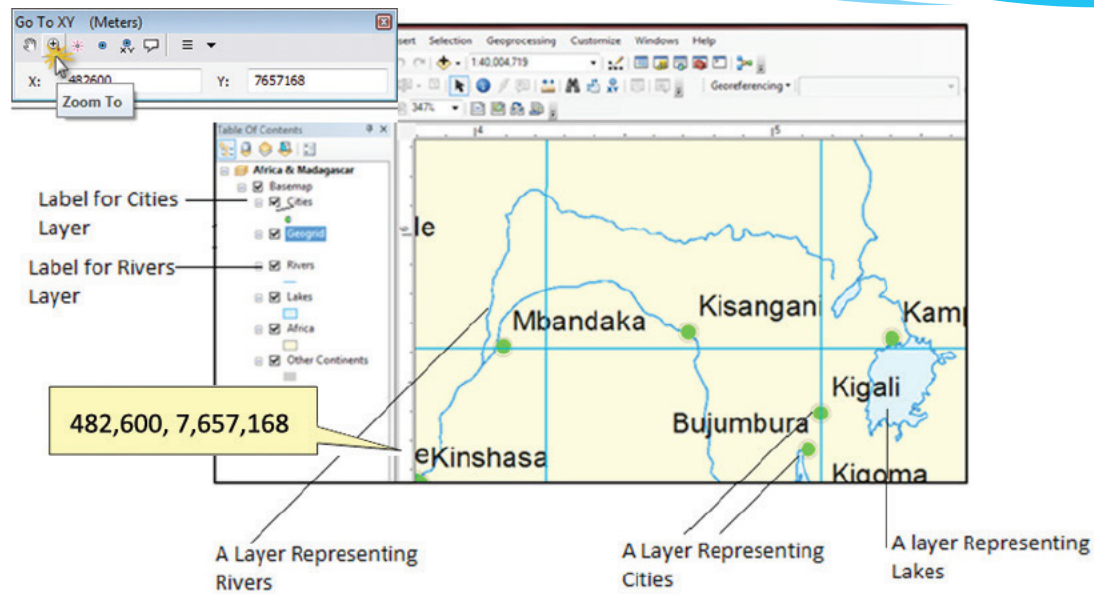


Figure 6.35: A location with XY coordinates

#### 6.4.4 Hyperlink

Hyperlinks allow access to documents or web pages related to features. These hyperlinks can be accessed for each feature using the **Hyperlink tool** on the Toolbar.

Hyperlinks have to be defined before using the Hyperlink tool. Hyperlinks are usually of three types:

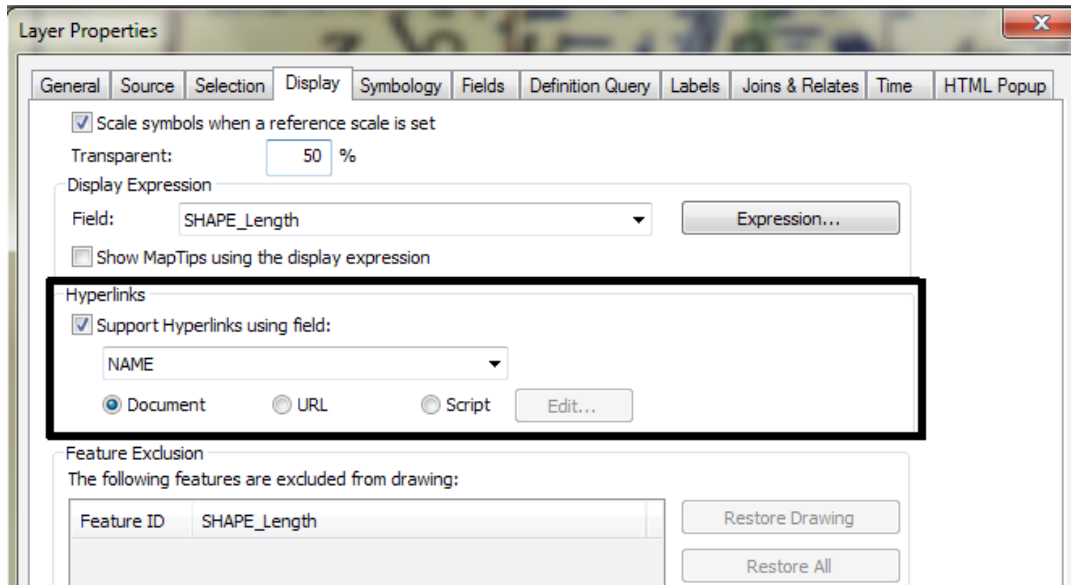
- (i) **Document:** Clicking a feature with the Hyperlink tool opens a document or file using its appropriate application (such as Microsoft Excel). For example, on selecting a hyperlinked feature such as a school, a linked Microsoft Word document pops up to provide more information on the school.
- (ii) **Universal Resource Locator (URL):** On clicking a feature with the Hyperlink tool, a web page is launched in the web browser. For example, when a hyperlinked feature like the Kigali Genocide Memorial Centre is selected with the hyperlink tool, a linked website pops up to give more details about the centre.
- (iii) **Script:** On clicking a feature with the Hyperlink tool, a feature value is sent to a script.

Hyperlink for a feature can be defined in a layer either by using field-based hyperlinks or by defining a dynamic hyperlink using the Identify tool.

To define field-based hyperlink properties:

- (i) Right-click the layer for which the hyperlink properties are to be set and choose Properties.

- (ii) Select the Display tab on the Layer Properties dialog box.
- (iii) Check **Support Hyperlinks using field**. Figure 6.36 below show the dialogue box.



*Figure 6.36: Setting Hyperlink Properties*

The hyperlink field has to be set up before specifying hyperlinks in this dialog box.

For example, if a particular web page needs to be launched whenever a feature is clicked with the Hyperlink tool, first add a text field to the attribute table of this layer to contain the URLs associated with each feature.

Then in the dialog box, check the **Hyperlink** option, choose the field from the drop-down list of fields, and choose the URL radio button option.

The values of the field chosen to provide hyperlinks can include the full path to the target document or the full URL of the target web page.

Alternatively, the value may just contain the name of the target document or web page, and one can use the **Hyperlink Base** property to specify the path or URL where the target can be found. Omit the "(http://)" part of the URL.

If a protocol different from http is to be used, then it must be included in the protocol at the beginning of the URL.

- (iv) Select the field name you wish to use for the hyperlink and the link type, either document, URL, or Script.
- (v) If you choose to use Script, use the **Edit** button to write your script using JScript or VBScript. Click **OK**.
- (vi) Click **OK** or **Apply** on the **Layer Properties** dialog box.

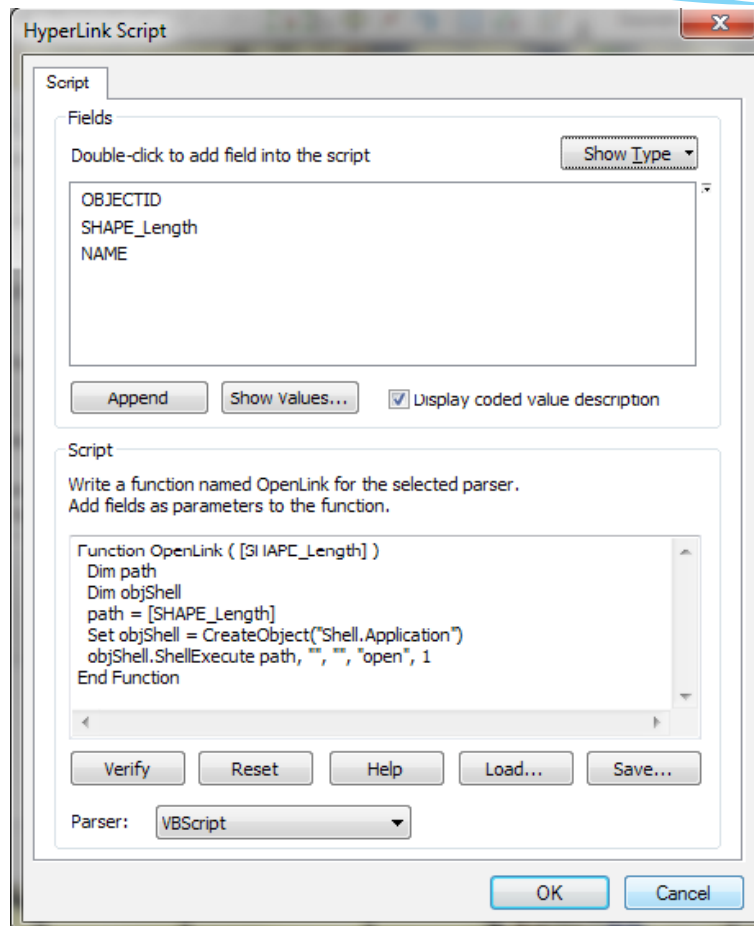


Fig. 6.37: Hyper Link Script Dialogue Box

**Note:**

- (a) The dialog box allows building of a script that will launch a hyperlink. The script should be coded using the rules of the scripting language selected in the Parser drop-down list. The script can include any valid statements supported by the selected scripting language.
- (b) Fields are enclosed in square brackets [ ], irrespective of the data type of the layer's data source.
- (c) The hyperlink script is written as a function, which can contain programming logic and multiple lines of code.
- (d) The default functions utilise the **ShellExecute** function, which is part of the MSDN library.
  - Microsoft ShellExecute Function Reference
  - Microsoft VBScript Language Reference




- Microsoft JScript Language Reference
  - Python Language Reference
- (e) Click **OK** or **Apply** on the **Layer Properties** dialog box.  
You can define a hyperlink for the features in a layer either by using field-based hyperlinks or defining a dynamic hyperlink using the Identify tool.

A hyperlink can be added to a feature using **Identify** tool. To define field-based hyperlink properties, do the following:

- Right-click the layer for which you want to set hyperlink properties and choose **Properties**.
- Select the **Display** tab on the **Layer Properties** dialog box.
- Check **Support Hyperlinks** using field.

Alternatively, you can also add a hyperlink as follows:

- Click the **Identify** tool  on the **Tools** toolbar.
- Click the feature for which you want to define a hyperlink.
- Right-click the feature in the **Identify** window and click **Add Hyperlink**.
- Specify the desired hyperlink target. Suppose we want to hyperlink the Public Library, we click on it with the Identify tool as shown in Figure 6.38.

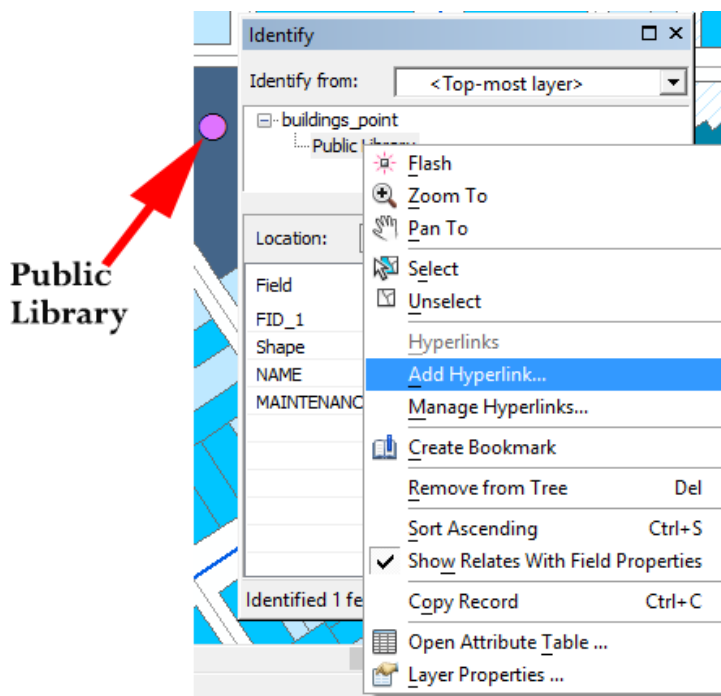
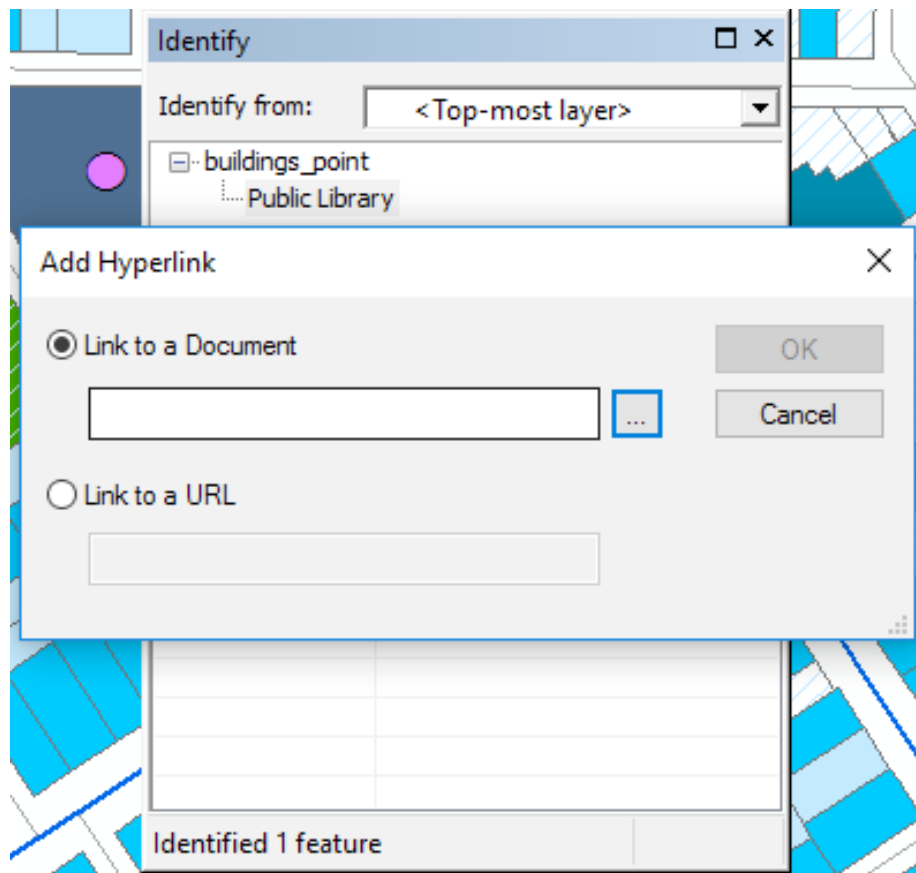


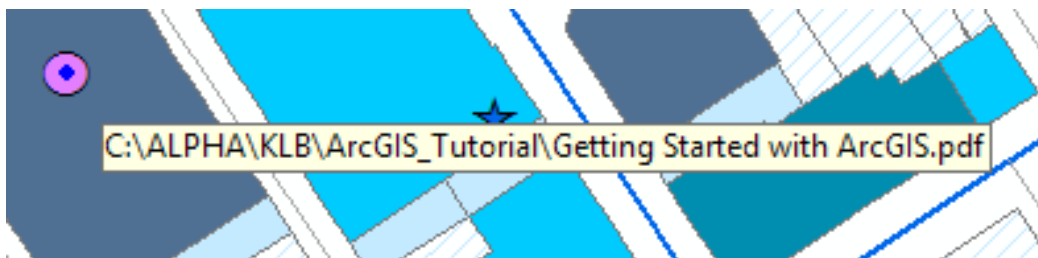
Figure 6.38: Adding Hyperlink using the Identify Tool

- (v) On clicking Add the Hyperlink, the dialogue box shown in Figure 6.39 below appears.




*Figure 6.39: Hyperlinking a Document or URL*

- (vi) Browse to link the document or type the URL and then click OK.  
(vii) To access the linked document, using the hyperlink tool, click on the feature; that is, Public library. The linked document opens. Moving the hyperlink tool over the feature displays the name of the linked document as shown in Figure 6.40.



*Figure 6.40: Displayed name of the hyperlinked document.*

### 6.4.5 Select Features

The Select Feature tool  allows the selection of features based on various categories relative to other features. Figure 6.41 below is showing the different options selections can be performed.

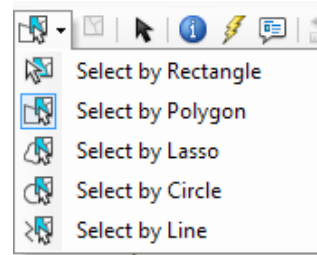


Figure 6.41: Different Select Options

#### For example:

If the number of schools within a certain area is to be found, and the area is mapped by a boundary, all the schools within that area can be selected.

To find all the students who live within a 10-kilometre radius of the school and who made a recent improvement in their academic performance so as to give awards, proceed as follows:

- (i) First select the students within this radius (select by location).
- (ii) Refine the selection by finding those students who have made a recent improvement according to the recently released results.

The example of the selection given above is known as **select by attribute**. The attributes in the above example are students selected by:

- Living within a 10-kilometre radius of the school.
- Made improvement in their academic performance.

### 6.4.6 Spatial Thinking Techniques

Spatial thinking is about how we think about and understand our environment. A spatial thinker visualises and understands his or her environment from various angles. We apply spatial thinking when we create representations such as maps.

#### Revision Activity 6.2

##### Part A: Fill in the dashes with the correct answers

1. A field in an attribute table is \_\_\_\_\_.
2. Freezing a column helps in \_\_\_\_\_.
3. The Measure tool is used for \_\_\_\_\_.
4. Hyperlinks are used to \_\_\_\_\_.
5. Questions used to perform selections based on a single feature are known as \_\_\_\_\_.

**Part B: Read the following questions carefully and give the correct answers**

1. Practise the steps that are followed in order to put hyperlink using the Identify tool.
2. Hyperlinks have to be defined before using the Hyperlink tool. Give the three types of hyperlink definitions.
3. How can one insert a call out in a map?
4. Give the procedure for sorting data in ascending order in a table.
5. Give the different types of data in a field.

**Part C: Read the instructions given below carefully in order to answer the questions accurately**

Your teacher will provide you with some geographic data (a map). Divide yourselves into groups of five, and perform the following tasks with the assistance of the teacher.

- |   |                             |
|---|-----------------------------|
| (i) Create a map.                       | (ii) Display a layer.       |
| (iii) Add and remove labels of a layer. | (iv) Add fields to a table. |
| (v) Sort records in attribute table.    | (vii) Create hyperlinks.    |
| (vi) Freeze and unfreeze a column.      |                             |

**Part D: Follow the instructions given below carefully**

Open the ArcGIS tutorial data in ArcCatalog. Using the Greenvalley data perform the following:

- (a) Open the Greenvalley map. Add more features to the following features to the Building \_point administrative layer and insert have their appropriate unique symbols.
  - (i) Church/mosque/Temple (Give it your local name )
  - (ii) Restaurant (Give it your favorite Hotel Name in Kigali )
  - (iii) Kigali International Airport.

Ensure the names of the features are displayed in the map.

- (b) Change the symbology of the roads into graduated symbols.
- (c) Add the following layers from the database
  - (i) Water use
  - (ii) Water mains arc
  - (iii) Water mains nodes.
- (d) Save your work.

## 6.6 Definition of Key Words in this Unit

Find out the meaning of the words given below. Share your findings with the rest of the students in a class presentation. Check the meanings you find against those provided in the glossary at the end of this course book:

Legends

Database

Geospatial data

Symbology

Graduated colours

Graduated symbols

Attribute Table

Layers

### Revision Exercise 6

1. Outline the general steps followed when creating maps.
2. Give the two different ways of adding data into ArcMap.
3. Explain the steps followed when performing Georeferencing.
4. Briefly give the steps followed when adding features to a feature class.
5. Outline the steps followed to display the name of a feature on the map, after the name has been entered into the attribute table.
6. Symbols can be applied in layers in different ways. Explain four different ways in which this can be achieved.
7. The Layer Properties dialog box has several tabs. Explain the function of the General tab, Selection tab, and Symbology tab.
8. Give the steps followed when measuring the area covered by Nyungwe Forest National Park.
9. The **Go To XY** tool works with different coordinate systems. Give some of the common systems its uses.
10. Hyperlink for a certain feature can be defined in a layer in two different ways. Give the two ways.

## Unit 7



# Complex Formulae and Functions

**Key Unit Competency: By the end of this unit, you should be able to:**

1. Work with spreadsheets to apply complex formulas and functions recognising the order of operations.
2. Apply conditional formatting to the content of a worksheet.
3. Use absolute and relative referencing.

### Introduction

Spreadsheets are programmed in such a way that they can accept different formulas and functions. Formulas may comprise a combination of actual values, cell references, functions and mathematical operators. When the correct formula is typed in the formula bar, the result of the formula appears in the active cell.

### 7.1 Predefined Operators and Symbols in Microsoft Excel

Some predefined operators used in excel include: addition, subtraction, multiplication and division operators which have been discussed in Unit 4. The symbols used include:

Name	Symbols	Function
Percentage	%	Obtain the percentages of values.
Opening Parenthesis or Brackets	(	Marks the beginning of parenthesis
Closing Parenthesis or Closing Brackets	)	Marks the ending of parenthesis.
Colon	:	Used as a separator between two cell references to define a range.
Dollar sign	\$	Used to fix cell reference.
Comma	,	Used as a separator between two cell references.

Name	Symbols	Function
Equal Sign	=	Begins a formula.
Quotation marks	“ ”	Specify criteria.
Exponential	^	Raises a number to a certain power.
At sign	@	Used as equal sign, but with functions only.

## 7.2 Complex Formulas

In Unit 4, we discussed how to create simple formula involving a single operator. Excel has a provision of using complex formula.

They are written using more than one operator. Example of a complex formula is  $= (B2 + B3)/2$  written in cell B5. In this case, the operators used are addition and division.

### Creating Complex Formulas

The following are the steps followed when creating complex formulas.

- (i) Click the cell where the result of the formula is to be displayed such as B5.
- (ii) Type the equal sign.
- (iii) Type an opening parenthesis.
- (iv) Click on the first cell to be included in the formula or type the cell address such as B2.
- (v) Type the mathematical operator such as (+).
- (vi) Click on the second cell in the formula or type the cell address such as B3.
- (vii) Type a closing parenthesis.
- (viii) Type the next mathematical operator such as (/).
- (ix) Type the next cell address or value such as 2.
- (x) Press **Enter**, or click the **Enter button** on the Formula bar to end the formula.

For example, figure 7.1 on page 188 shows the formula  $=(B35+B36)/2$  entered in cell B38.

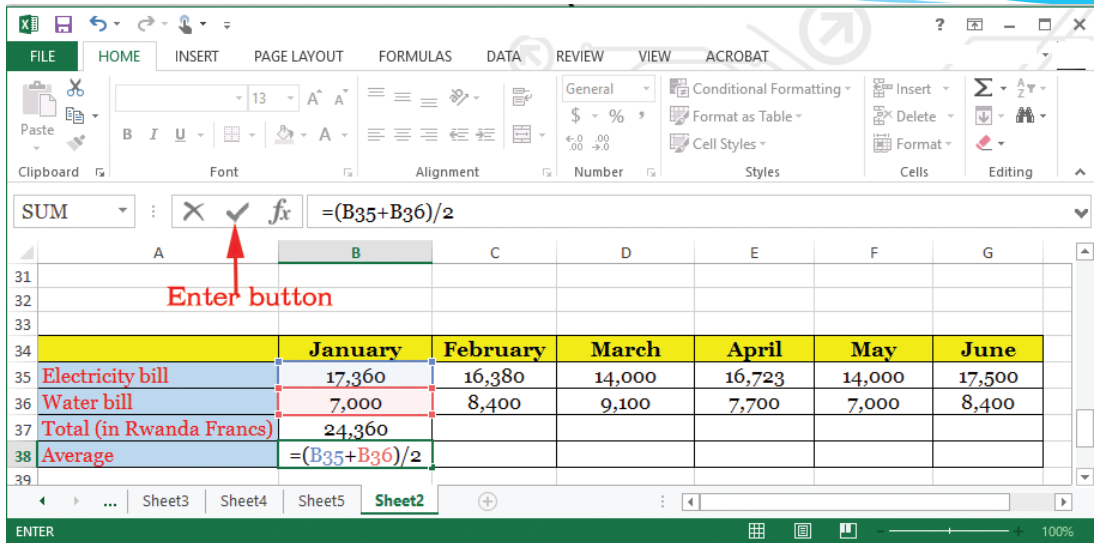


Figure 7.1: The formula for computing the average bill for January

### 7.3 Cell References

They are also known as **cell addresses**. Cell address consists of a column letter and row number. They are used in formulas. There are three types of cell references, namely relative, absolute, and mixed cell references.

- (i) **Relative cell reference:** This type of reference automatically changes the cell addresses of a formula relative to the position of the cell where it is copied. For example, if the formula  $=A1+B1+C1$  is written in cell D1 then copied to cell F1, the formula becomes  $=C1+D1+E1$ . It is the default cell referencing style used in excel anytime a formula is entered.

#### Practice Activity 7.1

Type the formula  $=A1+A2+A3+A4$  in cell A5.

Copy it from cell A5 to cell B5.

The copied formula will be as follows in cell B5

$$=B1+ B2 + B3 + B4$$

- (ii) **Absolute cell reference:** In this type of reference, the formula remains the same regardless of where it is copied. To make a cell absolute, type dollar signs before the column letter and the row number. For example,  $\$A\$1$  is an absolute cell reference of cell A1. If the formula  $=(\$A\$1*\$B\$1)$  is written in cell C1 then copied to G1, it remains  $=(\$A\$1*\$B\$1)$ .



### Practice Activity 7.2

Type the formula  $=A\$1+A\$2+A\$3+A\$4$  in cell A5.

Copy it from cell A5 to cell B5.

The copied formula will be as follows in cell B5.

$=A\$1 + A\$2 + A\$3 + A\$4$

Notice that although the formula has been copied it has not changed.

- (iii) **Mixed cell reference:** It is a type of reference that combines both relative and absolute cell reference. To apply this reference, the \$ sign appears on the column letter or row number in the cell reference but not on both. The row could be made absolute while the column is relative or vice versa. For example: Table 7.1 shows some examples of cell references together with an explanation of each.

### Practice Activity 7.3

Type the formula  $=A\$1$  in cell A5.

Copy it from cell A5 to cell B5.

The copied formula will be as follows in cell B5.

$=B\$1$

Notice that A changes to B but 1 remains the same.

Mixed cell reference	Explanation
\$A1	The column is absolute while the row is relative.
A\$1	The row is absolute while the column is relative.
\$A\$1 + B2	\$A\$1 is absolute while B2 is relative.

Table 7.1: Mixed cell references and their explanation

If any of these references are written in cell E2 then copied to cell G2 the formula would become:

E2	G2
$=A1$	$=A1$
$=A\$1$	$=C\$1$
$=A\$1 + B2$	$=A\$1 + D2$

Table 7.2: Example of mixed cell references

### Practice Activity 7.4

Open MS Excel type and copy the following formulas as indicated in the table below.

	Formula	Formula typed in cell	Formula copied in cell	Formula in the copied cell
1	=A2+ A3 + A4	A5	B5	=B2+B3+B4
2	=A2*\$A\$10	A6	B6	
3	=\$A\$2/4	A7	B6	

## 7.4 Cell References of another Worksheet

In Spreadsheets, it is possible to refer to a cell in another worksheet. Information can also be copied from a worksheet then pasted to another.

### 7.4.1 Copy Paste Option

To copy data from one worksheet to another, do the following:

- Highlight the data to be copied.
- Click **Home** tab, select **Copy** command from the **Clipboard** group.
- Click on the name of the sheet where the data is to be copied, for example, Sheet1.
- Click on the position where the data is to be copied.
- Click **Home** tab, select **Paste** command from the **Clipboard** group.

When a formula is copied to another worksheet, relative cell referencing is applied. To prevent adjusting the cell references in a formula automatically, do the following:

- Select the range of cells to be copied.
- Click **Home** tab from the menu, select the **Find & Select** icon in the **Editing** group. A drop down menu appears.
- Select **Replace** command from the drop down menu that appears. The **Find and Replace** dialog box appears as shown in Figure 7.2.

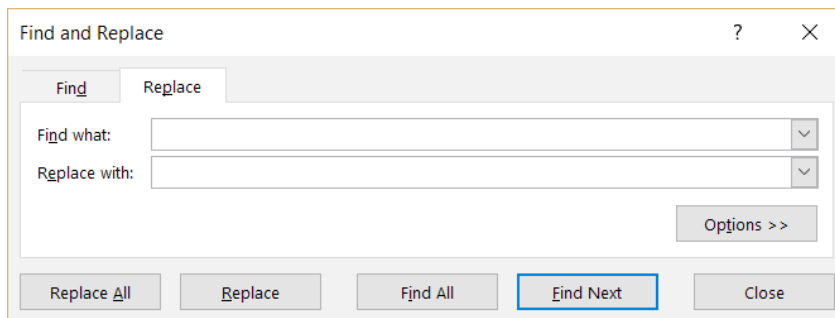


Figure 7.2: Find and replace dialog box

- (iv) In the **Find What** box type "=", and in the **Replace With** box type "#".
- (v) Click **Replace All**, to replace all occurrence of "=" with "#" in the range then close the dialog box. The formula is changed to a label. For example "=A1\*B1" becomes "#A1\*B1".
- (vi) Copy and paste the formula to the desired location in another worksheet.
- (vii) To change it back to formula, simply replace all occurrence "#" with "=".

### Copying formula

Once a formula is entered in a cell, it can be copied to other cells within the worksheet. When a formula is copied, the cell references are automatically adjusted depending on the type of reference used in the original formula. To copy a formula, do the following:

- (i) Click on the cell that contains the formula.
- (ii) Move the cursor to the fill handle of the cell selector. Ensure that the cursor changes to a plus sign.

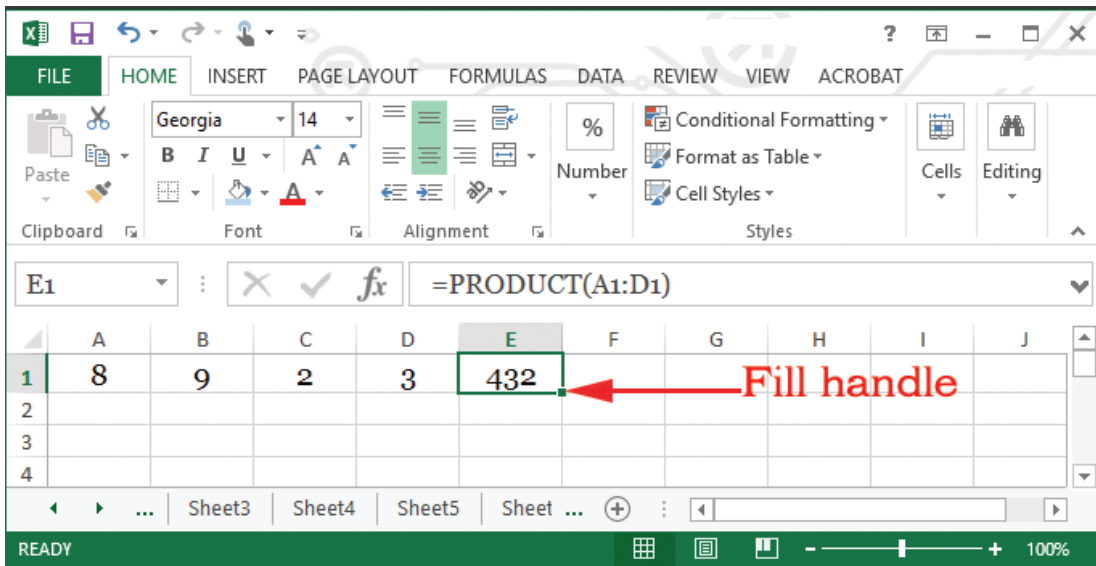


Figure 7.3: Copying a formula to the desired location

- (iii) Click and drag the cursor either across the row or column. Release the button once all the cells where the formula is to be copied are selected.

### Practice Activity 7.5

Figure 7.4 shows an extract from a Microsoft Excel worksheet. Use it to answer the questions (i) to (iii).

- (i) Open a Microsoft Excel program and type the data as it appears in the figure.

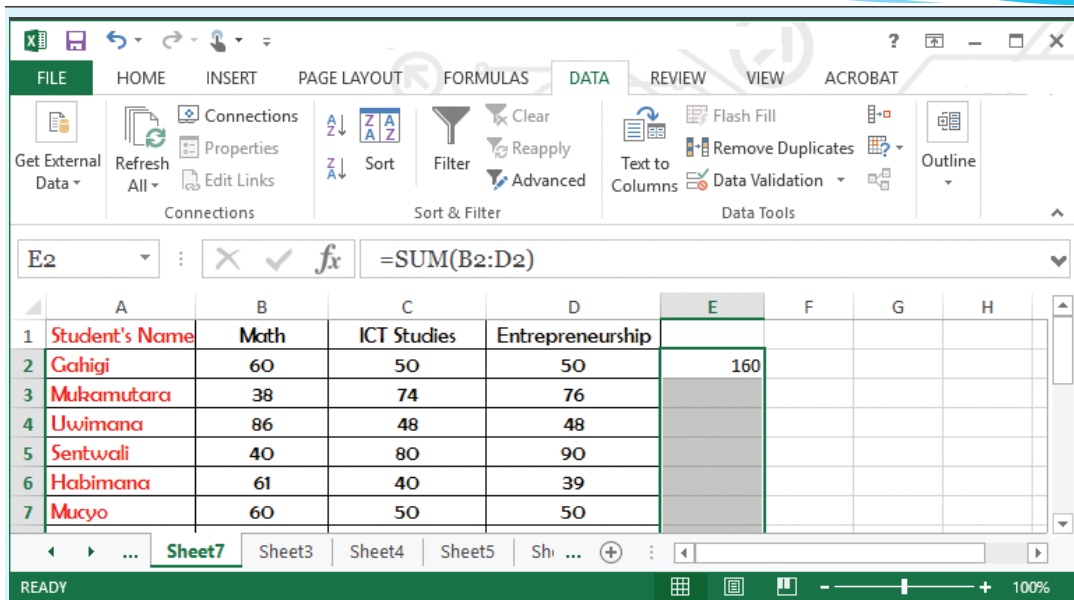


Figure 7.4: An extract from a spreadsheet showing selection of cells

- (ii) Using the SUM Function, compute the total for Gahigi.
- (iii) Copy the formula in cell 2E to cells E3 through to E7.

**Note:** The formula can also be copied by right-clicking on it then selecting **Copy** command from the pop-up menu that appears. Right-click on the cell where the data is to be copied, then select **Paste**.

#### 7.4.2 Sheet Reference

Instead of the copy paste option, the user can decide to write a formula to reference a specific value from another worksheet.

#### Practice Activity 7.6

To reference to data in another worksheet, do the following:

- (i) Click the destination worksheet tab then select the cell where the formula is to be entered.
- (ii) Type equal sign (=).
- (iii) Click the tab for the original worksheet.
- (iv) Hold down the **SHIFT** key and click the tab for the destination worksheet to be referenced.
- (v) Select the cell desired.
- (vi) Press **ENTER** key.

Alternatively, type the formula by beginning with the equal sign then sheet name then exclamation mark (!) and then the cell reference such as E14, for example, =Sheet1!E14: Sheet1 is the name of the sheet where the data is being obtained from.

### Practice Activity 7.7

- Assuming that in a secondary school there are three departments, namely Mathematics, Science, and ICT Studies.
- Each department has its own expenditure with the total expenditure computed.
- Information regarding the three departments is typed on a different worksheet.

#### Required

- Prepare a worksheet that contains the total expenditure for each department and then compute the grand total expenditure.
- Use the sheet referencing method.

Figures 7.5 to 7.9 show different worksheets and the formula when content is copied to a different worksheet.

	A	B	C	D	E	F	G
1		<i>Worksheet 1</i>					
2		<b>Expenditure for Mathematics Department</b>					
3	1	Textbooks	20,000				
4	2	Exercise books	15,000				
5	3	Geometrical sets	10,000				
6		Total	45,000				

Figure 7.5: Data entered in Worksheet 1

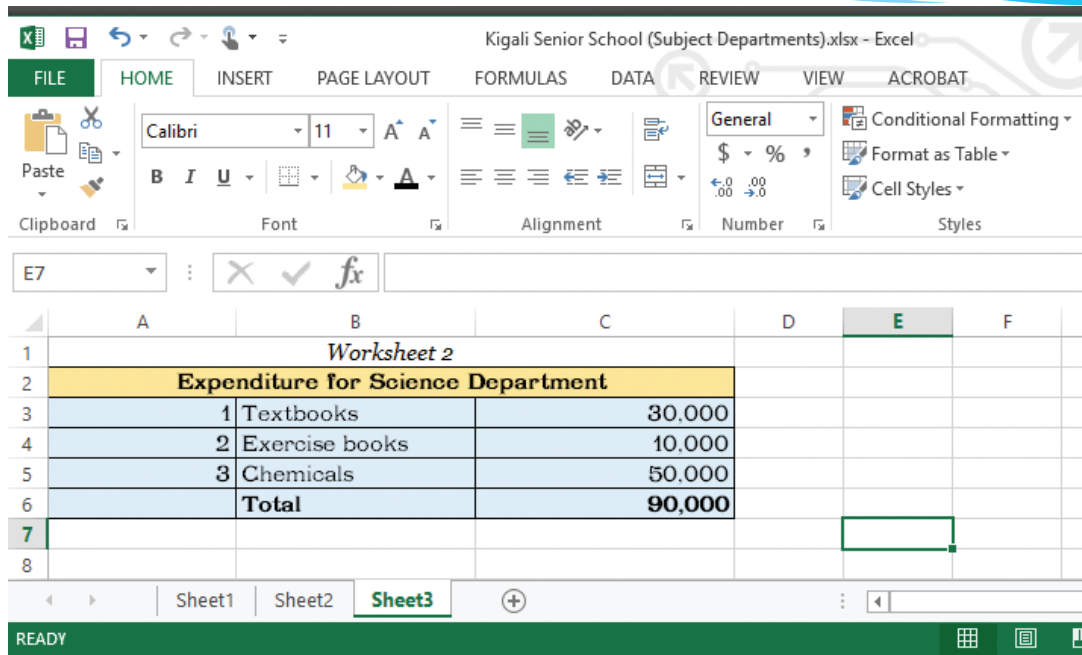


Figure 7.6: Data entered in Worksheet 2

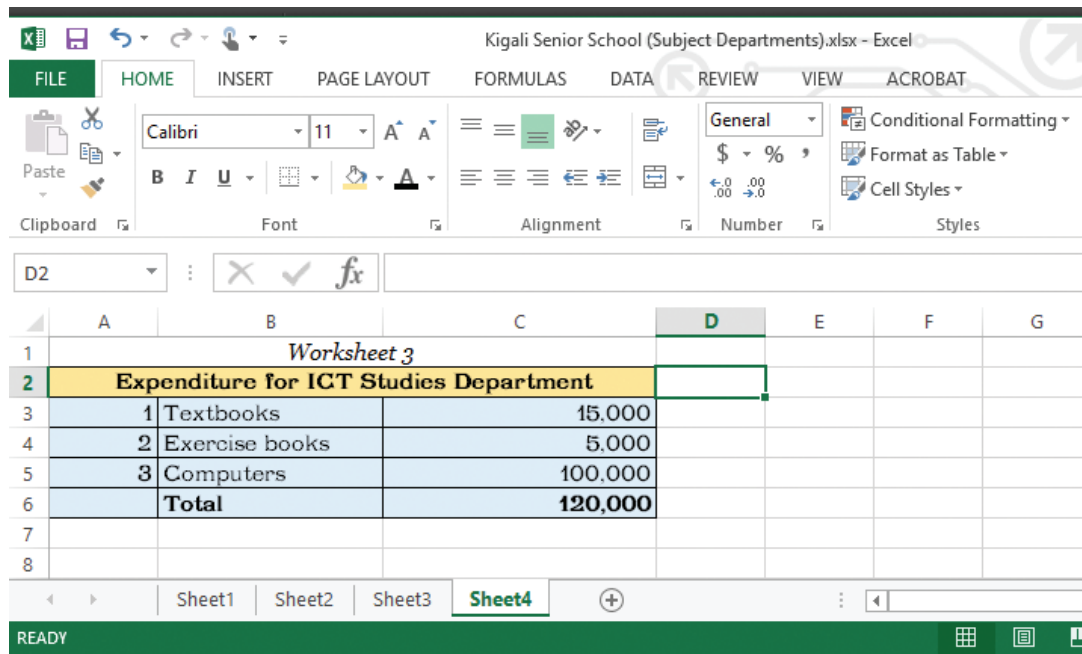


Figure 7.7: Data entered in Worksheet 3

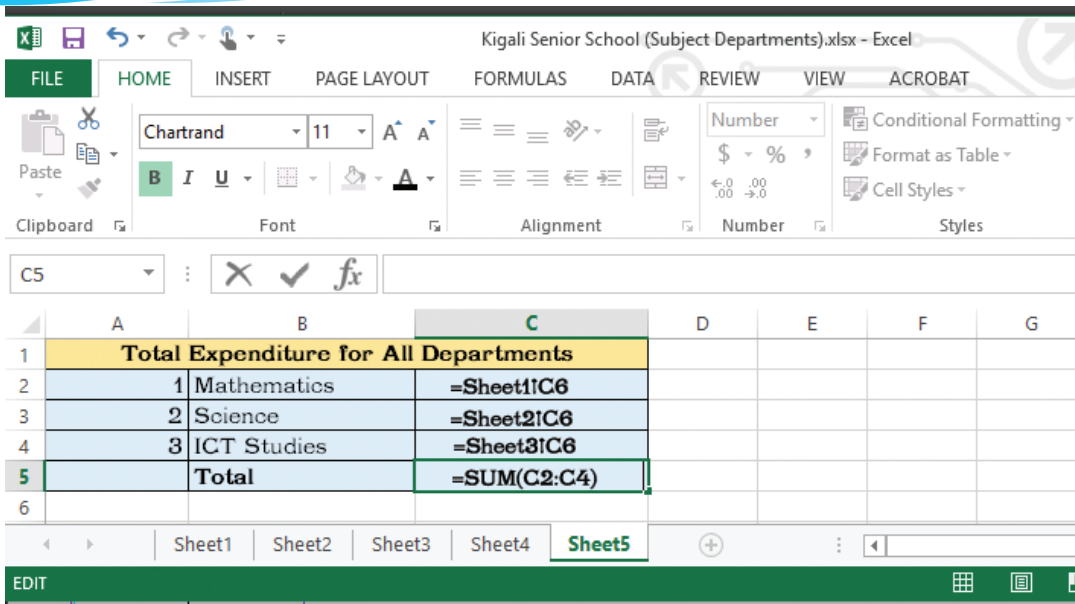


Figure 7.8: Data entered in Worksheet 4

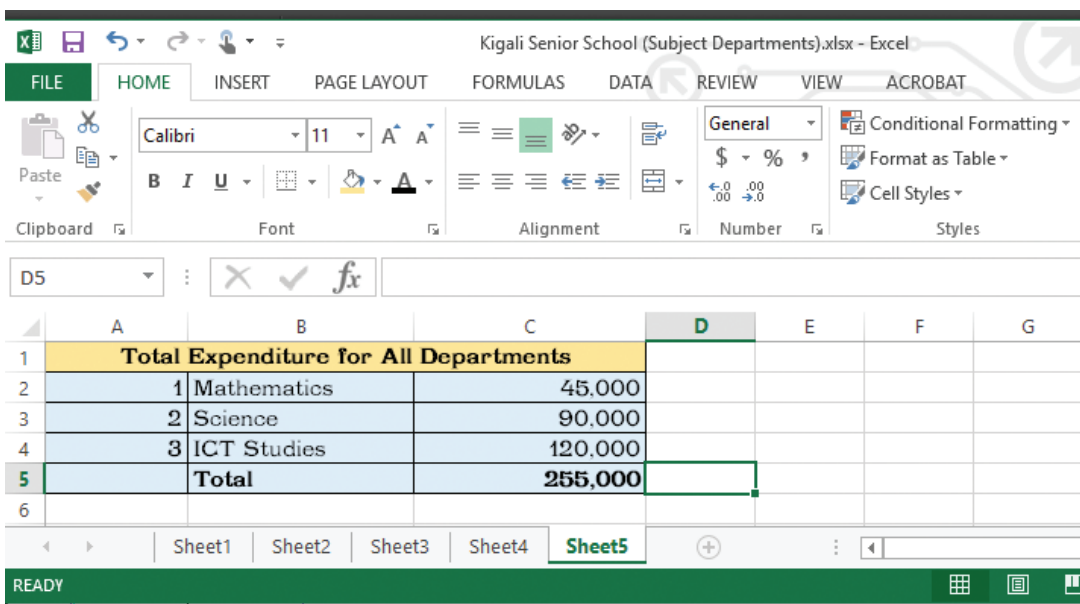


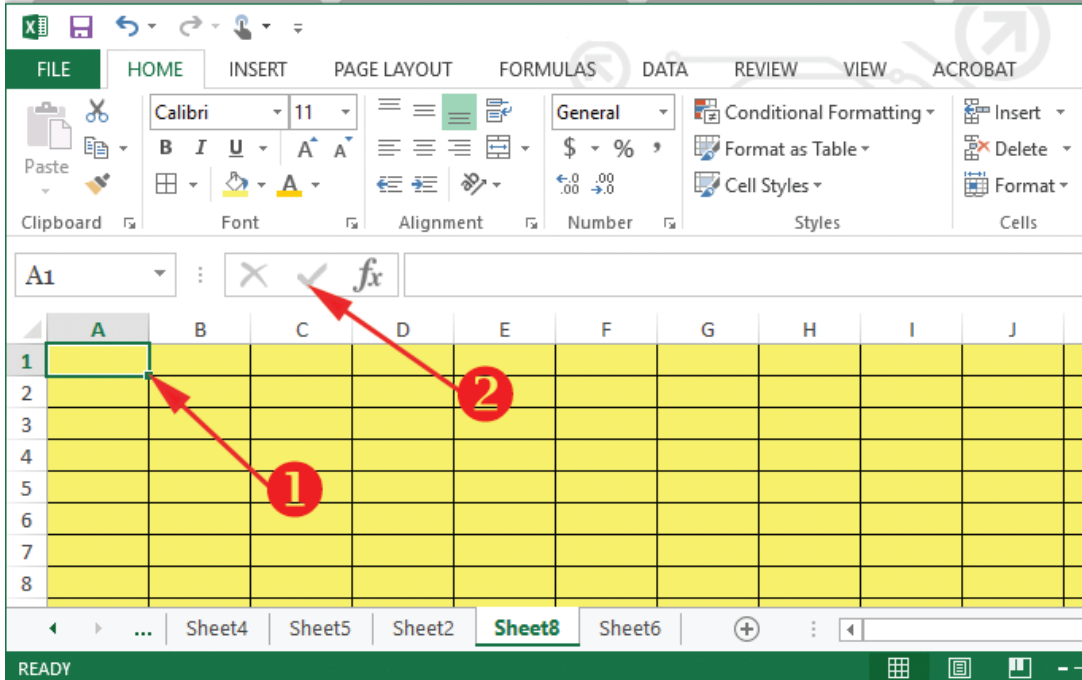
Figure 7.9: Data entered in Worksheet 5

The Worksheet in figure 7.8 displays the formula used in sheet reference whereas the worksheet in figure 7.9 shows the actual values. The advantage of using sheet referencing is that whenever values in the original sheet are changed, the values are automatically updated in the other worksheets.

### Revision Activity 7.1

**Part A: Fill in the blank spaces with the correct answer.**

1. The \_\_\_\_\_ sign is used at the beginning of a formula.
2. \_\_\_\_\_ formulas contain more than one operator.
3. Figure 7.10 shown below shows a section of Microsoft Excel worksheet. Use it to answer the questions that follow:



*Figure 7.10: A section of Microsoft Excel worksheet*

The part labelled 1 is known as \_\_\_\_\_.

The part labelled 2 is known as \_\_\_\_\_.

4. A cell address is also known as \_\_\_\_\_.
5. State the type of cell references used in each of the following cells:
  - (a) A\$2 \_\_\_\_\_
  - (b) \$X10 \_\_\_\_\_
  - (c) \$Y\$25 \_\_\_\_\_
6. To copy a formula to a different worksheet we use \_\_\_\_\_ referencing.



**Part B: Fill the blank spaces with TRUE if the Statement is right or FALSE if the statement is wrong.**

1. The equals sign (=) is used to begin a formula. \_\_\_\_\_.
2. All formulas must be enclosed within parenthesis. \_\_\_\_\_.
3. Formulas created using cell references cannot be copied, \_\_\_\_\_.
4. A function is a part of a formula. \_\_\_\_\_.

**Part C: Read each of the following questions carefully and give the correct answer.**

1. List **three** symbols that can be used in formulas.
2. Differentiate between simple formulas and complex formulas.
3. Differentiate between mixed cell reference and absolute cell reference.
4. Describe relative cell reference.
5. Kamali would like to create three worksheets to enter budgets for different departments in an office. Identify one advantage he would gain from referencing data from one worksheet to another in the workbook.

**Part D: Study the figure given below. Use your computer to perform the given tasks.**

1. The figure below shows marks scored by learners in a class. Use it to answer the questions that follow.

	A	B	C	D	E	F
1		S/No.	Name	CAT out of 30	Examination out of 70	Total Mark (100)
2	1	234	Rukundo	24	56	
3	2	567	Mulisa	25	57	
4	3	237	Mwiza	27	59	
5	4	290	Rwigema	20	50	

*Figure 7.11: Students' marks for CAT and examinations*

- (a) Type the worksheet as it appears and save it as *marks* on the desktop.
- (b) Using cell references only, compute:
  - (i) total mark for Rukundo;
  - (ii) copy the formula to cells F3, F4 and F5.
- (c) Save the changes.

2. Figure 7.12 shows a list of items in a shop. Use it to answer the questions that follow.

	A	B	C	D	E	F
1		S/No.	Name	Cost in dollars per unit	VAT	Cost
2	1	234	Cement	750		
3	2	567	Shovel	300		
4	3	237	Box of Tiles	1090		
5	4	290	Iron Sheet	600		
6	VAT rate(%)			20		

Figure 7.12: Costs of items

- (a) Open a new workbook and type the following data in a worksheet as it appears and save it as **Costs** on the desktop.
- (b) Use cell references to:
  - (i) Compute the VAT for cement using the cost in cell D6.
  - (ii) Copy the formula entered in cell E2 to cells E3 to E5.
  - (iii) Compute the total cost of cement, including VAT in cell F2.
  - (iv) Copy the formula entered in cell F2 to cells F3 to F5.
3. The following is a hypothetical budget for three ministries in Rwanda. Use it to answer the questions that follow.
  - (a) Open Microsoft Excel and type the data in figures 7.13, 7.14, and 7.15 in separate worksheets that are named **Sheet1**, **Sheet2**, and **Sheet3** respectively. Save the Excel document as **Budgets** on the desktop.

Ministry of Education		
Items	Cost in Rwanda Francs	
1 Textbooks for each Primary School	1,000,000	
2 Textbooks for each Secondary School	1,300,000	
3 Salaries for teachers for each School	280,000,000	
<b>TOTAL</b>		

Figure 7.13: Cost of items at the Ministry of Education

Ministry of Agriculture		
	Items	Cost in Rwanda Francs
1	Fertilisers	2,000,000
2	Seedlings	1,300,000
3	Salaries	138,000,000
TOTAL		

Figure 7.14: Cost of items at the Ministry of Agriculture

Ministry of Health		
	Items	Cost in Rwanda Francs
1	Medicine	120,000,000
2	Syringes	12,340,000
3	Salaries	150,000,000
TOTAL		

Figure 7.15: Costs of items at the Ministry of Health

- (b) Calculate the total in each ministry.
- (c) Create another worksheet and key in the information shown in Figure 7.16.

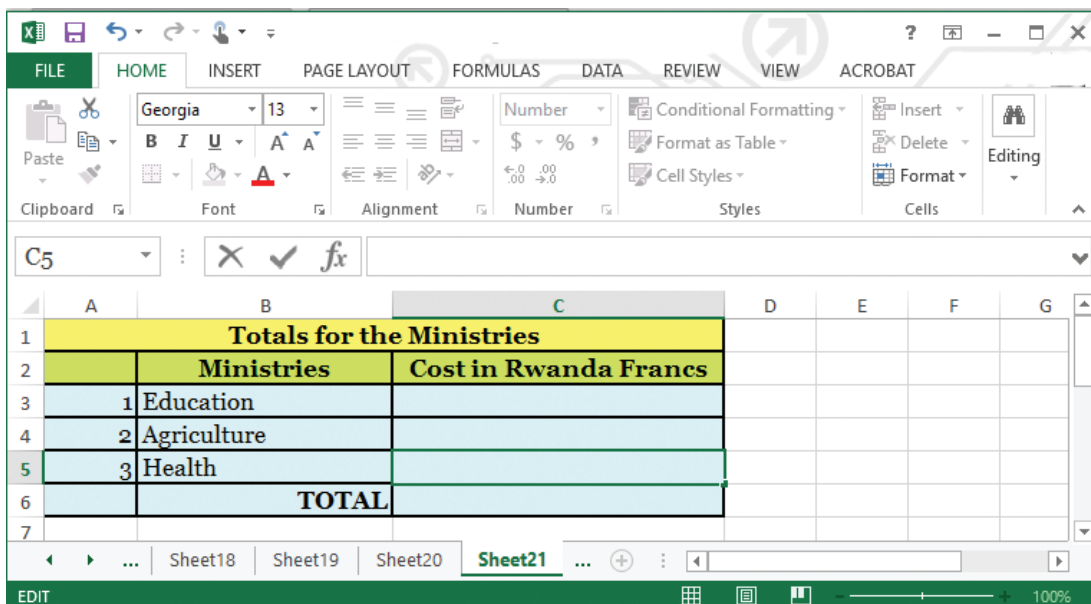


Figure 7.16: Total cost of items for the ministries

- (d) Sheet reference the total for each ministry to appear on Sheet4.
- (e) Calculate the totals for all the ministries.
- (f) Change the cost of seedlings from 1,300,000 to 1,350,000 on Sheet1.
- (g) Observe the change in the worksheet you created for TOTALS.
- (h) Save the changes in the document as Final.

## 7.5 Functions

Functions are inbuilt formulae that you can quickly use to perform calculations automatically. As discussed in Unit 4, every function must have the following components:

- (i) Begin with an equal sign (=) or the at (@) sign.
- (ii) The name of the function.
- (iii) Cell addresses or data range. The data range is enclosed in parenthesis () or round brackets (). It contains the cell addresses which have the information to be manipulated mathematically. The addresses can be separated by use of a colon or comma.

The user can either type functions on their own or use the **paste (fx) function**. To activate this function, simply click on the **fx** label on the formula bar or click the **Formulas** menu on the menu bar and select **Insert function** from the **Function Library** group. A dialog box appears as shown in Figure 7.17(a).

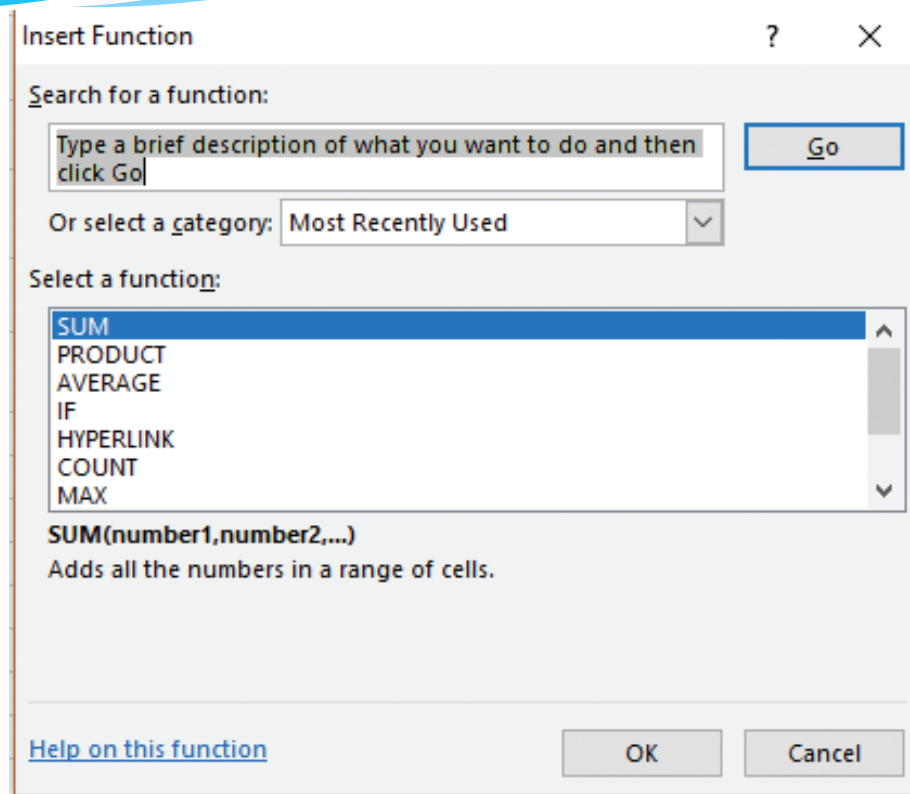


Figure 7.17 : The Insert Function dialog box

To make use of this function, do the following:

- (i) Click on the cell where the result is to be displayed.
- (ii) Activate the **Paste function** to display the **Insert Function** dialog box shown in Figure 7.17.
- (iii) Select the function required to manipulate the data under **Select a function:** section.
- (iv) Click **OK** to apply and to open the **Function Arguments** dialog box. See Figure 7.18.
- (v) Excel automatically inserts the data range under **Number1** box and displays all or some of the values to be manipulated besides the box.

However, the user has an option of either accepting the argument or typing their own. To type a new argument, click on the box and delete the given range then type another one.

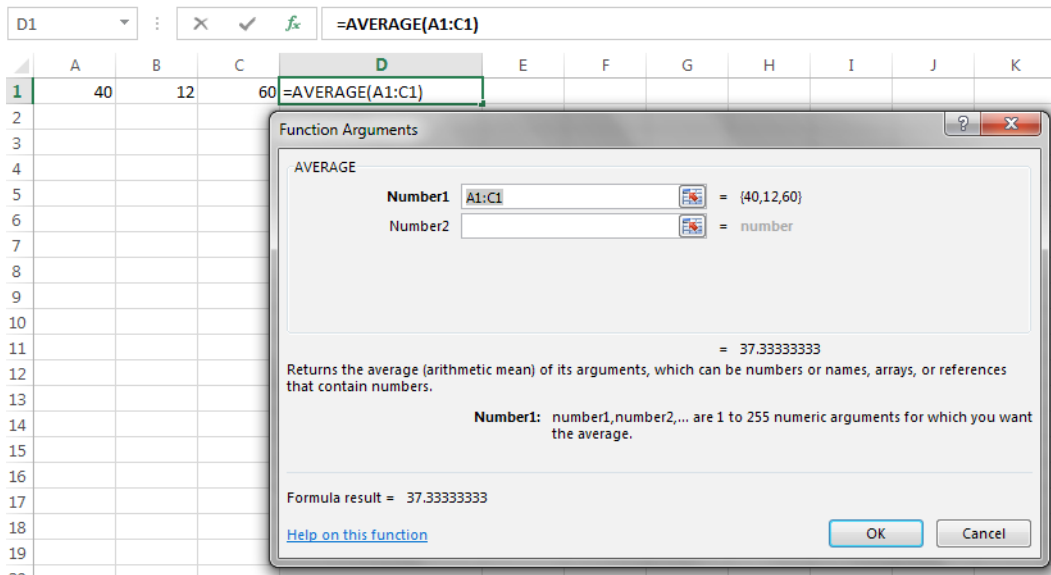


Figure 7.18: Function Arguments dialog box

Excel has many functions which are divided into different categories. The following are some categories of functions: **Mathematical**, **Logical** and **Text**.

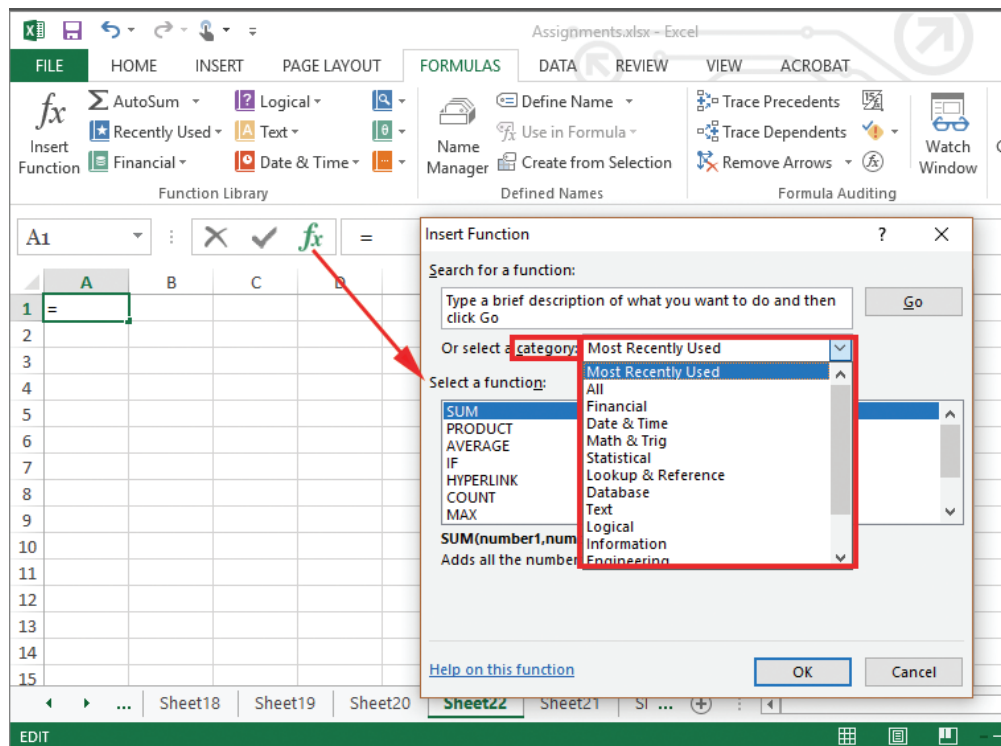


Figure 7.19: Categories of functions

## 7.6 Mathematical Functions

They are used to perform common mathematical operations. They include: SUM, AVERAGE, ODD, INT, ROUND, EXP, SQRT, POWER, MOD, MAX, and PRODUCT.

- **SUM:** This function **adds** all the values in a specified range of cells. The general syntax is =SUM(Number1, Number2...Number N).

### Practice Activity 7.8

Open Microsoft Excel. Key in the following values in cells A1 to G1: 90, 30, 80, 40, 50, 90, and 20. Use the **SUM** Function to sum all the values. The function would be written as: =SUM (A1:G1). This function should return 400.

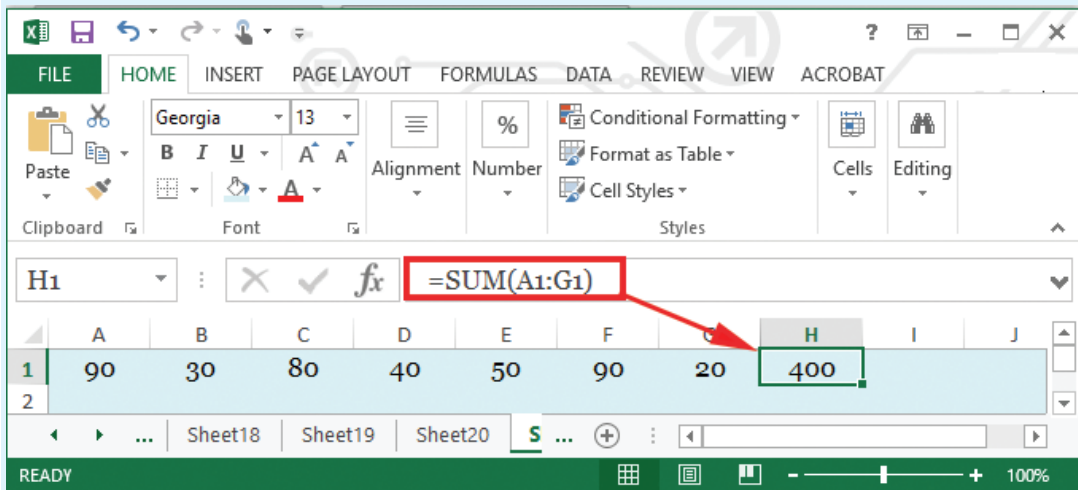


Figure 7.20: Using the SUM function

- **AVERAGE:** It is used to calculate the mean of values specified in a selected range of cells. Empty cells within the range are ignored while those that have zero values are included. The syntax is: =Average(data range).

### Practice Activity 7.9

Open Microsoft Excel. Key in the following values in cells B4 to H4: 90, 30, 80, 40, 50, 90, and 20. Use the **AVERAGE** Function calculate the average, the function would be written as: = Average (B4:H4).

This function would return 57.14286.

- **ODD:** It returns a value rounded up to the nearest odd integer. The general syntax is =ODD(number) where number is the value to be rounded.

**Note:**

- (i) If number is non-numeric, ODD returns the #VALUE! error.
- (ii) Regardless of the size of the number, a value is rounded up when adjusted away from zero.
- (iii) If number is an odd integer, no rounding occurs.

**Practice Activity 7.10**

Open Microsoft Excel. Use the ODD function to round off the given digits. The results to expect are given in the column titled Result:

	Formula	Description	Result
(i)	=ODD(1.2)	Rounds 1.2 up to the nearest odd integer	3
(ii)	=ODD(5)	Rounds 5 up to the nearest odd integer	5
(iii)	=ODD(6)	Rounds 6 up to the nearest odd integer	7
(iv)	=ODD(-9)	Rounds -9 up to the nearest odd integer	-9
(v)	=ODD(-2)	Rounds -2 up to the nearest odd integer	-3

- **INT:** Rounds a number down to the nearest integer. The general syntax is =INT(number) where number is the real number to be rounded down to an integer.

**Practice Activity 7.11**

Open Microsoft Excel. Use the integer function =INT to round down 14.9 to the nearest integer. The formula would be: =INT(14.9). The result should be 14.

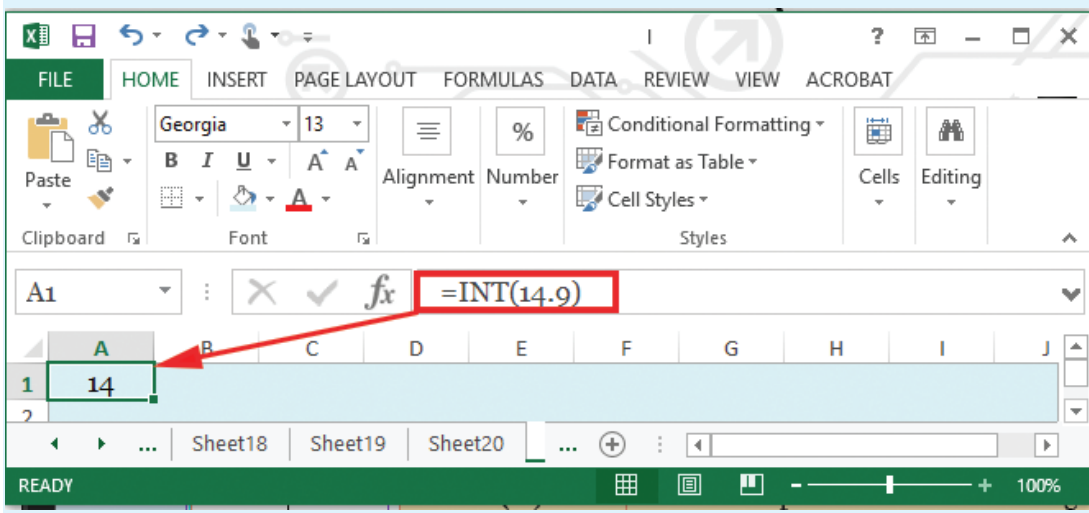


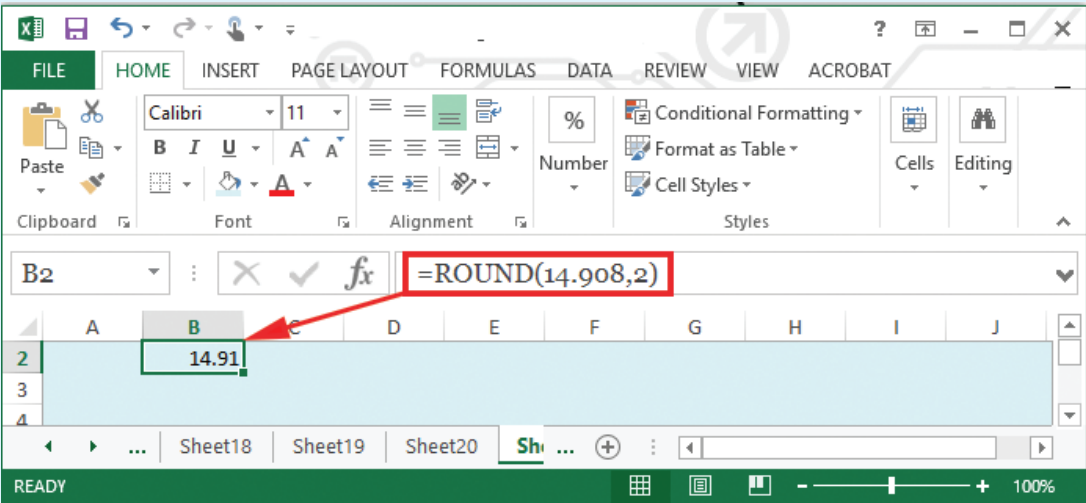
Figure 7.21: Using the INT function



- **ROUND:** This function rounds off a number to a specified number of digits. The general syntax is **=ROUND(number, num\_digits)** where **number** is the value to be rounded and **num\_digits** is the number of digits in the fractional part of the number to which the result is to be displayed.

**Practice Activity 7.12**

Open Microsoft Excel. **ROUND** off the value 14.908 to 2 digits. Have your answer inserted in cell B2. The formula to use is: **=ROUND(B2,2)**. The result should be 14.91.



*Figure 7.22: Using the ROUND function*

**Note:**

- If **num\_digits** is greater than 0, then number is rounded to the specified number of decimal places.
- If **num\_digits** is 0, the number is rounded to the nearest integer.
- If **num\_digits** is less than 0, the number is rounded to the left of the decimal point.

**Practice Activity 7.13**

Open Microsoft Excel. **ROUND** off the given digits: The results to expect are given in the column titled Result:

Formula	Description	Result
(i) =ROUND(2.33, 1)	Rounds 2.33 to one decimal place.	2.3
(ii) =ROUND(61.5, -1)	Rounds 61.5 to one decimal place to the left of the decimal.	60

- **EXP:** Returns “e” raised to the power of number. The constant e equals 2.71828182845904, the base of the natural logarithm. The syntax is =EXP(number) where the number is the exponent application to the base of “e”.
- **SQRT:** This function returns a positive square root of a number. The general syntax is =SQRT(number) where number is the value for which the square root is to be obtained. If number is negative, this function returns #NUM! error.

#### Practice Activity 7.14

Open Microsoft Excel. Use the square root function to obtain the square root of 14.908. The formula should be written as: =SQRT (B2). The result should be 3.861088.

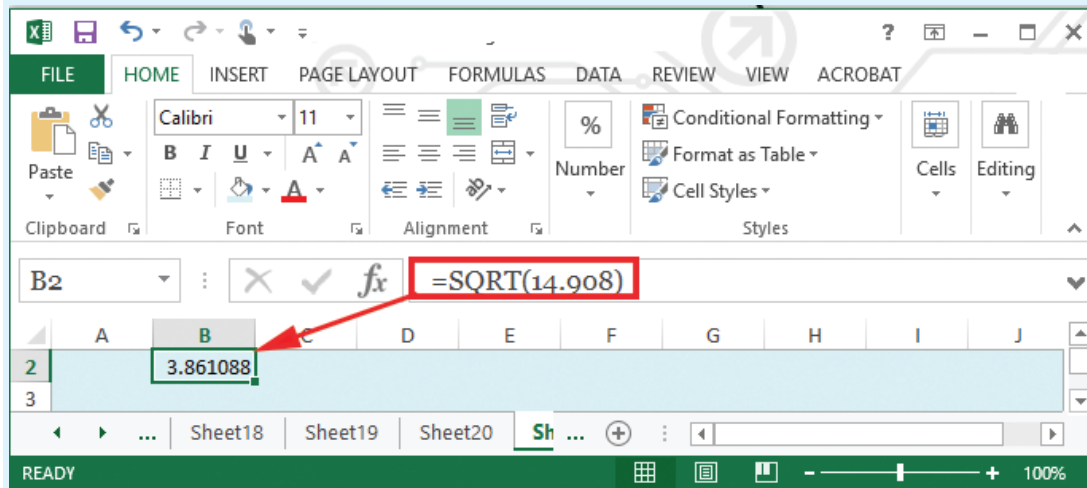


Figure 7.23: Using the SQRT function

- **POWER:** Return the result of a number raised to a power. The general syntax is =Power(number, power) where number is the base number which can be any real number while power is the exponent to which the base number is raised.

The “^” operator can be used instead of Power to indicate to what power the base is to be raised.

#### Practice Activity 7.15

Open Microsoft Excel. Use the POWER function to raise the value 6 to power 2. The formula would be: =Power (B2,2) or =B2^2. The result would be 36.

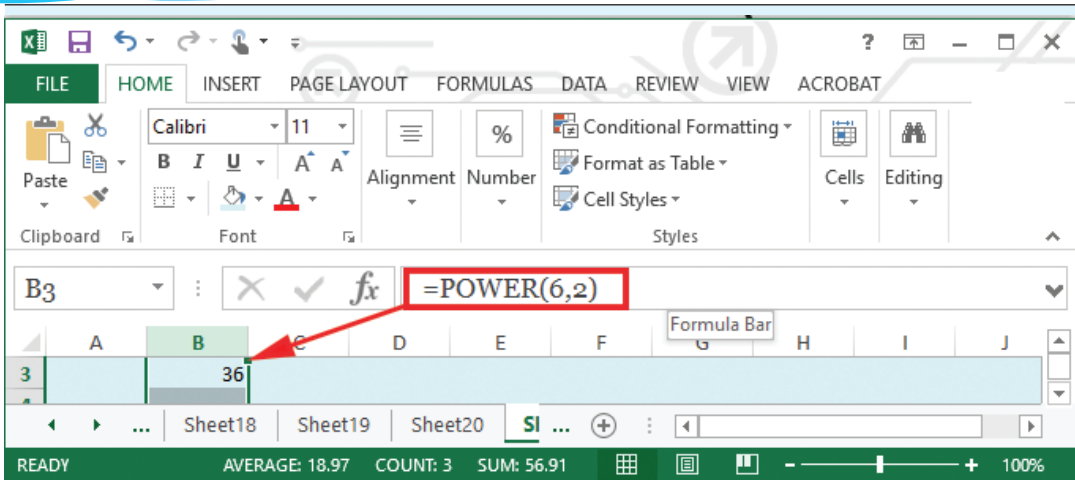


Figure 7.24: Using the POWER function

- **MOD:** It returns the remainder after a number is divided by a divisor. The result obtained has the same sign as the divisor. The general syntax is: =MOD (number, divisor). Where number is the number for which the remainder is to be found and divisor is the number used for dividing.

#### Practice Activity 7.16

Open Microsoft Excel. Use the MOD function to obtain the remainder after dividing the following values. The results to expect are given in the column titled Result:

Formula	Description	Result
(i) =MOD(5,2)	Remainder of 5/2	1
(ii) =MOD(-5,2)	Remainder of 5/2	1
(iii) =MOD(5,-2)	Remainder of 5/-2	-1
(iv) =MOD(-5,-2)	Remainder of -5/-2	-1

- **Note:** If divisor is 0, MOD function returns the #DIV/0! error value.
- The MOD function can be expressed in terms of the INT function:  $\text{MOD}(n, d) = n - d * \text{INT}(n/d)$ .
- **MAX:** The term Max refers to the function used for obtaining the maximum or largest value in a selected range of cells. If the selected range of cells contains no value, it returns a zero. The syntax is: =Max(data range).

### Practice Activity 7.17

Open Microsoft Excel. Key in the following values 9, 3, 8, 4, 5, 9 and 2 in cells B4 to H4. Use the MAX function to obtain the largest value. The function to use is: =MAX (B4:H4). This function should give the result as 9.

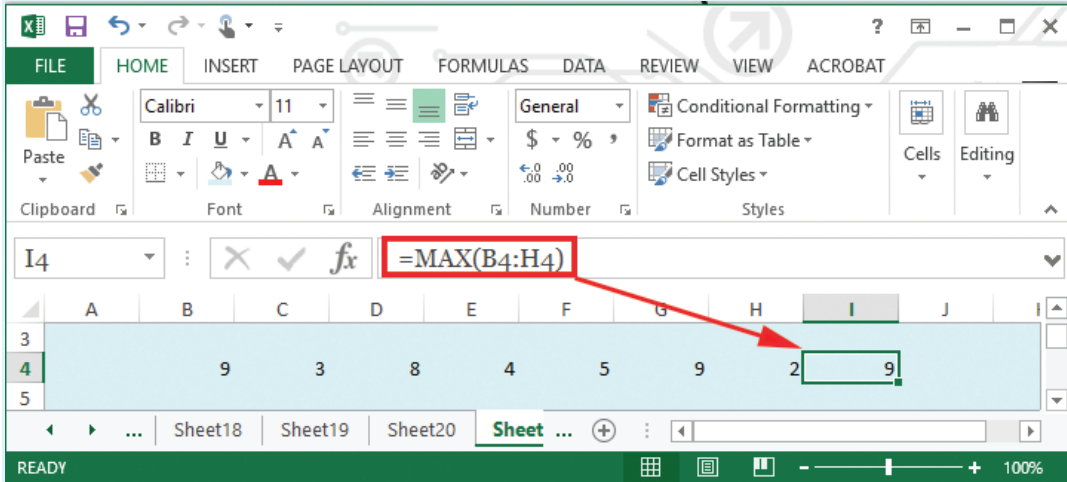


Figure 7.25: Using the MAX function

- **PRODUCT:** This function multiplies all the values within a specified range of cells. The general syntax is =Product(Number1, Number2... NumberN).

### Practice Activity 7.18

Open Microsoft Excel. Key in the following values 9, 3, 8, 4, 5, 9 and 2 in cells B4 to H4. Use the PRODUCT function to multiply these values.

The function to use is: =PRODUCT (B4:H4). This function should give the result as 77760.

## 7.7 Logical Functions

All logical functions return either the logical TRUE or logical FALSE when their functions are evaluated. They include AND, NOT, OR and IF.

**IF:** This function evaluates a condition and returns one of the values in case it is found to be true and another value if it is false. When writing a formula using this function, there should be no space however long it is.

The syntax for this function is dependent on the number of options and is as follows:

- **For two options only:**
  - ➔ General syntax =IF(Condition, True, False)

### Example

- ↪ For example =IF(A3>=40,"Pass","Fail")
- ↪ If the value in A3 is greater than or equal to 40 the output will be Pass else Fail.

- **For three options only:** General syntax =IF(Condition1,Option1,IF(Condition2,Option2,Option3))

### Example

- ↪ For example =IF(A3>=60,"Good",IF(A3>=40,"Pass","Fail"))

- **For four options only:** General syntax =IF(Condition1,Option1,IF(Condition2,Option2,IF(Condition3,Option3,Option4)))

### Example

- ↪ For example: =IF(A3>=80,"Very Good",IF(A3>=60,"Good",IF(A3>=40,"Pass","Fail")))

### Note:

- It is important to note that the number of conditions is always one less than the options. For example, if the options are four then the conditions are three because the last option is always the default.
- Any open bracket should be closed at the end of the entire "IF" function.
- **No space** should be used in the entire formula instead use commas.
- **AND:** It returns TRUE if all values are TRUE and it returns FALSE if one or more values are FALSE. The syntax is =AND(logical1, logical2,...) where logical1 is the first condition to be evaluated and logical2 is the optional condition.

### Practice Activity 7.19

1. Open Microsoft Excel and key in the values 50 and 104 in cells A3 and A4 respectively. Work out three possible ways of writing AND function. The following are some options.

Formula	Description	Result
=AND(1<A3,A3<100)	Displays TRUE if the number in cell A3 is between 1 and 100. Otherwise, it displays FALSE	TRUE

<code>=IF(AND(1&lt;A4,A4&lt;100),A4, "The value is out of range.")</code>	Displays the number in cell A4, if it is between 1 and 100. Otherwise, it displays the message "The value is out of range"	The value is out of range
<code>=IF(AND(1&lt;A3,A3&lt;100),A3, "The value is out of range.")</code>	Displays the number in cell A3, if it is between 1 and 100. Otherwise, it displays a message "The value is out of range"	50
<p>2. Write down the names of 10 students and the marks they have obtained out of 100. Grade them using the following:</p> <p><b>80&lt;100 =A                      70–80=B;                      60–70 =C;</b>  <b>50–60=D                              &lt;50=Fail</b></p>		

**Notes:**

- Text or empty cells found within the selected range of cells are ignored.
- If the selected range of cells does not contain any logical values, the function returns a #VALUE error.
- **NOT:** Reverses the value of its argument, that is, it changes FALSE to TRUE and TRUE to FALSE. It is used to make sure a value is not equal to one particular value. The syntax of the function is =NOT(logical) where logical is a value or expression that can be evaluated to TRUE or FALSE. If logical is FALSE, NOT returns TRUE and if logical is TRUE, NOT returns FALSE.

**Practice Activity 7.20**

Open Microsoft Excel. Work out three possible ways of writing the NOT function. The following are some options.

Formula	Description	Result
<code>=NOT(FALSE)</code>	Reverses FALSE.	TRUE.
<code>=NOT(1+1=2)</code>	Reverses an equation that evaluates to TRUE.	FALSE.
<code>=NOT(ISBLANK(A1))</code>	Reverses an equation that evaluates on whether the cell A1 is blank.	Returns TRUE if A1 is not blank and FALSE otherwise.

- **OR:** Checks whether any of the arguments are TRUE, and returns TRUE if any argument is TRUE and returns FALSE if all the arguments are FALSE. The syntax is:

=OR(logical1, logical2, ...) where Logical1 is required and subsequent logical values are optional.

**Notes:**

- Text or empty cells given as arguments are ignored.
- It returns a #VALUE error if no logical values are found.
- Each logical condition must evaluate to TRUE or FALSE.

**Practice Activity 7.21**

Figure 7.26 contains details of members of an insurance company. Use it to answer the questions that follow.

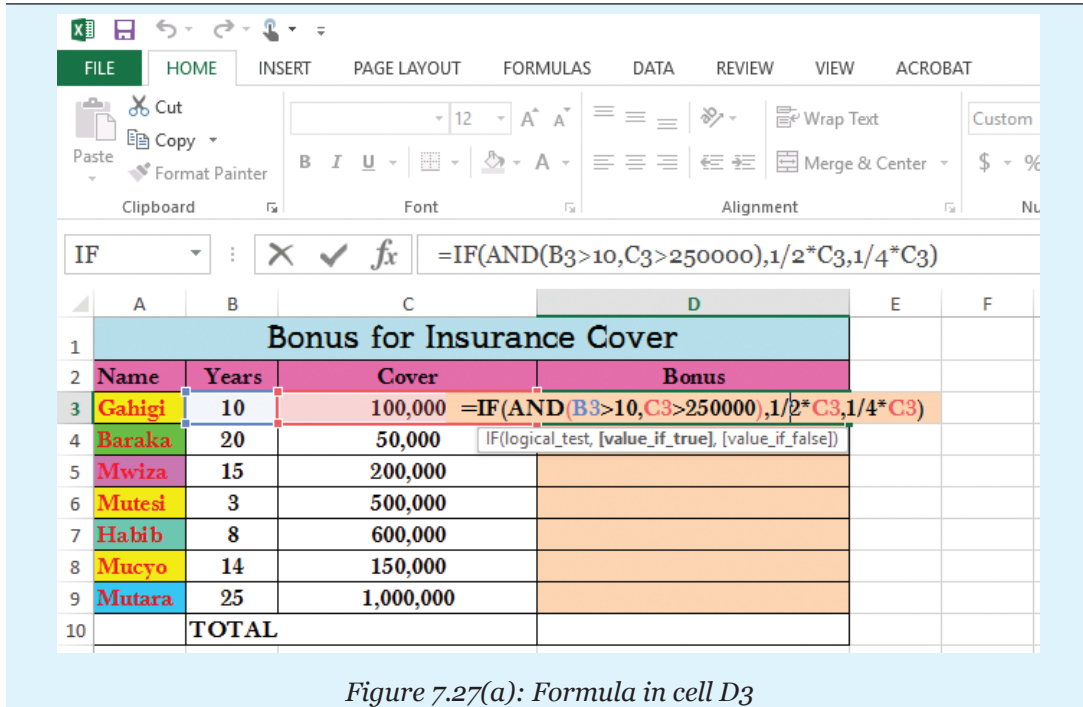
If a member has a cover of 250,000 for a period of more than 10 years, the bonus would be half of the cover otherwise bonus is quarter of the cover.

Bonus for Insurance Cover			
Name	Years	Cover	Bonus
Gahigi	10	100,000	
Baraka	20	50,000	
Mwiza	15	200,000	
Mutesi	3	500,000	
Habib	8	600,000	
Mucyo	14	150,000	
Mutara	25	1,000,000	
TOTAL			

Figure 7.26: Insurance cover for different customers

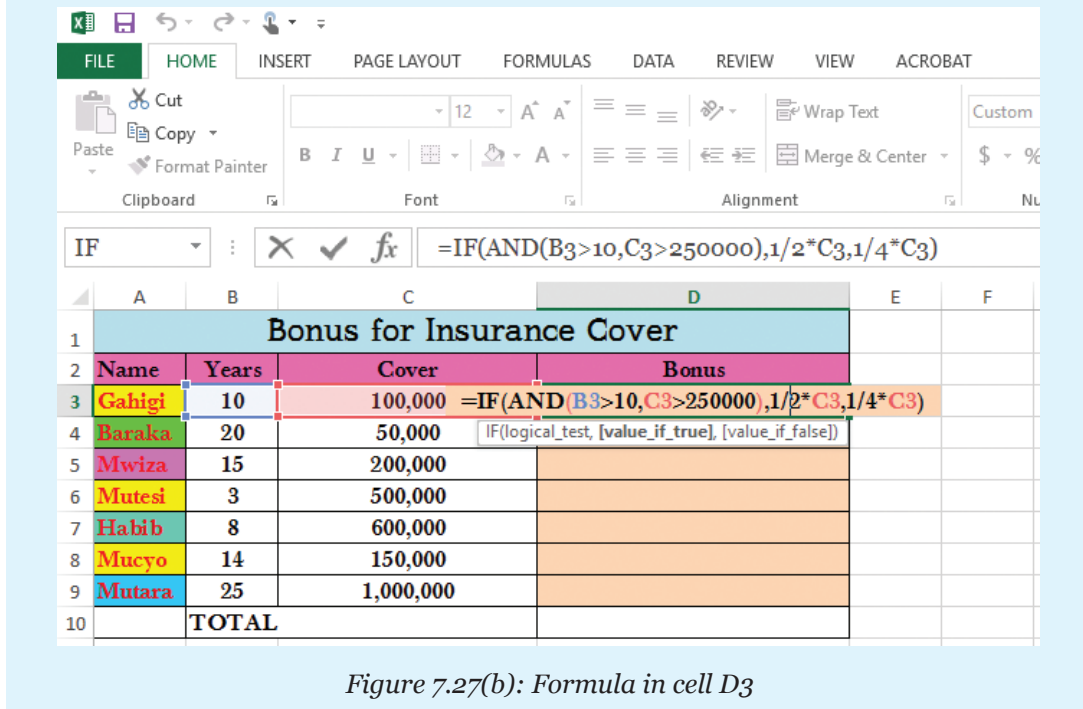
- (a) Using a function and cell reference only, compute the bonus for Gahigi.

## Solution



## Solution with formulas

(b) Copy the formula in cell D3 to cells D4 up to D9.





Bonus for Insurance Cover			
Name	Years	Cover	Bonus
Gahigi	10	100000	=IF(AND(B3>10,C3>250000),1/2*C3,1/4*C3)
Baraka	20	50000	=IF(AND(B4>10,C4>250000),1/2*C4,1/4*C4)
Mwiza	15	200000	=IF(AND(B5>10,C5>250000),1/2*C5,1/4*C5)
Mutesi	3	500000	=IF(AND(B6>10,C6>250000),1/2*C6,1/4*C6)
Habib	8	600000	=IF(AND(B7>10,C7>250000),1/2*C7,1/4*C7)
Mucyo	14	150000	=IF(AND(B8>10,C8>250000),1/2*C8,1/4*C8)
Mutara	25	1000000	=IF(AND(B9>10,C9>250000),1/2*C9,1/4*C9)
	TOTAL		

Figure 7.28: Copied formula for the other customers

### Solution showing calculated values

Bonus for Insurance Cover			
Name	Years	Cover	Bonus
Gahigi	10	100,000	25,000
Baraka	20	50,000	12,500
Mwiza	15	200,000	50,000
Mutesi	3	500,000	125,000
Habib	8	600,000	150,000
Mucyo	14	150,000	37,500
Mutara	25	1,000,000	500,000
	TOTAL		

Figure 7.29: The bonus for each person

## 7.8 Text Functions

These are functions used in manipulating text strings. Examples of the text functions include: COUNTA, COUNTBLANK, UPPER, LOWER and REPLACE and SEARCH.

- **COUNTA:** This function counts the number of cells that are not empty in a specified range (range: Two or more cells on a sheet. The cells in a range can be adjacent or nonadjacent.). It counts cells containing any type of information such as error values, text and empty text (“”).

For example, if the specified range contains a formula that returns an empty string, the **COUNTA** function counts that value. However, it does not count empty cells.

The syntax of the **COUNTA** function is: =COUNTA(value1, value2,...). **Note:** To count cells containing only values use **COUNT** function and to count cells that meet a given criteria, use **COUNTIF** function.

### Practice Activity 7.22

Open a Microsoft Excel worksheet. Key in the information given in Figure 7.30.

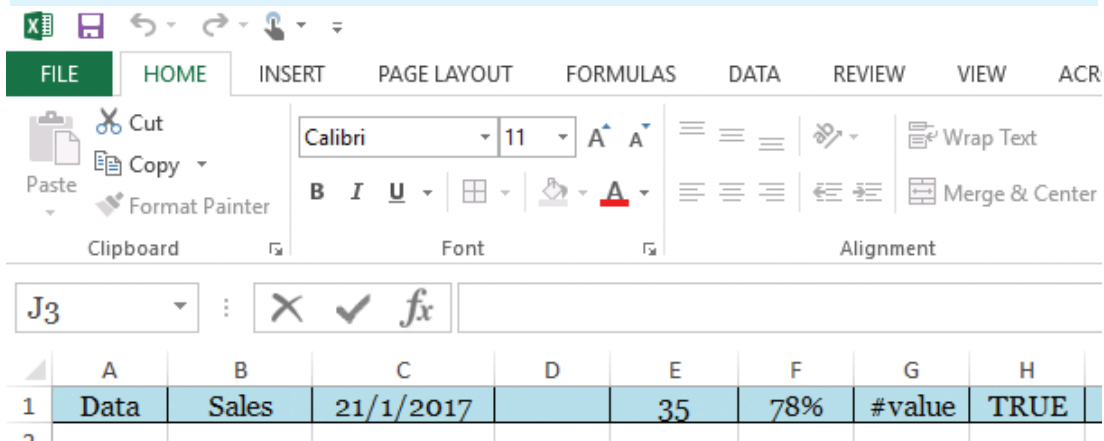


Figure 7.30: Contents of a row in a worksheet

Provide a comparison of the **COUNTA** and **COUNT** function results based on Figure 7.30. Your results should be as shown in the column titled Result.

Formula	Description	Result
=COUNTA(A1:H1)	Counts the number of non-blank cells in the range A1 through to H1.	7
= COUNT(A1:H1)	Counts the number of cells with values only in the range A1 through to H1.	2

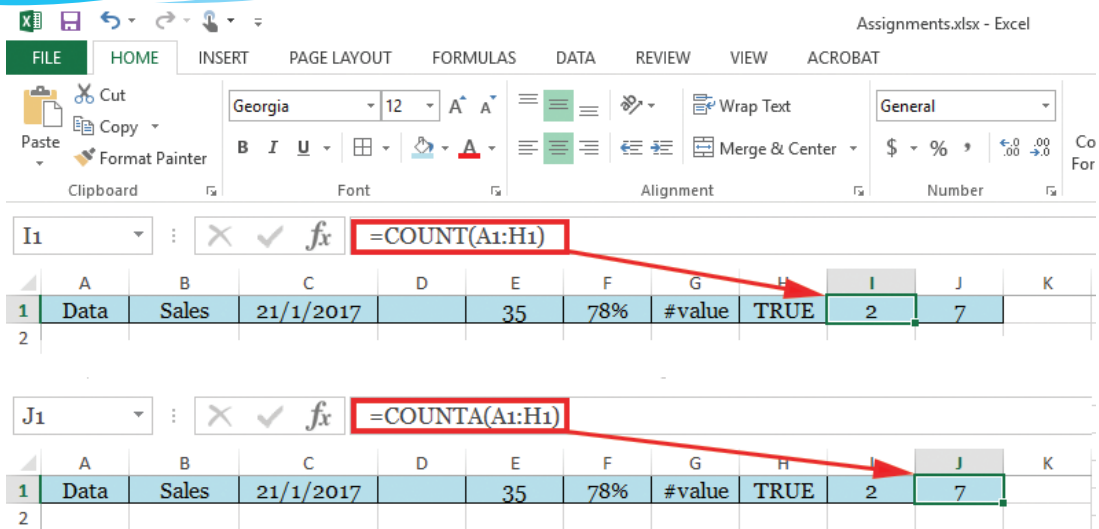


Figure 7.31: Comparison of COUNTA and COUNT functions

- COUNTBLANK:** This function counts the number of empty cells in a specified range of cells as well as cells with formulas that return empty text (""). However, it does not count cells with zero (0). The syntax is: `=COUNTBLANK(data range)`.

### Practice Activity 7.23

Open a Microsoft Excel worksheet. Key in the information given in Figure 7.31.

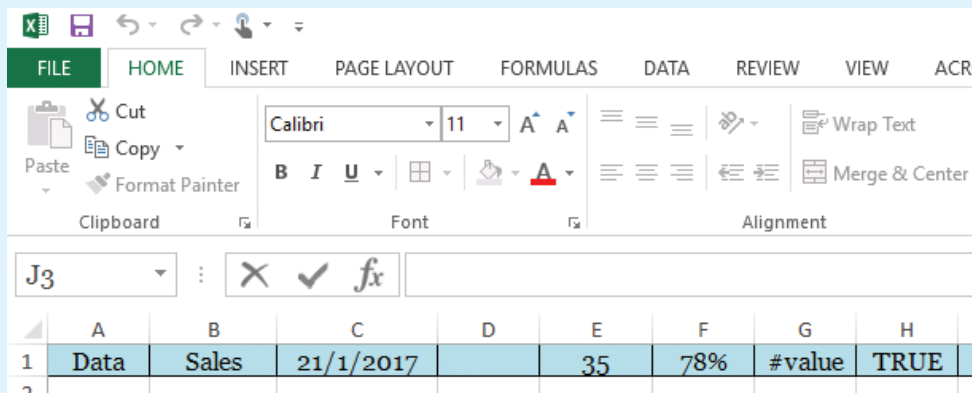


Figure 7.32: Worksheet data containing different types of data

To count the empty cells only in the range, the formula would be written as `=COUNTBLANK(A1:H1)`. The result is 1.

- UPPER:** This function converts text to uppercase. The syntax of the function is: `=UPPER(text)` where text is the information to be converted to upper case which can be a reference or text string.

### Practice Activity 7.24

Open a Microsoft Excel worksheet. Key in the word “integrity” in cell A2.

Use the =UPPER function to write this word in upper case in cell A4.

Note: The formula =UPPER(A2) is typed in the destination cell (A4). The result you get should be INTEGRITY.

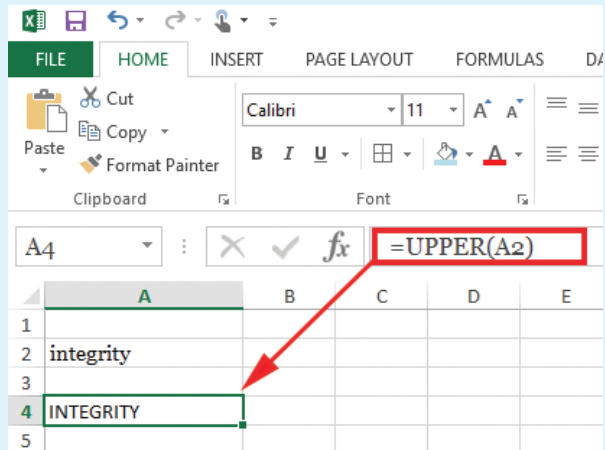


Figure 7.32: Using the UPPER function

- **LOWER:** This function converts all uppercase letters in a text string to lowercase. The syntax of the function is: =LOWER(text) where text is the information to be converted to lower case.

### Practice Activity 7.25

Open a Microsoft Excel worksheet. Key in the word “mARKS” in cell A4.

Use the =LOWER function to write this word in lower case in cell A5.

Note: The formula =LOWER(A4) is typed in the destination cell (A5). The result you get should be marks.

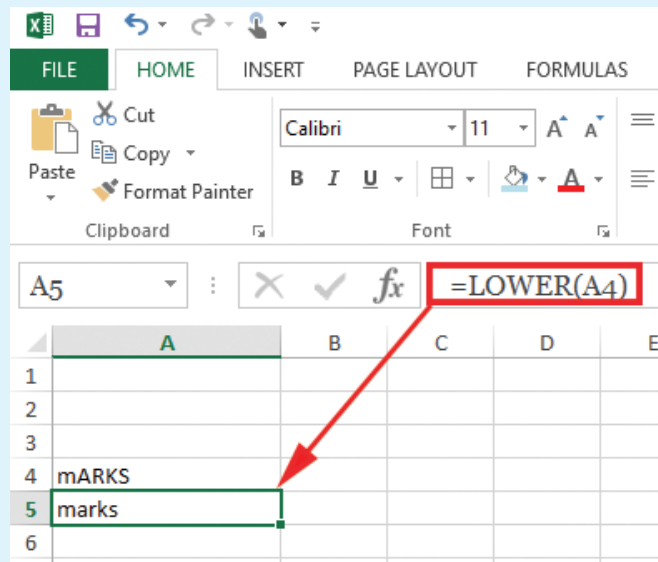


Figure 7.33: Using the LOWER function

### Practice Activity 7.26

Open a Microsoft Excel worksheet. Key in the word “dETERMINATION” in cell A3. Use the =LOWER function to write this word in lower case in cell A6.

Note: The formula =LOWER(A3) is typed in the destination cell (A6). The result you get should be “**determination**”.

- **REPLACE:** It is used to substitute part of a text string based on the number of characters specified, with a different text string. The syntax of the function is: =REPLACE(Old\_text, start\_num, num\_chars, new\_text) where:
  - ➔ **Old\_text:** This refers to the text containing some characters to be replaced.
  - ➔ **Start\_num:** This is the position of the character to be replaced in the old\_text.
  - ➔ **Num\_chars:** is the number of characters in old\_text that the REPLACE function is to replace with new\_text.
  - ➔ **New\_text:** is the text that will replace characters in old\_text.

### Practice Activity 7.27

Open a Microsoft Excel worksheet. Key in the value 2008 in cell A2 as shown in Figure 7.34. Use the =REPLACE function to change the last two digits of the value to 16. Insert your result in cell A4.

Note: The function to use is =REPLACE(A4,3,4,"16"). This simply means that the function will replace the last two digits (08) of 2008 with 16. The result is 2016.

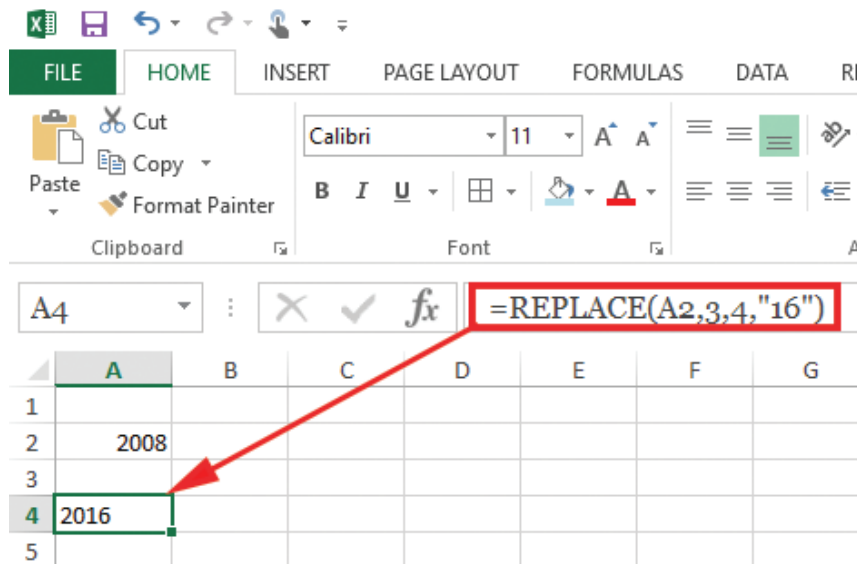


Figure 7.34: Using the REPLACE function

- **SEARCH:** This function locates one text string within a second text string then returns the number of the starting position of the first text string from the first character of the second text string. The syntax is: =SEARCH(find\_text,within\_text,start\_num) where:
  - ➔ **Find\_text** is the text to be found.
  - ➔ **Within\_text** is the second text string where the text in the **find\_text** is to be found.
  - ➔ **Start\_num** It is optional. It is the character number in the **within\_text** argument at which the search should begin.

### Practice Activity 7.28

Open a Microsoft Excel worksheet. Use the =SEARCH function to do the following:

1. =SEARCH("e", "printer")  
Note: This should return 6 since "e" is the sixth character in the word "printer".
2. =SEARCH("sheet", "Spreadsheet")  
Note: This should return 7 since "sheet" begins at the seventh character in the word "Spreadsheet".

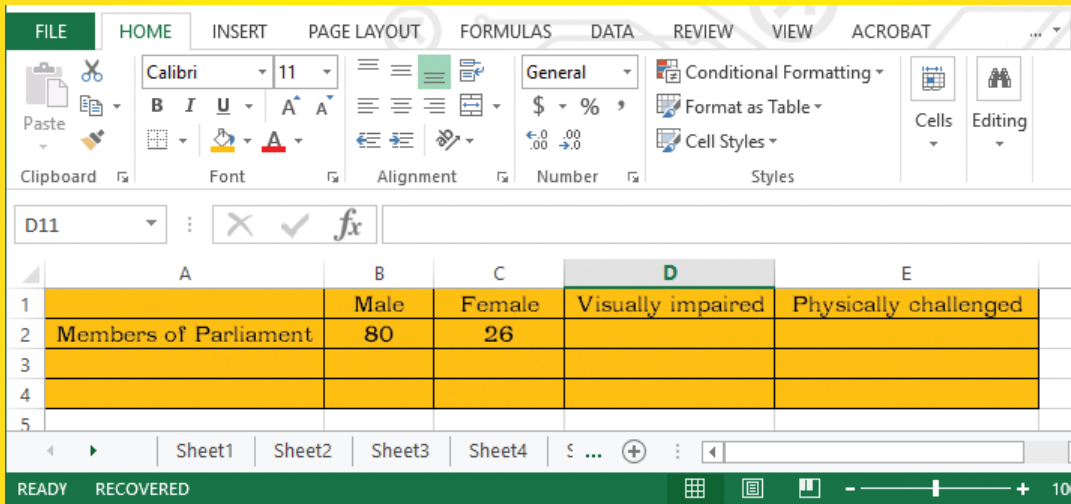
### Revision Activity 7.2

#### Part A: Fill in the blanks with the correct answers

1. A \_\_\_\_\_ is an inbuilt formula that the user can quickly use to perform calculations automatically.
2. The fx is known as \_\_\_\_\_ function.
3. \_\_\_\_\_ function adds all the values in a specified range of cells.
4. \_\_\_\_\_ function returns a value rounded up to the nearest odd integer.
5. The formula =ODD(1.7) rounds 1.7 up to the nearest odd integer which is \_\_\_\_\_.
6. IF is an example of \_\_\_\_\_ function.
7. The syntax of the command that counts the number of nonblank cells in the range A1 through to H1 is \_\_\_\_\_.
8. The \_\_\_\_\_ function is used to change text from small letters to capital letters.
9. The syntax of the REPLACE function is =REPLACE(\_\_\_\_\_, start\_num, num\_chars, \_\_\_\_\_).

**Part B: Use Figure 7.35 to answer the questions that follow.**

10. Figure 7.35 shows a section of Ms Excel worksheet. Use it to answer the questions (a) and (b) that follow.



The screenshot shows the Microsoft Excel interface. The ribbon is set to 'HOME'. The formula bar shows 'D11' and a formula icon. The worksheet data is as follows:

	A	B	C	D	E
1		Male	Female	Visually impaired	Physically challenged
2	Members of Parliament	80	26		
3					
4					
5					

*Figure 7.35: Extract of a spreadsheet worksheet*

- (a) \_\_\_\_\_ is the result when the formula =LOWER(A2) is applied.
- (b) \_\_\_\_\_ is the result when the formula = COUNTBLANK (A2:E2).

**Part C: Study Figure 7.36 shown below. Use your computer to perform the tasks described in (a) to (j).**

Figure 7.36 shows marks scored by some students in Senior 2. Use it to answer the questions that follow.

Riviera High School							
Senior 2 Marks for Term 1							
Subjects and Marks							
Name	Mathematics	English	ICT Studies	Physics	Total	Average	Grade
Gahigi	50	45	70	55			
Mukamutara	60	68	75	56			
Uwimana	61	65	74	58			
Sentwali	55	67	70	54			
Habimana	70	60	80	90			
Mucyo	65	61	86	60			
Mutara	80	50	70	89			
Ruterana	85	80	84	90			
Kalisa	45	40	60	40			
Kamali	40	45	65	45			
<b>Maximum</b>							
<b>Minimum</b>							
<b>Average</b>							
<b>Mode</b>							

*Figure 7.36: Marks for some students in Senior 2*

- Open a spreadsheet program and create this document as it appears. Save it as *marks* on the desktop.
- Using a function and cell references only, compute the total mark for Gahigi in cell F5.
- Enter a formula to determine the number of empty cells in the range A1 to H19.
- Copy the formula inserted in cell F5 to cells F6 through to F14.
- Write a formula using a function and cell references to compute each of the following for each subject:
  - Maximum
  - Minimum
  - Average
  - Mode



- (f) Using the logical If and cell references, determine the grade for Jane in cell G5 given that:

Total Mark	Grade
Greater than or equal to 80	A
70–79	B
60–69	C
50–59	D
0–49	E

- (g) Copy the formula entered in cell G5 to cells G6 through to G14.
- (h) Using the logical functions and cell references, determine the possible career for Gahigi in cell H5 given that, if a student scored 80% in Mathematics and ICT Studies can be a Technologist otherwise Decide.
- (i) Copy the formula entered in cell H5 to cells H6 through to H14.
- (j) Save the document with the changes as **Analysis**.

**Part D: Read the following questions carefully and answer them correctly**

1. Define the term *function* as used in spreadsheets.
2. Write the syntax of each of the following functions using the range A1 to D1.  
(a) Average;      (b) Round;      (c) Maximum.
3. List **three** logical functions.
4. Outline the function of each of the following functions:  
(a) CountA; (b) Search; (c) Lower; (d) Replace.
5. Name the function that rounds a positive number up and a negative number down to the nearest odd number.
6. Under what circumstance would the ODD function be used?

## 7.9 Conditional Formatting

Conditional formatting enables the user to answer specific questions about the data in a worksheet. It can be applied to a cell range or an entire worksheet. It changes the appearance of a range of cells based on the conditions (or criteria).

If the condition is true, the range of cells is formatted based on that condition. However, if the condition is false, the range of cells is not formatted.

When a conditional format is created, it is possible to reference only other cells on the same worksheet or, in certain cases, cells on worksheets in the same workbook currently open.

Conditional formatting, however, cannot be used on external references to another workbook. The following are some of the features of conditional formatting that can be applied: **highlight cell rules**, **top bottom rules**, **data bars**, **colour scales**, and **icon sets**.

### 7.9.1 Highlight Cell Rules

To apply **Highlight cell rules**, do the following:

- (i) Select the data where the highlight cell rules are to be applied.
- (ii) Click on the **Home** tab, in the **Styles** group, click on **Conditional Formatting** icon then point to **Highlight cell rules**. A drop down menu appears as shown in Figure 7.37. The keyboard shortcut is as follows: **Long press ALT** then **H** followed by **L**, and finally **H** key.

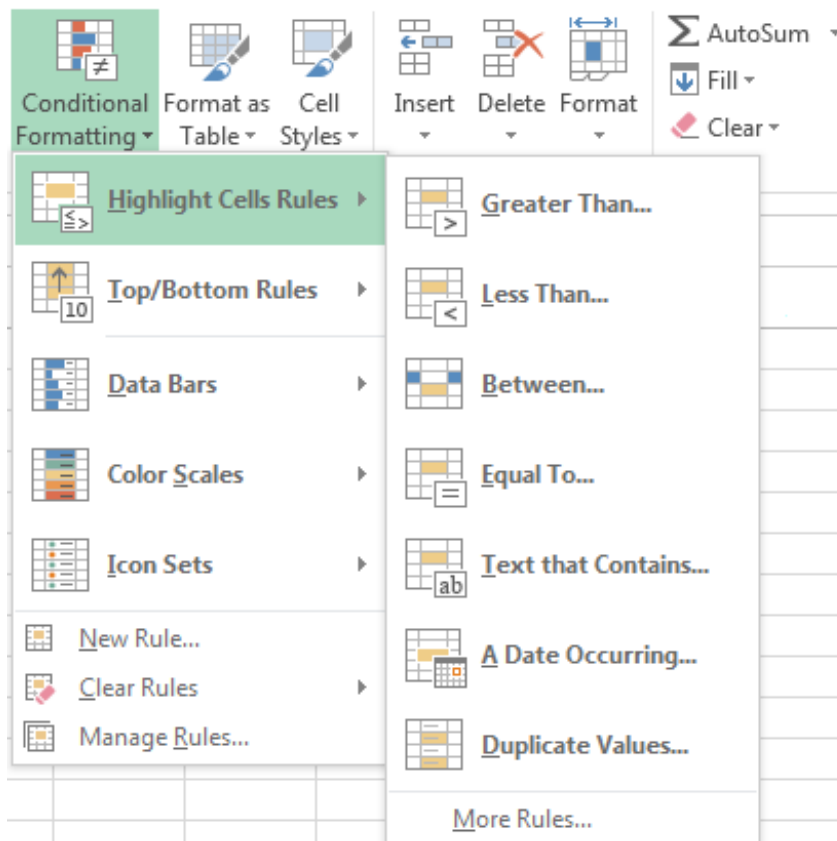


Figure 7.37: Highlighting cell rules

- (iii) Select the desired highlight cell rules option such as greater than or less than options.

The following are the options available and their descriptions.

Option	Apply the format on cells containing:
Greater Than	Values greater than the specified one.
Less Than	Values less than the specified one.
Between	Values within the specified range.
Equal To	Values equals to the specified one.
Duplicate Values	Duplicate values.
Text that Contains	The specified data.
A date occurring	The specified date.

Figure 7.38: Highlight cell rules

(iv) Choose the desired format style from the **with** box as shown in Figure 7.39.

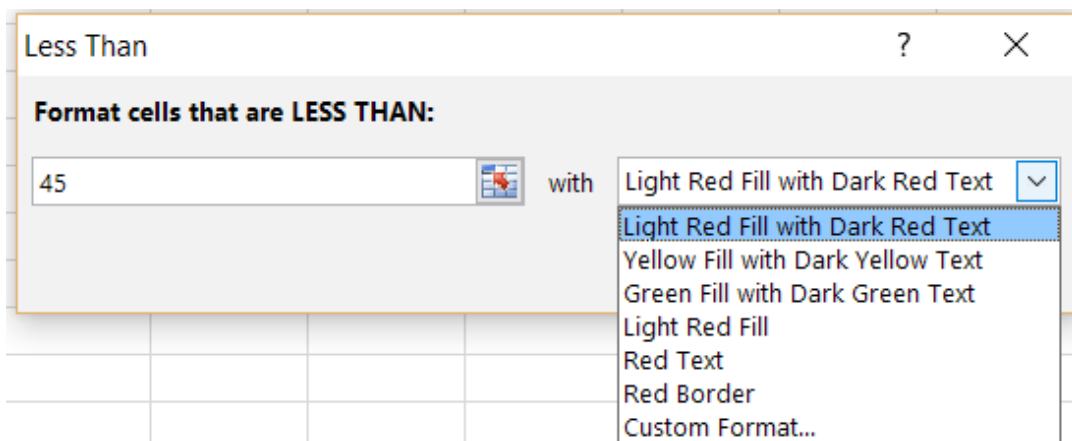


Figure 7.39: Different fill options that are available

(v) Click **OK** to apply.

### 7.9.2 Top/Bottom Rules

To apply **Top/Bottom**, rules do the following:

- (i) Select the data where the **Top/Bottom Rules** is to be applied.
- (ii) Click on the **Home** tab, in the **Styles** group, click on **Conditional Formatting** icon then point to **Top/Bottom Rules**. A drop down menu appears as shown in Figure 7.40. The keyboard shortcut is as follows: Long press **ALT** then **H** followed by **L** and finally **T** key.

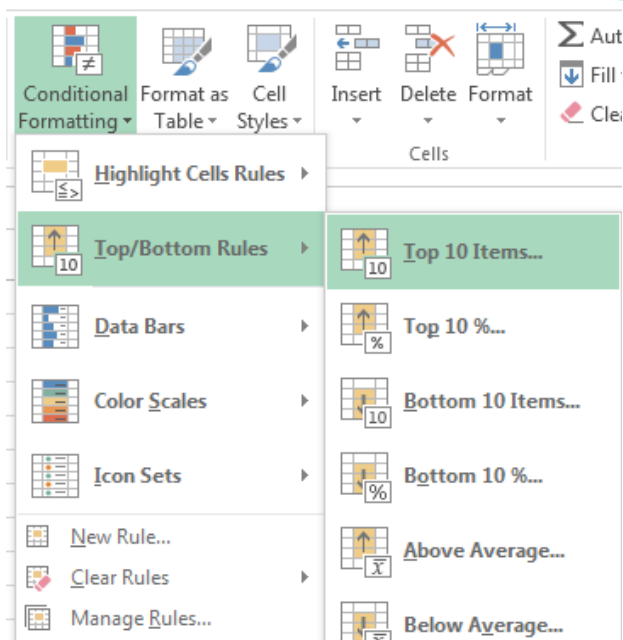


Figure 7.40: Applying Top/Bottom rules

- (iii) Select the desired top/bottom option such as **Above Average** options.
- (iv) Choose the desired format style from the **with** box.
- (v) Click **OK** to apply.

### 7.9.3 Data Bars

To apply **Data Bars** do the following:

- (i) Select the data where the data bar is to be applied.
- (ii) Click on the **Home** tab, in the **Styles** group, click on **Conditional Formatting** icon then point to **Data Bars**. A drop down menu appears as shown in Figure 7.41. The keyboard shortcut is as follows: **Long press ALT** then **H** followed by **L** and finally **D** key.
- (iii) Select the desired data bars option. The format is automatically implemented.

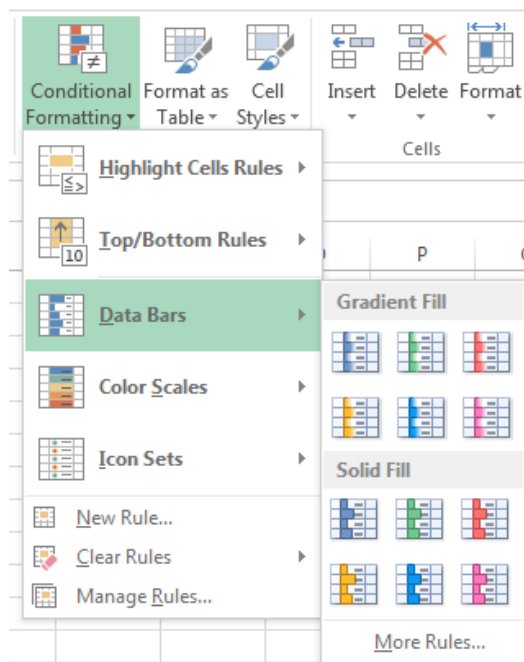


Figure 7.41: Applying data bars

### 7.9.4 Colour Scales

To apply colour scales, do the following:

- (i) Select the data where the colour scales is to be applied.
- (ii) Click on the **Home** tab, in the **Styles** group, click on **Conditional Formatting** icon then point to **Colour Scales**. A drop down menu appears as shown in Figure 7.42. The keyboard shortcut is as follows: **Long press ALT** then **H** followed by **L** and finally **S** key.

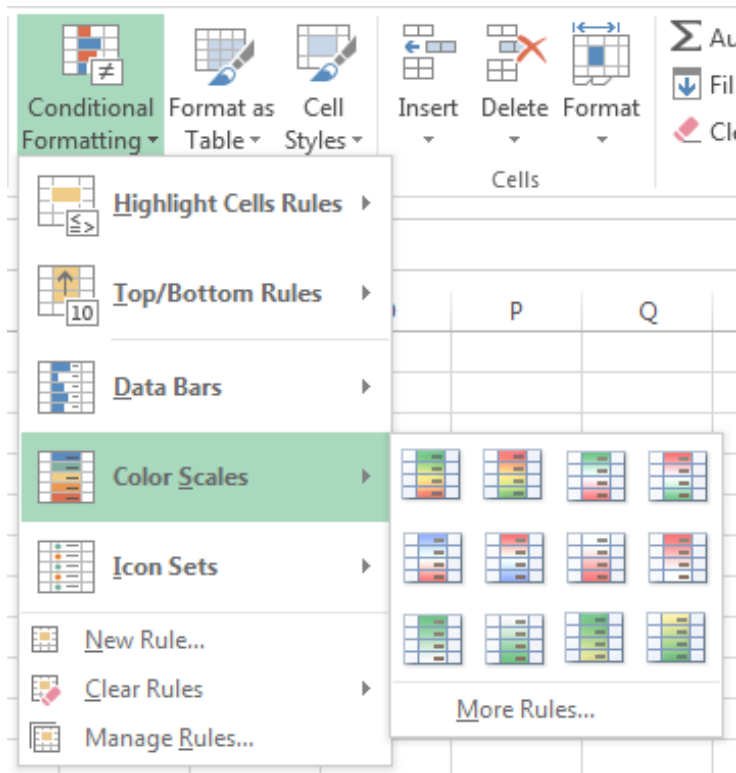


Figure 7.42: Applying colour scales

- (iii) Select the desired colour scales option. The format is automatically implemented.

### 7.9.5 Icon Sets

To apply icon sets, do the following:

- (i) Select the data where the icon sets is to be applied.
- (ii) Click on the **Home** tab, in the **Styles** group, click on **Conditional Formatting** icon then point to **Icon Sets**. A drop down menu appears as shown in Figure 7.43. The keyboard shortcut is as follows: **Long press ALT** then **H** followed by **L** and finally **I** key.

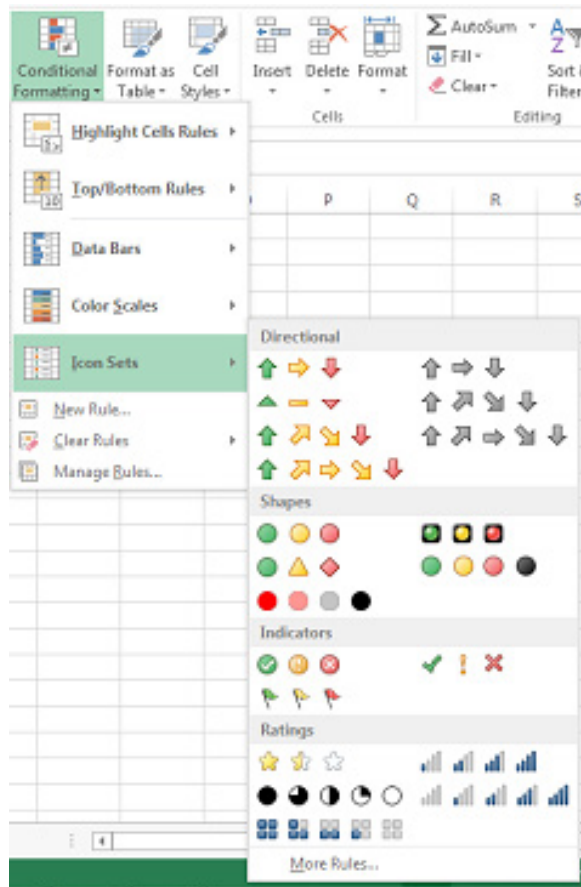


Figure 7.43: Applying icon sets

- (iii) Select the desired icon sets option. The format is automatically implemented on the cells containing values.

### Revision Activity 7.3

#### Part A: Fill in the blanks with the correct answers

1. Some examples of conditional formatting are \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
2. Top 10% is an example of \_\_\_\_\_ rules.
3. To change colour scales of data in a worksheet click on \_\_\_\_\_ tab, in the \_\_\_\_\_ group, click on **Conditional Formatting**.
4. The data fill has the \_\_\_\_\_ fill and \_\_\_\_\_ fill options.
5. The conditional formatting style used to add icons in a document is known as \_\_\_\_\_.

**Part B: Read the following questions carefully and give the correct answers**

1. List **three** types of conditional formatting.
2. Outline the steps followed to apply colour on data in a worksheet.
3. State the function of the **Between** option in conditional formatting.
4. Outline the steps followed to apply conditional formatting on data in a worksheet.
5. State the advantage of using conditional formatting.

**Part C: Study Figure 7.44 and use your computer to answer the questions that follow:**

Figure 7.44 shows an extract from Ms Excel. Use it to answer the questions that follow.

<b>Proportion of seats held by women in National Parliaments</b>						
<b>Country</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	
1 Rwanda	56	56	64	64	64	
2 Uganda	28	28	28	28	28	
3 Kenya	10	10	19	19	20	
4 Burundi	17	18	18	19	19	
5 Tanzania	8	32	32	32	32	

*\*Note: The above figures are not bonafide. They have been created for the purpose of answering this question.*

Figure 7.44: Extract from a worksheet

Format the cells:

- (a) that are greater than 50 with Red border;
- (b) that are equal to 32 with Light Red fill;
- (c) with data bars using one of the available gradient fills;
- (d) with colour scales of your choice.

## 7.10 Definition of Key Words in this Unit

### Revision Activity 7.4

Find out the meaning of the words given below. Share your findings with the rest of the students in a class presentation. Check the meanings you find against those provided in the glossary at the end of this course book:

Parenthesis	Operators	Formula
Function	Cell reference	Mixed reference
Relative reference	Absolute reference	Logical
Conditional formatting	Text	

### Revision Exercise 7

1. Outline **three** examples of operators used in spreadsheets.
2. Differentiate between a relative cell reference and a mixed cell reference.
3. Explain the advantage of referencing data from a different worksheets.
4. Outline the steps followed when copying formulas.
5. Explain the use of each of the following spreadsheet functions:
  - (a) Average;
  - (b) Odd;
  - (c) Round;
  - (d) Max.
6. Musabe created a document showing the list of students in a class and she would like to assign a pass or a fail to a student given that a score of 40 and above attracts a pass remark otherwise a fail. Write a formula using the If function that would be used to assign a pass or fail remark to a student.
7. Outline the use of each of the following functions in Spreadsheets:
  - (a) Upper
  - (b) Replace
  - (c) Countblank
8. Explain a circumstance under which conditional formatting would be used in a worksheet.
9. Identify the errors in the following formula:  
 $=IF(AND,(B3>10:C3>2500)1/2*C3:1/4*C3)$



10. Figure 7.45 shows a spreadsheet worksheet. Use it to answer the questions that follow.

Bonus for Insurance Cover			
Name	Years	Cover	Bonus
Gahigi	10	100,000	25,000
Baraka	20	50,000	12,500
Mwiza	15	200,000	50,000
Mutesi	3	500,000	125,000
Habib	8	600,000	150,000
Mucyo	14	150,000	37,500
Mutara	25	1,000,000	500,000
	<b>TOTAL</b>		

Figure 7.45: Worksheet extract for Insurance cover for different customers

- (a) Using a function and cell references only, write a formula that would be used to:
- Calculate the total cover paid by Gahigi;
  - Total cover collected;
  - Bonus for Gahigi given that all clients who have more than 15 years in the insurance and pay more than 200,000 cover get 50% of the cover otherwise they get a 25% of the cover.
- (b) Calculate the total bonus.

## Unit 8



# Network Components and Social Media Applications

**Key Unit Competency: By the end of this unit, you should be able to:**

1. Identify computer network devices, medium and peripherals.
2. Connect different computer devices to the network.
3. Use social media to exchange information on social life.

### Introduction

Sharing of information is vital within organisations and institutions locally, nationally, regionally and internationally.

Due to technological developments, sharing of information is made possible through **Internet connectivity**. Indeed, the term **Global Village** is now commonly used to refer to the world. This is because the world is today considered as a single community where members are connected by **electronic communications**.

Electronics and technology refer to devices such as computers and mobile phones that enable people to easily communicate and share information through Internet connectivity. A person can communicate with friends and relatives within Rwanda, Africa and even the entire world.

### 8.1 Definition of network and computer network

The term **network** refers to a collection or a group of interconnected objects or people. A computer network refers to a set of computers that are connected together for the purpose of sharing resources.

The most common way of connecting computers is through the Internet. Examples of resources that are shared through a computer network are printers or a file server.

A **computer network** is also defined as set of interconnected computing **nodes** that are organised in such a way that they can exchange data, information, or resources. A **node** is a connection point in a computer

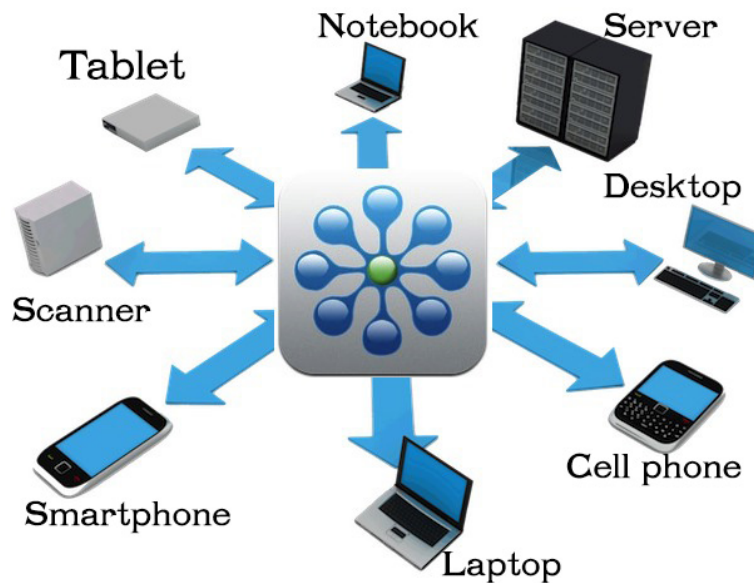
network. Devices such as a personal computer, laptop, cell phone, smart phones, tablet, scanners and printers are examples of nodes.

## **8.2 Devices that can be connected to a network**

Computers in a network are connected through a transmission medium using a set of rules called **protocols**. In computing, a protocol or **communication protocol** refers to a set of rules in which computers communicate with each other.

Devices that can be connected to a network are also referred to as **Data Terminating Equipment (DTE)** or **computing nodes**. Examples include desktops, laptops, printers, scanners, PDAs, smartphones and the server.

A **server** is an application program that provides services to other computer programs in a network. Note that the computer on which the server application program runs is also referred to as a server.



*Figure 8.1: Devices connected in a computer network*

## **8.3 Connecting different Devices to the Computer Network**

Through technology, any of the devices shown in Figure 8.1 can be connected to a computer network through the use of cables, or through wireless connectivity.

### **8.3.1 Connecting Devices Using Cables**

To connect devices in a computer network, you can use cables. There are different types of cables.

The cables are connected to the devices through an Ethernet port. An Ethernet port is a socket on a computer that allows one to connect devices to a computer network.

An Ethernet port is usually found on networking devices, such as computers, routers, and television sets. Devices are connected in a network through an Ethernet cable.

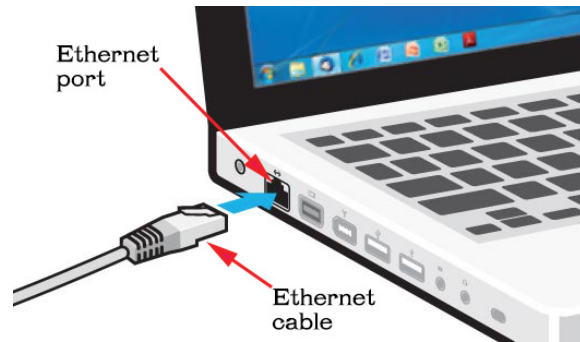


Figure 8.2: An Ethernet port and cable

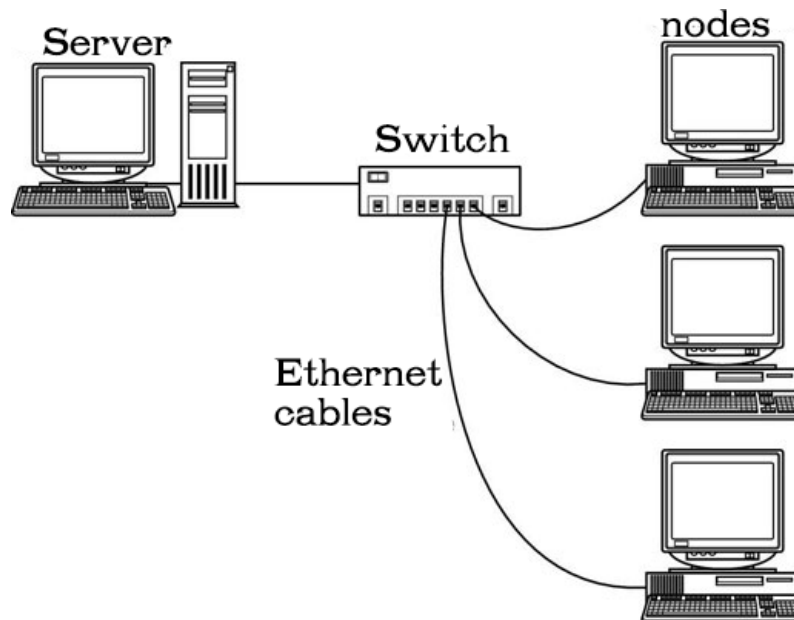


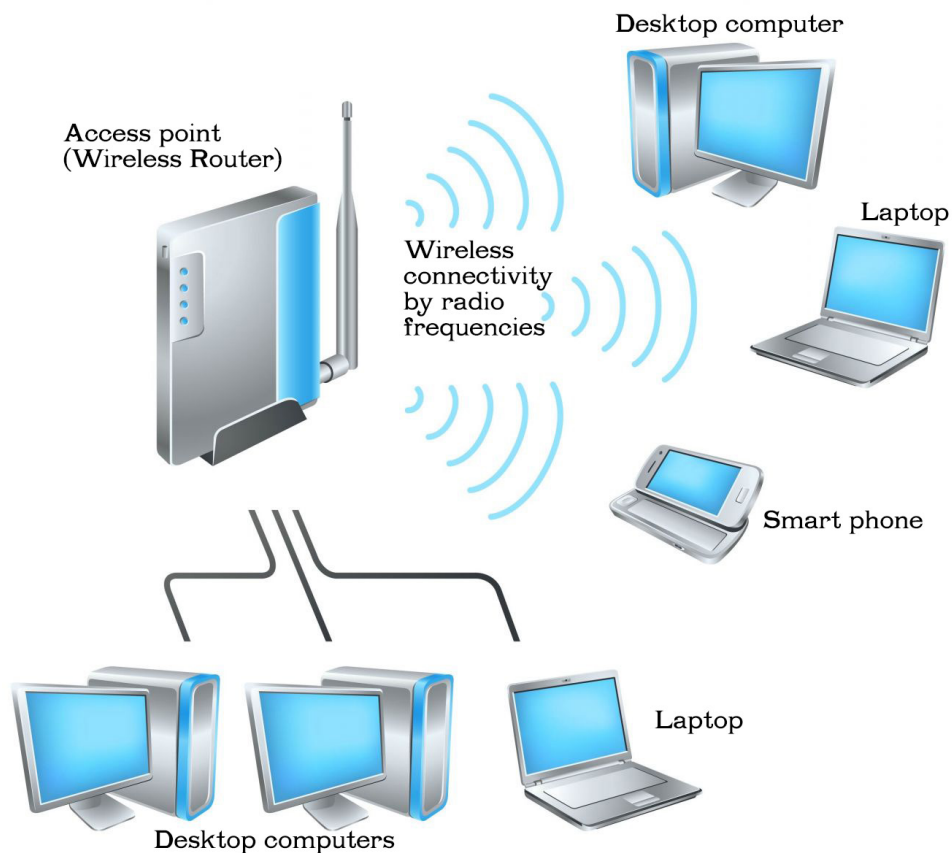
Figure 8.3: Computers in an Ethernet network

### 8.3.2 Connecting Devices Using Wireless Media

As the word **wireless** suggests, it means without wires. A wireless computer network, therefore, does not require a cable of any kind for connection. Sometimes the wireless network is also referred to as a **Wi-Fi** network. Wi-fi stands for **Wireless Fidelity**. It is a technology that allows computers, smart phones, or other devices to connect to the Internet or communicate with one another in a wireless network. The use of a wireless network enables devices to be connected to a network without the process of introducing cables into buildings. Instead, the devices are connected by radio waves.

In a wireless network there is a component called the **wireless router** or **access point**.

The wireless router or access point should be installed in a way that ensures that the network coverage is wide. In a large area, one may require more than one access point in order to have adequate coverage. One can also add access points to the existing wireless router to improve coverage.



*Figure 8.4: Devices connected in an wireless network*

In Windows 10 that you covered in Senior 1, you can connect to a **wireless hotspot** using your laptop.

A wireless hotspot is an area covered by a usable signal that allows wireless connection to the Internet or to some other computer network.

Wireless connections are secured by use of passwords. To connect to a locked hotspot, you must know the password.

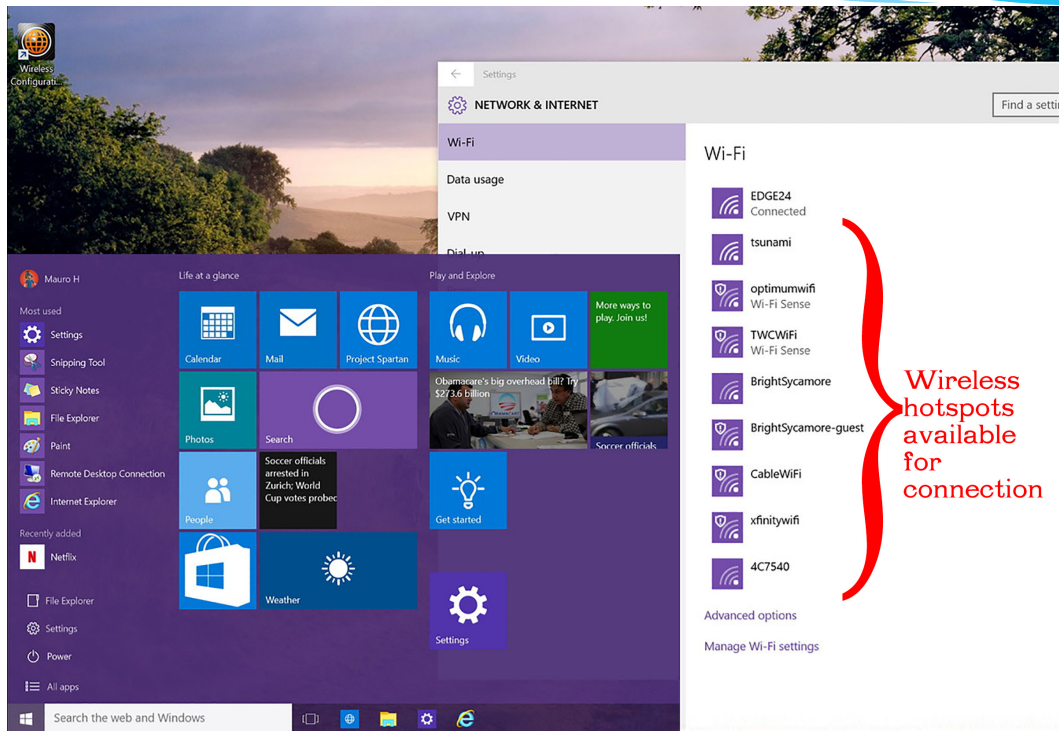


Figure 8.5: A laptop screen showing wireless connections available

## 8.4 Network Resources and Services

Computers in a network share resources. **Network resources** refer to forms of data, information, hardware devices, and software that can be accessed by a group of computers through the network. Network resources are also known as **shared resources**.

Shared resources are important in work environments where collaboration is essential to success.

### Network Services

The term network services refers to software and connectivity tools that are installed in a network. Network services are managed by a central server and are then distributed to the networked computers. The computers are able to access the shared files and other services from a central location.

In a computer network, the desktops connected are known as **client computers** or **workstations**.

The server may be located in a different room or building away from the workstations. The networked services are accessed through network cables or through a wireless network. Through the network, data is transferred within the network. Cables or wireless network connection also provide access to the Internet.



Some of the services offered by a network include:

- User management
- Email services
- File sharing
- System administration
- Shared printing
- Shared computer software

### 1. User management

- This involves the creation of user accounts. Each account contains user names and their respective passwords.
- It also involves allocation of user access rights and privileges to ensure data protection.
- For example, when a student joins a school, the **network administrator** creates a new account for the student to be able to access the network services. A **network administrator** is also called a **systems administrator**. This person manages the network in a school or organisation. The network administrator ensures that the computer network is up to date and running smoothly.

### 2. System Administration

- The system administrator is able to control all the computer users from a central location.
- The administrator is able to view what each user is doing with their computer and even control the kind of programs that the users can access.
- The system administrator can add new programs or update existing software from the network. This increases the overall quality of the network and reduces staff time spent on computer maintenance.

### 3. Email Services

- These are also known as webmail or online email services.
- Email services enable users in a network environment to send, receive and review e-mails from their workstations.
- Email services offer easy access and storage of e-mail messages for users.
- When logging into an email service, users type in their username and password. The messages are stored on the provider's server.

### 4. Shared Printing

- A printer is connected to a computer within a network.
- The shared printer can be used by all other computers within the network instead of having each computer connected to its own printer.

## 5. File sharing

- A computer network enables users to share files.
- You were introduced to Windows 10 in Senior 1. This operating system has the feature that allows you to share your files with others and access their files as well.
- The Share tab in the File Explorer has different tools and options you can use to share files within a computer network.
- File sharing allows students to collaborate when doing a project.

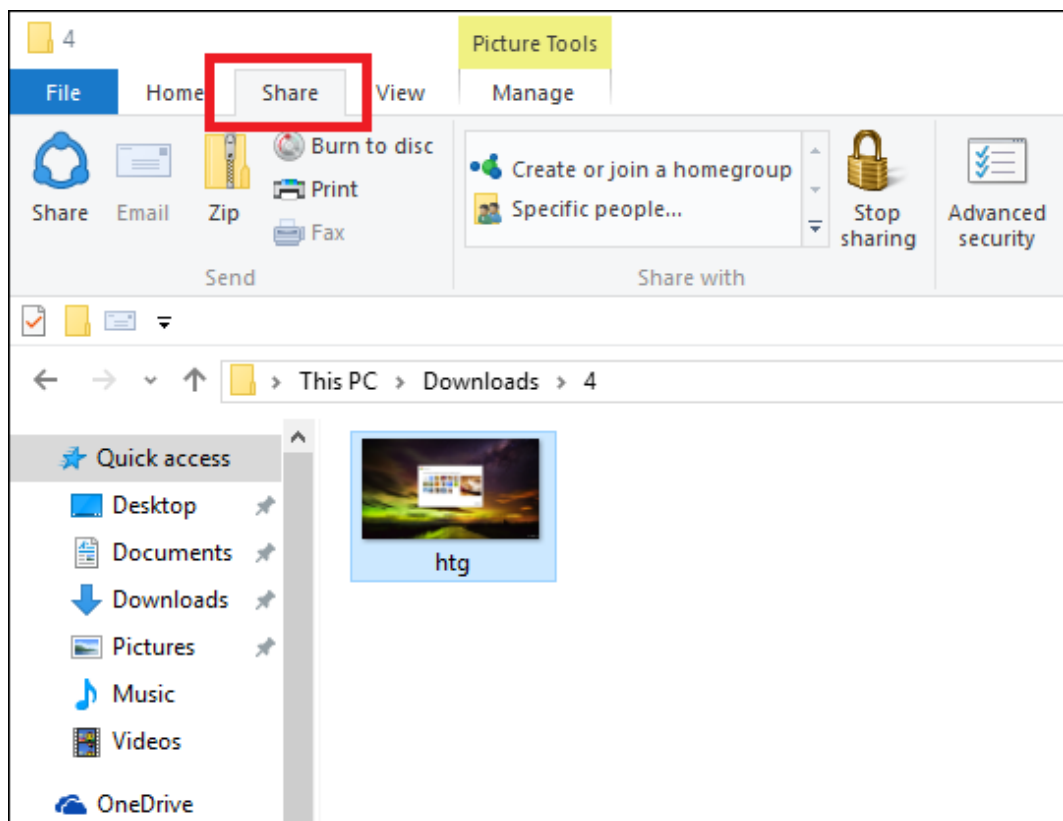


Figure 8.6: File sharing in a computer network

## 6. Shared Computer Software

- A computer network allows users to share software. Users do not have to install the application software on their different computers. The software is hosted on the server. In this way, the individual computers do not have to utilise disk space for installation.



### Revision Activity 8.1

#### Part A: Fill in the blank spaces with the correct answers

1. A system or a group of interconnected objects or people is known as \_\_\_\_\_.
2. \_\_\_\_\_ is a set of interconnected computing nodes that can exchange data or resources.
3. The set of rules that allow communication between two or more computing nodes are called \_\_\_\_\_.
4. The following letters can be re-arranged to form words relating to network resources. Identify the words and write them in the space provided.
  - (i) CSEVERIS \_\_\_\_\_
  - (ii) LAPICPIONTSA \_\_\_\_\_
5. Identify devices that can be connected in a computer network. (**Look for the words in this puzzle**)

Q	A	D	E	S	K	T	O	P	S	D
W	H	E	N	E	V	Y	N	R	C	R
E	M	T	E	O	U	P	A	I	A	E
R	H	E	S	G	T	R	E	N	T	N
L	A	P	T	O	P	O	W	T	E	N
T	O	P	A	L	D	E	S	E	T	A
Y	C	A	N	N	A	K	T	R	O	C
S	M	A	R	T	P	H	O	N	E	S

**Part B: Read the questions carefully and give the correct answers**

1. Define the term computer network.
2. Differentiate between a laptop and a desktop computer.
3. What is a computing node?
4. List **three** network services.
5. Give **three** types of devices that can be connected in a network.

**Part C: Read the questions carefully and give the correct answers**

- (a) Connect to a network and share two resources on the computer.
- (b) Explain two advantages of a computer network.

## 8.5 Network Medium

It is also known as transmission media or channels. They facilitate interconnection of computers and other devices in a network by providing a pathway through which data and information is carried from one point to another. Examples of transmission media are cables and radio waves.

### 8.5.1 Cables

They are also known as bounded or guided media. Data signals are carried from source to destination through a physical pathway that is restricted. They are made up of a conductor protected by a jacket insulating material.

There are three types of bounded media, namely **Twisted Pair Cable**, **Coaxial Cable**, and **Fibre Optic Cable**.

#### 1. Twisted-pair cable

This is a cable made up of pairs of insulated copper wires twisted along each other. The twists are done to protect the cable from crosstalk.

**Crosstalk** is interference that is caused by one or more wires. Crosstalk can cause errors, noise, or prevent cables from transmitting accurate data. They are usually packed as four sets of pairs in a cable. There are two types of twisted pair cables namely: **Unshielded Twisted Pair (UTP)** and **Shielded Twisted Pair (STP)**.

#### 2. Unshielded Twisted Pair

This is a type of twisted pair cable where each pair is not shielded from the others and hence the name unshielded twisted pair. This cable is vulnerable to noise whose source could be radio signals, radiation from spark plugs in motor vehicles and lightning sparks.

### 3. Shielded Twisted Pair

Each twisted pair has a shield around it protecting the pair from others. The shielding minimizes electromagnetic interference, as well as cross-talk from neighboring pairs.

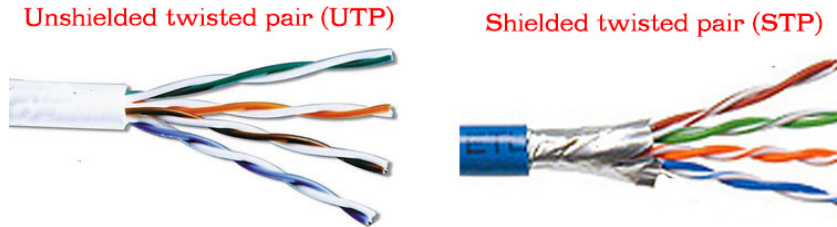


Figure 8.7: Types of twisted cables

#### Advantages of Twisted Pair

- It is easy to install.
- STP cables yield maximum bandwidth regardless of the external conditions. The shielding, however, makes the cable heavier and more difficult to bend.
- Cost of installation is low since the cables are readily available in the market.
- STPs are commonly used by large-scale companies in high-end applications that require the maximum bandwidth.
- It can carry only up to a maximum of 100Mbps (Megabits per second).

#### Disadvantages of Twisted Pair

- It is very sensitive to Electromagnetic Interference compared to other cables.
- UTP has a great disadvantage in that it has a limited bandwidth, which restricts long distance transmission with low error rates.

### 4. Coaxial Cable

This type of cable contains two conductors, namely copper wire which runs through the centre of the cable where the actual data travels and a shield made of wire mesh tube, metallic foil, or both.

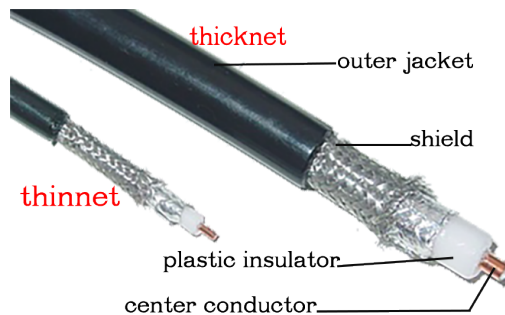


Figure 8.8: Coaxial cables

The copper wire is surrounded by plastic insulator which is covered by a conducting shield that acts as a return path and also filters Electromagnetic Interference (EMI).

The outer jacket which also acts as an insulator forms a protective covering for the cable. It resembles the cable used for connecting a television (TV) aerial to the TV set. It carries data in form of electrical signals.

There are two types of coaxial cable, namely **thinnet** and **thicknet**. Thicknet is also called **thickwire** and thinnet and called **Thinwire**. Thicknet and thinnet are commonly used terms for the larger and smaller size of coaxial cable used in Ethernet local area networks.

#### Advantages of Coaxial Cable

- It can carry data, voice and video signals. Therefore, it is commonly used in TV aerial cables.
- It is more resistant to radio and electromagnetic interferences (EMI) hence more stable than twisted pair.
- It can transmit up to one Gigabite per second (1Gbps).

#### Disadvantages of Coaxial Cable

- They are more expensive to buy as compared to twisted pair cables.
- Installation cost is high compared to twisted pair cables.

### 5. Fibre Optic cable

This type of cable uses glass material strands or fibres which are as thin as a human hair. Fibre optic cables carry digital information over long distances.

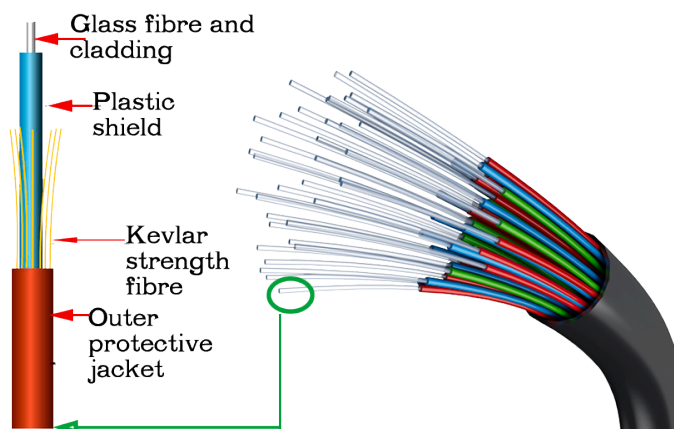



Figure 8.9: Fibre optic cable

Light is used to transmit data signals unlike in coaxial and twisted pair cables which use electrical signals. The electrical signal from the computing node is



converted to a light signal using a Light Emitting Diode (LED) or lasers and then they are transmitted through the cable. At the receiver the light signals are converted back to electrical signals by a photosensitive device.

### Advantages of fibre optic cable

Note the following facts about fibre optic cables:

- Fibre is thinner and smaller than other types of cabling such as copper. They are therefore lightweight. They are suitable for situations where space is limited.
- Fibre optics have more bandwidth. This means that fibre optics can carry more information with far greater efficiency than cables. This translates to faster internet speed.
- Fibre optic cabling is easier to work with and transport.
- Fibre optics are more secure.
- Fibre optics are more efficient. Signals sent over fibre optics do not reduce nearly as quickly as those sent over copper wiring. There is nearly no signal loss in many situations.
- Fibre optics use less energy. Lower energy requirements means that fibre optics are more friendly to the environment.
- Fibre optics use light. Since there is no electrical current passing through a fibre optic cable, there is no heat. No heat means that fibre optic cabling is not a fire hazard in the same way that metal wiring is.
- Fibre optic cables are not affected by weather conditions such as changes in the temperature, rain, cold, or any other environmental conditions.
- Fibre optics are faster. Data is transmitted faster because of the increased capacity of fibre optic cables.
- Fibre optic cables are immune to Electromagnetic Interference (EMI). They do not generate electrical signals hence can be used in dangerous places such as flammable areas.

### Disadvantages of fibre optic cable

- They require expensive connectivity devices and media.
- Their installation is a delicate process because the cables must be handled carefully.
- They are relatively complex to configure.
- A broken fibre optic cable is difficult and expensive to repair.

## 8.5.2 Wireless Connectivity

### 1. Radio waves

They travel just like surface water waves that is, when an object is dropped in a body of water, waves move out from the object in all directions (omnidirectional). This means that radio waves start from a central point and spread outwards over the covered area hence they travel in all directions from the source.

As they travel outward, their energy spreads outwards over the covered area. They have no physical link between sender and receiver. They are also known as unbounded, unguided or wireless media. Usually radio waves are sent through the atmosphere.

At the source there is a transmitting antenna which propagates the signals and at the destination there is a receiver antenna which collects the signals.

Radio waves are used in radio and television broadcasts, but they can also be used to transmit data. Radio waves can be of High Frequency (HF), Very High Frequency (VHF) or Ultra-High Frequency (UHF).

### 2. Infrared transmission

Infrared does not penetrate walls or solid objects hence security and interference problems are not encountered. There is no frequency allocation issue since no licence is required. This technology is used in TV remote control and wireless computer networking.

For transmission to take place, there must be a transceiver to aid in the communication. Transceivers must be in close range with each other, either directly or via reflection from a light-coloured surface such as the ceiling of a room.

### 3. Bluetooth

This is a technology that enables the connection of electronic devices over a short distance of up to about 10 metres creating a Personal Area Network (PAN) with a high level of security.

This technology can be used with cell phones, personal computers, laptops, printers, digital cameras and telephones among others. It is also an example of radio transmission technology. It is not licensed, therefore, communication takes place at no cost.

To connect a laptop to a Bluetooth network, do the following:

- (i) Click on the **Bluetooth** icon on the task bar as shown in Figure 8.10.
- (ii) Ensure that the Bluetooth feature in the other device is activated.

- (iii) Click on **Add a Bluetooth Device** for the system to automatically locate a nearby Bluetooth device.
- (iv) Pair the devices then click **Join a Personal Area Network**.

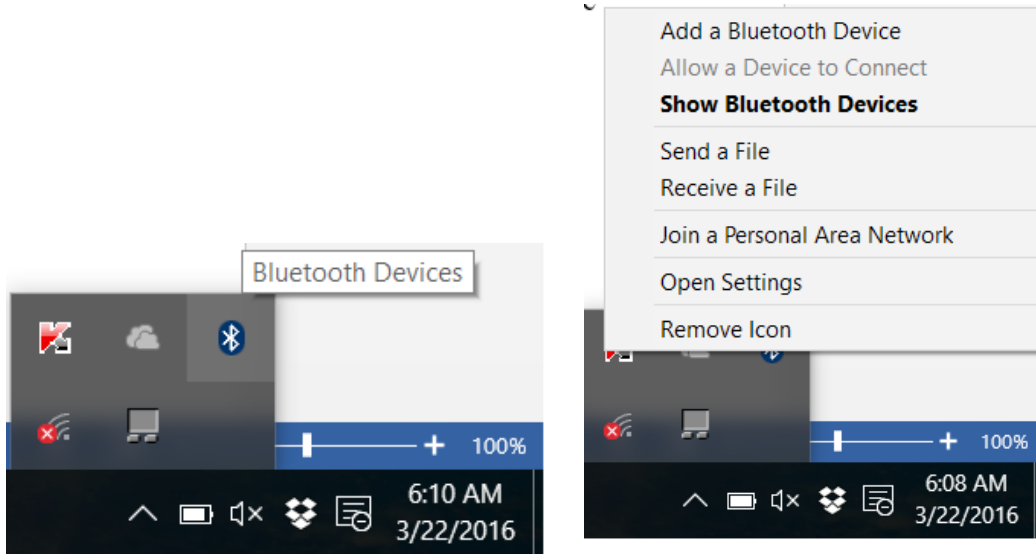


Figure 8.10 : Connecting via Bluetooth

#### 4. Wi-Fi (Wireless Fidelity)

It is a wireless networking technology that uses radio waves to provide high-speed Internet and networking connections. Examples of WiFi-enabled devices include laptops, cell phones, tablets, iPads, peripheral devices such as printers and keyboards among others. They communicate with a single computer which is fitted with a **WiFi adapter**.

##### Advantages of wireless communication

- Allows users of the network to roam without losing access to the network.
- It is easier to add and remove nodes.
- It is ideal for use in networks that cover a wider geographical area.
- Enables communication in remote areas where the laying of cables is not possible.

##### Disadvantages of wireless communication

- Initial installation cost is very high.
- Security of information can be compromised since it can be easily tapped.
- Speed is slower than the use of fibre optic.

## Revision Activity 8.2

### Part A: Fill in the blanks with the correct answers

- Write the following abbreviations in full:  
(a) Wi-Fi \_\_\_\_\_ (b) HF \_\_\_\_\_  
(c) LED \_\_\_\_\_ (d) UTP \_\_\_\_\_
- An optical material that surrounds the core is known as \_\_\_\_\_.
- Radio waves is an example of \_\_\_\_\_ media.
- What is the other term for:  
(a) Bounded media \_\_\_\_\_  
(b) Unbounded media \_\_\_\_\_
- STP is a type of \_\_\_\_\_ cables.

### Part B: Read the questions carefully and give the correct answers

- State two advantages of each of the following media:  
(a) Twisted pair  
(b) Fibre optic cable
- Give **three** advantages of wireless communication.
- Define the following terms:  
(a) Bluetooth  
(b) Network media
- State **two** disadvantages of twisted pair cable.

### Part C

- Identify the various types of network connectivity.
- Connect to a Bluetooth enabled network and share files of your choice.

## 8.6 Computer Network Devices

They are communication devices that are used in networking. They are used in between the DTE and transmission media to provide an interface or junction for the network to be fully operational.

They are also known as Data Circuit Terminating Equipment (DCE). Examples of computer network devices include: Switch, Hub, Access Point, Router and Multifunctional device.

### 8.6.1 Hub

A hub is a connection point in a network. The hub connects many computing nodes together and is able to send signals from one node to another on the same network.



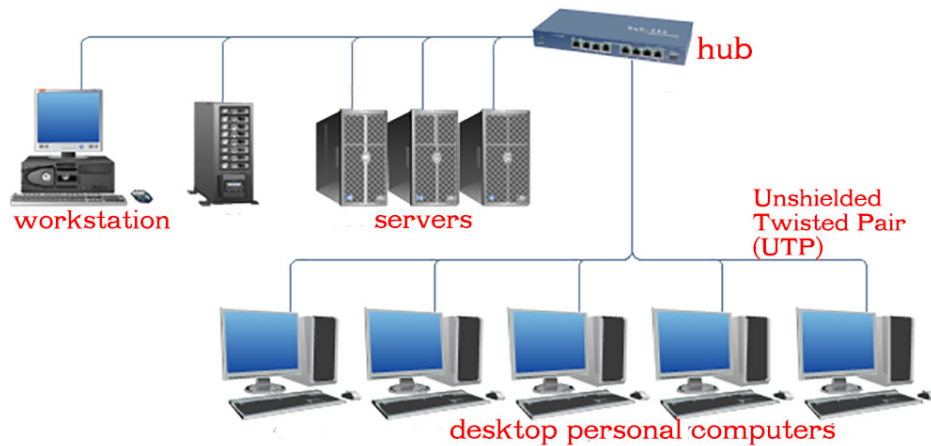


Figure 8.11: A hub that has devices connected to it

A hub connect networks that have the same rules and it transmits signals by broadcasting them to all the computing nodes in the network.

### 8.6.2 Switch

A switch is similar to a hub in physical structure except that it forwards data directly to its destination address without broadcasting it to all the other nodes in the network. Figure 8.12 shows computers in a network connected through a switch.

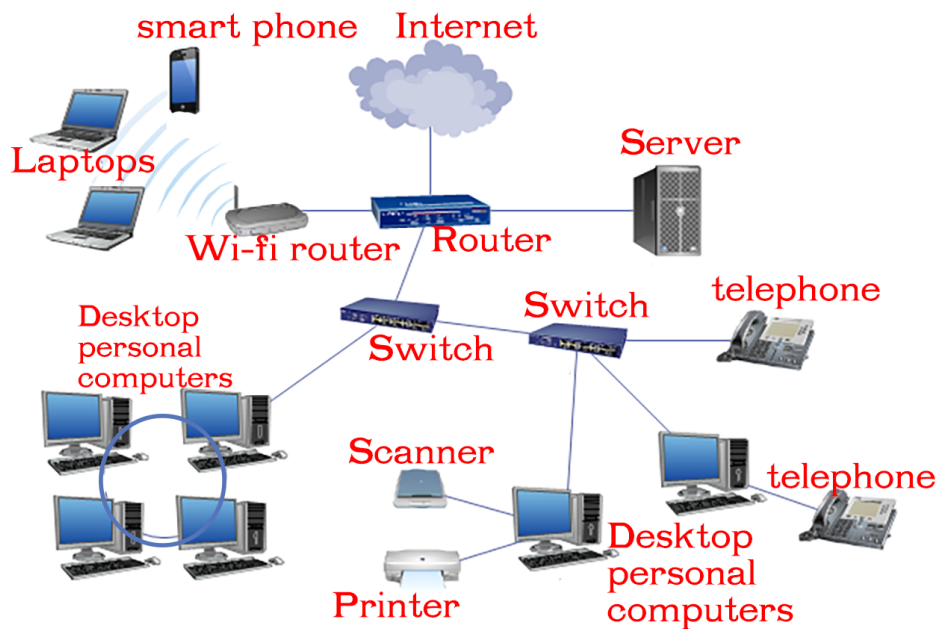


Figure 8.12: Computers connected to a network switch

In order for a switch to be able to perform its function, it has to keep records of the addresses of all the nodes in the network.

When a data signal is received, it goes through the records to confirm the address and transmits the signal directly to the device whose address matches the one in the signal.

### 8.6.3 Wireless Access Points (WAP)

In a wireless computer network, a **wireless access point** (WAP) is a hardware device that allows a Wi-Fi enabled devices such as tablets, laptops, and smartphones to connect to a wired network.

### 8.6.4 Router

It is a device that connects two different networks and sends data signals from one network to another. For example, it can connect a Local Area Network to a Wide Area Network.

A router performs a routing function. **Routing** is the process of moving data signals across a network from the source node to the destination node.

A router performs its function by listening to the entire network to determine the best path to route a data signal based on the destination address and the source.

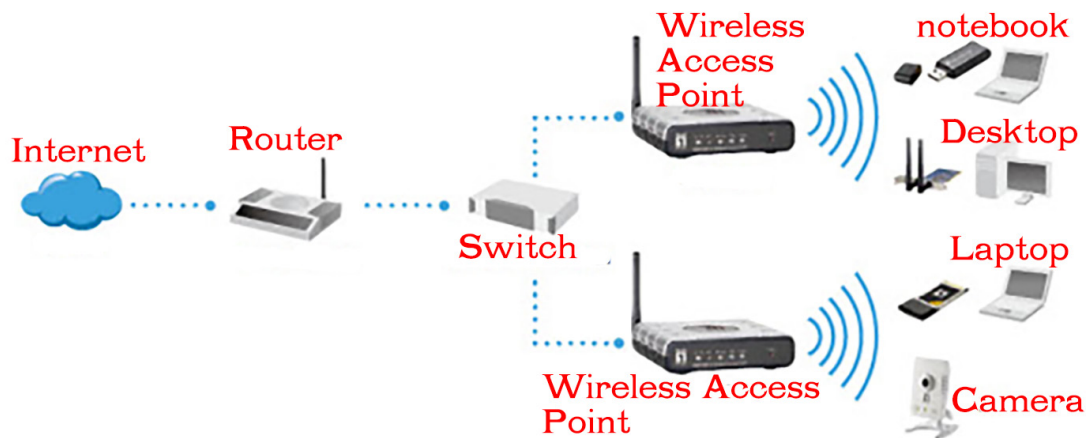


Figure 8.13: A network using a Wireless Access Point (WAP)

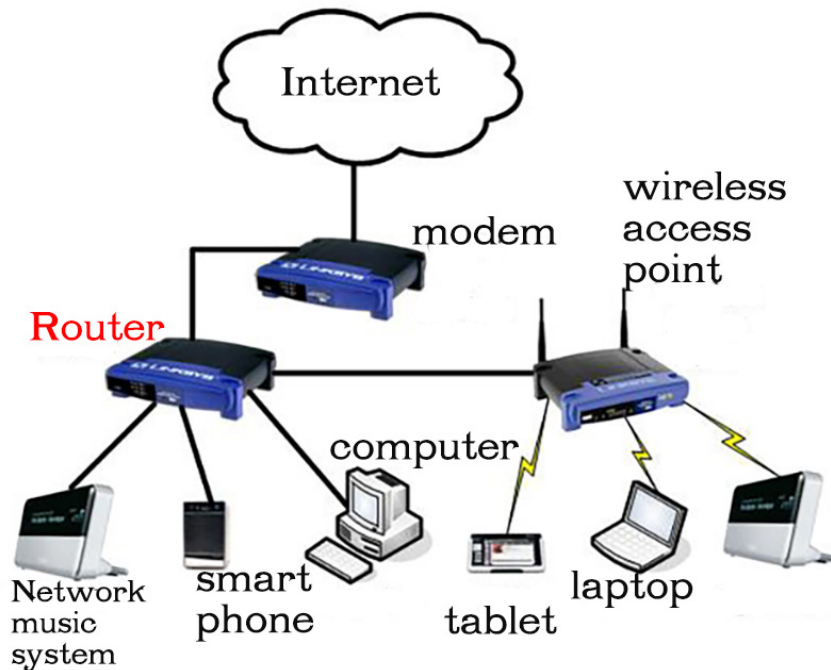


Figure 8.14: A Router

## 8.7 Network Peripherals

With Internet connectivity, computers can easily be connected to a network. Networking peripherals refer to hardware equipment, which enables computers to network.

Examples include hardware such as routers, switches, access points, network interface cards, and other hardware devices.

Hubs, switches, and routers are all devices that allow computers to be connected to other computers, other network devices, or even other networks. Each of the above peripherals has two or more connectors called ports. In connecting devices, the connecting cables are plugged in through the ports.

A network peripheral can also be a device that can be connected to a computer in the network either through the ports using data interface cables or using wireless media. Examples are: printers and scanners.

- **Scanners:** These are peripheral devices that input data by capturing the data directly from the source to the computer and convert it into a digital format. They are used for making turnaround documents. A turnaround document is a hardcopy output that has been taken back to softcopy for further processing. A scanner in a network can be used by several computers in a network, if it is shared.

- **Printers:** A printer is an output device that produces hardcopy output usually on a physical print medium such as paper. A printer in a network can serve many computers which submit their print jobs to it. If more than one computer sends a job to the printer at the same time, the submitted jobs are placed in a queue. The jobs in the queue are printed one after the other in the order in which they are admitted in the queue until they are completed.

### Practice Activity 8.1: Connecting network peripherals

#### Part A: Do this activity:

Implement a peer-to-peer network. This is a simple network in which less than ten computers are connected.

All the computers have the same status. That explains the term 'peer'. The computers are connected and can communicate with each other.

In this kind of network you will be able to share files, such as word processing or spreadsheet documents.

You will also be able to share devices, such as printers or scanners, which are connected to any one computer.

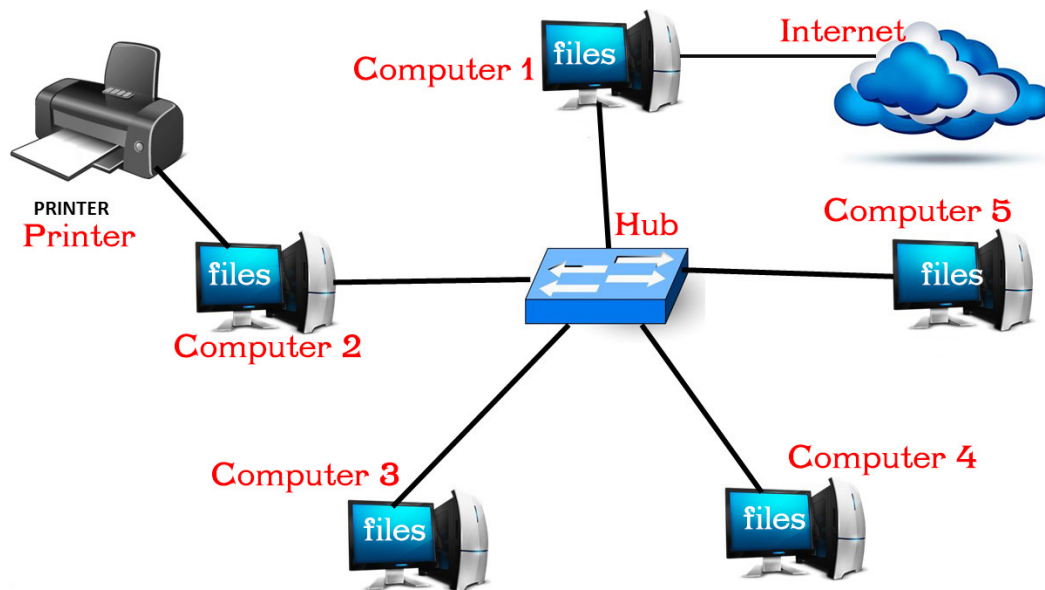


Figure 8.15: A peer to peer network

### Revision Activity 8.3

#### Part A: Fill in the blanks with the correct answers

- Write the following abbreviations in full:
  - DCE \_\_\_\_\_
  - LED \_\_\_\_\_
  - DTE \_\_\_\_\_
  - AP \_\_\_\_\_
- A network device that forwards data directly to its destination address without broadcasting is known as \_\_\_\_\_.
- A hub connects networks that have the same \_\_\_\_\_.
- Access points are devices used on a \_\_\_\_\_ network.
- A \_\_\_\_\_ is a device that can connect to a Local Area Network to a Wide Area Network.

#### Part B: Read the following questions carefully and answer them correctly

- Define the term multifunction media.
- State the function of a router.
- Differentiate between a switch and a hub.
- Explain the term routing.
- List **two** types of network peripherals.

#### Part C: Connect various devices in a network:

You could connect two phones via Bluetooth; a laptop to a wireless hotspot. Identify other devices that you could connect within your environment.

## 8.8 Social Media

Social media refers to Internet-based applications that enable users to create and exchange information, career interest ideas and other content such as images or videos. They enable people to participate in group networking.

### 8.8.1 Value of Social Media

The following are some of the values of social media:

- Clarity of information:** The information should be clear and easy to understand in order to be very helpful.
- Effectiveness:** Only write or talk about something when there is solid evidence that it is true.
- Interesting:** One should not be boring. Ensure that the information is engaging and interesting.

- **Respectful:** One should be careful to be respectful and to appreciate diverse points of view with openness and inclusion.

### 8.8.2 Social Media Best Practices

The following are some of the social media best practices:

- **Transparency:** Being open builds trust among the social media members. It creates links to connect us with one another by always keeping in touch.
- **Be genuine:** Be the real person the members would have the pleasure to know.
- **Be interested in others:** Be a good listener. This shows that one takes an interest in other people.
- **Follow back and interact:** The interacting members should always be in contact. This creates a healthy goodwill for chatting with each other.
- **Do not overshare:** Always focus on sharing items that are of value to members.
- **Respond to positive and negative comments:** Do not only respond to positive comments; pay attention to negative comments as well and respond with maturity. Use good judgement to determine which ones to ignore.
- **Keep it short:** Some social media platforms, for example, Twitter limit the number of characters in a message Others such as Facebook and Google+ do not have this limit. Strive to keep your messages short.

### 8.8.3 Examples of Social Media

Some examples of social media include Facebook, Twitter, Google+, LinkedIn, YouTube, Blogging platforms, and Skype among others.

#### Facebook

This is a popular free online social networking website that allows registered users to create profiles, share information such as messages, games, photos and video and keep in touch with friends, family and colleagues.



Figure 8.16: Facebook Logo

#### Practice Activity 8.2: Log in to Facebook

##### Do this activity:

Log in to Facebook or sign up for an account. Search “Facebook” on Google, and follow the instructions given:

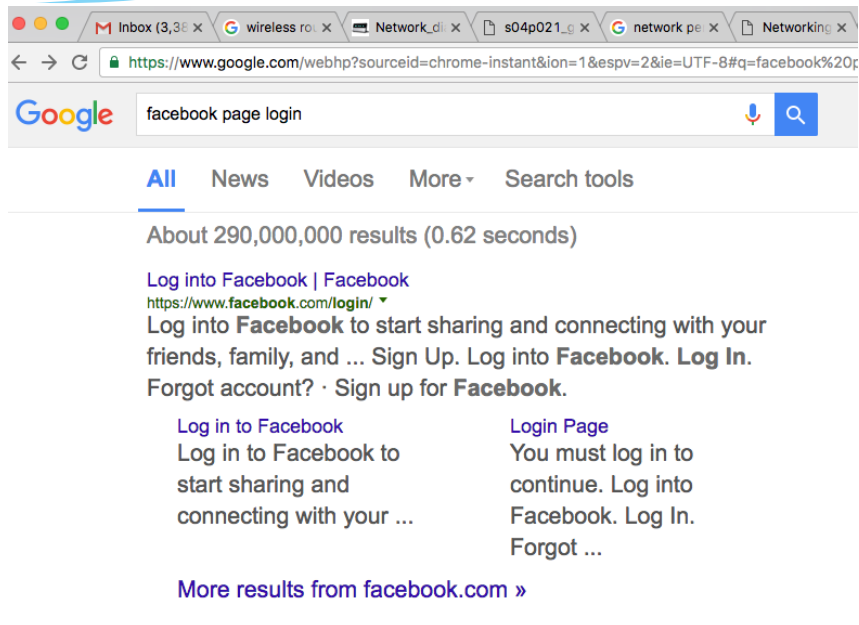


Figure 8.17: Logging in to Facebook

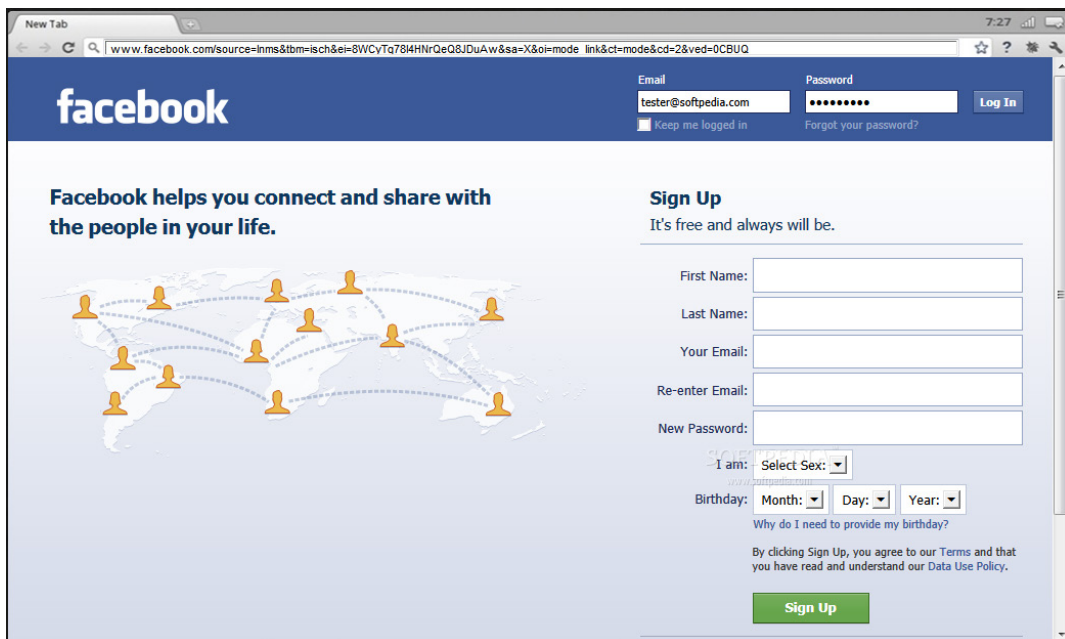


Figure 8.18: Log in to Facebook

## Twitter

This is a free online social networking service that allows registered members to send short messages or short posts referred to as tweets.

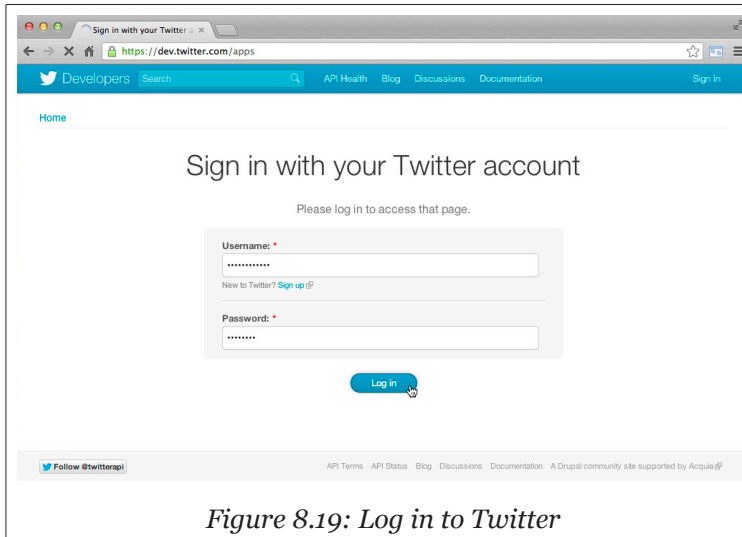


Figure 8.19: Log in to Twitter



Figure 8.20: Twitter Logo

### Practice Activity 8.3: Log in to Twitter

#### Do this activity:

Log in to Twitter or sign up for an account. Search “Twitter” on Google, and follow the instructions given:

### Google+

It is pronounced **Google plus**. This is a social networking site that is designed by Google to imitate the way people interact offline more closely as compared to other social networking services. It is also used to share other articles on other websites.

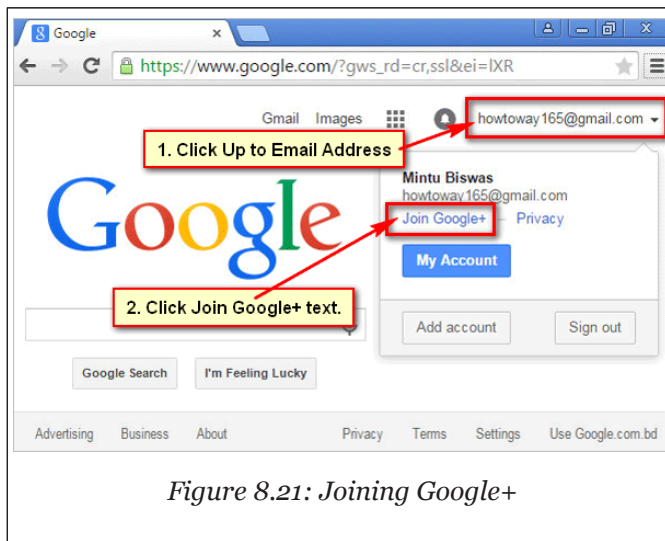


Figure 8.21: Joining Google+



Figure 8.22: Google+ Logo



### Practice Activity 8.4: Log in to Google+

**Do this activity:** Log in to Google+ or sign up for an account. Search “Google+” on a search engine, and follow the instructions given:

### LinkedIn

This is a social networking site designed for professional networking. It allows registered members to establish and document networks of people they know and trust professionally.

To log in to LinkedIn or sign up for an account, search “LinkedIn” on Google, and follow the instructions given.



Figure 8.23(a): LinkedIn Logo

A screenshot of the LinkedIn registration page. The background is teal. At the top, the LinkedIn logo is displayed. Below it, the text "Make the most of your professional life" is centered. The registration form is a white box with the following fields: "First name", "Last name", "Email", and "Password (6 or more characters)". Below the password field, there is a line of small text: "By clicking Join now, you agree to LinkedIn's User Agreement, Privacy Policy, and Cookie Policy." Below this text is a blue button labeled "Join now". Underneath the button is the word "or" flanked by horizontal lines. Below that is a blue button with the Facebook logo and the text "Continue with Facebook". At the bottom of the form, it says "Already on LinkedIn? Sign in". At the very bottom of the teal background, it says "LinkedIn Corporation © 2016".

Figure 8.23: Registering a LinkedIn account

### YouTube

This is a free social media site that allows a user to upload, share or watch video content posted from other users.

To log in to YouTube or sign up for an account, search “YouTube” on Google, and follow the instructions given.



Figure 8.24: YouTube Logo



Email Address:

Username:   
Your username can only contain letters A-Z or numbers 0-9  
[Check Availability](#)

Location:

Postal Code:

Date of Birth:

Gender:  Male  Female

Let others find my channel on YouTube if they have my email address

I would like to receive occasional product-related email communications that YouTube believes would be of interest to me

Terms of Use: Please review the Google Terms of Service and YouTube Terms of Use below:

1. Your Acceptance

Uploading materials that you do not own is a copyright violation and against the law. If you upload material you do not own, your account will be deleted.

Figure 8.25: Registering a YouTube account

### Practice Activity 8.5: Log in to YouTube

**Do this activity:** Log in to YouTube or sign up for an account. Search “YouTube” on Google, and follow the instructions given:

### Blogging

A blog is a website that contains online personal content such as opinions, reflections, comments and experiences provided by the writer. It usually has images and links to other websites.

**Blogging** is the act of posting content on a blog or posting content on another person’s blog. Examples of blogging platforms are Wordpress, Blogspot, Tumblr, Weebly, LiveJournal, and Blogger.

### Skype

Skype is a social media service that enables file transfers, texting, calling and video conferencing. It is a service that can be accessed using desktop computers, laptop/notebooks or tablets and other mobile devices, such as mobile phones.



Figure 8.26: Skype Logo

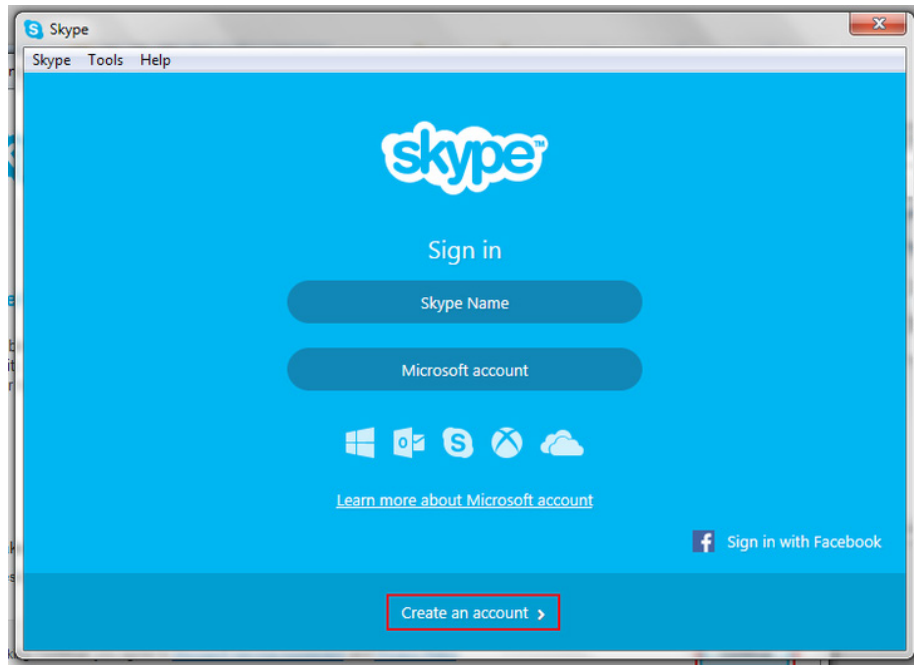


Figure 8.26: Creating a Skype Account

## 8.9 Definition of Key Words in this Unit

### Revision Activity 8.4

Find out the meaning of the words given below. Share your findings with the rest of the students in a class presentation. Check the meanings you find against those provided in the glossary at the end of this course book:

Smartphone	Switch	Coaxial cable
Fibre optic cable	Twisted pair cable	Radio waves
Infrared	Bluetooth	Hub
Access point	Router Wi-Fi	Protocol
Multifunctional device	Social media	Facebook
Twitter	LinkedIn	Blogging
Skype	PDA	Google+

## Revision Exercise 8

1. Define the following terms:
  - (a) Computer network
  - (b) Network devices
2. Explain **three** benefits that an institution would gain by installing a computer network.
3. Name **two** types of twisted cables.
4. (a) Identify the transmission media depicted by figure x.

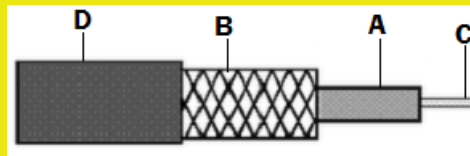


Figure x

- (b) Name the parts labelled A to D.
5. Apart from printers and scanners, give **two** other network peripheral devices.
  6. Describe the following types of transmission media:
    - (a) Twisted pair
    - (b) Coaxial cable
    - (c) Fibre optic cable
  7. At the Football World Cup, officials and photographers will have wireless-enabled notebook computers. These will be used to update results, statistics and photographs for the website.

The digital video cameras are connected to computers and may transmit their video images to the temporary server by wireless or cable network.

    - (a) State **two** disadvantages of using wireless network.
    - (b) Identify **two** networking resources that will be used.
    - (c) Identify **one** network peripheral that will be used.
  8. Social media is today becoming very popular in communication. List **three** examples of social media.
  9. State **three** best practices of social media.
  10. Mention **two** values of social media.

# Unit 9



## Game Programming (Scratch)

**Key Unit Competency: By the end of this unit, you should be able to:**

Design a game, collect data in a table and add game rules.

### Introduction

Game programming is the process of writing codes that make things happen in a video game. It involves taking the design specifications of the game designs, combining the art and sound and translating it all into a playable game.

The educational value of game programming in Scratch extends beyond providing an easy and interesting introduction to programming. Programming requires logical thinking, critical reasoning, problem identification and solving skills and persistence.

### 9.1 Game Concepts

To create a basic game, the student must have an idea of the game name, list of sprites, sprite interaction, backgrounds and the counter rule and level advancement rule.

The following stages are involved when creating a game to ensure clarity and greater understanding:

- (i) Design the game.
- (ii) Create game sprites.
- (iii) Add game rules to game sprite(s).
- (iv) Change background when the sprite moves.
- (v) Manage scores and levels.

#### 9.1.1 Game Name

When creating a game, it is important to assign a unique name to it. This is done in order to be able to retrieve and play the game easily. It is good practice to have the name of the game related to the nature of the game.

#### For example:

When creating a Cat and Mouse game a favourable name would be:

**Cat\_Mouse Game.**

## 9.1.2 List of Sprites

### Designing a Game

This involves creating a basic table that can be filled in as shown below:

<b>Game Name</b>	<b>Desired game name, for example, Cat_Mouse Game</b>
<b>Sprites</b>	List of sprites in the game (Sprite name, Costumes, Sounds, Movements)
<b>Sprite Interaction</b>	Relationship between sprites in the game.
<b>Backgrounds</b>	The area that is behind the sprites, forming the setting for it. For example, the <b>Blue sky</b> available in the <b>Backdrop Library</b>
<b>Scores and Levels</b>	The score counter rule and level of advancement rule used to determine the result of the game.

Table 9.1: Aspects of a game

After creating a basic table, it can be expanded by placing each item to its own table as shown in the **Cat-Mouse-Cake Game** example below:

#### Example 9.1

- (i) The **Cat** moves back and forth across the screen and keeps moving in one direction. When it hits the edge of the stage, it bounces back. When the **Cat** touches the **Mouse**, it produces the sound, **Meow2** and the thought bubble **Meow!!!** is displayed. The background switches to **Brick Wall1** when the **Cat** eats the **Mouse**.
- (ii) The **Mouse** reappears after four seconds.
- (iii) The **Mouse** chases the mouse-pointer in steps and when it touches the **Cat** sprite, it disappears. The **Mouse** reappears after a certain period of time.
- (iii) The **Cake** disappears when it is touched by the **Mouse**; that is, it is eaten. The background switches to **Garden Rock** when the **Cake** is eaten and the **Cake** keeps changing between **Cake-a** and **Cake-b** costumes.

The following are the relevant tables that can be associated with this game.

#### (a) Game Name Table

<b>Game Name</b>	<b>Cat_Mouse_Cake</b>
------------------	-----------------------

Table 9.2: Game name table for the Cat\_Mouse table.

### (b) Sprites Table

The table below provides a list of the sprites in a project with details about the name, costumes, sounds and movements.

	Name	Costumes	Sounds	Movements
Sprites	Cat	None	Meow 2	Run
	Mouse	None	Pop	Run
	Cake	<ul style="list-style-type: none"><li>• Cake-a</li><li>• Cake-b</li></ul>	None	None

Table 9.3: List of sprites in the Cat\_Mouse\_Cake game

### (c) Sprite Interaction Table


The table below lists all the relevant interactions between various sprites in the project.

Sprite 1	Sprite 2	Interaction
Cat	Mouse	If the <b>Cat</b> touches the <b>Mouse</b> , the <b>Mouse</b> disappears.
Mouse	Cake	If the <b>Mouse</b> touches the <b>Cake</b> , the <b>Cake</b> disappears.

Table 9.4: Interaction of sprites in the Cat\_Mouse\_Cake game

### (d) Backgrounds Table

The table below lists the relevant backgrounds in the project.

Name	Description
 Level 1_1	Start of the game, all sprites displayed.



Name	Description
 Level 1_2	Cat and Mouse as enemies.
 Level 2_1	Mouse and Cake as enemies.
Level 2_2	Garden rock

Table 9.5: Backgrounds table

(e) Levels Table



Level	Requirement for this level	Starting Background	Ending Background
1	When the game is started	 <i>Doily Level 1_1</i>	 or  <i>Brick wall Level 1_2 or Garden rock Level 2_2</i>
2	When the cat catches the mouse	 <i>Doily Level 1_1</i>	 <i>Brick wall Level 1_2</i>
3	When the Mouse eats the Cake.	<i>Doily Level 1_1</i> or <i>Brick wall Level 1_2</i>	 <i>Garden rock Level 2_2</i>

Table 9.5: Levels table



## Costumes

Sprites can have different costumes. Once a sprite has been inserted in a game, its appearance can change to any of the available costumes. The game designer can also draw a costume for a sprite.

However, some sprites do not have costumes. In the *Cat\_Mouse\_Cake* game, the cake has two costumes, namely *cake-a* and *cake-b*. The mouse and cat do not have costumes. To switch between costumes, do the following:

- (i) Select the sprite if already inserted, otherwise insert the sprite.
- (ii) Click on the costume tab.
- (iii) Select the desired costume from the available thumbnails displayed.

Figure 9.1 shows the available Cake costumes in this game.

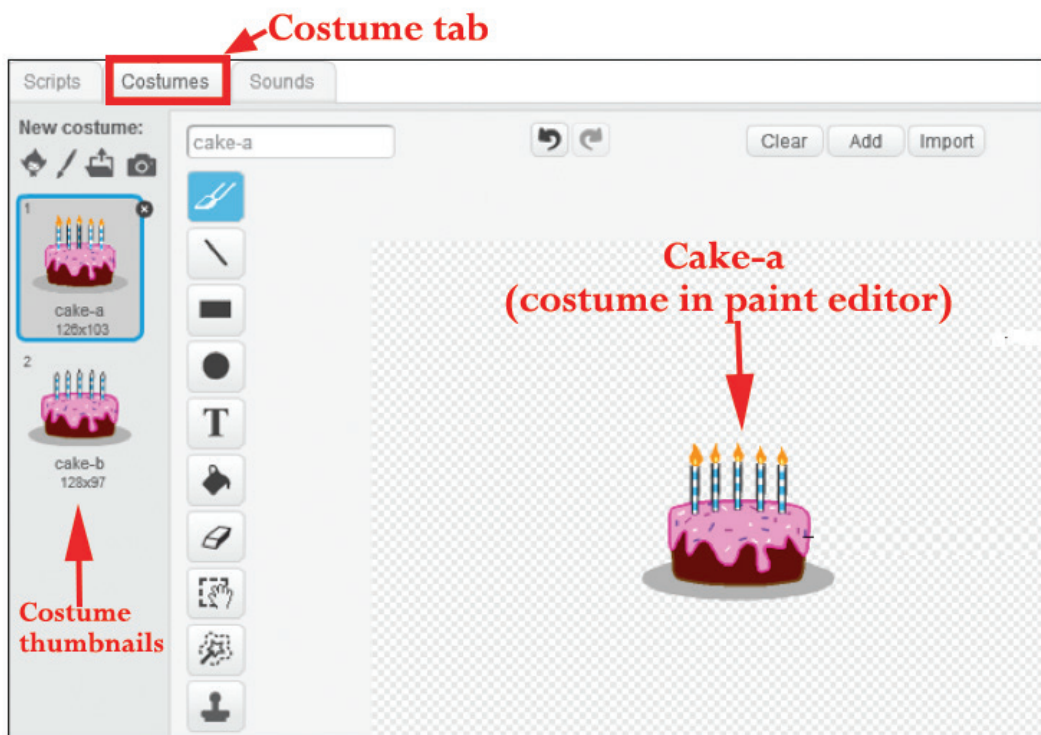


Figure 9.1: Cake costumes

## Sounds

A sprite existing in a game can be assigned a sound. By default, some sprites do not have sounds assigned to them.

The designer can choose sound from the sounds library, record new sound or

upload a sound from file. In the `Cat_Mouse_Cake` game described above, the Cat has the **Meow** sound.

To assign a sound to a sprite, do the following:

- (i) Select the **Sprite**.
- (ii) Click on the **Sounds** tab.
- (iii) Select the sound from the thumbnail displayed. If no sound is displayed in the thumbnail area, click on the **Speaker** icon to choose sound from library, click the **Record** button icon to record new sound or click on **Folder/Import** button to select the sound file from the computer.

Figure 9.2 shows the available Cat sound.

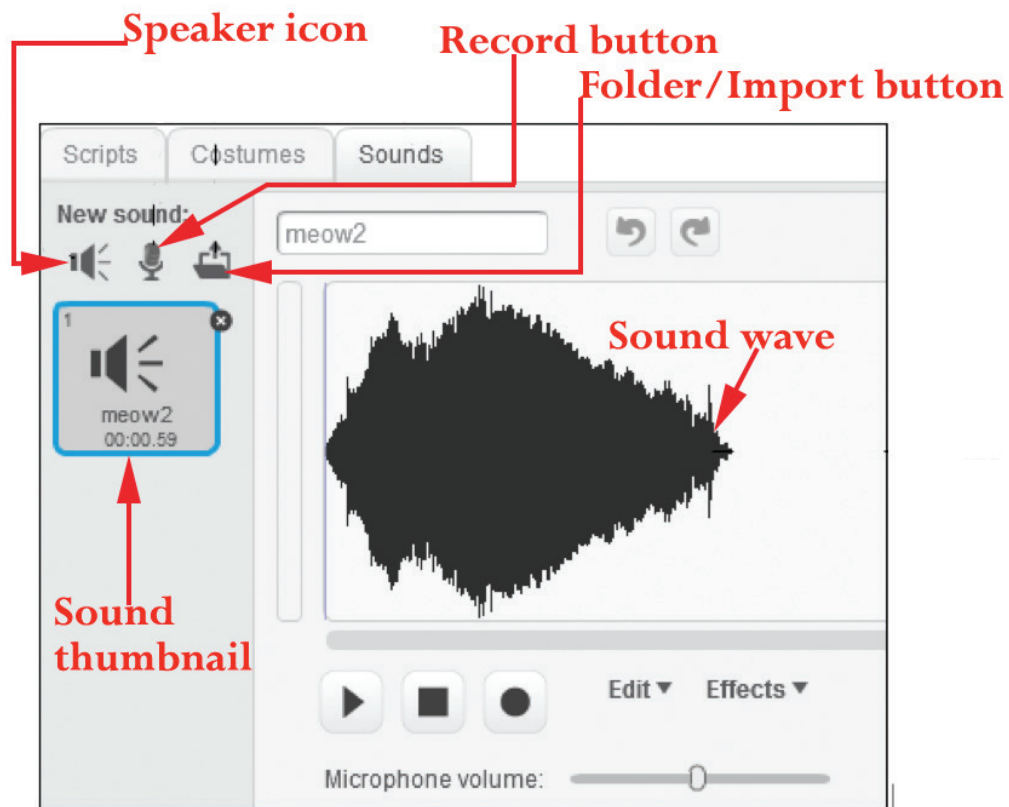


Figure 9.2: Sounds tab displaying selected sound

### Movement

Sprite movement is also referred to as sprite action. The **Motion** block palette contains the commands for assigning controlling movement to a sprite. There are

seventeen Motion blocks categorized into two namely **Motion Stack** blocks and **Motion Reporter** blocks with fourteen and three blocks respectively.

Figure 9.3 shows the Motion Stack blocks.

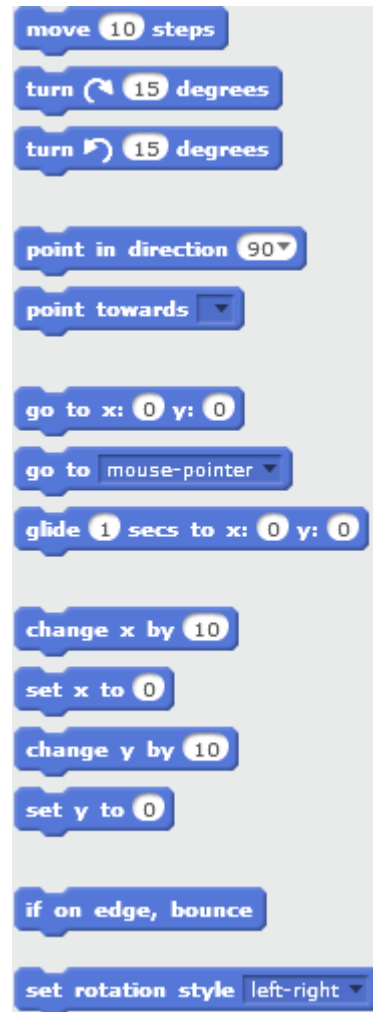


Figure 9.3: Motion Stack blocks

- **Move () steps:** Moves the sprite in the direction it is facing the amount of steps specified.
- **Turn () degrees:** Turns the sprite either clockwise or anti-clockwise by the specified amount of degrees.
- **Point in direction ():** Points the sprite in the direction specified.
- **Point towards ():** Points the sprite towards the mouse-pointer or the selected sprite.

- **Go to x: () y: ()**: Moves the sprite to the specified x and y positions.
- **Go to ()**: Moves the sprite to the mouse-pointer or the selected sprite.
- **Glide () secs to x: () y: ()**: Moves a sprite smoothly to an x y position on the stage by the amount of time specified.
- **Change x by ()**: Changes the x position of the sprite by the amount specified.
- **Set x to ()**: Sets the x position of the sprite by the amount specified.
- **Change y by ()**: Changes the y position of the sprite by the amount specified.
- **Set y to ()**: Sets the y position of the sprite by the amount specified.
- **If on edge, bounce**: This means that if the sprite is touching the edge of the screen, its direction turns over quickly or reverses.
- **Set rotation style ()**: Determines the manner in which the sprite rotates.

The following are **Motion Reporter** blocks:

- **X position**: Displays the X position of the sprite.
- **Y position**: Displays the Y position of the sprite.
- **Direction**: Displays the direction of the sprite.



Figure 9.4: Motion Reporter blocks

Check-marking the Reporter block option displays a counter at the stage area.


### 9.1.3 How Sprites Interact in this Game

In a game different sprites interact with each other for the success of the game. In the interaction class, there are different commands which are used when creating a game. In the example of **Cat\_Mouse\_Cake** game, the sprites name Cat, Mouse, and Cake relate with one another as shown earlier in Table 9.4.

### 9.1.4 List of Backgrounds

The term background refers to those things that can be seen behind the main things. There are various backgrounds in Scratch and can be accessed through the backdrop pane. The user can choose a backdrop from library, paint a new backdrop, upload a backdrop from file or get a new backdrop from camera.

To apply a background in a game, do the following:

- (i) Click on the icons under **New backdrop** and select the desired option.
- (ii) To choose backdrop from library, click the **Choose backdrop from library**  icon. This displays the **Backdrop Library**.
- (iii) Scroll to view all backdrops available in Scratch or click on each folder under

the Backdrop Library pane to view the backgrounds underneath.

(iv) Select the desired background.

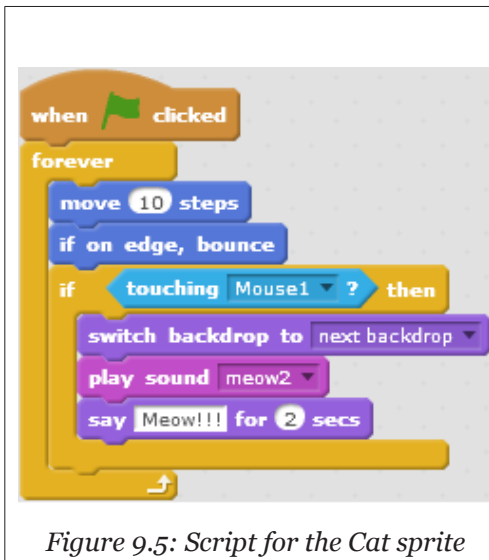
(v) Click **OK** to apply.

The following are some of the available backgrounds in Scratch 2.0.

Name	Description
	Doily
	Brick wall1
	Hay field
	Bedroom1
	Garden rock

*Table 9.7: Examples of backgrounds in Scratch 2.0*

From example 9.1, the following scripts apply to the sprites:



From Figure 9.5:

- (i) The starting background switches to **Doily** when the **Green flag** is clicked.
- (ii) The **Cat** moves back and forth across the screen and keeps moving in one direction and when it hits the edge of the stage it bounces back.
- (iii) When the **Cat** touches the mouse it produces sound **Meow2** and thought bubble **Meow!!!** is displayed.
- (iv) The background switches to **Brick wall1**.

Figure 9.5: Script for the Cat sprite

From Figure 9.6 below, the mouse chases the mouse-pointer in steps and when it touches the Cat sprite, it disappears; that is, it is eaten. The Mouse reappears after four seconds.

From Figure 9.7 below, the **Cake** disappears when it is touched by the **Mouse**; that is, it is eaten and reappears after two seconds. The background switches to **Garden rock** when the **Cake** is eaten and the **Cake** keeps changing between **Cake-a** and **Cake-b** costumes.

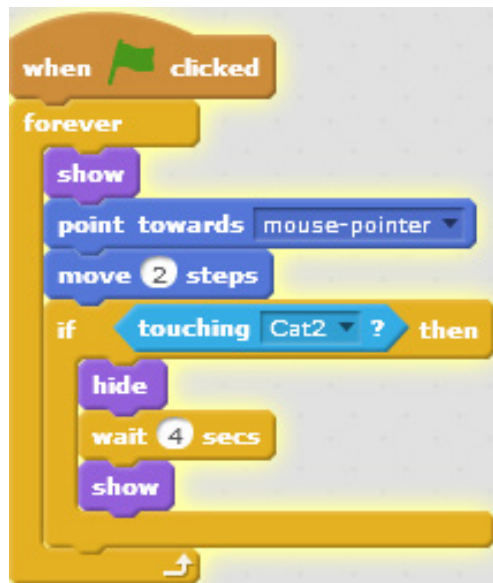


Figure 9.6: Script for the Mouse sprite

```

when clicked
  forever
    if touching Mouse1 ? then
      hide
      wait 2 secs
      show
      next costume
  
```

Figure 9.7: Script for the Cake sprite

```

when clicked
  switch backdrop to doily
  forever
    move 10 steps
    if on edge, bounce
    if touching Mouse1 ? then
      play sound meow2
      say Meow!!! for 2 secs
      switch backdrop to brick wall1
  
```

```

when clicked
  forever
    show
    point towards mouse-pointer
    move 2 steps
    if touching Cat2 ? then
      hide
      wait 4 secs
      show
  
```

```

when clicked
  show
  forever
    if touching Mouse1 ? then
      hide
      switch backdrop to garden rock
      wait 2 secs
      show
      next costume
  
```

Figure 9.8: Final Scripts for the Cat\_Cake-Mouse game



Figure 9.8: Cat\_Mouse\_Cake game

### Revision Activity 9.1

#### Part A: Fill in the blank spaces with the correct answers

1. Sprite movement is also referred to as \_\_\_\_\_.
2. \_\_\_\_\_ block palette contains the movement commands.
3. Motion blocks can be divided into \_\_\_\_\_ and \_\_\_\_\_ blocks.
4. Sound can be assigned to a sprite by clicking on the \_\_\_\_\_ icon, \_\_\_\_\_ button or \_\_\_\_\_ button.

#### Part B: Read the following questions carefully and provide the correct answers

1. Give the three Motion Reporter blocks.
2. Which motion block turns the sprite either clockwise or anti-clockwise by the specified amount of degrees?
3. Give the steps for adding sound to a sprite.
4. What is the procedure for applying a background in a game?



**Part C: Study the following questions carefully and carry out the activity**

1. Open the Scratch program.
2. Identify each of the block palettes and write down brief notes in your notebook. Prepare to make a class presentation.
3. Combine blocks from the block palettes to create scripts that perform the following:
  - (i) The sprite turns 10 degrees anticlockwise when the left arrow is pressed and moves 10 steps. The sprite direction turns over quickly or reverses if it touches the edge of the screen.
  - (ii) When the Green Flag button is clicked, it sets the position where the sprite starts by x (-140) and y (4) and the sprite moves 10 steps around the screen following the mouse pointer.

## 9.2 Commands to Set Game Rules

The following are some of the commands used in setting game rules: Switch to costume, forever, if, touching colour, broadcast, when I receive, go to, change by, show, repeat, hide, wait, stop all, point in direction, round pick random, if on edge bounce, turn and if else among others.

To use these commands, do the following:

- (i) Click on the **Scripts** tab.
- (ii) Select the desired block palette.
- (iii) Click and drag the desired block to the script area.

The above commands have been categorised under the various block palettes they are found as discussed below;

### 9.2.1 Looks Block palette

**Switch costumes to:** Changes to a specified sprite or stage costume.



Figure 9.9: The Switch costumes to block

**Show:** Displays the sprite.

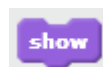


Figure 9.10: Show block

**Hide:** Hides the sprite.



Figure 9.11: Hide block

Other commands under the **Looks** block palette include the following:

- **Say ( ) for ( ) secs:** A specified speech bubble appears over the sprite and delays for the amount of time specified.
- **Say ( ):** A specified speech bubble appears over the sprite and will not delay over time.
- **Think ( ) for ( ) secs:** A specified thought bubble appears over the sprite and delays for the amount of time specified.
- **Think ( ):** A specified thought bubble appears over the sprite and will not delay over time.
- **Next costume:** Changes the sprite's or stage's costume to the next one in the costume list.
- **Switch backdrop to ( ):** Changes to a specified backdrop.
- **Change ( ) effect by ( ):** Changes the specified effect by the specified amount.
- **Set ( ) effect to ( ):** Sets the specified effect to the specified amount.
- **Clear graphic effects:** Removes all graphic effects on the sprite.
- **Change size by ( ):** Changes the size of the sprite by the specified amount.
- **Set size to ( ) %:** Sets the size of the sprite to the specified amount.
- **Go to front:** Puts a sprite in the front.
- **Go back ( ) layers:** Changes the value of the sprite layer by the specified amount.

### 9.2.2 Control Block Palette

**Forever** – Runs the blocks inside over and over.



Figure 9.12: Forever block

**If** – Activates the blocks inside it if the condition is true.



Figure 9.13: If () then block

**If else** – Activates the blocks inside the first C block if the condition is true. If the condition is false, the blocks inside the second C block will be activated.



Figure 9.14: If () then, else block

**Repeat** – Runs the blocks inside a specified number of times.



Figure 9.15: Repeat () block

**Wait () secs** – Pauses for the specified amount of time, in seconds, and then continues with next block.



Figure 9.16: Wait () secs block

**Wait until ()** – Pauses until the specified condition is true then runs the blocks below.



Figure 9.17: Wait until () block

**Stop all** – Stops all scripts in all sprites.



Figure 9.18: Stop () block

Other commands under the **Control** block palette are:

- **Create clone of ()**: Creates the specified clone.
- **Repeat until ()**: A loop that stops once the condition is true.
- **Delete this clone**: Erases a specified clone.
- **When I start as a clone**: It is activated whenever a clone is created and will only be run by that clone.

### 9.2.3 Sensing Block Palette

**Touching colour** – Reports true if sprite is touching specified colour.



Figure 9.19: Touching colour () block

Other commands under the **Sensing** block palette are:

- **Ask () and wait**: Displays an input box where you type the value and it stores the value in the answer variable.
- **Reset timer**: Sets the timer to zero.
- **Turn video ()**: Activates the video.
- **Set video transparency to () %**: Sets the transparency of the video to the specified amount.
- Set video transparency to () %, distance to ()
- Answer
- Mouse x
- Mouse y
- Loudness
- Timer
- Video () on ()
- Video () off ()
- Current ()
- Days since 2000; and
- Username

### 9.2.4 Events Block Palette

**Broadcast** – Sends a message to all sprites and activates **When I receive ()** blocks that are set to that broadcast message.



Figure 9.20: Broadcast () block

**When I receive** – The script activates when the specified broadcast message is received.



Figure 9.21: When I receive () block

### 9.2.5 Motion Block Palette

**Go to** – Moves the sprite to the mouse-pointer or the selected sprite.



Figure 9.22: Go to () block

**Change by** – Changes the x position of the sprite by the amount specified.



Figure 9.23: Change x by () block

Changes the y position of the sprite by the amount specified.



Figure 9.24: Change y by () block

**Point in direction** – Sets the direction of the current sprite.



Figure 9.25: Point in direction () block

**If on edge bounce** – If the sprite is touching the edge of the screen, its direction turns over quickly or reverses.



Figure 9.26: If on edge, bounce block

**Turn** – Turns the sprite either clockwise or anti-clockwise by the specified degrees.



Figure 9.27: Turn clockwise block

Turns the sprite clockwise.



Figure 9.28: Turn anti-clockwise block

Turns the sprite anti-clockwise.

### 9.2.6 Operators Block Palette

**Round** – Rounds the value to the nearest whole number.



Figure 9.29: Round () block

**Pick random** – Picks a random number between the specified two limits.



Figure 9.30: Pick Random () to () block

Other commands under the **Operators** block palette are:

- **() < ()**: Checks if a value is less than the other.
- **() = ()**: Checks if two values are equal.
- **() > ()**: Checks if a value is greater than the other.
- **() and ()**: Joins two conditions.
- **() or ()**: Joins two conditions that function separately.
- **Not ()**: Checks if the condition is false.
- **() + ()**: Displays the value of the addition.
- **() - ()**: Displays the value of the subtraction.
- **() \* ()**: Displays the value of the multiplication.
- **() / ()**: Displays the value of the division.
- **Pick Random () to ()**: Picks a random number between the specified two limits.
- **Join () ()**: Displays a combination of two values.
- **Letter () of ()**: Displays the specified character of the value.
- **Length of ()**: Displays the length of the value.
- **() Mod ()**: Displays the remainder of the division.

- **Round ()**: Rounds the value to the nearest whole number.
- **() of ()**: Displays the absolute value (abs), square root (sqrt), sine (sin), cosine (cos), tangent (tan), asine (asin), acosine (acos), atangent (atan), natural logarithm (ln), logarithm (log), exponential function (e<sup>^</sup>) or base 10 exponential function (10<sup>^</sup>) of a specified value.

### Example 9.2: Creating a game

#### Collect detailed data in the table

The following are the two relevant tables that can be associated with this game.

#### Game Name Table

Game Name	Car Racing game
How to play	<ul style="list-style-type: none"> <li>• The car is driven along a road by manipulating the arrow keys.</li> <li>• Clicking the Green flag takes the car to the beginning of the track.</li> </ul>
How to win	<ul style="list-style-type: none"> <li>• The Car should not leave the track or touch the grass, and should get to the finish line; that is, touch the Red line.</li> </ul>

Tables 9.8: Game Name table for the Car Racing game

#### Sprites Table

There is only one sprite for this game, that is, the Car.

Sprites	Name	Costume	Sounds	Movements
	• Car	• Car-bug	• None	• Drive

Tables 9.9(a): Car sprite table

#### Background Table

Name	Description
Level 1_1	Green ground, game stops when car touches the green colour.
Level 1_2	Track for the car to move
Level 1_End	Red line

Tables 9.9(b): Background table

### Score Management Table

How	How many points
Car off the track	Percentage of the distance before car getting off the track
Car touching red line	Total distance =100%

Table 9.9(c): Scores table

### Sprite Interaction Table

The sprite interacts with the backgrounds; that is, the Track (black colour) and the Grass (green colour). This is shown in the table below.

Sprite	Background	Interaction
Car	Track (Black)	The game continues provided the Car does not leave the Track.
Car	Grass (Green)	If the Car touches Grass, the game stops.

Table 9.10: Sprite Interaction table


### Game rules

- (i) The car goes back to the beginning of the track after 2 seconds if it touches the grass and a message “You are off track” is displayed.
- (ii) If the car gets to the end of the track by touching the Red line, a message “Congratulations” is displayed for 2 seconds followed by a timer showing how long it took for the car to get to the finish line.

### To create the game:

- (i) Delete the Cat sprite.
- (ii) **Create background.** Go to the Stage backdrop pane and click **Fill with colour**. Click the Scripts area to apply the preferred background colour. The background colour for this game is green to signify green grass.
- (iii) Paint a road running across the screen and draw a coloured line at one end to mark the finish line. To paint a road and line, use the **Brush** and **Line** icons respectively. The road is black and the finish line is red.
- (iv) **Add a new sprite.** The sprite for this game is a **Car**. Go to **Choose sprite from library** and click **Transportation**. Select **Car-Bug**.



- (v) Reduce the size of the sprite to fit on the road and to enable the car to go around the bends using the **Shrink** button . To do this, click on the **Shrink** button then click on the car.

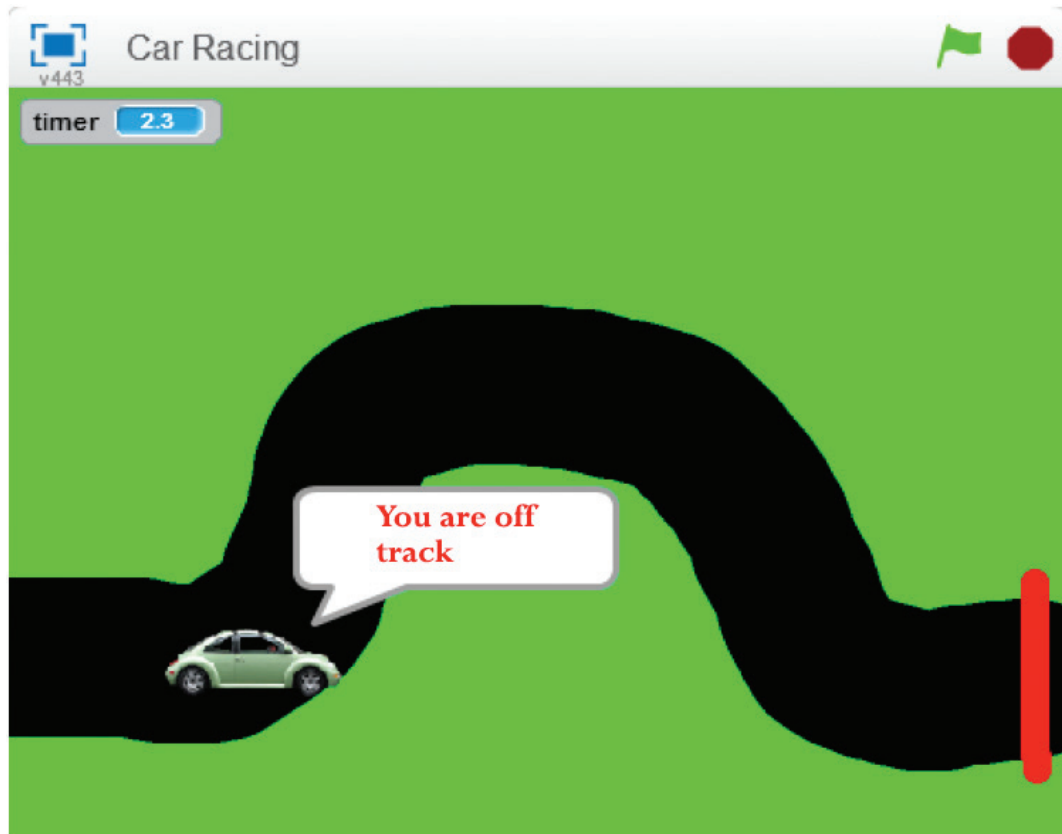



Figure 9.31: Stage Area showing the Car Racing Game

### Set game rules

- (i) Program the arrow keys to move the car using the following scripts:
- (ii) **Rule: If the car touches the grass**

The Car continually moves 1 step when the Green flag is clicked. If the Car touches green colour (grass), a message “You are off track” will be displayed for two seconds and it goes back to the starting point. The game is won if the Car gets to the finish line as explained in figure 9.32.

**Note:** To get the correct colour, click in the colour box of the  block. The arrow turns into an eyedropper. Move the eyedropper over the area of the stage containing the desired colour and click to reflect the new colour.

```

when right arrow key pressed
  move 5 steps

when left arrow key pressed
  move -5 steps

when up arrow key pressed
  turn 15 degrees
  move 5 steps

when down arrow key pressed
  turn 15 degrees
  move 5 steps

when green flag clicked
  point in direction 90
  go to x: -195 y: -90

```

Figure 9.32: Scripts to move the Sprite

```

when green flag clicked
  forever
    move 1 steps
    if touching color green ? then
      say You are off track for 2 secs
      point in direction 90
      go to x: -195 y: -90

```

Figure 9.33: Script to control the Sprite if it touches grass

**Note:**

To get the correct colour hold the dropper over the area of the stage containing the desired colour.

**(iii) Rule: If the car gets to the end of the road.**

A message “Congratulations” is displayed for 2 seconds each time the car touches the Red line, followed by a timer that takes 10 seconds showing how long it took for the car to get to the finish line.

**(iv) Combine the if conditions**



Figure 9.34: Script to control the Sprite to the end of the road



Figure 9.35: Script to control the Game

### Final Script for the Car racing game

The above scripts can be combined using the if ( ) then block as shown in figure 9.36.



Figure 9.36: Final Script for the Car racing game

### Example 9.3: Creating a simple game after observing the Mario game

In this game, the **Mario sprite** has been replaced with **Anna sprite** from the **Sprite Library**.

#### Game Name Table

Game Name	Anna game
How to play	<ul style="list-style-type: none"><li>• Anna moves by pressing the left arrow and right arrow.</li><li>• If Anna sprite's hand with red colour touches the Brick, the Brick would crack.</li><li>• When the Brick cracks, Coin would start spinning above it.</li></ul>
How to Score	<ul style="list-style-type: none"><li>• Anna gets one point each time the Coin disappears.</li></ul>

#### Sprites Table

	Name	Costumes	Sounds	Movements
Sprites	Coin	Spin1; Spin2 Spin3	None	Spin
	Brick	Regular; Cracked	None	Crushed
	Anna	Walk1; Walk2 Jump	Jump	Walk Jump

#### Sprite Interaction Table

	Sprite 1	Sprite 2	Interaction
Sprite Interaction	Anna	Brick	<ul style="list-style-type: none"><li>• If Anna sprite's hand with red colour touches the Brick, the Brick would crack.</li></ul>
	Coin	Anna	<ul style="list-style-type: none"><li>• Each time the Coin disappears,</li><li>• Anna scores 1 point.</li></ul>
	Brick	Coin	<ul style="list-style-type: none"><li>• When the Brick cracks, the Coin would start spinning above it.</li></ul>

### Background Table

Name	Description
Level 1_1	Normal background, brick, Anna as enemy
Level 1_2	Normal background, coins, Anna as enemy

### Score Management Table




How	How many points
Anna collects one coin by touching the brick	1

### Game rules

#### Rule: How Anna can Score

- If Anna sprite's hand with red colour touches the Brick, the Brick would crack.
- When the Brick cracks, the Coin would start spinning above it.
- Anna will get one point each time she collects the Coin.

#### To create the game:

- (i) Delete the Cat sprite and create three new sprites, that is, Anna, Brick and Coin.
- (ii) Use the **Choose sprite from library**  option to create Anna sprite and **Paint new sprite**  option for the Brick and Coin sprites.
- (iii) Use the **Paint new costume** option to create three costumes for the Coin sprite and two costumes for the Brick sprite, that is, Spin1, Spin2, Spin3 and Regular, Cracked respectively.
- (iv) For the Anna sprite, click on the **Costumes** tab and create another costume to add on the existing ones. To do this, right-click on **anna-a** costume and duplicate to get **anna-a2** sprite. Click on **anna-a2** sprite, then click Flip left-right  button at the top corner of the paint editor to change the direction of the sprite. Rename the costumes as walk1, walk2 and jump.
- (v) Click on the Red colour in the paint editor and paint Anna's right hand to make it sensitive to the Brick sprite.

The scripts for this game are as follows:

#### (i) Scripts for the Anna Sprite

- The first script takes Anna to the starting location when the game starts.

- The two that follow enable Anna to switch between costumes while moving both left and right when the left and right arrows are pressed.
- When space key is pressed Anna sprite switches to *jump* costume and changes its Y position by 50 and -50 after a wait of 0.5 seconds.
- The score increases by 1 when Anna sprite receives the coin\_collected message.

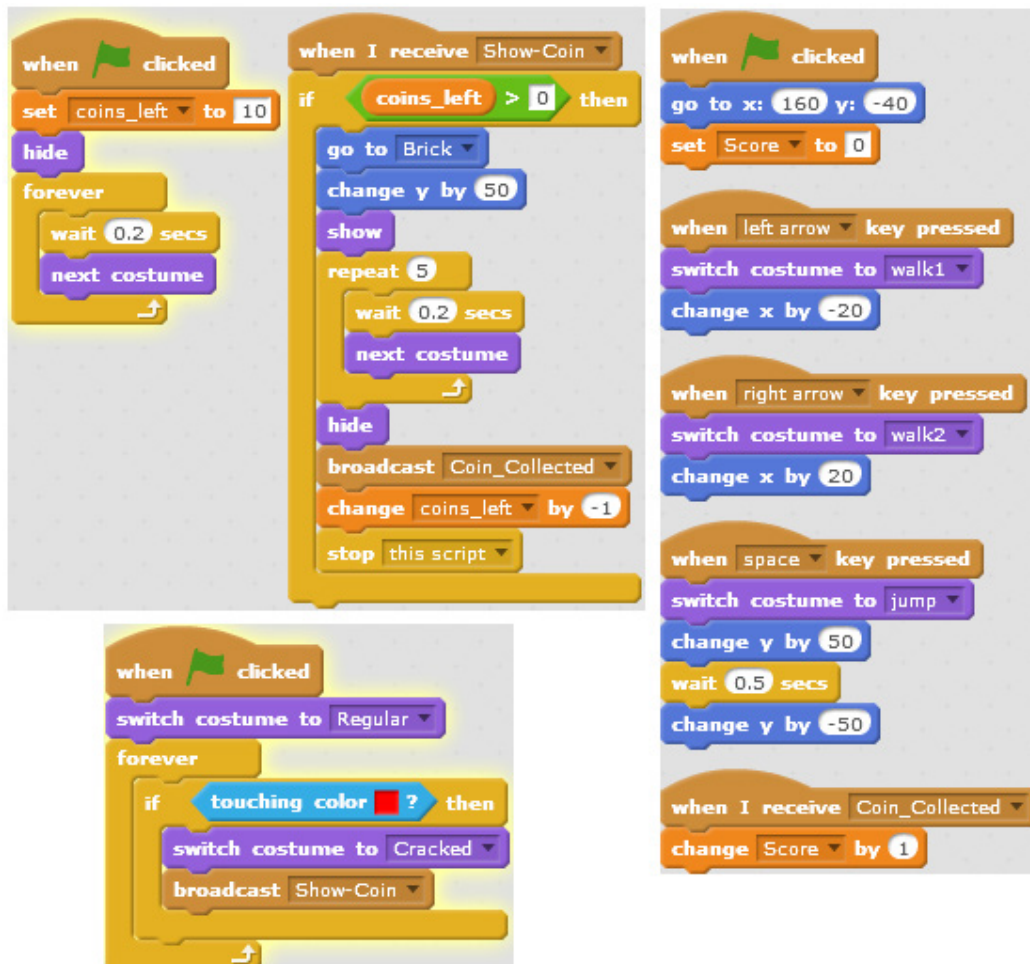


Figure 9.37: Scripts for the Anna Game

## (ii) Scripts for the Brick Sprite

The Brick sprite is not cracked when the game starts.

If Anna touches the Brick with the Red hand, it would crack and send out a “show-coin” message to the Coin sprite.

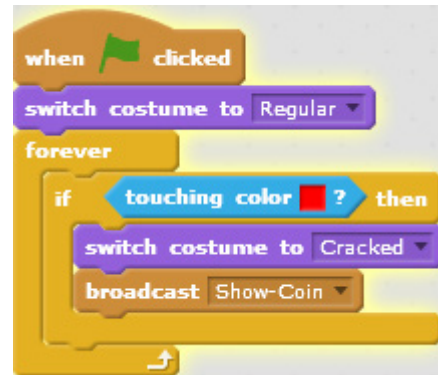


Figure 9.38: Script for the Brick Sprite

### Note:

- A colour, for example, **Red** used in this game is known as a **sensitive colour** and the Brick is known as a **colour-sensitive sprite** of the **Red** colour.
- A sensitive colour of a colour-sensitive sprite is a colour to which the sprite is sensitive and responds when touched.
- A good sensitive colour for a colour-sensitive sprite is a colour that has not been used by any sprite in the project.
- Any colour can be used as a sensitive colour.

## (iii) Scripts for the Coin Sprite

- The first script creates a spinning effect such that the **Coin** would forever turn switching between costumes at intervals of 0.2 seconds when the **Green Flag** button is clicked.
- The second script displays a variable named **Coins\_left** set to 1. The Coin is hidden when the game starts.
- The third script checks if **Coins\_left** is greater than 0 when it receives a show-coin message from the **Brick sprite**.
- If the answer is Yes, then the coin will be displayed spinning five times and then be hidden.
- A “coin\_collected” message will be sent out, reduce coins\_left by 1 and finally stop script when coins\_left is 0.





The image displays three Scratch scripts for a coin sprite. The first script is a 'forever' loop that starts with a 'when green flag clicked' event, followed by a 'wait 0.2 secs' block and a 'next costume' block. The second script starts with a 'when green flag clicked' event, followed by a 'set coins\_left to 10' block and a 'hide' block. The third script starts with a 'when I receive Show-Coin' event, followed by an 'if coins\_left > 0 then' conditional block. Inside this conditional block, the script performs the following actions: 'go to Brick', 'change y by 50', 'show', a 'repeat 5' loop containing 'wait 0.2 secs' and 'next costume', 'hide', 'broadcast Coin\_Collected', 'change coins\_left by -1', and 'stop this script'.

```
when green flag clicked
  forever loop
    wait 0.2 secs
    next costume

when green flag clicked
  set coins_left to 10
  hide

when I receive Show-Coin
  if coins_left > 0 then
    go to Brick
    change y by 50
    show
    repeat 5
      wait 0.2 secs
      next costume
    hide
    broadcast Coin_Collected
    change coins_left by -1
    stop this script
```

Fig. 9.39: Scripts for the Coin Sprite



Figure 9.40: Stage area showing Anna Game

Figure 9.40 shows a Brick that has cracked after being touched by Anna's hand that contains Red colour. The Coin spins above the brick by switching between costumes and disappears when touched by Anna, thus increasing the score by 1 and reducing coins\_left by 1.

### Revision Activity 9.2

Improve the **Car Racing Game** to include the following:

1. Add more bends to the road to make the game more challenging.
2. Paint the car.
3. Add sound effects to different parts of the game.
4. Add a variable called timer and, at the end of the game, broadcast a message saying how long it took for the car to get to the finish line.

### Example 9.4: Creating a ping pong game

The following is an example of a **Ping-Pong Game**. In this game, there are two sprites that interact to control the game.



### Game Name Table

<b>Game Name</b>	<b>Ping Pong game</b>
<b>How to play</b>	<ul style="list-style-type: none"> <li>The Rod sprite follows the mouse horizontally and vertically on the stage.</li> <li>It controls the ball from touching the baseline of the stage.</li> </ul>
<b>How to win</b>	<ul style="list-style-type: none"> <li>The Ball should not touch the base of the stage. If it touches the baseline, the game stops.</li> <li>Clicking on the Green Flag button restarts the game.</li> </ul>

### Sprites Table

Sprites	Name	Costume	Sounds	Movements
	Rod	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
	Ball	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>Chord</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>

### Backgrounds Table

Name	Description
 Level 1_1	<ul style="list-style-type: none"> <li>Green background when the game starts.</li> </ul>
 Level 1_2	<ul style="list-style-type: none"> <li>Blue background when the ball touches the baseline of the stage.</li> </ul>

### Level Management Table

Level	Requirement for this level	Starting Background	Ending Background
1	When the game starts and the game touches the baseline of the stage.	Level 1_1	Level 1_2

### Score Management Table

How	How many points
Ball bounces on the Rod	Timer value
Ball touches baseline	Timer reset

Note that in this game, a timer has been used instead of a variable to display the score and continuously counts until the game is restarted by pressing the Green Flag button.

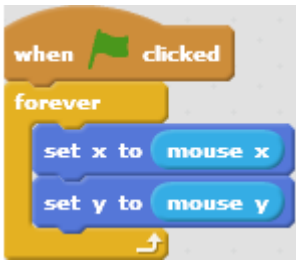

## Game rules

- (i) The paddle controls the ball from touching the base line of the stage.
- (ii) The game stops if the ball touches the base line of the stage.

## To create the game

- (i) Delete the **Cat** sprite.
- (ii) Go to the Stage backdrop pane. Click on **Backdrops**. Add the preferred base line using the paint brush or line. For this game, a thick red line has been used.
- (iii) Add a new Sprite called Rod. For this game, a black line has been used.
- (iv) Add another Sprite called Ball. Either draw the ball or select it from the **Sprite Library**.

## Set game rules

<p>(i) Program the Rod sprite to follow the mouse horizontally (x-axis) vertically (y-axis).</p>	 <p><i>Figure 9.41: Script to control the Rod</i></p>
<p>(ii) <b>Rule:</b> If the ball touches the base line of the stage, the game stops.</p>	 <p><i>Figure 9.42: Script to position the ball at the start of the game</i></p>

- (iii) **Rule:** If the ball does not touch the base line of the stage, the game continues.

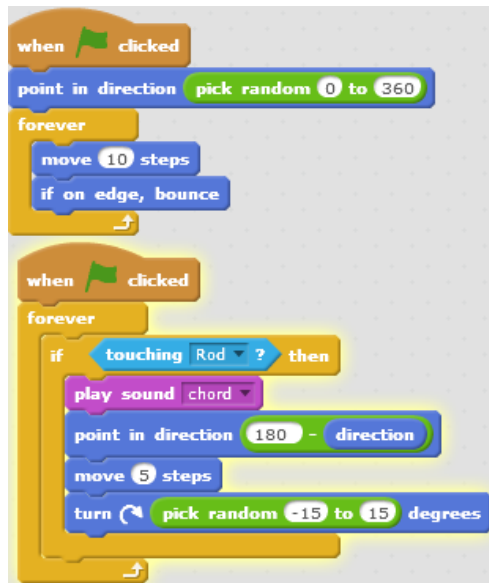


Figure 9.43: Scripts to control the Game

### Final Scripts for the Ping Pong game

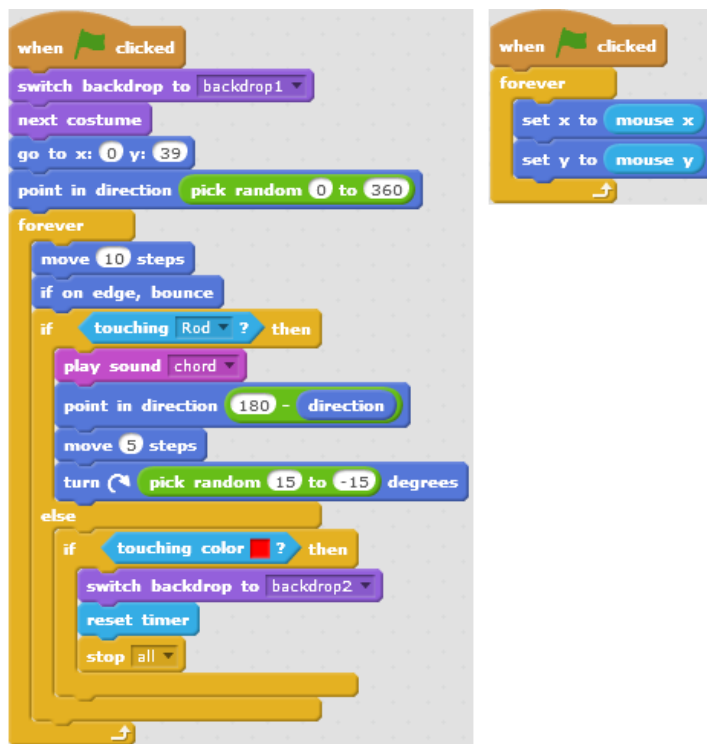


Figure 9.44: Scripts for the Ping Pong game

The first script controls the movement of the Ball and the other script controls the Rod.

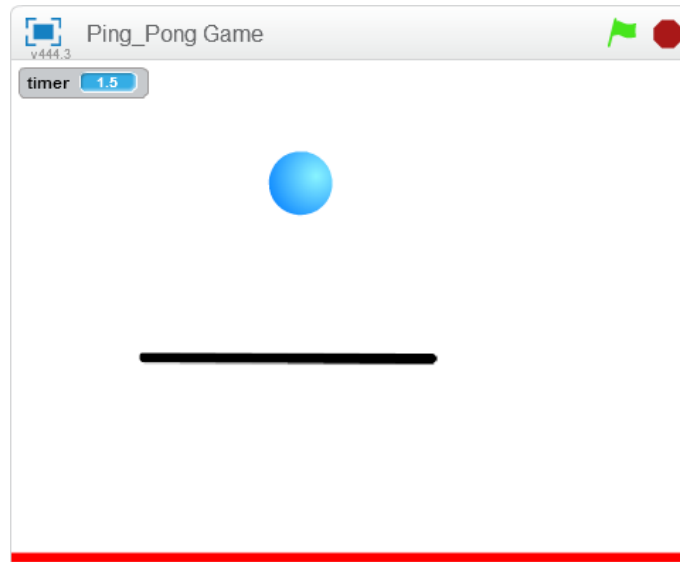


Figure 9.45: Stage area showing the Ping-Pong Game

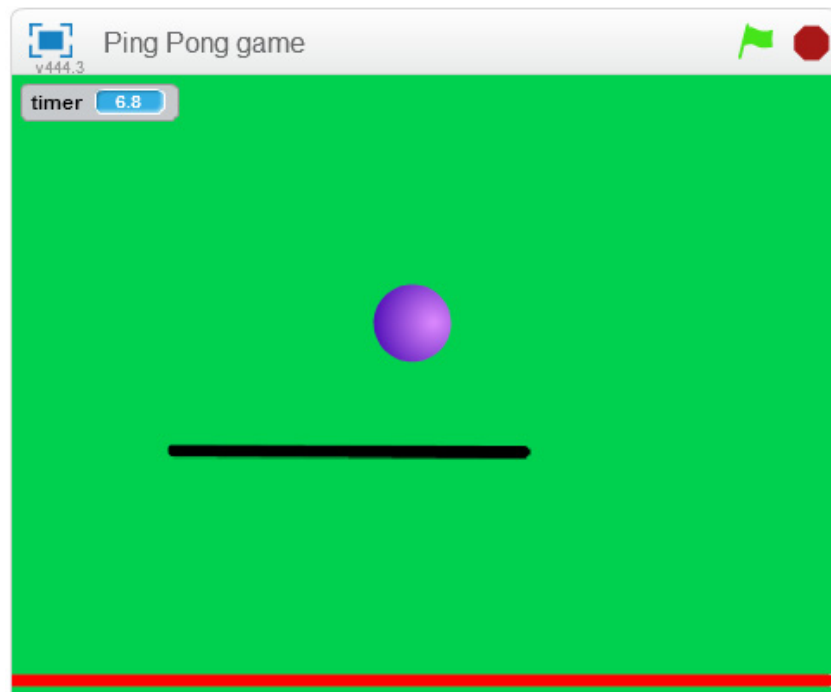


Figure 9.46: Starting background for the Ping pong game

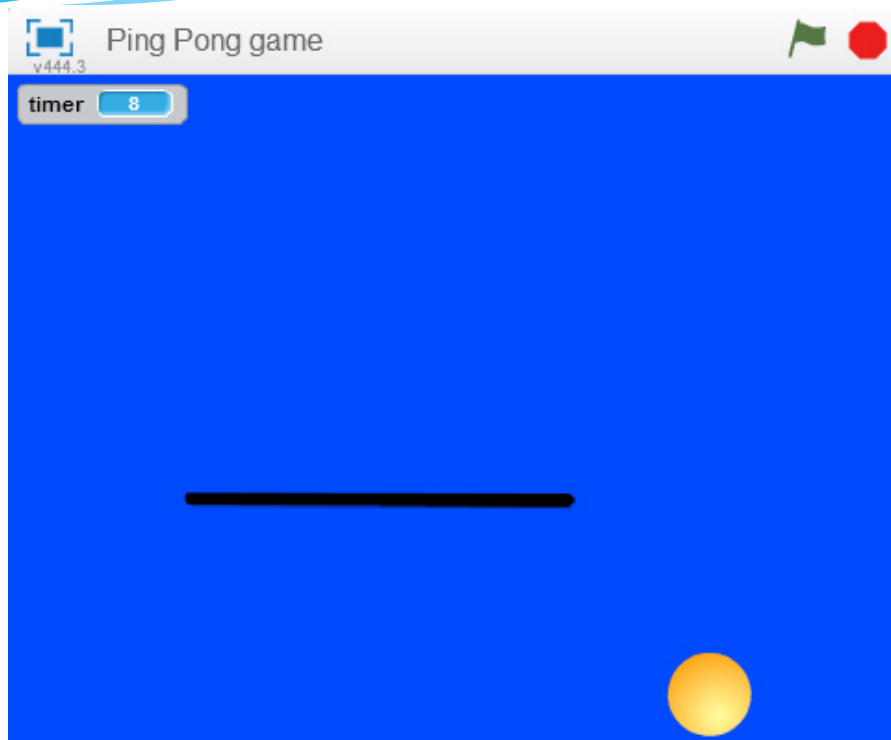


Figure 9.47: Ending background for the Ping pong game

### Revision Activity 9.3

#### Part A: Fill in the blank spaces with the correct answers

1. \_\_\_\_\_ block starts every script while \_\_\_\_\_ block ends scripts.
2. \_\_\_\_\_ blocks are shaped with a bump at the bottom and notch at the top.
3. \_\_\_\_\_ blocks are shaped with rounded edges and display the values (answers).
4. \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ are examples of **C** blocks under Control block palette.
5. \_\_\_\_\_ block turns over quickly or reverses the direction of the sprite if it is touching the edge of the screen.

**Part B: Study the following questions carefully and provide the correct answers**

1. Under which block palette would you find **Point in direction ( )** block?
2. Name the three Motion Reporter blocks.
3. Name any two Event Hat Blocks.
4. What type of block is the **Broadcast ( )** block?
5. Explain any 3 Sensing Reporter blocks.
6. Nkundiushuti, a Senior 2, student would like to create a game with Scripts that move, detect things and can be directed. What are the three useful block palettes that will he use to achieve this?
7. State the main difference between a timer and variable counter.

**Part C: Study the following questions carefully and carry out the activity**

1. Paint a new ball.
2. Change the speed of the ball in the Ping Pong game.
3. Adjust the angle of the ball.
4. Change the background and colour of the base line to the preferred colour.
5. Add a variable named **Score**, which keeps score of how many times the ball bounces on the Rod.

## 9.4 Projects in Game Programming

### Project 1: Helicopter Game

Create a game which can be used to pilot a helicopter in a cave with the following requirements:

1. Paint a cave.
2. Add a script to control the rising of the helicopter and simulate gravity.
3. Provide feedback to tell the user that the Game is over or Game is won. The game is won when the x position of the helicopter is greater than 205 and is over when it touches the edges of the cave.
4. Switch between costumes when the Game is over or when it is won.
5. Add sound using Audacity to signal the helicopter passing and crashing.

### Project 2: Moving Eyes Game

Create a game with a set of moving eyes that follow the mouse.

#### Required:

1. Paint a person's face.
2. Create 2 sprites for the eyes and add scripts to move the eyes.



### Revision Activity 9.4

Part A: Choose the correct answer from the given options.

- Which of the following is right according to Motion blocks?
  - Wait ( ) secs, move ( ) steps, repeat ( ), if ( ) then.
  - Move ( ) steps, point in direction, change by, if on edge, bounce, turn ( ) degrees.
  - Stop all, forever, go to front, pick random ( ) to ( ), change by.
  - Switch to costume, when I receive ( ), hide, broadcast.
- Which control block runs the blocks inside a specified number of times?
  - Forever
  - If ( ) then
  - Repeat ( )
  - Repeat until ( )
- Senior 2 students were in group discussion on how to associate commands and produce a good game. A Senior 1 student suddenly entered the classroom and posed the question “Which category of blocks control events and activate scripts to run”? The correct answer is:
  - Sensing blocks
  - Control blocks
  - Event blocks
  - Motion blocks
- What is the name given to a block that checks if a sprite is touching a specific colour?
  - Colour ( ) is touching ( )
  - Touching colour ( )
  - Touching ( )
  - Current ( )
- In a Senior 2 class, there was a discussion on commands to set game rules. Four students gave the following categories of blocks that could be used to control how the sprite appears. Which one is correct?
  - Switch costume to ( ), show, hide, switch backdrop to ( ).
  - Rest for ( ) beats, play note ( ) for ( ) beats, set pen colour to ( ), change pen shade by ( ).
  - Set ( ) to ( ), change ( ) by ( ), add ( ) to ( ), show list ( ).
  - Switch costume to ( ), go to ( ), hide, set y to ( ).

**Part B: Study the following questions carefully and carry out the activities. Use the Anna game above and do the following:**

1. Add two scripts to the Anna game namely Crab and Bat and make these enemies move randomly.  
Hint: Use the “pick random ( ) to ( )” block from Operators block palette.
2. Rule: If Anna is touched by Crab or Bat, she would die.
  - (a) The Crab randomly crawls to the right and left.
  - (b) The Bat flies towards Anna with some randomness and in all four directions.Hint: Use the “Point towards ( )” block and “Move ( ) steps” block from Motion block palette to have the Bat fly towards Anna.

## 9.5 Definition of Key Words in this Unit

### Revision Activity 9.5

**Find out the meaning of the words given below. Share your findings with the rest of the students in a class presentation. Check the meanings you find against those provided in the glossary at the end of this course book:**

Game designer

Timer

Stack blocks

Reporter blocks

C block

Cap block

Hat blocks



# 10

## Glossary

**Absolute cell reference:** With this type of cell reference, a formula remains the same regardless of where it is copied.

**Access point:** These are devices on a wireless network that act as a central transmitter and receiver of radio signals since they contain an inbuilt transceiver.

**Active cell:** It is a rectangular box highlighting the cell being worked on.

**Agency banking:** It is a retail or postal outlet contracted by a financial institution or a mobile network operator to process clients' transactions.

**AND:** It is a function that checks whether all arguments are true, and returns TRUE if all arguments are TRUE.

**Antispyware:** This is a program designed to prevent and detect unwanted spyware programs.

**Antivirus:** These are programs that detect, scan, and clean out viruses and other malware from a computer system.

**ATM:** This is the short for Automatic Teller Machine (ATM). It is an automatic transaction machine used together with ATM/debit cards to access, deposit, withdraw, and check the account balances, as well as print mini statements among other things.

**Attribute Table widget:** This one displays a tabular view of operational layers' features joined or related to spatial data layers, and can be used to find, query, and symbolize features or raster cells.

**AVERAGE:** This function provides the arithmetic mean of the values specified in a block of cells.

**Backup:** Is the process of making copies of data on a separate storage device.

**Biometrics:** This is an authentication method used to measure unique physical characteristics of a person, such as voice pattern, the iris or retina pattern of the eye or fingerprint patterns.

**Blog:** It is a website that contains online personal content such as opinions, reflections, comments and experiences provided by the writer.

**Blogging:** It is the act of posting content on a blog or posting content on another person's blog.

**Bluetooth:** This is a wireless protocol that connects electronic devices over a short distance of up to about 10 metres, creating a Personal Area Network (PAN) with a high level of security.

**C blocks:** Are also known as Wrap blocks. These are blocks that are shaped like a C and loop the blocks within the Cs or check if a condition is true. They can be capped or bumped at the bottom.

**Cap blocks:** Blocks that end scripts. They are shaped with a notch at the top and a flat bottom to prevent placing any blocks below them.

**Cell reference:** This is also called cell address and it consists of a column letter and a row number that intersect to show the location of a cell.

**Cell:** It is a box formed by the intersection of a row and column in a table or worksheet. It is where data is entered.

**Coaxial cable:** This is a type of transmission media that has two conductors.

**Column Title:** This is a row containing the column labels.


**Column:** It is a range of vertical cells labelled using a unique letter. Columns are labelled using letters and they contain data of a particular field.

**Complex formulae:** These are formulas that involve more than one operator and operand.

**Compressing files:** This means to combine several files into a single compressed folder in order to reduce its size to make sharing via a network easy.

**Copying:** This is the process of creating a duplicate of data. It is done using the Copy command.

**COUNTA:** This is a function that counts the number of cells that are not empty and the values within the list of arguments.



**COUNTBLANK:** This is a function that counts the number of empty cells in a specified range of cells.

**Credit card:** It is a plastic card normally issued by a financial institution to allow its user to borrow short term pre-approved funds at the point of sale in order to complete a purchase.

**Cutting:** It is the process of changing the position of data to a new location. The data is deleted from its original location. It is done using the Cut command.

**Data:** These are raw facts or inputs entered into a computer.

**Database:** This is a collection of data and information that is organised so that it can easily be accessed, managed, and updated.

**Debtor:** This is a company or an individual who owes money.

**Equation:** It is a mathematical statement that has two expressions, usually separated by an equals sign.

**EXP:** This is a function that returns 'e' raised to the power of a given number. The number is the exponent applied to the base e. The constant e equals 2.71828, the base of the natural logarithm.


**Facebook:** This is a popular free online social networking website that allows registered users to create profiles, share information such as messages, games, photos and video and keep in touch with friends, family and colleagues.

**Feature Class:** This is a collection of geographic features with the same geometry type such as point, line, or polygon, the same characteristics, and the same spatial position.

**Feature Dataset:** This is a collection of feature classes stored together to share the same spatial coordinate system, and their features fall within a common geographical area.

**Fibre optic cable:** This is a type of cable that uses glass material strands which are as thin as human hair.

**Filter:** This term refers to the process of displaying only records that meet a certain criteria.



**Firewall:** This is a computer network security system, either a hardware- or software-based that controls incoming and outgoing network traffic.

**Formatting:** This is the process of improving the appearance of a data in a worksheet.

**Formula bar:** This provides the user with a box for entering or editing data or formula in a cell.

**Formulas or Formulae:** They are mathematical expressions created by the user.

**Fraud:** This is an intentional act of dishonesty involving financial dealings for the purpose of personal gain.

**Freeze Command:** The freeze command is used to permanently display selected rows or columns.

**Functions:** They are inbuilt formulas that the user can quickly apply to a cell to perform mathematical calculations. The user can also quickly use functions to perform calculations automatically.

**Game designer:** This refers to a person who devises what a game consists of and how it plays by defining all the core elements.

**Georeferencing:** This is the process of aligning spatial data (layers that are shape files, polygons, and points) to an image file such as an historical map, satellite image, or aerial photograph.


**Geospatial Data:** This is information about a physical object that can be represented by numerical values in a geographical coordinate system.

**Google+:** This is a social networking site that is designed by Google to imitate the way people interact offline more closely as compared to other social networking services.

**Gradient:** This is a function in graphic software that enables a user to make an image contain a gradual change of colours, such as purple turning to blue and finally green.

**Graduated Colours:** This refers to a range of colours used to show qualitative differences in feature values.

**Graduated Symbols:** They show qualitative differences in feature values with varying symbol sizes.



**Hat blocks:** Blocks that start every script. They are shaped with a bump at the bottom and a rounded top. The bump enables placing of blocks only below them.

**Hub:** This is a device that connects many computers or other network devices together.

**IF:** This function evaluates a condition and returns one of the values in case it is found to be true and another value if it is false.

**Infrared:** Transceivers must be within the line of sight of each other either directly or via reflection from a light-coloured surface such as the ceiling of a room.

**INT:** It is a function that rounds a number down to the nearest integer.

**Internet:** Refers to interconnected networks.

**Labels:** They are text or alphanumeric characters that are entered into a cell which cannot be manipulated mathematically.

**Layers:** These define how a set of geographical features will be drawn when they are added to a map.

**Legend:** This is a key accompanying a map to give the meaning of symbols, figures, shapes, lines, and colours used in the map.

**Line weight:** It defines the thickness of a line.

**Linked text boxes:** They are text boxes connected to allow display of overflow text without interfering with the size of the text box.

**LinkedIn:** This is a social networking site designed for professional networking.

**LOWER:** It is a function that converts all letters in a text string to lowercase.

**Malware:** This is an abbreviation for **malicious software**. These are programs that are specifically designed to gain access or damage a computer system without the user's knowledge.

**Maps:** These are important ways of organising and displaying data in ArcGIS.

**MAX:** This is a function that returns the largest value in a selected range of cells.

**Merge cells:** This is combining more than one cell to appear as one large cell. It refers to the combination of two or more horizontally or vertically



adjacent cells to become one large cell that is displayed across multiple columns or rows.

**Mixed references:** This refers to a cell reference that contains both relative as well as absolute references.

**Mobile banking:** This refers to the use of a mobile application and device to provide banking services to customers. Most banks nowadays have the mobile banking facility.

**MOD:** This function returns the most frequently appearing value in a list of values or a range.

**Multifunctional device:** This is a device that has multiple functions. An example is a printer that makes copies by printing, photocopying, scanning, and faxing documents.

**Name box:** It displays the name of the active cell.

**NOT:** This is a function that changes FALSE to TRUE and TRUE to FALSE.

**ODD:** This is a function that rounds a positive number up and a negative number down to the nearest odd number.

**Operators:** They are symbols used in a formula to define the relationship between two or more values or cell references.

**OR:** It is a function that checks whether any of the arguments are TRUE, and returns TRUE. It returns FALSE if all the arguments are FALSE.

**Password:** This is a secret code used to deter unauthorised access to a computer, data, and software. A strong password should consist of at least eight characters, which should be a combination of letters in lower and uppercase, numbers, and special symbols.


**Pasting:** This is the process of inserting the current clipboard contents to a new location. It is done using the Paste command.

**Payables:** This refers to money owed for services or goods purchased on credit.

**PDA:** This is abbreviation for personal digital assistant. It is a palmtop computer that operates as a personal organiser, and also provides e-mail and Internet access.

**Personal Geodatabase:** This is a Microsoft Access database that can store, query, and manage both spatial and non spatial data.





**Piracy:** This refers to unauthorised duplication of copyrighted content.

**Plastic Money:** This is an electronic card that contains customer's financial details.

**POWER:** This function returns the result of number raised to a power.

**PRODUCT:** This function multiplies all the numbers given as arguments.

**Protection:** This is the process of safeguarding data from corruption, loss, or unauthorised access.

**Protocol:** These are a set of rules that allow exchange of data, information or resources through a transmission medium.

**Quick Access Toolbar:** It is a small customisable toolbar of the most commonly used commands.

**Receivables:** This refers to money owed by customers.

**Record keeping:** This is a systematic process of keeping records, creating, capturing and maintaining transactions and events in an accounting system.

**Rectification:** This is the process of transforming an image from the file coordinate system to a map coordinate system.

**Relative cell reference:** This is a type of cell reference that automatically changes the cell addresses of a formula relative to the position of a cell to where it is copied.


**REPLACE:** This is a function that substitutes part of a text string with a different text string.

**Reporter blocks:** Blocks that hold numbers and strings. They are shaped with rounded edges and display the values (answers). For example, what is your age? Reporter blocks would answer say "12".

**Restore:** To reinstate, recover, repair or bring back, data that was lost.

**Ribbon:** It consists of icons of commands organised and classified into groups.

**Root kit:** A rootkit is a program designed to hide the fact that an operating system has been compromised. It sometimes replaces vital executable files.



**ROUND:** It is a function that rounds off a number to a specified number of digits.

**Router:** This is a device that sends data traffic from one network to another.

**Row title:** This is a column containing the row labels.

**Row:** It is a range of horizontal cells having a unique number. Rows are labelled using numbers and they contain data of a particular entity.

**Scan:** This is searching a system for virus signatures that have attached executable programs and applications.

**Scroll bar:** This is part of an application window that allows one to move or navigate through a large worksheet, up or down, left, or right.

**SEARCH:** It is a function that returns the number of the character at which a specific character or text string is first found, reading left to right. It is not case sensitive.

**Sheet Tab:** This one contains the names of the worksheets in the workbook.

**Skype:** This is a social media service that enables file transfers, texting, calling and video conferencing.

**Smartphone:** This is a cellular phone that performs most of the functions of a computer, typically having a touch screen, Internet access, and an operating system capable of running applications.

**Social media:** This refers to Internet-based applications that enable users to create and exchange information, career interest ideas and other content such as images or videos or to participate in group networking.


**Sort:** This term refers to the process of arranging data in a predefined order.

**Split cells:** It is dividing a cell to more than one section hence appearing as many different cells.

**Spreadsheet:** This is an application software that is made up of rows and columns.

**Spyware:** A spyware is a program that monitors or tracks personal information or Internet activity and sends such information to someone else.

**SQRT:** Returns the square root of a number.



**Stack blocks:** Blocks that perform the main commands. They are shaped with a bump at the bottom and notch at the top. The bump and notch enables placing blocks below and above them respectively.

**Status bar:** It is located at the bottom of the window and it displays status on options that are selected to appear on the status bar.

**Stock exchange:** This is a market where securities of publicly held companies are issued, bought, and managed.

**SUM:** This function adds all the numbers in a specified range of cells.

**Switch:** This is a device that forwards data directly to its address without broadcasting it to all the devices within the network.

**Symbology:** This is a set of conventions, rules, or encoding systems that defines how geographic information is represented with signs on a map.

**Symbols:** These are non-alphabetical signs that have specific meaning when used in a particular context.

**Table:** This is a feature that is used to present information in an organised layout and consists of rows and columns intersecting to form cells where data is entered and manipulated.

**Text box:** It is an object created to contain text.


**Text Direction:** It is used to define the orientation of a text in a text box.

**Theme:** A theme is a set of formatting choices such as a set of theme colours, fonts (including heading and body text fonts) and effects (including lines and fill effects).

**Timer:** This is a feature that records how much time, in seconds, has passed since the last time the timer was reset or a project was started.

**Title bar:** Displays the name of the application currently in use, as well as the name of the active workbook.

**Trojan:** This is a harmful program that disguises itself as legitimate software. Users are tricked into loading and executing it on their systems. After it is activated, it can irritate the user by popping up windows or changing the desktop, deleting files, stealing data, or activating and spreading other malware.



**Twisted pair cable:** This is a cable made up of pairs of insulated copper wires twisted along each other.

**Twitter:** It is a free online social networking service that allows registered members to send short messages or short posts referred to as tweets.

**UPPER:** It is a function that converts all letters in a text string to all uppercase letters.

**User privileges:** Is the permission given to a user to perform an action. It used to regulate who or what can view or use resources in a computer.

**Values:** They are numeric data that can be manipulated mathematically.

**Viruses:** These are programs that can make a copy of themselves over and over again (replicate) in a computer. A virus is loaded into a computer without the user's knowledge and can spread from one computer to another.

**Wi-Fi (Wireless Fidelity):** It is a wireless networking technology that uses radio waves to provide high-speed Internet and networking connections.

**Workbook:** This refers to a file that can contain one or more worksheets.

**Worksheet:** This is a collection of cells organised in rows and columns.

**Worm:** A worm is a malicious program that replicates itself and finally occupies the system memory of the storage media.


**Wrap text:** It is a feature that enables a cell to contain content that is larger than its size. The content is displayed in multiple lines.

# 11



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