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Education
FREE STATE PROVINCE

NATURAL SCIENCES

GRADE 9

CONTENT MANUAL BASIC CONCEPTS WITH ACTIVITIES (Recovery ATP 2022)

TERM 1 (p. 2)

TERM 2 (p. 25)

TERM 3 (p. 53)

ANNEXURE A (p. 93)



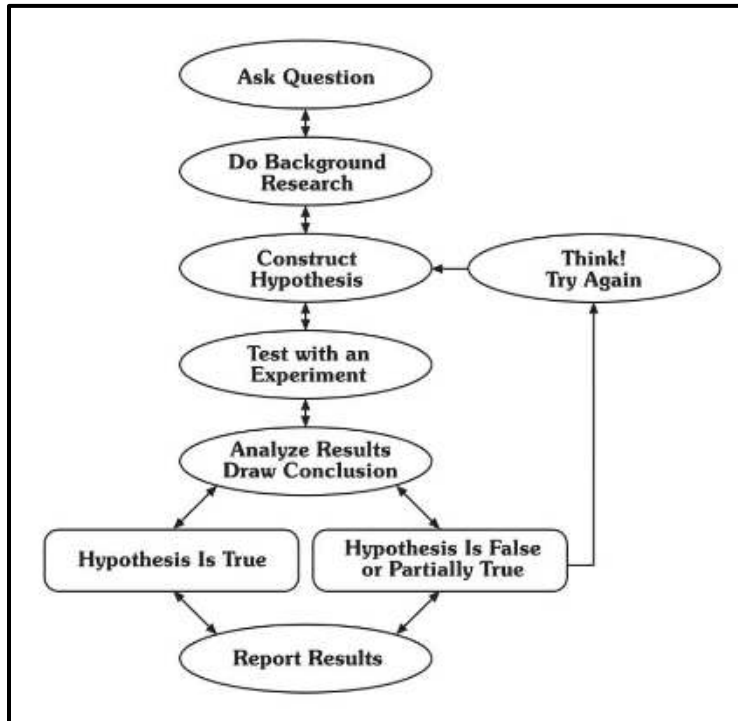
TERM 1

Strand: Life and Living

INTRODUCE / REVISE THE SCIENTIFIC METHOD:

Worksheet and teacher's guide available at www.mindstream.co.za OR use any other suitable activity.

Scientific Method:



1. Purpose of experiments or scientific investigations in the science classroom

An experiment can provide proof of a theory, and a scientific investigation is used to determine a *relationship* between different variables and to confirm or reject a hypothesis.

To determine the relationship between variables you must alter ONE variable and measure or observe another variable while keeping everything else the same. Why just one? If you changed more than one variable it would be hard to figure out which change is causing what you observe.

2. Variables

In science, a **variable** is any item, factor, or condition that can be controlled or changed.

2.1 Independent variable

The independent variable is the *one* that is deliberately changed by the scientist.
(Independent variable = I control; the scientist controls)

2.2 Dependent variable

The dependent variable is the one that is observed or measured in the experiment. The observation or measurement of the dependent variable will change as the independent variable is altered.

2.3 Controlled variables

Controlled variables are quantities that a scientist wants to remain constant.

3. **The investigative question**

- Must include the independent AND the dependent variable.
- Must ask a QUESTION about the RELATIONSHIP between the variables.
- How will the affect the?

OR

What is the relationship between and?

- Must end with a question mark (?).
- Make sure the answer to the question is NOT yes or no. Yes or no questions are not well-formulated investigative questions.
- Change the aim into a question.

4. **The hypothesis**

- Indicates what you expect the outcome of the investigation to be.
- Must include both variables and indicate the relationship between them.
- If, then
- Use words like increase, decrease, etc. to indicate that if one variable gets more/less, the other variable gets more/less.

5. **Apparatus and method**

- Plan an investigation which is fair and will produce reliable results.
- Write down what you will be doing.
- Organise your method in steps.
- **Fair test:** Change only one variable at a time.
- **Reliable test:** Repeat the experiment a few times; a few trials.
- Keep precautionary and safety measures in mind.

6. **Results**

- Record observations and measurements in a table. Provided a clear heading for the table and each column/row.
- Draw graphs to illustrate the data (independent variable on x-axis and dependent variable on y-axis).

7. **The conclusion**

- Must contain both variables.
- Must indicate the relationship between the variables.
- Is the answer to the investigative question.
- Must confirm or reject the hypothesis.



Topic: Cells as basic units of life**Background knowledge:** CAPS Grade 4: Living things**Grade 9 content:****What you should know:**

- ✓ **Cell structure**
 - **Identify and describe and give the function of the basic components of plant and animal cells**
 - **Draw and label a generalised plant and animal cell**
- ✓ **Differences between plant and animal cells**
- ✓ **Cells in tissues, organs, and systems**
 - **Explain the relationship between cells, tissues, organs and systems**

1.1 Plant and animal cells:

What does a cell look like?

Cells are very small, but there are much smaller parts (components or structures) in the cell, each with its own function, all working together as a family in the cell.

Cells are usually microscopic, which means that it can only be seen underneath a microscope.

There are, however, cells that can be seen with the naked eye, for example a chicken egg.

A chicken egg consists of one cell only. Did you know that?

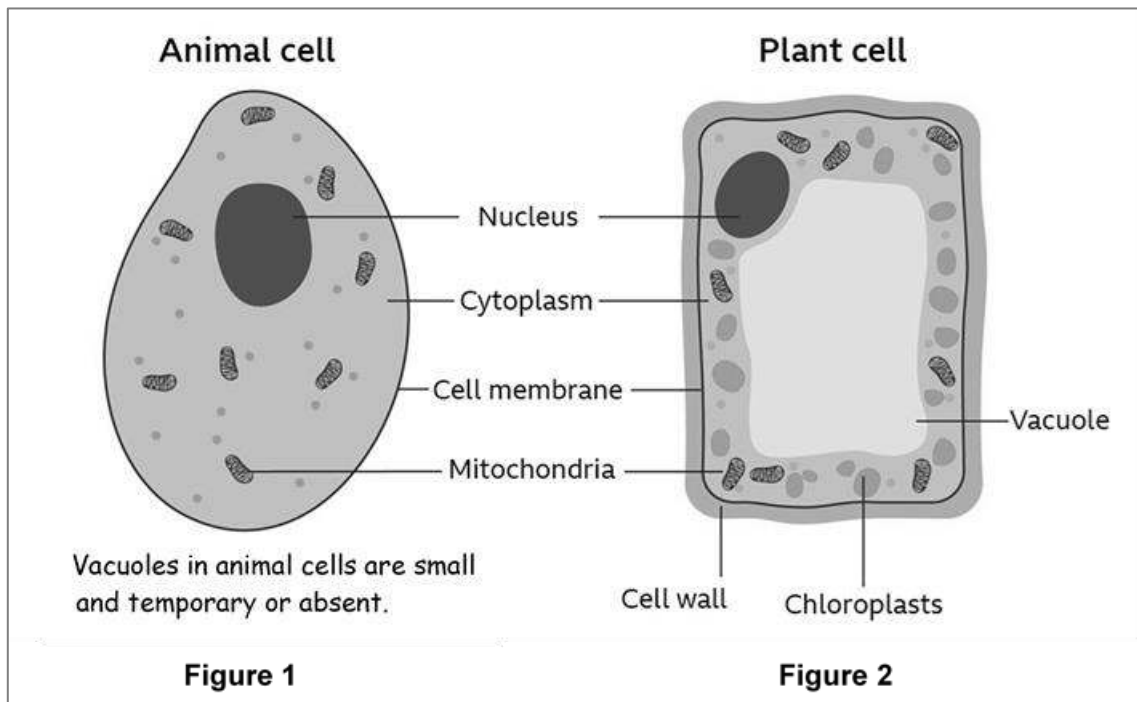
Cell structure

As mentioned previously, all cells have some common structures. These are:

- **A cell membrane**
- **Cytoplasm**; and
- In most eukaryotic cells, a **nucleus**

Let us look at the structure of these components of the cell, and some of the other organelles common to cells. An organelle is a specialised structure within the cell that performs a function for the cell. Examples of organelles in cells are **vacuoles, mitochondria, etc.** Study the diagrams of a plant and an animal cell which identifies the different components.





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- ✓ Draw labelled (annotated) diagrams of a plant and animal cell separately over two pages (A4 each) in workbook. Draw a labelled diagram of the animal cell and or plant cell on the left-hand page. Label the diagram and write the function of each part on the right-hand page next to the label so that learners have all the information in front of them on one page to make studying easier.
- ✓ **ANNEXURE A:** Refer to Annexure A at the back of this document for **DRAWING SKILLS IN NATURAL SCIENCES**

1.2 Differences between plant and animal cells

Now that you know what the main similarities between all plant and animal cells are, let's see how they differ.

Why do plant and animal cells have differences?

Plant and animal cells differ because they perform different functions.

It is important to understand the role of each organelle in the cell.

Apply your knowledge and understanding to explain WHY some cells have an abundance of certain organelles (like chloroplasts and mitochondria) when comparing plant and animal cells.

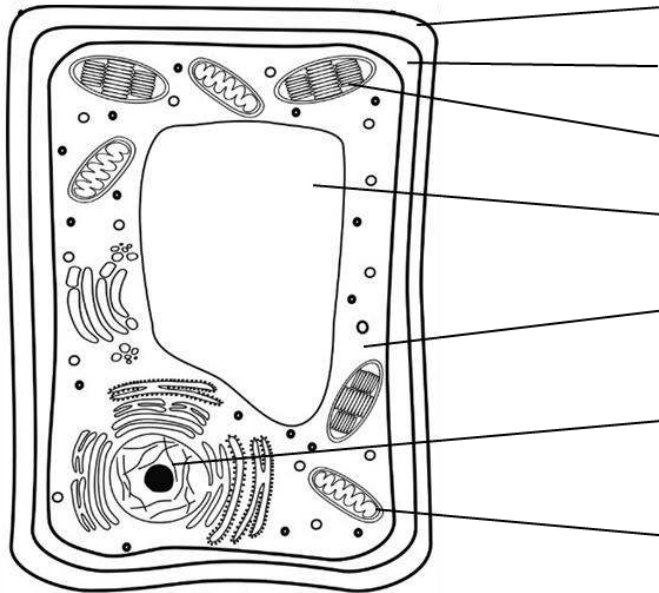
- ✓ **To identify a plant cell**, look for 3 main properties: cell wall, big vacuole, and chloroplasts.
- ✓ Draw small vacuoles in animal cells.
- ✓ Focus on **definitions and functions of the different organelles and structures** in the cell.

Formal practical activity: Cells (worksheet available at <http://mindstream.co.za>)

Purpose of this practical task: To draw WHAT is seen (what is observed) on the micrograph of a plant an animal cell.

Informal activity – Plant cell

1. Name the smallest unit of all living organisms. _____ (1)
2. Label the plant cell below. Write the label NEXT TO the label line.



(7)

3. Identify from the drawing above, the component / organelle which performs each of the functions below:

Function	Name of organelle or component
Contains the DNA which determines the inherited characteristics.	
It surrounds the contents (cytoplasm) of the cell and controls the materials which pass into or out of a cell (selectively permeable).	
A jelly-like substance which provides the liquid medium for all the chemical reactions that take place in the cell.	
The organelle in which cellular respiration takes place to release energy from glucose.	
The organelle that contains chlorophyll for photosynthesis.	
It surrounds the cell membrane and provides support and protection.	
Fluid-filled sacs that store substances such as water, sugar, and salts.	

(7)

4. Name TWO **parts/organelles** VISIBLE in the diagram that prove that this is a PLANT cell.
_____ (2)
5. Which component of a plant cell is responsible for its regular shape? _____ (1)

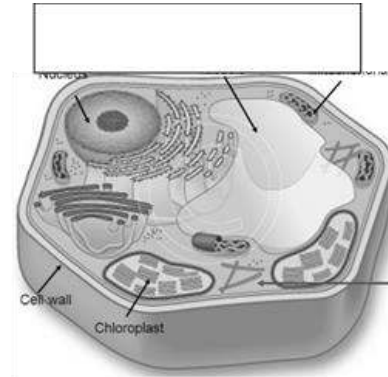
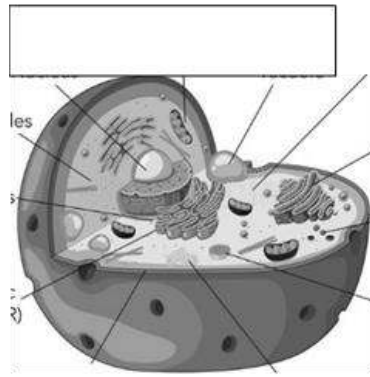
6. Which organelle consists of the nucleoplasm and nuclear membrane? _____ (1)
7. Name the green pigment present in chloroplasts. _____ (1)
- [20]**

Informal activity – Animal cell

1. Make a simple line drawing of an ANIMAL cell. Clearly label the diagram.
(Refer to the DRAWING SKILLS IN NS in Annexure A at the back of this document.)
- (6)
2. Explain why animal cells do not need chloroplasts.
_____ (1)
3. Of which organelle is their either a few small ones or none? _____ (1)
4. Compare a plant cell to an animal cell.
- 4.1 TABULATE the differences in the table below: (4)
- | | Plant cell | Animal cell |
|---------------------|-------------------|--------------------|
| Cell wall | | |
| Shape | | |
| Chloroplasts | | |
| Vacuoles | | |
- 4.2 Similarities: Name the organelles / components present in both plant- and animal cells. _____ (4)
5. Explain why animal cells do not need cell walls as much as plant cells do.
_____ (2)
6. Explain why animal cells need more mitochondria than plant cells.
_____ (1)



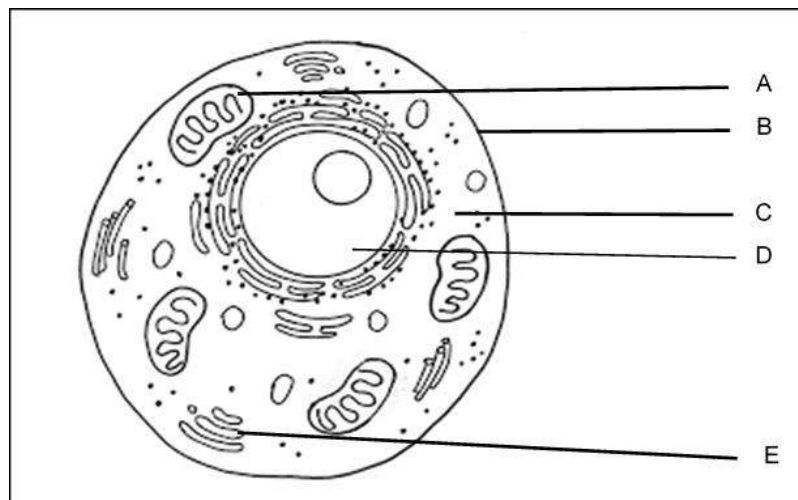
7. Provide a suitable caption for each of the cell models below:



(1)
[20]

QUESTION 1 (EXEMPLAR QUESTION ON CELLS FROM PREVIOUS QUESTION PAPER)

Study the diagram of a cell and answer the questions that follow:



- 1.1 Provide a suitable heading for the diagram. (1)
 - 1.2 Give TWO visible reasons for your answer in question 1.1. (2)
 - 1.3 What is the function of the part labelled C? (1)
 - 1.4 Identify the parts labelled B and D. (2)
 - 1.5 Why is the cell in the diagram above unable to make its own food? (1)
 - 1.6 Explain why there are so many of organelle A present in the cell. (2)
- [9]

FOR MORE EXAMPLES OF EXAM TYPE QUESTIONS, VISIT www.mindstream.co.za.

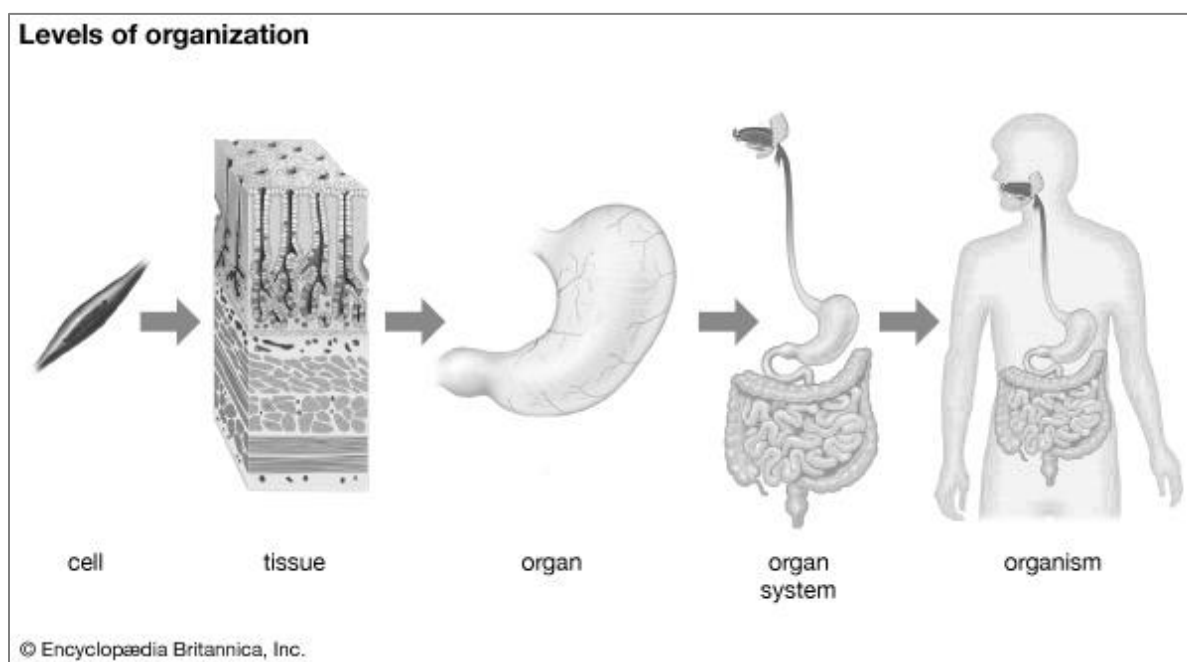
1.3 Different cells for different jobs

Practically all cells contain a nucleus and cytoplasm but show many variations in shape and form. In the human body there are at least twenty different cell types. Each cell type has a specific function. There is thus a division of labour amongst cells.

Cells performing the same function and massed together are called tissue e.g., muscle tissue. One of the simplest tissues is called epithelium. It forms the lining of spaces and tubes in the body and is also found on the surface of the skin. Plants have a similar surface tissue called epidermis. This tissue supports and protects tissues underneath.

Different tissues are combined into organs. An organ is a complex structure with a particular job to do e.g., the heart is an organ responsible for pumping blood to all parts of the body. Leaves, flowers, bulbs and tubers are examples of plant organs, each with its specific function. Thus, organs have specialised functions.

Organs are grouped together into systems. An example is the digestive system. The organs in the digestive tract like the liver, pancreas, etc. all work together to digest and absorb food. Some organs belong to more than one system e.g., the liver. It belongs to the digestive and to the excretory system. Plants have for example a reproductive system, a transport system, and so on.



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Informal activity - Levels of biological organisation: Cell to organism

1. Arrange the terms in the correct order: **tissue, organism, organ, cell, system**

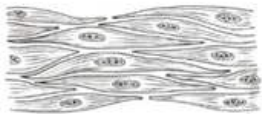
_____ → _____ → _____ → _____ → _____ (1)

2. For each description in COLUMN B, choose the correct word/term from COLUMN A. Write the correct word/term next to the description in the open spaces.

COLUMN A	COLUMN B	CORRECT WORD or TERM
Macroscopic	Organisms that consist of many cells.	
Microscopic	Organisms that consist of a single cell.	
Unicellular	Something that can be seen with the naked eye.	
Multicellular	Something too small to be seen with the naked eye.	

(4)

3. Complete the empty blocks with the correct information:

Diagram	Label	Description
	Cell	
		A group of cells that all have the same structure and perform the same function.
	Organ	
	System	
		Made up of a number of systems which all work together.

(5)
[10]

2. Systems in the human body

Introduction:

The human body is made up of many systems that work together for our bodies to perform our daily activities. These body systems are integrated and work together. Each system has a group of organs working together to perform a common function.

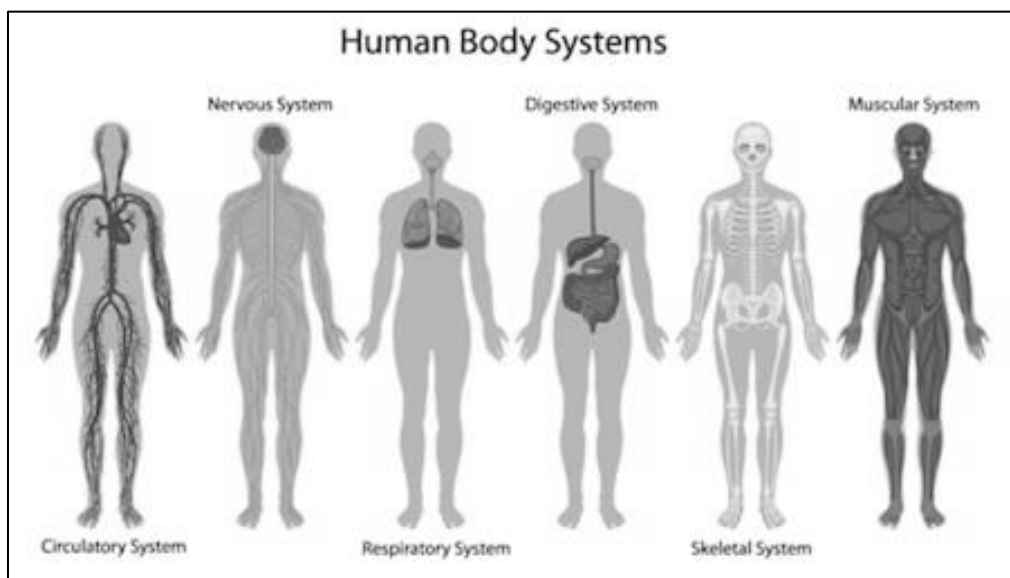
Every part of your body is working throughout the whole day, even while you are sleeping, just like a machine, with various parts that have various jobs to perform.

The intention of this topic is to provide learners with an **overview** of the structure and functions of organs and systems in the human body, which includes:

- The main function (purpose) of the system.
- The main processes.
- The main components.
- The health issues.

The human body consist of several integrated systems working together. The seven systems studied in Grade 9 are:

- Reproductive system;
- Circulatory system;
- Respiratory system;
- Digestive system;
- **Musculoskeletal system (NOT included in Recovery ATP 2022);**
- **Excretory system (NOT included in Recovery ATP 2022);**
- **Nervous system (NOT included in Recovery ATP 2022).**



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NOTE:

The Reproductive System, the Digestive System and the Circulatory and Respiratory systems will be studied as part of the integrated systems in the human body.

2.1 The Human Reproductive System

Background knowledge: CAPS Grade 5: Animal Skeletons; Grade 5: Life Cycles;
Grade 7: Human Reproduction

Grade 9 content:

What you should know:

- ✓ The OVERVIEW of the Human Reproductive System:
 - The main function (purpose)
 - The main processes
 - The main components
 - Health issues

System	Main function (Purpose)	Organs (CAPS p. 59)	Processes	Health issues
Human Reproductive System	To produce gametes (male and female sex cells) to combine for the continuation of the species.	The male reproductive organs include:	1. Cell division 2. Growth 3. Maturation 4. Copulation 5. Ejaculation 6. Ovulation 7. Menstruation 8. Fertilisation 9. Implantation	1. Infertility 2. Foetal alcohol syndrome 3. STD's (Sexually transmitted diseases)
		1. Penis 2. Sperm duct (vas deferens) 3. Testes (produces sperm cells) 4. Scrotum 5. Urethra		
		Female reproductive organs include:		
		1. Vagina 2. Uterus 3. Ovaries (contain egg cells / ova) 4. Oviducts (Fallopian tubes)		

- ✓ **The detail of the human reproduction system:**
 - Purpose and puberty
 - Reproductive organs (label the reproductive system/male and female reproductive organs).
 - Describe and give the function of the male and female reproductive systems.
 - Stages of reproduction.
 - Stages of reproduction: explain the main processes in reproduction, such as menstruation, fertilisation, etc.
 - Explain the impact (effect) of factors such as smoking and alcohol on the foetus during pregnancy.

Purpose and puberty:**Purpose:**

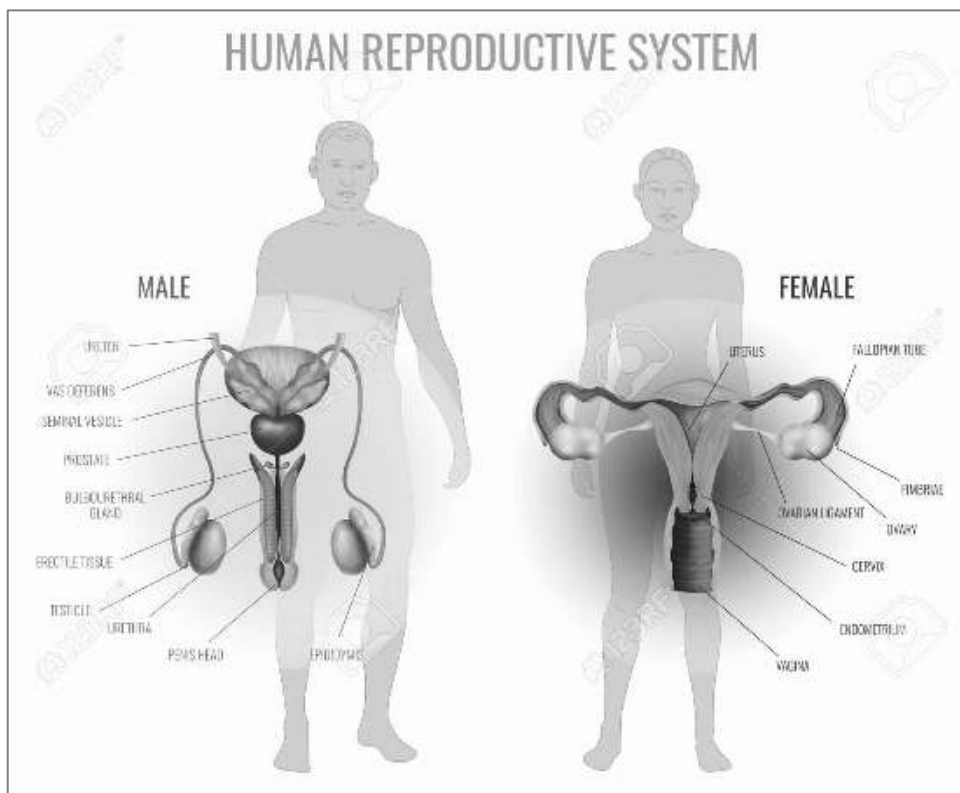
The **main purpose** of the reproduction system is for gametes (male and female sex cells) to combine for the continuation of the species.

Puberty:

- Puberty is the stage in the human life cycle when sexual organs mature for reproduction. This process is initiated when the pituitary gland releases hormones into the bloodstream, triggering the testes and ovaries to release sex hormones (testosterone and oestrogen).
- Testosterone (from the testes) and oestrogen (from the ovaries) cause **secondary sexual characteristics** such as menstruation, breast development, pubic hair, facial hair, deepening of the male voice.

Organs of the Human Reproductive System:

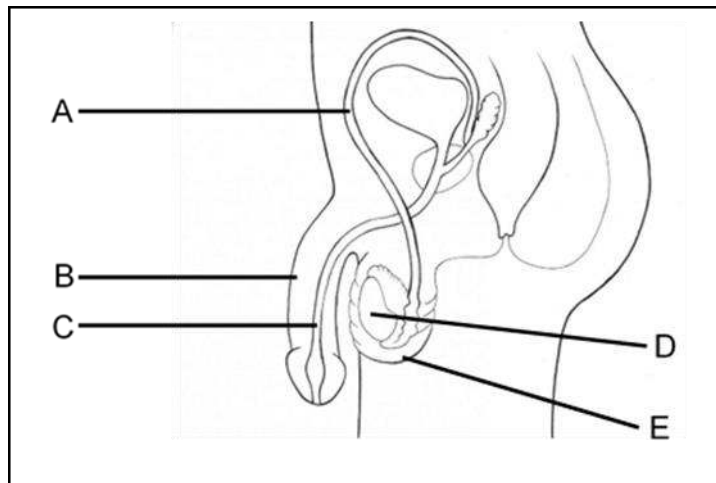
- The male reproductive organs include the penis, sperm duct (vas deferens), testes (produces sperm cells), scrotum, urethra.
- The female reproductive organs include the vagina, uterus, ovaries (contain egg cells/ova), oviducts (Fallopian tubes).



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Informal activity - The male and female reproductive organs

1. Study the diagram:



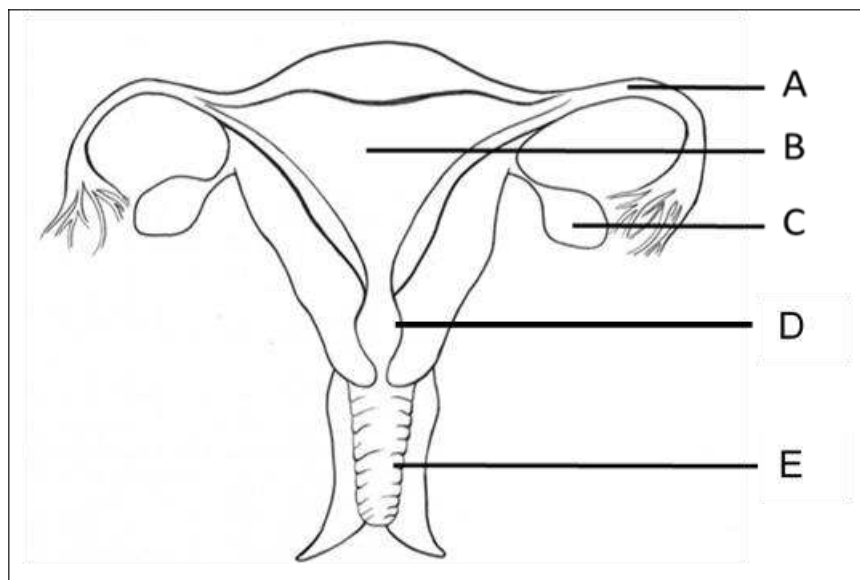
- 1.1 Classify the reproductive system above as male or female. (1)

- 1.2 Copy the table below and provide the missing information. Label parts A to E. Also provide the function for each part.

Label	Name of the part	Function
A		
B		
C		
D		
E		

(10)

2. Study the diagram:



- 2.1 Classify the reproductive system above as male or female. (1)
- 2.2 Copy the table and provide the missing information. Write down the correct name for parts A to E. Also provide the function for each part.

Label	Name of the part	Function
A		
B		
C		
D		
E		

(10)

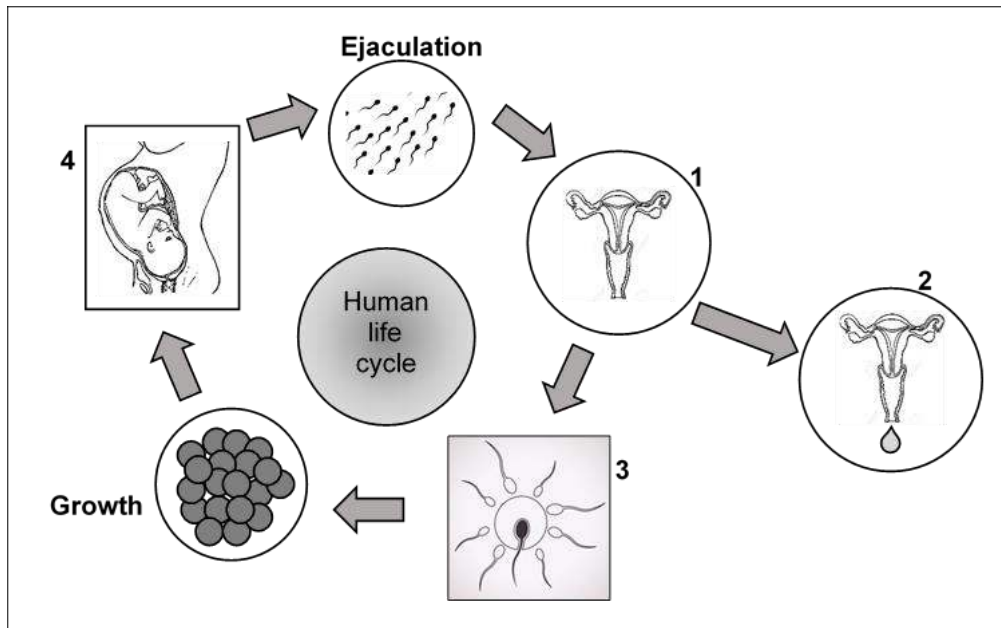
3. Give **one word/term** for the following description:
The stage in the human life cycle when sexual organs mature for reproduction. (1)
4. Identify the part from which each of the following hormones is released:
- 4.1 It releases hormones into the bloodstream, triggering the release of sex hormones. (1)
- 4.2 It releases testosterone. (1)
- 4.3 It releases oestrogen. (1)
5. List FOUR secondary sexual characteristics that is caused by the release of sex hormones (changes that take place in the teenage body during puberty). (4)
- [30]**

Stages of reproduction:

- Once a month one of the ovaries releases a ripe egg in a process called ovulation.
- In preparation of the possible implantation of a fertilised egg, the uterus develops a thick layer of blood.
- If fertilisation DOES NOT take place, menstruation occurs.
- Menstruation is the breakdown of the thick layer of blood in the uterus (which is not necessary if fertilisation does not occur), which is released through the vagina.
- The menstrual cycle is usually a 28-day cycle.
- During copulation, the erect penis is inserted into the vagina and semen is released (ejaculation).
- Fertilisation is the fusion of the sperm and egg, producing a **zygote**.
- If fertilisation takes place, the fertilised egg is implanted (implantation) in the blood layer in the uterus, and pregnancy results.
- The developing embryo/foetus is attached to the uterus wall by the **placenta** which plays a vital role in feeding and removing waste from the foetus.
- The stage of *pregnancy* in humans (*gestation*) is about 40 weeks.
- Pregnancy can be prevented** by using contraceptives such as condoms to prevent the sperm reaching the egg.
- Condoms also prevent the transmission of HIV/AIDS and other STDs (sexually transmitted diseases), if used effectively.

Informal activity – The stages of reproduction

Study the diagrammatic representation of the stages of reproduction in humans.



1. Diagram 1 represents ovulation. Define ovulation. (2)
2. Which diagram illustrates the fusion of the sperm with an egg? (1)
3. What is the PROCESS mentioned in question 2, called? (1)
4. What is the fertilised egg called? (1)
5. Which process takes place in diagram 2? (1)
6. Explain why the process in diagram 2 will take place. (2)
7. Give **one word or term** for each of the following descriptions:
 - 7.1 The structure through which the developing embryo/foetus is attached to the uterus wall and plays a vital role in feeding and removing waste from the foetus. (1)
 - 7.2 When the fertilised egg is inserted into the blood layer in the uterus. (1)
 - 7.3 Pills or condoms that prevent pregnancy. (1)
8. What is the length of the period of:
 - 8.1 the menstrual cycle? (1)
 - 8.2 gestation in humans? (1)
9. Study **diagram 4** in the picture above.
 - 9.1 What is this stage of the human life cycle called? (1)
 - 9.2 Does diagram 4 show an embryo or a foetus? (1)
 - 9.3 Explain the difference between an embryo and a foetus. (2)
10. Name three health issues associated with the human reproductive system. (3)

[20]

2.2 The Digestive System:

Background knowledge: CAPS Grade 6: Nutrition & Nutrients in food

Grade 9 content:

What you should know:

- ✓ The OVERVIEW of the Digestive System:
 - **The main function (purpose)**
 - **The main processes**
 - **The main components**
 - **Health issues**

System	Main function (Purpose)	Organs	Processes	Health issues
Digestive system	Breaks down food into soluble nutrients that can be absorbed in the small intestine into the bloodstream and transported to the cells throughout the body.	1. Mouth 2. Oesophagus 3. Stomach 4. Small intestine 5. Large intestine 6. Liver	1. Ingestion 2. Digestion 3. Absorption 4. Egestion	1. Ulcers 2. Anorexia nervosa 3. Diarrhoea 4. Liver cirrhosis

What else you should know:

- ✓ Label the digestive system.
- ✓ Healthy diet (eating plan):
 - Requires different components including proteins, carbohydrates, fats and oils, vitamins and minerals, fibre, and water.
 - Disorders of the digestive system can be related to inappropriate eating plans.
- ✓ Alimentary canal and digestion:
 - The alimentary canal is composed of the mouth, oesophagus, stomach, small intestine, large intestine, rectum, and anus.
 - Digestion is the breakdown of food into a usable dissolved form.
 - There are two types of digestion:
 - **Mechanical digestion:** the physical breaking down, crushing and mashing of food.
 - **Chemical digestion:** the mixing of food with the digestive enzymes and hydrochloric acid. (No detail of enzymes required.)
- ✓ The structure of each part and alimentary canal is adapted to its function. (No detail required.)



Informal activity – Digestive System**QUESTION 1**

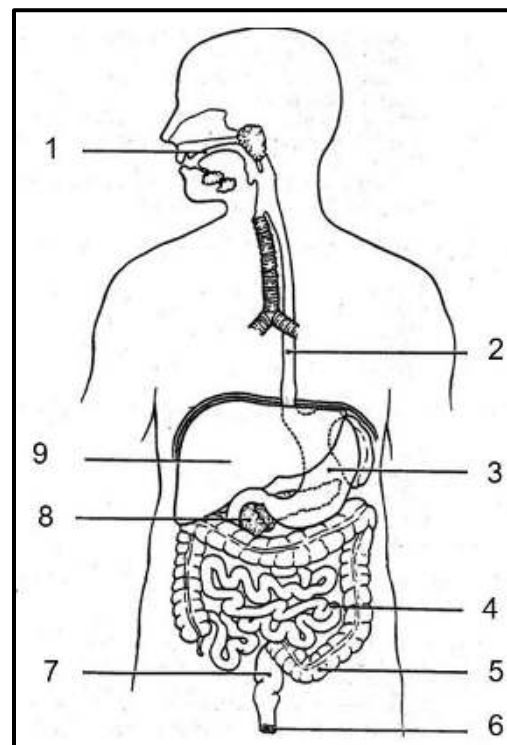
For each description in COLUMN A, choose the correct word/term from COLUMN B. Write the correct **LETTER** next to the question number e.g., 1.16 R.

	COLUMN A		COLUMN B
1.1	A condition resulting from a lack of nutrients.	A	Proteins
1.2	The intake of food by biting, chewing, and swallowing.	B	Ulcers
1.3	The organ which produces bile.	C	Anus
1.4	The rhythmic contractions of the muscles in the digestive canal that push food forward.	D	Saliva
1.5	The mechanical and chemical processes that convert insoluble food into soluble nutrients.	E	Ingestion
1.6	The part of the digestive track where absorption of water takes place.	F	Absorption
1.7	The nutrient found in meat, eggs, and fish.	G	Liver
1.8	Sugars and starch present in bread and rice.	H	Anorexia nervosa
1.9	When soluble nutrients are taken up by the blood stream.	I	Peristalsis
1.10	The end opening through which egestion of wastes takes place.	J	Digestion
1.11	Open sores on the inside lining of the intestines.	K	Large intestine
1.12	An eating disorder causing people to starve themselves in the fear of gaining weight.	L	Balanced diet
1.13	A healthy eating plan that contains the five food groups in daily meals.	M	Carbohydrates
1.14	The liquid secreted into the mouth that mixes with food and helps with chemical digestion.	N	Malnutrition
1.15	Required for mechanical digestion.	O	Teeth and tongue

(15)

QUESTION 2 (EXEMPLAR QUESTIONS FROM PREVIOUS QUESTION PAPERS)

Use the diagram to answer the questions that follow:



- 2.1 The digestive system makes use of both chemical as well as mechanical digestion. Explain the meaning of MECHANICAL DIGESTION. (1)
- 2.2 Make use of the diagram above and give the NUMBERS, as well as the NAMES of THREE places in the digestion system where mechanical digestion takes place. (6)

- 2.3 Janine decided to lose some weight for the upcoming school concert. She got the following diet (eating plan) from the internet and decided to follow it strictly on a daily basis.

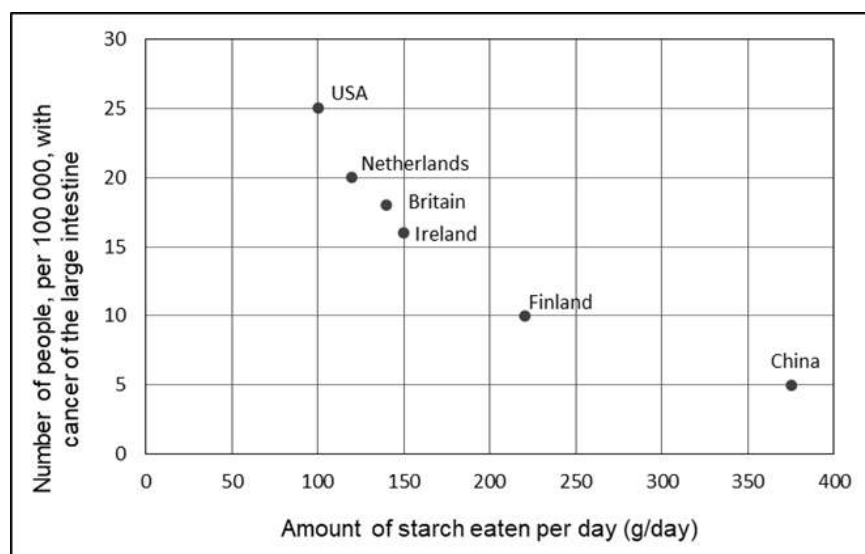
- Breakfast: 1 hardboiled egg
- Snack: 1 Apple and 30 g nuts
- Lunch: Steamed fish with a green salad
- Snack: 1 Cup chopped cucumber
- Dinner: 250 ml yoghurt with 50 grams of fruit

- 2.3.1 Which food group is missing from this diet? (1)

- 2.3.2 Janine's body needs a minimum of 1 600 kJ energy per meal.

Does dinner adhere to this requirement? Accept that 250 ml of yoghurt contains 660 kJ of energy and 50 grams of nuts contain 1 100 kJ of energy. Show your calculations. (2)

- 2.4 People in different countries eat different amounts of starch. A scientist investigated the relationship between the amount of starch people eat per day and the number of people who suffers from cancer of the large intestine. The scatter graph below shows the results.



- 2.4.1 Which country has the smallest proportion of people with cancer of the large intestine? (1)
- 2.4.2 Identify the independent variable. (1)
- 2.4.3 Identify the dependent variable. (1)
- 2.4.4 What conclusion can you make about the relationship between the amount of starch people eat and the occurrence of cancer of the large intestine? (2)

[30]

2.3 Circulatory and Respiratory Systems:

Background knowledge: CAPS Gr. 4: Living things; Gr. 6: Photosynthesis; Gr. 8: Respiration

Grade 9 content:

What you should know:

- ✓ The OVERVIEW of the Circulatory System:
 - The main function (purpose)
 - The main processes
 - The main components
 - Health issues

System	Main function (Purpose)	Organs	Processes	Health issues
Circulatory system	Brings nutrients and oxygen to cells and removes waste products.	1. Heart 2. Capillaries 3. Arteries 4. Veins 5. Blood	Two circulatory pathways:	1. High blood pressure 2. Heart attacks 3. Strokes
			1. Circulating blood between the heart and lungs.	
			2. Circulating blood between the heart and the rest of the body.	

- ✓ The OVERVIEW of the Respiratory System:
 - The main function (purpose)
 - The main processes
 - The main components
 - Health issues

System	Main function (Purpose)	Organs	Processes	Health Issues
Respiratory system	Supplying oxygen to the body and removing carbon dioxide.	1. Nose 2. Mouth 3. Trachea 4. Bronchi 5. Bronchioles 6. Alveoli 7. Lungs 8. Blood	1. Breathing a) Inhalation b) Exhalation 2. Gaseous Exchange (diffusion) 3. Respiration (cellular respiration)	1. Asthma 2. Lung cancer 3. Bronchitis 4. Asbestosis

What you should know:

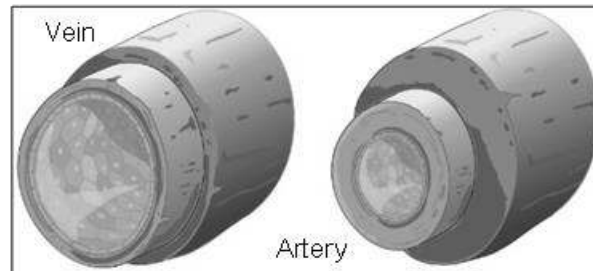
- ✓ Define **breathing**, **gaseous exchange**, **circulation**, and **respiration**.
 - Oxygen is *inhaled* in a process called *breathing (inhalation and exhalation)*.
 - In the lungs, gases are exchanged (*gaseous exchange*) between the alveoli and the surrounding capillaries by the process of *diffusion*.
 - Oxygenated blood is transported (*circulation*) from the lungs to the left side of the heart where it is pumped under high pressure to the body through the arteries [*arteries transport oxygenated blood except for the pulmonary arteries*].
 - Arteries subdivide to form capillaries which are in close contact with the body cells. Here, *gaseous exchange* occurs and oxygen moves into the cell by the process of *diffusion*.
 - In the mitochondria of the cells, oxygen is combined with food in the process of *respiration* and energy is released for other body processes.
 - Carbon dioxide (a by product of *respiration*) diffuses from the cells into the capillaries for excretion and is transported (*circulation*) in the blood to the right side of the heart by veins [*veins transport deoxygenated blood, except for the pulmonary veins*].
 - The heart pumps the deoxygenated blood (contains carbon dioxide), to the lungs where it diffuses into the air that is *exhaled* out of the body.
- ✓ Label the Respiratory / Circulatory Systems.

Informal / formal practical activity: Measuring and comparing the heart rate before and after exercise. Worksheet, 2020 version found at <http://www.mindstream.co.za> .

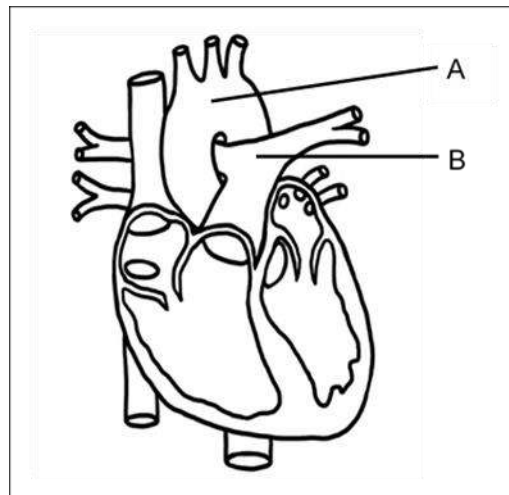


Informal Activity: Circulatory and Respiratory Systems**QUESTION 1 (EXEMPLAR QUESTIONS FROM PREVIOUS QUESTION PAPERS)**

- 1.1 The diagram below shows the cross sections of a vein and an artery. Study the diagram and answer the questions that follow.



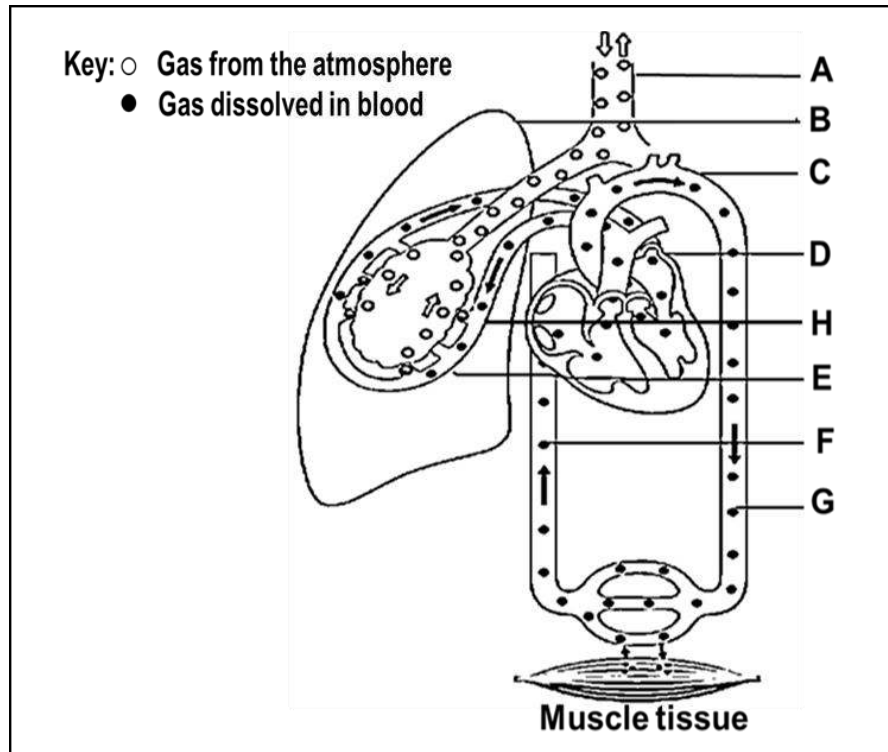
- 1.1.1 Why do arteries have much thicker walls than veins? (1)
- 1.1.2 **Tabulate** TWO other differences between arteries and veins. (2)
- 1.2 Study the diagram of the internal structure of the heart and answer the questions that follow.



- 1.2.1 Identify the parts labelled A and B. (2)
- 1.2.2 What type of blood is transported in part B? (1)
- [6]**

QUESTION 2

2.1 Study the diagram below and answer the questions that follow.



2.1.1 Identify TWO body systems represented in the diagram. (2)

2.1.2 Give the NAMES of the parts labelled A and B. (2)

2.1.3 Give the NAME of the structure responsible for pumping blood throughout the body. (1)

2.1.4 Give the LETTER of the structure transporting deoxygenated blood to the lungs. (1)

2.2 The blood at G is OXYGENATED BLOOD on its way to the muscle.

2.2.1 In the muscle, oxygen diffuses from the blood into the muscle cells. What is this process called? (1)

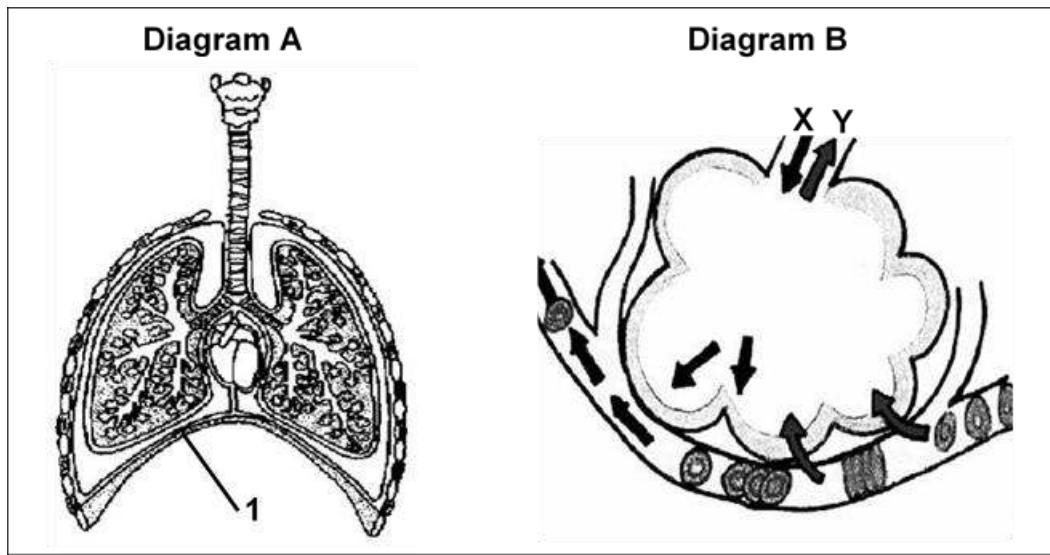
2.2.2 Which process inside the muscle cells requires oxygen to release energy? (1)

2.2.3 What type of blood is leaving the muscle? (1)

[9]

QUESTION 3

The diagrams below show structures associated with breathing and gaseous exchange.



- 3.1 Name the structure labelled 1. (1)
- 3.2 Identify gasses X and Y in diagram B. (2)
- 3.3 The structures in diagram A would look very different in a person who has chronic bronchitis. (Bronchitis is the inflammation of the lining of the bronchial tubes, which carry air to and from the lungs.)
- 3.3.1 Describe what these structures would look like in a person with chronic bronchitis. (1)
- 3.3.2 Give ONE symptom of chronic bronchitis. (1)
- TOTAL:** **[5]**
20

🌀🌀🌀 END OF TERM 1 🌀🌀🌀

TERM 2

Strand: Matter and Material

Topic: Compounds

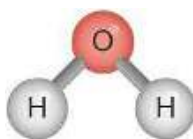
Background knowledge Gr. 7:

- All known elements can be arranged on the Periodic Table (PT).
- Elements make up all matter and materials.
- An element is a pure substance which consists of atoms of only one kind and cannot be broken down.
- Elements are arranged according to their properties on the PT.
- Each element has its own name, symbol, atomic number (number of protons), and position on the PT.
- Three main groups of elements: metals (left-hand side), non-metals (far right) and semi-metals.
- **METALS** are shiny, ductile, malleable, solid (except mercury), have high melting and boiling points, good conductors of heat and electricity.
- **NON-METALS** are brittle solids or liquids or gases, have no metallic luster (are dull), poor thermal conductors, poor electric conductors (except carbon), lower melting and boiling points than metals.
- **SEMI-METALS** are solids and have some properties of metals and some of non-metals. Have a metallic appearance but are brittle, only fair conductors of electricity, have nonmetallic chemical properties. Semi-metals are elements like boron (B), silicon (Si), germanium (Ge), arsenic (As), tellurium (Te), antimony (Sb).

Background knowledge Gr. 8:

- Atoms are the building blocks of matter and consist of subatomic particles: protons (p^+) and neutrons (n^0) in the nucleus; electrons (e^-) moving around the nucleus.
- Atoms are neutral; number of $p^+ =$ number of e^- .
- Elements and compounds are pure substances. They consist of the same type of particle.
- Elements like hydrogen, oxygen, carbon, copper, etc. consists of atoms.
- Elements like H_2 , N_2 , F_2 , O_2 , I_2 , Cl_2 and Br_2 consist of diatomic molecules (two identical atoms).
- Compounds like H_2O and CO_2 consist of molecules. Atoms react to form molecules.
- A chemical bond is the force that holds atoms together in a compound.
- Atoms in a given compound are always bonded in a fixed ratio.

H_2O (water) consists of two hydrogen atoms and one oxygen atom. Ratio $H:O = 2:1$



CO_2 (carbon dioxide) consists of one carbon atom and two oxygen atoms. Ratio $C:O = 1:2$



- Compounds can be broken down in decomposition reactions by heating or electrolysis for e.g., copper chloride ($CuCl_2$) can be broken down into copper (Cu-metal) and chlorine gas (Cl_2).

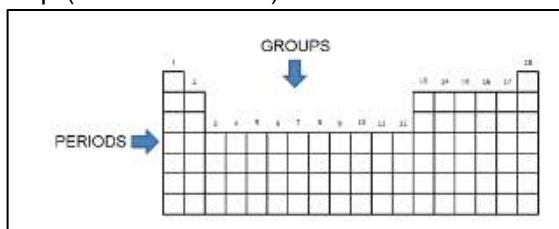
Grade 9 Content:

Periodic Table																	
1 H 1.00794																	2 He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.9984032	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050	3	4	5	6	7	8	9	10	11	12	13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6534	29 Cu 63.545	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.504	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 196.56655	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 Cs 132.90545	56 Ba 137.327	71 Lu 174.967	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.56655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.58038	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	103 Lr (262)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 Ds (269)	111 Rg (272)	112 Cn (277)	113 Uut (277)	114 Uuq (277)	115 Uup (277)	116 Uuh (277)	118 Uuo (277)	
57 La 138.9055	58 Ce 140.116	59 Pr 140.50765	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.92534	66 Dy 162.50	67 Ho 164.93032	68 Er 167.26	69 Tm 168.93421	70 Yb 173.04				
89 Ac 232.0381	90 Th 232.0381	91 Pa 231.035888	92 U 238.0289	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)				

*Use different coloured pencils to indicate metals, non-metals, and semi-metals. Also mark gases (H_2 , O_2 , N_2 , F_2 , Cl_2 , noble gases in group 18) and liquids (bromine and mercury/Hg).

What you should know:

- Names and symbols of the first 20 elements as well as iron (Fe), copper (Cu), zinc (Zn).
- If the symbol consists of two letters, the first is a CAPITAL LETTER and the second a small letter e.g., Mg, Br, Cu, Hg, etc.
- Elements can be classified as metals, non-metals, and semi-metals.
- Elements in the same group (vertical column) have similar chemical properties.



- Each element has a name, symbol, atomic number (smaller number), mass number or atomic mass (larger number).

29	atomic number
Cu	chemical symbol
63.5	atomic mass

- Elements are arranged according to their atomic numbers (number of protons in nucleus).
- In a neutral atom, the number of protons (p^+) = number of electrons (e^-).
- Mass number (atomic mass) = number of protons AND neutrons (n^0) in the nucleus.
- Therefore, number of neutrons = mass number – atomic number.

NOTE: The purpose of most of the activities is to drill **BASIC** concepts. Refer to question banks and previous question papers for questions on higher cognitive levels at www.mindstream.co.za.

Informal activity 1 - Periodic Table (PART 1)

1. Name the following elements (ensure correct spelling of the names). Write numbers and answers UNDERNEATH each other.

1.1	Na	1.2	Al
1.3	Be	1.4	P
1.5	Mg	1.6	Ne
1.7	Li	1.8	I
1.9	F	1.10	Ar

(10)

2. Underneath each other, give the symbols for the following elements.

2.1	Iron	2.2	Boron
2.3	Potassium	2.4	Copper
2.5	Carbon	2.6	Nitrogen
2.7	Hydrogen	2.8	Chlorine
2.9	Calcium	2.10	Zinc
2.11	Helium	2.12	Bromine
2.13	Sulphur / Sulfur	2.14	Silicon
2.15	Oxygen		

(15)

3. Give the symbol and the name of the element found on the Periodic Table in:

3.1	Group 2, Period 4.	(2)
3.2	Group 14, Period 3.	(2)
3.3	Group 17, Period 2.	(2)

4. Classify each of the following elements as a metal, non-metal or semi-metal:

4.1	Lithium	4.2	Chlorine
4.3	Aluminium	4.4	Silicon
4.5	Sulfur	4.6	Boron

(6)

5. Give ONE word/term for each of the following descriptions:

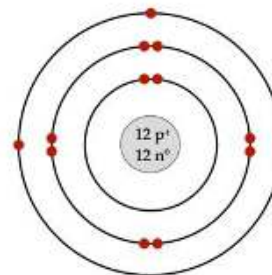
5.1	The orderly arrangement of all known elements.	
5.2	The vertical columns of the Periodic Table.	
5.3	The horizontal rows on the Periodic Table.	(3)

[40]

Informal activity 2 - Periodic Table (PART 2)

1. Give ONE word/term for each of the following descriptions:
 - 1.1 Elements which are malleable, ductile, and mostly solids at room temperature.
 - 1.2 The group of elements which are dull, brittle, and poor conductors of heat.
 - 1.3 The group of elements Si, B, Ge and As belong to. (3)

2. Study the model of an atom:



- 2.1 How many electrons are there in this atom? (1)
- 2.2 Explain why this atom is electrically neutral. (2)
- 2.3 In which group and period is this element found on the Periodic Table? (2)
- 2.4 Give the name and the symbol of this element. (2)
- 2.5 Choose the correct representation for this element. Only write down the letter of the correct answer (A, B, C or D). (2)

A $^{12}_{12}\text{C}$ B $^{24}_{12}\text{Cr}$ C $^{24}_{12}\text{Mg}$ D $^{36}_{24}\text{Kr}$ (1)

3. For $^{27}_{13}\text{Al}$ write down the following:
 - 3.1 Symbol of the element.
 - 3.2 Name of the element.
 - 3.3 Atomic number.
 - 3.4 Atomic mass or mass number.
 - 3.5 Number of protons in the nucleus of the atom.
 - 3.6 Number of electrons in a neutral atom of the element.
 - 3.7 Number of neutrons in the nucleus.
 - 3.8 Metal or non-metal?
 - 3.9 Conductor of electric current or insulator?
 - 3.10 Metallic lustre or dull? (10)

4. For $^{31}_{15}\text{P}$ write down the following:
 - 4.1 Metal or non-metal?
 - 4.2 Symbol of the element.
 - 4.3 Name of the element.
 - 4.4 Atomic number.
 - 4.5 Atomic mass or mass number.
 - 4.6 Number of protons in the nucleus of the atom.
 - 4.7 Number of electrons in a neutral atom of the element.
 - 4.8 Number of neutrons in the nucleus.
 - 4.9 Where is it found on the Periodic Table? Give the group number and period number.
 - 4.10 Malleable or brittle? (11)

5. An unknown element contains 11 protons, 11 electrons and 12 neutrons. Identify this element and draw its symbol in the form of $^{\text{A}}_{\text{X}}\text{E}$. (3)

[35]

What you should know:**Names of compounds**

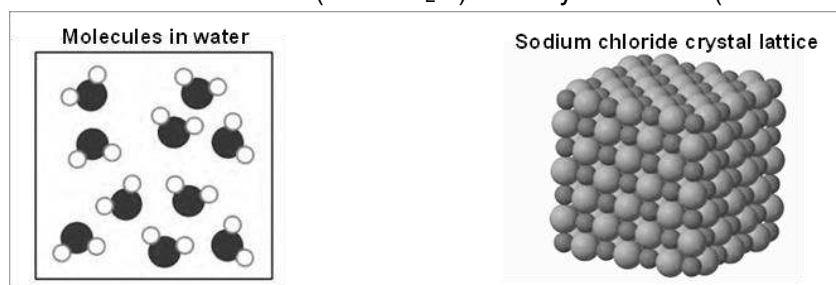
- Many compounds are named according to their elements:
Sodium chloride, made up of sodium (Na) and chlorine (Cl).
Magnesium oxide, made up of magnesium (Mg) and oxygen (O).
- Other compounds have common names such as water (H₂O) and ammonia (NH₃).
- Names sometimes depend on the number of non-metal atoms present:
carbon **monoxide** CO **[ONE]** (mono) oxygen atom combined with the carbon atom]
carbon **dioxide** CO₂ **[TWO]** (di) oxygen atoms combined with the carbon atom]
sulfur **trioxide** SO₃ **[THREE]** (tri) oxygen atoms combined with the sulfur atom]
- Usually in compounds like **copper** chloride, **potassium** oxide, the metal is written first.
- The name of the non-metal (written last) is changed from oxygen to oxide, chlorine to chloride, bromine to bromide, fluorine to fluoride, etc.

Elements in compound	Name of compound	Formula of compound
potassium and chlorine	potassium chloride	KCl
sodium and bromine	sodium bromide	NaBr
magnesium and oxygen	magnesium oxide	MgO

- "Groups of atoms" are named differently:

When the formula ends on ...	The name ends on ...	Formula of compound	Name of compound
CO ₃	carbonate (carbon and oxygen)	CaCO ₃	calcium carbonate
SO ₄	sulphate (sulfur and oxygen)	MgSO ₄	magnesium sulphate
NO ₃	nitrate (nitrogen and oxygen)	NaNO ₃	sodium nitrate
OH	hydroxide (hydrogen and oxygen)	KOH	potassium hydroxide
When the formula starts with ...	The name starts with ...		
NH ₄	ammonium	NH ₄ OH NH ₄ NO ₃	ammonium hydroxide ammonium nitrate

- Compounds can consist of molecules (water/H₂O) or a crystal lattice (sodium chloride/NaCl).



FOR ENRICHMENT ONLY!

Group on Periodic Table	1	2	13	15	16	17	18
Ionic charge of the elements in that group	+1	+2	+3	-3	-2	-1	0
Example	Na ⁺	Mg ²⁺	Al ³⁺	N ³⁻	O ²⁻	Cl ⁻	He Ne

Ionic charges of ions	Name of ion
CO ₃ ²⁻	carbonate
SO ₄ ²⁻	sulphate
NO ₃ ⁻	nitrate
OH ⁻	hydroxide
Cl ⁻ Br ⁻ F ⁻ I ⁻	chloride bromide fluoride iodide
O ²⁻	oxide
NH ₄ ⁺	ammonium

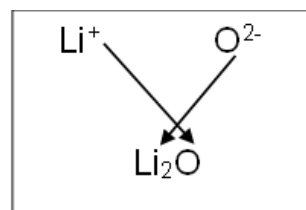
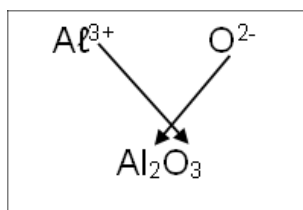
- An atom that gains electrons (negative charges), becomes a negative ion.
- An atom that loses electrons (negative charges), becomes a positive ion.

What you should know:**Writing of chemical formulae**

The compound will always be electrically neutral, meaning all charges will cancel out.

For example:

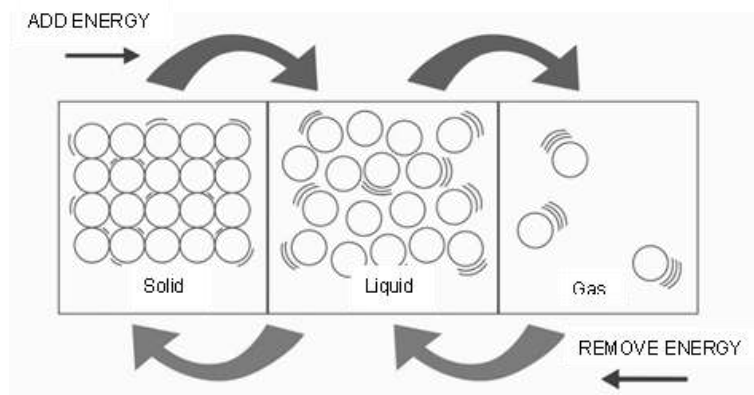
1. Sodium chloride: Na⁺ and Cl⁻ (charges cancel out), thus NaCl
2. Magnesium oxide: Mg²⁺ and O²⁻ (charges cancel out), thus MgO
3. Magnesium chloride: Mg²⁺ and Cl⁻
Need to combine one Mg²⁺ ion with 2 Cl⁻ ions to cancel out the charges, therefore MgCl₂
4. Calcium carbonate: Ca²⁺ and CO₃²⁻ (charges cancel out), thus CaCO₃
5. Magnesium hydroxide: Mg²⁺ and OH⁻
Need to combine one Mg²⁺ ion with 2 OH⁻ for charges to cancel out, therefore Mg(OH)₂

Criss-cross method to write formulae:

Chemical reactions

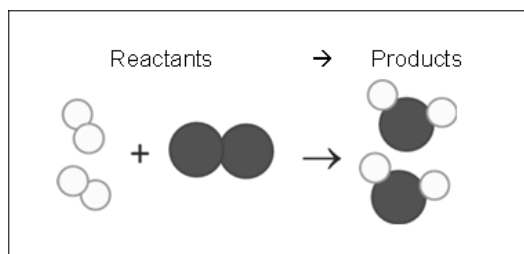
Background knowledge Gr. 8:

Particle model of matter:



Reactants and products:

- In a chemical reaction, the substances that react with one another are called the **reactants**.
- The substances that are produced are called the **products**.
- The products have different chemical properties than the reactants.
- During a chemical reaction, chemical bonds of the reactants break and new bonds form to produce the products (new substances).



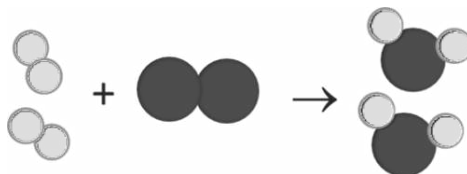
Grade 9 Content – What you should know:

Chemical equations to represent reactions:

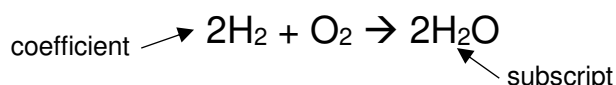
1. Chemical reactions can be represented with words (**word equation**):



2. Chemical reactions can be represented with pictures / models (**picture equation**):



3. Chemical reactions can be represented with chemical formulae (**balanced chemical equation**):



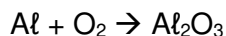
4. **Explanation:** TWO hydrogen molecules react with ONE oxygen molecule to form TWO water molecules. Atoms were conserved (4 H-atoms before and after; 2 O-atoms before and after) but new molecules were formed (molecules not conserved).

Balanced equations: HOW TO BALANCE A CHEMICAL EQUATION

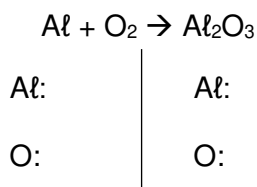
(ANY OTHER method can also be used to balance chemical equations)

Step 1: The unbalanced chemical equation

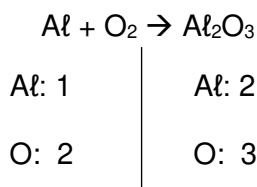
Write down the unbalanced chemical equation. Check that EACH formula is written correctly.

**Step 2: Make a list**

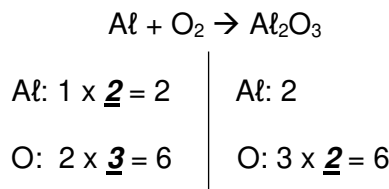
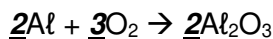
Make a list of the elements on each side under the equation for both the reactants and products.

**Step 3: Identify the number of atoms of each element**

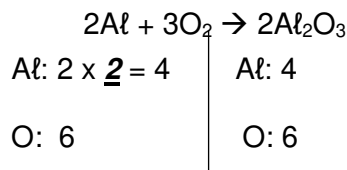
Next to each element, put the number of atoms of the specific element.

**Step 4: Multiply the number of atoms**

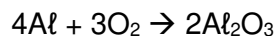
Multiply the number of atoms of each element until both sides are equal.

**Step 5: Placing the coefficients in front of the molecules**Put the number, the coefficient, you multiplied the element by and place in front of that element or compound in the equation. The 2 in front of Al, the 3 in front of O₂ and the 2 in front of Al₂O₃.**Step 6: Check equation**

Check to see if multiplying the coefficient with the subscript give equal numbers of atoms on both sides. Rework the calculation where necessary.



Final step: Write the balanced equation (and do a final check to see if it is balanced)



[Note: When balancing chemical equations, write the unbalanced equation once, do all the calculations beneath it and in the end write the final balanced equation. Do not rewrite the equation with each step.]

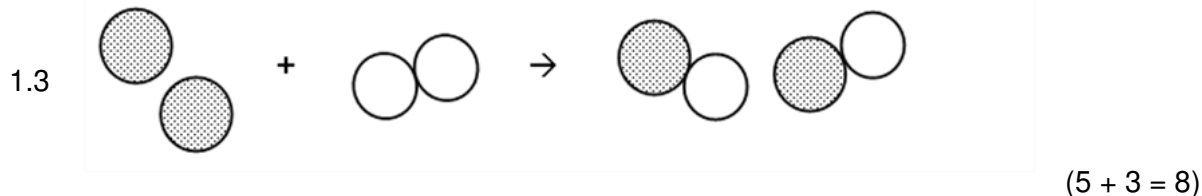
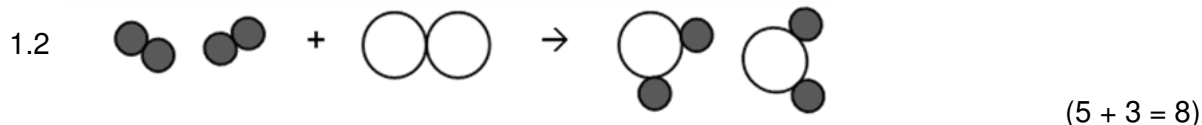
Informal activity 4 – Writing and balancing of chemical equations

Study the given models for the atoms of different elements:

Element	Model
Hydrogen (H)	
Oxygen (O)	
Carbon (C)	
Magnesium (Mg)	

1. For each of the following picture equations, write down the:

- balanced chemical equation, using chemical formulae.
- word equation.



2. Use the models of the atoms given in the table to provide the following:

2.1 Draw the picture equation for the chemical reaction: $2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$ (4)

2.2 Write down the word equation for this reaction. (3)

3. Balance each of the following chemical equations:

NOTE: The mark per sub-question is an indication of how many coefficients are necessary to balance each equation. In tests and exams, less marks will be awarded for balancing.



Reactions of metals and non-metals with oxygen

Background knowledge Gr. 7:

Many foods and household chemicals can be classified as acids, bases, or neutrals.

Properties of:

Acids (such as lemon and other fruit juices, vinegar, tartaric acid, swimming pool acid):
Taste sour, feel rough on the skin, are dangerous to taste or feel (are corrosive).

Bases (such as bicarbonate of soda, washing powder, most soaps, bleach and household cleaners):
Taste bitter, feel slippery on the skin, many are dangerous to taste or feel (are corrosive).
Soluble bases are called alkaline/s.

Neutrals (such as pure water, table salt solution, sugar solution, cooking oil) are neither acids nor bases.

Acid-base indicators

Red litmus paper remains red in an acid and in a neutral solution but turns blue in a base.
Blue litmus paper remains blue in a base and in a neutral solution but turns red in an acid.



Grade 9 content (What you should know):**Reactions of METALS WITH OXYGEN (O₂)**

- Some metals react with oxygen during burning (combustion).
- Combustion is the reaction of a substance with oxygen during burning (to release heat and light energy).
- When a metal reacts with oxygen (in the air), a metal oxide is formed as a product.
- The general equation for this type of reaction is: **metal + oxygen → metal oxide**

Reaction of IRON with oxygen

- When iron (steel wool) is burnt in air, the reaction forms iron oxide as a product. (Teacher demonstration)
- Word equation: iron + oxygen → iron oxide
- Chemical equation: $\text{Fe} + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3$ [unbalanced]
 $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$ [balanced]

Reaction of MAGNESIUM with oxygen

- When magnesium (magnesium ribbon) is burnt in air (which contains oxygen), the reaction forms magnesium oxide as a product. (Teacher demonstration)
- Word equation: magnesium + oxygen → magnesium oxide
- Chemical equation: $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$ [unbalanced]
 $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ [balanced]
- Metal oxides form alkaline solutions in water (red litmus turns blue; pH >7)

Formation of rust

- Rusting is a slow chemical reaction of iron metal, with oxygen and moisture (water) to form a complex compound, part of which is iron oxide.
- Rust (a form of corrosion) only occurs at the surface of the iron exposed to the air.
- Steel (which consists mostly of iron) is an essential material in modern construction.
- Equipment and structures can rust and weaken.

Ways to prevent rusting

- Iron and steel can be painted to keep away moisture and oxygen.
- Iron and steel can be coated with a thin layer of chromium or zinc (metals which do not rust). This is done by an electroplating technique which is a form of electrolysis.
- Galvanising (covering iron with zinc oxide).



Reactions of NON-METALS WITH OXYGEN (O₂)

- Non-metals react with oxygen to form non-metal oxides.
- When any non-metal is burnt in an excess oxygen (air), the general equation is:
non-metal + oxygen → non-metal oxide

Reaction of CARBON with oxygen

- When carbon is burnt in oxygen, carbon dioxide [CO₂ (g)] is produced. (Teacher demonstration)
- Word equation: carbon + oxygen → carbon dioxide
- Chemical equation: $C + O_2 \rightarrow CO_2$
- When CO₂ is dissolved in water, the solution is acidic (blue litmus turns red; pH < 7)
- **Enrichment:** $H_2O + CO_2 \rightarrow H_2CO_3$ (carbonic acid / hydrogen carbonate forms part of acid rain)

Reaction of SULFUR with oxygen

- When sulfur reacts with oxygen, sulfur dioxide [SO₂ (g)] is produced. (Teacher demonstration - OUTSIDE)
- Word equation: sulfur + oxygen → sulfur dioxide
- Chemical equation: $S + O_2 \rightarrow SO_2$
- When SO₂ is dissolved in water, the solution is acidic (blue litmus turns red; pH < 7)
- **Enrichment:** $H_2O + SO_2 \rightarrow H_2SO_3$ (sulphurous acid / hydrogen sulphite forms part of acid rain)

Differences between metal and non-metal oxides:

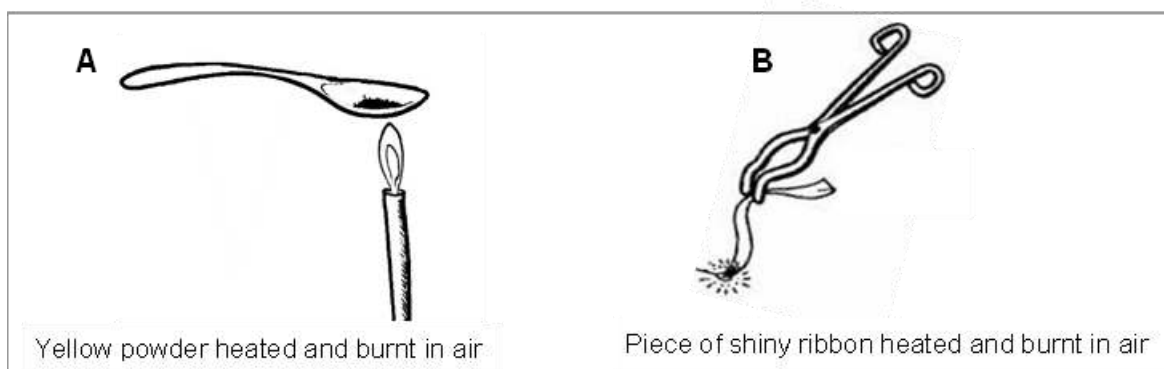
Metal oxides	Non-metal oxides
metal + oxygen → metal oxide	non-metal + oxygen → non-metal oxide
base	acid
pH > 7	pH < 7
Examples: Li ₂ O, Na ₂ O, MgO, CaO	Examples: CO ₂ , SO ₂ , NO ₂ , P ₂ O ₅

➤ Formal Practical Activity:

Practical Task 1 Term 2 Combustion (Reaction of Mg and S with O₂) – Available on www.mindstream.co.za

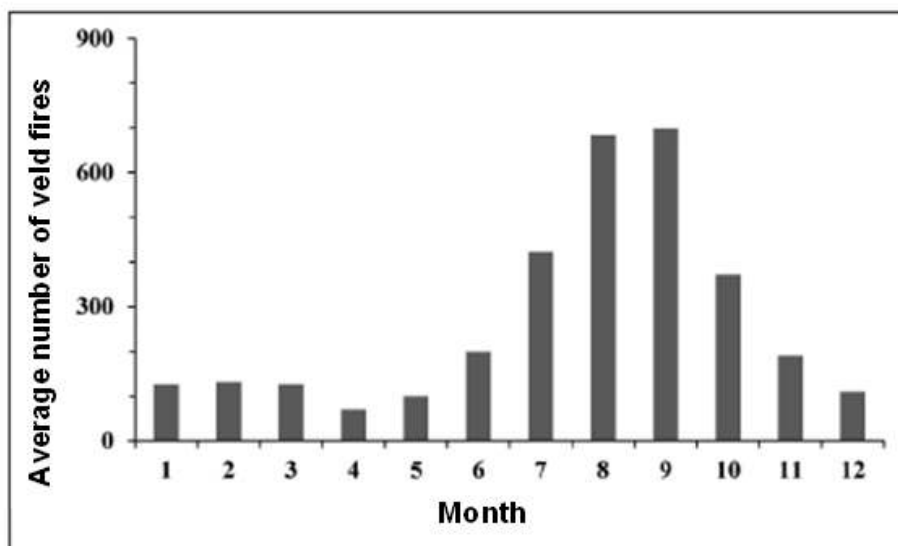
Informal activity 5 – Reaction of metals and non-metals with oxygen

1. A practical demonstration is conducted to demonstrate combustion of elements.
 In A, a yellow powder in a teaspoon is heated over a flame and burnt in the air.
 In B, a piece of shiny ribbon held with a pair of tongs, is also heated, and burnt in the air.



- 1.1 Which part of the air is responsible for the combustion reactions that take place? (1)
- 1.2 The yellow powder in A burns with a bluish-purple flame.
- 1.2.1 Give the name of the yellow powder. (1)
- 1.2.2 Classify the element as a metal or a non-metal. (1)
- 1.2.3 Give the name of the product that forms. (1)
- 1.2.4 Is the product a solid, a liquid or a gas? (1)
- 1.2.5 Write down the balanced chemical equation for the reaction that takes place in A. (2)
- 1.3 The element used in B is magnesium.
- 1.3.1 Classify magnesium a metal or a non-metal. (1)
- 1.3.2 What is the colour of the flame magnesium burns with in air? (1)
- 1.3.3 Write down the word equation for the reaction that takes place in B. (3)
- 1.3.4 Write down the balanced chemical equation for the reaction in B. (3)

2. The graph below shows the monthly average number of veld fires in South Africa. The data was collected between 2003 and 2013.



(Month 1 is January ... month 12 is December)

- 2.1 During veld fires trees, shrubs and grass burn freely in air and large amounts of carbon dioxide is released into the atmosphere.
- 2.1.1 Give the names of the two main reactants in any veld fire. (2)
- 2.1.2 Write down a balanced chemical equation for the combustion reaction that takes place during a veld fire. (2)
- 2.1.3 Explain the term "combustion". (2)
- 2.2 Name TWO negative effects veld fires have on the ATMOSPHERE. (2)
- 2.3 Study the graph and answer the following questions:
- 2.3.1 Identify the independent variable. (1)
- 2.3.2 Identify the dependent variable. (1)
- 2.3.3 How many veld fires occur on average in June? (1)
- 2.3.4 In which months is the occurrence of veld fires the highest? (2)
- 2.3.5 Give a possible explanation for the observation made in question 2.3.4. (2)
- [30]**

Informal activity 6 – Rusting

1. Study the picture of a rusted iron shipwreck on a beach.



- 1.1 Tabulate ONE difference between rusting and combustion. (3)
- 1.2 Name THREE reactants (chemicals) required for rusting to occur. (3)
- 1.3 What is the CHEMICAL name for the reddish-brown rust on the shipwreck. (1)
- 1.4 Write down a balanced chemical equation for the rusting of iron. (3)
2. Shown below, a rusted iron chain (A) and a shiny, new chain (B).



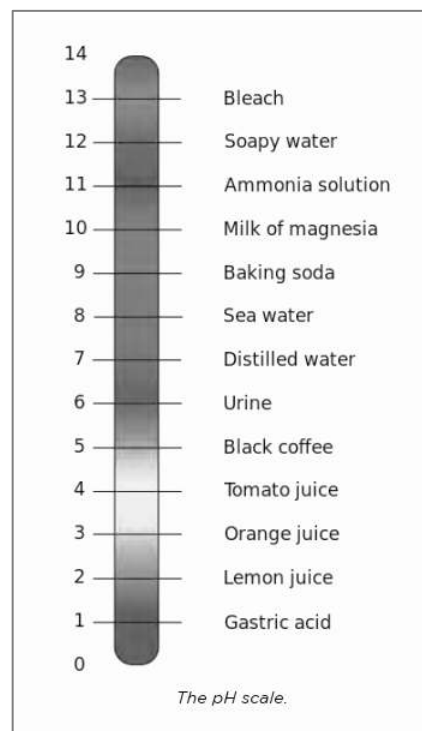
- 2.1 Explain why a rusted chain can easily break. (2)
- 2.2 Why will covering the new chain with oil help to prevent rusting? (2)
- 2.3 Suggest another way, apart from painting or covering with oil, to prevent rusting of iron objects. (1)

[15]

Acids, bases, and pH value

The concept of pH value

- pH is a measure of how acidic or basic a substance is.
- The pH scale ranges from 1 to 14.
- Acids have a pH in the range of 1 to 7.
- Bases have a pH in the range of 7 to 14.
- A neutral substance has a pH of 7.
- Chemical indicators (such as universal indicator, litmus paper, red cabbage water, red onion water, turmeric water, bromothymol blue, phenolphthalein) indicate whether a substance is an acid / base / neutral.
- Universal indicator indicates the full range of pH values by colour changes.
- Acids change the colour of universal indicator towards yellow/orange/red.
- Bases change the colour of universal indicator towards the blue/purple.
- Neutral substances change the colour of universal indicator to green.



Informal activity 7 – The concept of pH value with informal practical investigation

1. Give the correct word/term for each of the following descriptions:
 - 1.1 A chemical that shows whether a substance is an acid or a base.
 - 1.2 The measure of how acidic or basic a substance is.
 - 1.3 An indicator that can indicate the full range of pH values by colour changes.
 - 1.4 A substance with a pH of 7.
 - 1.5 A substance with a pH between 7 and 14.
 - 1.6 A substance with a pH below 7. (6)
2. Investigate a selection of household substances to determine whether they are acids, bases or neutrals using universal indicator.
 - 2.1 Select FIVE to TEN substances like water, milk, dishwashing liquid, rooibos tea, vinegar, bicarbonate of soda, tartaric acid, lemon juice, salt water, etc.

Draw a table in your workbook, like the one below.

Record the results in the table and provide the table with a suitable heading.

Household substance	Colour of universal indicator	pH	Acid, Base or Neutral
---------------------	-------------------------------	----	-----------------------

(7)

- 2.2 Identify the independent variable in this investigation. (1)

- 2.3 Identify the dependent variable in this investigation. (1)

[15]

Reactions of acids with bases (Part I)

Neutralisation and pH

- An acid and a base neutralise each other in a neutralisation reaction.
- A base reacts with an acid, to make it less acidic / neutral.
- An acid reacts with a base, to make it less basic / neutral.
- After reacting an acid and a base together, the resultant pH will vary based on the strength of the acid and base reactants.
- A strong acid reacting with a weak base will result in a pH below 7 (acidic solution).
- A strong base reaction with a weak acid will result in pH above 7 (basic/alkaline solution).
- Non-metal oxides tend to be acidic (low pH).
- Bases (high pH) include metal oxides, metal hydroxides, metal carbonates.
- Examples of common acids and bases:

ACIDS		BASES	
Strong acids	Weak acids	Strong bases	Weak bases
Hydrochloric acid HCl	Citric and ascorbic acid in citrus fruit	Sodium hydroxide NaOH	Bicarbonate of soda OR Sodium hydrogen carbonate NaHCO_3
Sulfuric acid H_2SO_4	Acetic acid (in vinegar)	Potassium hydroxide KOH	Ammonia NH_3
Nitric acid HNO_3	Tartaric acid		Calcium hydroxide Ca(OH)_2
	Carbonic acid H_2CO_3		Magnesium hydroxide Mg(OH)_2



Informal activity 8 – Neutralisation and pH

1. Choose an item from COLUMN B that matches the statement in COLUMN A. Write only the letter (A - G) next to the question number.

COLUMN A		COLUMN B	
1.1	The reaction of an acid with a base.	A	HCl
1.2	The pH of non-metal oxide solutions.	B	pH > 7
1.3	The pH of metal oxide solutions.	C	Neutralisation
1.4	Hydrochloric acid	D	Sodium hydroxide (NaOH)
1.5	Sulphuric acid	E	pH < 7
1.6	A strong acid reacts with a weak base to ...	F	Ammonia (NH ₃)
1.7	A strong base reacts with a weak acid to ...	G	form an acidic solution.
1.8	Example of a strong base.	H	H ₂ SO ₄
1.9	Example of a weak base.	I	form an alkaline solution.

(9)

2. Fill in the missing word or choose the correct word in brackets:

- 2.1 A base reacts with an acid to make it less ...
- 2.2 An acid reacts with a base to make it less ...
- 2.3 When an acid reacts with a base, the process is called ...
- 2.4 When hydrochloric acid reacts with ammonia, the final product will have a pH of (below / above) 7.
- 2.5 When sodium hydroxide reacts with carbonic acid, the final solution will have a pH of (below / above) 7
- 2.6 The chemical formula for sulphuric acid is ...

(6)

[15]

Reactions of acids with bases (Part II)

The general reaction of an acid with a metal oxide (base)

- When metals react with oxygen, they tend to form oxides which are bases, for e.g., MgO.
- When any acid reacts with a metal oxide, the products formed are a salt and water.
- The type of salt formed will depend on the specific acid and metal oxide used in that reaction.
- The general equation is always: **acid + metal oxide $\rightarrow$ salt + water**

• Example 1:

Word equation: hydrochloric acid + magnesium oxide $\rightarrow$ magnesium chloride + water

Balanced chemical equation: $2\text{HCl} + \text{MgO} \rightarrow \text{MgCl}_2 + \text{H}_2\text{O}$

When **hydrochloric acid/ HCl** is used, the salt formed is a **chloride** (MgCl_2).

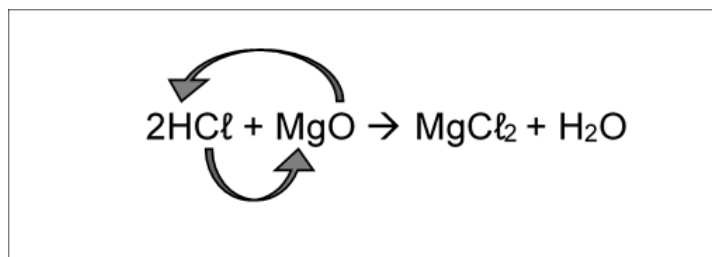
• Example 2:

Word equation: sulphuric acid + magnesium oxide $\rightarrow$ magnesium sulphate + water

Balanced chemical equation: $\text{H}_2\text{SO}_4 + \text{MgO} \rightarrow \text{MgSO}_4 + \text{H}_2\text{O}$

When **sulphuric acid/ H₂SO₄** is used, the salt formed is a **sulphate** (MgSO_4).

- The reaction between an acid and a metal oxide is an EXCHANGE REACTION:



Applications

- Burning wood and fossil fuels releases carbon dioxide and sulfur dioxide into the atmosphere.
- These gases combine with water in the atmosphere to produce acid rain.
- Limestone (CaCO_3 / calcium carbonate) is used in agriculture to make soil less acidic.

Informal activity 9 – Reaction of an acid with a metal oxide (base)

1. The following TWO experiments are conducted:

Experiment 1:

- (A) A piece of magnesium ribbon is burnt in air to react with and excess oxygen.
 (B) The white powder that forms, is dissolved in a small amount of water.
 (C) When a piece of red litmus paper is dipped into the solution, it turns blue.

Experiment 2:

- (D) A piece of wood (carbon) is burnt in air to react with and excess oxygen.
 (E) The gas that forms, is bubbled through (dissolved in) a small amount of water.
 (F) When a piece of blue litmus paper is dipped into the solution, it turns red.

Use the information above to answer the questions:

- 1.1 Give the chemical formula of the white powder that forms in step B. (1)
 1.2 Is magnesium oxide a basic or an acidic oxide? (1)
 1.3 Prove your answer in question 1.2 by referring to step C. (1)
 1.4 Is the gas that formed in step E, a metal oxide, or a non-metal oxide? (1)
 1.5 Are non-metal oxides basic or acidic oxides? Prove your answer. (2)
2. A few drops of universal indicator are added to a magnesium oxide solution. The colour scale for universal indicator is given below.

	Universal indicator		
Colour	Red, orange, yellow	Green	Blue, purple
pH	below 7	7	above 7

- 2.1 What will the colour of the universal indicator be in the magnesium oxide solution? Give a reason for your answer. (2)

While a diluted hydrochloric acid solution is added to the magnesium oxide solution, the colour of the solution gradually changes to green.

- 2.2 Explain the observation. (2)
- 2.3 Give the chemical formulae for:
 2.3.1 magnesium oxide
 2.3.2 hydrochloric acid (2)
- 2.4 Complete the following general word equation:
 metal oxide + acid $\rightarrow$... + ... (2)
- 2.5 Write a balanced chemical equation for the reaction between magnesium oxide and hydrochloric acid. (4)
- 2.6 Write down the NAMES of the products. (2)
- 2.7 What is a reaction between a base and an acid called? (1)
3. Write down the balanced chemical equation for the reaction between magnesium oxide and sulphuric acid to form magnesium sulphate and water. (4)

[25]

Informal activity 10 – Applications of the reaction of acids and bases

1. Some plants, like blueberries, grow well in very acidic soil, while plants like lavender and beans grow better in alkaline soil. Below, the properties of different compounds that can be added to soil to change its pH.

Compounds	Properties
Calcium carbonate	Basic
Water	Neutral
Aluminium sulphate	Acidic

- 1.1 The soil available has a pH of 8 and you need to grow blueberries. With which compound must the soil be treated to prepare it for growing blueberries? (1)
- 1.2 Motivate your answer in question 1.1. (2)
- 1.3 If soil with a pH of 5 must be used to grow beans in, which compound will be the most suitable to prepare the soil for growing the beans? (1)
- 1.4 Explain your answer in question 1.3. (2)

[6]**NEXT PAGE:**

- **Informal practical activity to practise process skills**

Practical Task / Investigation**Marks: 20****Acids, bases, and the use of an indicator during neutralisation****PART 1****Aim:****To determine the colour of an indicator in an acid, a base and a neutral substance.****Materials:**

- Universal indicator or red cabbage water (see instructions for preparation below)
- pH scale and colours for universal indicator or red cabbage water (Table 1)
- Bicarbonate of soda (Baking soda, NaHCO_3 or sodium hydrogen carbonate)
- Vinegar (Ethanoic acid)
- Water (Distilled water if possible)
- Test tubes, glass containers or transparent plastic cups
- Test tube rack
- Droppers
- Plastic teaspoon

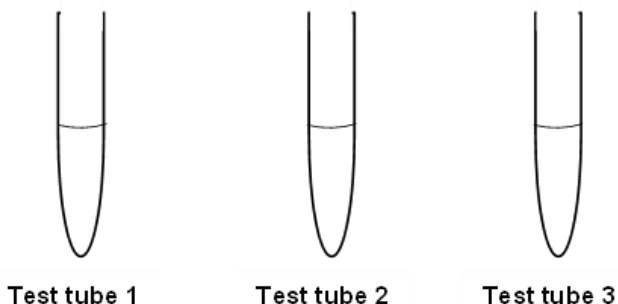
How to prepare red cabbage indicator:*Chop up a few (2 to 3) red cabbage leaves.**Cover the leaves with boiling water and boil for a few minutes.**Let the mixture cool down.**Instead of boiling the mixture, liquidise the leaves and water with an electric food processor.**Strain the mixture to remove the solid pieces from the indicator (red cabbage water).****How to prepare the bicarbonate of soda solution:****Dissolve 2 teaspoons of bicarbonate of soda in 100 ml (20 teaspoons) of water.**Stir until all the solid has dissolved.***Table 1: Colour scale and pH for universal indicator and red cabbage water**

pH	Colour of universal indicator	Colour of red cabbage water
0	Dark red	Red
1	Red	
2	Red	Light pink
3	Orange red	
4	Orange	Dark pink
5	Orange yellow	
6	Greenish yellow	Purple
7	Green	
8	Greenish blue	Blue
9	Blue	
10	Navy blue	Blue green/Cyan
11	Purple	
12	Dark purple	Green
13	Violet	
14	Violet	Yellow



Method:

1. Put 3 test tubes in a test tube rack and number them **1, 2** and **3**.
2. Pour 5 to 10 ml of vinegar in test tube **1**.
3. Pour 5 to 10 ml of (distilled) water in test tube **2**.
4. Pour 5 to 10 ml of the bicarbonate of soda solution in test tube **3**.
5. Add a few drops of universal indicator or red cabbage water to each test tube.
6. Observe the colour of each solution.
7. Determine the pH of each solution. Use Table 1.
8. Decide whether the solution in each of test tubes **1, 2** and **3** is an acid, a base or neutral.
9. Keep the solutions to use as a reference in **Part 2** of the investigation.

**Table of results:**

Test tube	Colour	pH	Acid, base or neutral
1 (Vinegar)			
2 (Distilled water)			
3 (Bicarbonate of soda)			

Conclusion:

1. Which substance is neutral with a pH of 7? _____ (1)
2. Which substance is an acid with a pH below 7? _____ (1)
3. Which substance is a base with a pH above 7? _____ (1)
4. **Definition of an indicator:**
An indicator indicates whether a substance is an _____ or a _____
through a _____ change. (2)

PART 2

Aim: To investigate how the pH changes when vinegar is treated with a solution of bicarbonate of soda.

Investigative question: How will the pH change when vinegar is treated with a solution of bicarbonate of soda?

Method:

1. Pour a small amount (5 ml or 1 teaspoon) of vinegar in a test tube or glass jar.
2. Add a few drops of universal indicator or red cabbage water to the vinegar.
3. Record the colour and the pH of the vinegar, using **Table 1**.
4. Use a medicine dropper or propette to transfer 10 drops of the original bicarbonate of soda solution, prepared in **Part 1**, to the vinegar-indicator mixture.
5. Stir the solution gently or swirl the test tube.
6. Record the colour and the pH of the solution.
7. Add another 10 drops of bicarbonate of soda and record the colour and pH.
8. Repeat steps 4 to 6 until the pH of the solution is well above 7.

Table of results: (Determine own results or use the set of results given below.)

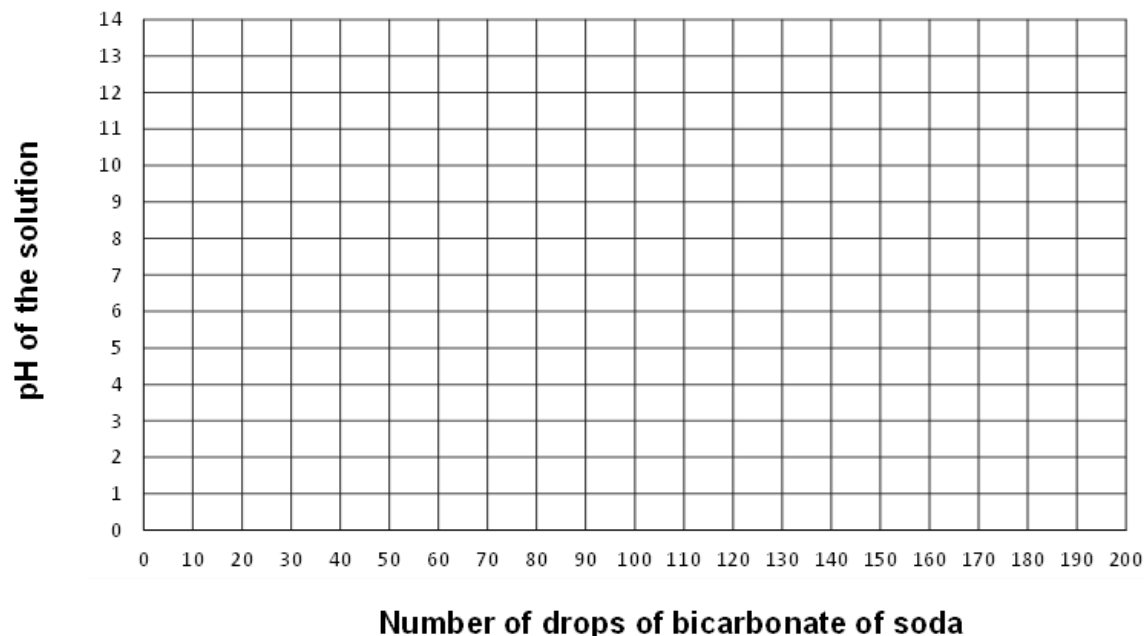
Possible results			Own results		
Total number of drops of bicarbonate of soda	Colour	pH	Total number of drops of bicarbonate of soda	Colour	pH
0	Red	2			
10	Red	2			
20	Red	2			
30	Red	2			
40	Red	2			
50	Orange red	3			
60	Orange	4			
70	Greenish yellow	6			
80	Green	7			
90	Greenish blue	8			
100	Blue	9			
110	Blue	9			
120	Blue	9			
130	Blue	9			



Graph of the results:

Draw a graph of the results in the table. Use the graph paper given below. (3)

Change in pH as bicarbonate of soda is added to vinegar

**Conclusion:**

Underline the correct word in brackets to formulate the conclusion and to answer the investigative question.

When more bicarbonate of soda (a base) is added to vinegar (an acid), the pH becomes (higher / lower) and the mixture becomes (more / less) acidic.

Acids and bases (neutralise / destroy) each other. (2)

Questions:

1. When the vinegar and bicarbonate of soda (NaHCO_3) react with each other, gas bubbles are observed. Which gas is liberated (formed)? (1)

2. Complete the general WORD equation for this reaction: (3)

Acid + metal carbonate $\rightarrow$ _____ + _____ + _____

3. How many drops of bicarbonate of soda neutralised the vinegar in this investigation? (1)



4. Explain how you determined your answer in question 3. (2)

5. Identify the:

- 5.1 Independent variable in this investigation. (1)

- 5.2 Dependent variable. (1)

6. When you are stung by a bee, an acid is injected into the skin, causing a burning sensation. Why would bicarbonate of soda help to calm the burning sensation after the bee sting? (1)

TOTAL: 20

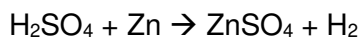
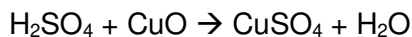
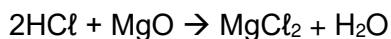
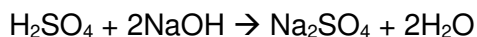
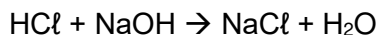
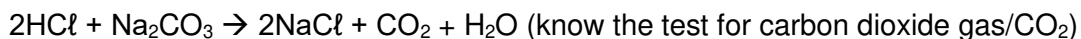
Reaction of acids with metal hydroxides, metal carbonates and metals

The following content can be covered for enrichment purposes (CAPS p. 68, 69).

SUMMARY OF REACTIONS OF ACIDS WITH ...**1. Acid + metal → salt + hydrogen**

(NOTE: Mg, Zn, Fe can replace hydrogen from an acid, but Ag and Cu cannot.)

Balanced chemical equations:

**2. Acid + metal oxide (base) → salt + water****3. Acid + metal hydroxide (base) → salt + water****4. Acid + metal carbonate (base) → salt + carbon dioxide + water**

END OF TERM 2



TERM 3

Strand: Energy and Change

Topic: Forces

Grade 9 Content - What you should know:

Types of forces

- A force is a push or pull (or twist) exerted upon an object. (Forces are invisible, we can only see the effect of forces on objects.)
- Force is measured in units called newtons (N).
- Forces that two objects exert on each other always act in pairs.
- A force can change the shape, direction, and speed of an object.
- All forces acting on objects can be placed into two broad groups:
 - contact forces
 - field forces

Contact forces

- A contact force (including friction, tension, compression) results when two bodies are in contact (touch) with each other.

Field forces (non-contact forces)

- Field forces result from action-at-a-distance between two bodies.
- Common examples of field forces include gravitational, magnetic, and electrostatic forces.

Gravitational force:

- Gravity is the force of attraction (pull) that objects/bodies have on one another due to their masses, for e.g., the attraction of the Sun and planets, Earth and Moon, Earth, and objects on the surface (people and other things).
- Objects with greater mass have more gravitational pull on each other.
- Force decreases as distance between the objects increases.
- Force of gravity is measured in newtons (N).
- The weight of an object is the gravitational force exerted on it by the Earth (or the moon, or another planet). It is also measured in newtons (N).
- The MASS of the object stays the same no matter where it is determined.
- However, the WEIGHT of an object will change when weighed in different places with different gravitational force such as on Earth compared to the Moon.

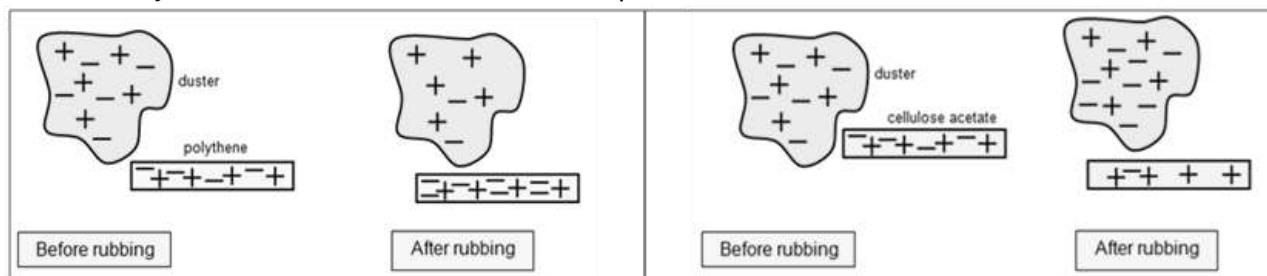
Magnetic force:

- Magnets attract magnetic substances including steel, iron, cobalt, nickel.
- All magnets have two ends/poles (north & south).
- Opposite poles attract and like poles repel each other (magnetism is a push / pull force).
- Just like a bar magnet, the Earth has a magnetic field (north and south poles).

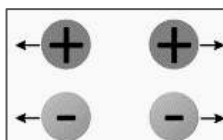


Electrostatic force:**Background knowledge - GRADE 8****Friction and static electricity**

- Friction (rubbing) between certain materials (such as plastic, perspex, glass, nylon, wool, silk) transfers electrons between the atoms of the two materials being rubbed together.
- The electrons move from one material causing a positive charge on its surface and causing a negative charge on the surface of the other material.
- It is only the electrons that are transferred; protons and neutrons do not move.



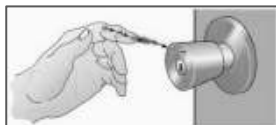
- Objects/materials with same/like charges repel each other.



- Objects/materials with opposite/unlike charges attract each.



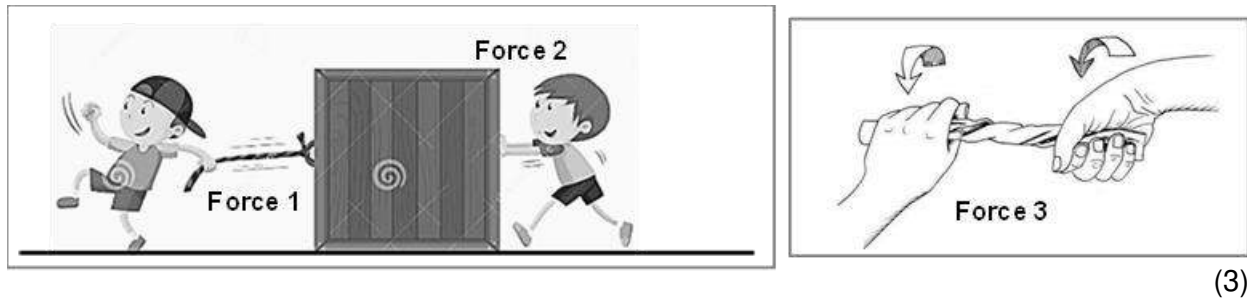
- A discharge of the electrons causes the sparks or shock of static electricity, especially when the air is dry.

**Grade 9 Content – What you should know:**

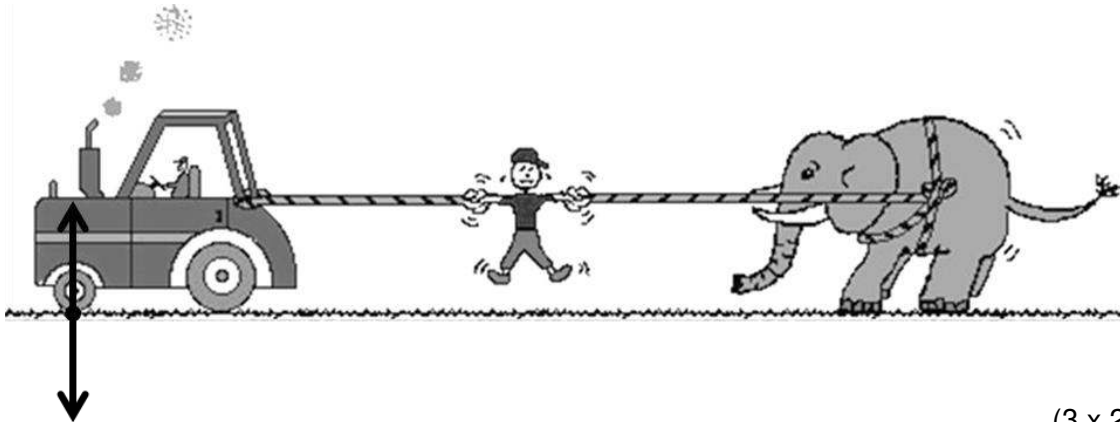
- When certain materials are rubbed together, they can acquire an electrostatic charge because of the loss or gain of electrons.
- Due to friction, energy is transferred to the electrons, enabling them to move.
- Only the electrons are transferred, protons cannot move.
- During rubbing, the electrons move from one material causing a positive charge on its surface and causing a negative charge on the surface of the other material.
- Objects which have like charges (+ and + or - and -) repel (push) each other and those with unlike charges (+ and -) attract (pull) each other.
- Charged objects in an electrostatic system possess potential energy. The energy comes from the work done during rubbing.
- A thunder cloud becomes charged by the rubbing together of air and water particles moving past each other in the atmosphere.
- A lightning strike occurs when there is a massive discharge (release of charge) between the thunder cloud and the ground.
- Lightning is a giant spark of electricity.
- Safety precautions should be considered during thunder and lightning storms.

INFORMAL ACTIVITY – FORCES (PART 1)

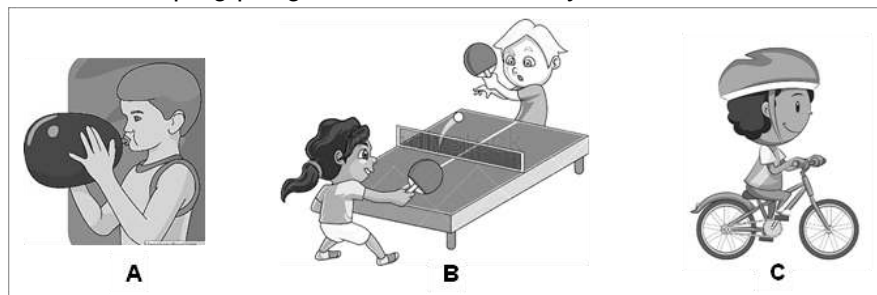
1. Identify Force 1, 2 and 3 as either a twist force or a push force or a pull force.



2. One force-pair is indicated in the diagram below. Use arrows to indicate THREE other force-pairs. NAME the forces e.g., force of wheel on ground and force of ground on wheel.

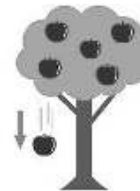


3. Identify ALL the EFFECTS the forces have on each of the objects:
The balloon in A, the ping pong ball in B and the bicycle in C.



4. Consider the diagram:

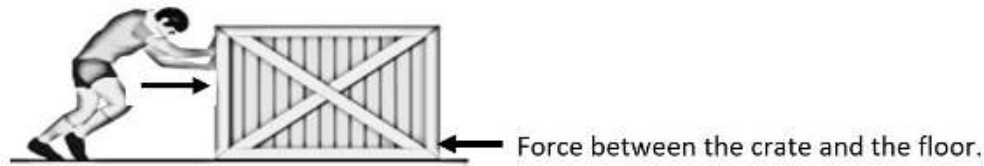
- 4.1 Re-write the sentence in your classwork book and underline the correct words in brackets:



The apple falls towards the earth due to (a magnetic force / gravitational force) which is a (contact force / field force). (2)

- 4.2 Compare the magnitude of the force the earth exerts on the apple with the magnitude of the force the apple exerts on the earth. (1)

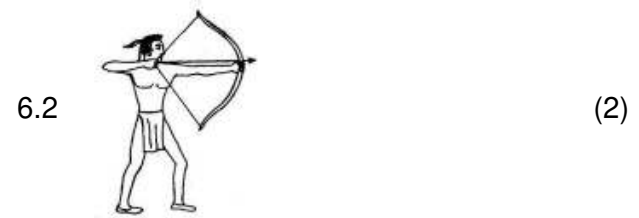
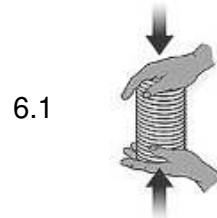
5. Study the diagram:



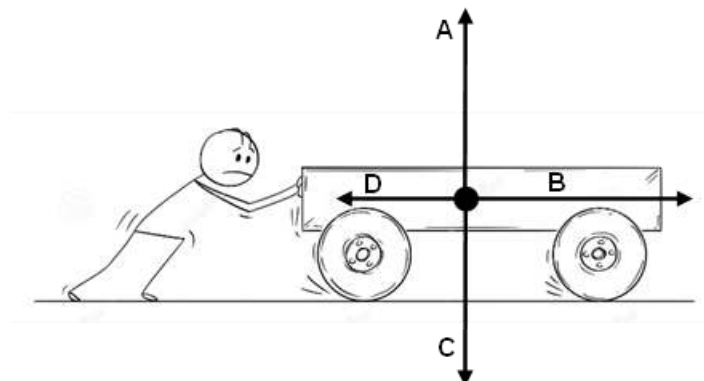
5.1 Name the force between the crate and the floor. (1)

5.2 The force between the crate and the floor is a (field force / contact force). (1)

6. Identify the contact force in 6.1 and 6.2 as TENSION or COMPRESSION:



7. In the picture below, a man is pushing a cart to the right. The forces exerted on the cart are indicated by the arrows labelled A, B, C and D.



7.1 Give the correct LETTER of the arrow representing each of the following forces:

7.1.1 The force exerted by the man on the cart. (1)

7.1.2 The weight of the cart. (1)

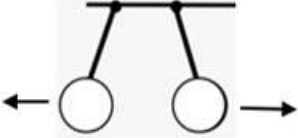
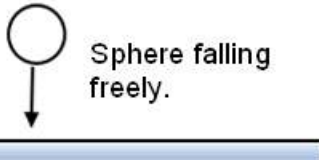
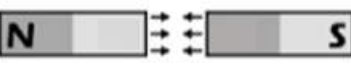
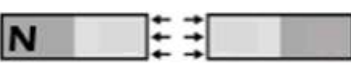
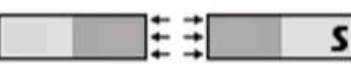
7.1.3 The force of friction between the wheels of the cart and the ground. (1)

7.1.4 The normal force (the force of the ground on the cart). (1)

7.2 If Force D = 44 N and Force B = 120 N, calculate the net horizontal force exerted on the cart. Also indicate the direction of the net force. (3)

7.3 Explain why the forces exerted on the cart are unbalanced. (2)

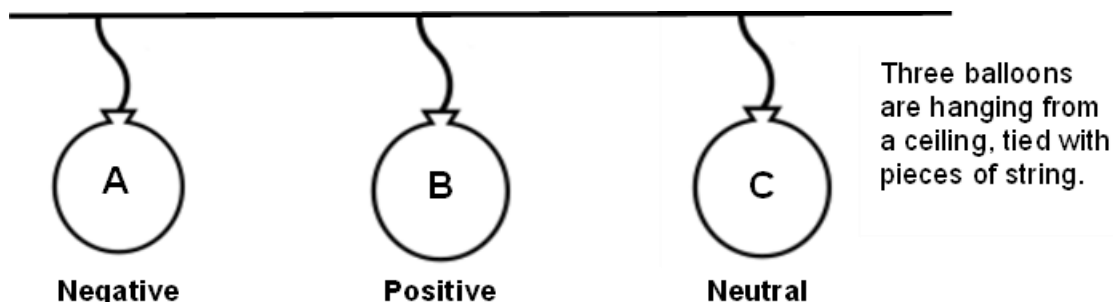
8. Follow the instructions to complete the table:

Indicate the CHARGES on the spheres as well as the MISSING POLES on the magnets	Contact force (CF) or Field force (FF)?	Gravitational, magnetic, or electrostatic force? (GF, MF or EF?)
	8.1	8.2
	8.3	8.4
 Sphere falling freely.	8.5	8.6
	8.7	8.8
	8.9	8.10
	8.11	8.12

(9)
[40]

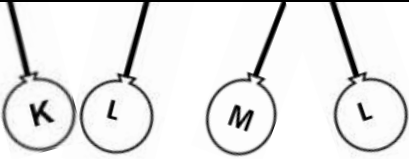
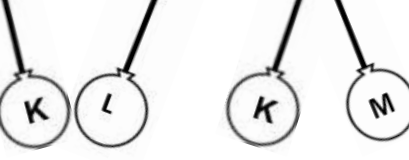
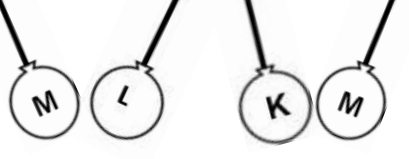
INFORMAL ACTIVITY – FORCES (PART 2): Electrostatic force

1. Rewrite the following statements in your workbook and choose the correct word in brackets.
 - 1.1 A negatively charged object (gained / lost) electrons and has an (excess / shortage) of electrons. (2)
 - 1.2 A positively charged object (gained / lost) electrons and has an (excess / shortage) of electrons. (2)
2. When certain materials are rubbed together, they can acquire an electrostatic charge because of the loss or gain of electrons.
 - 2.1 What is needed for objects to be charged electrostatically? (1)
 - 2.2 By referring to sub-atomic particles (electrons, protons, and neutrons) explain what it means when an object is electrically neutral. (2)
3. Each of the following balloons A, B and C are charged electrostatically. Balloon A is charged negatively, B positively and C is neutral.
 - 3.1 Redraw the balloons in your answering book. Indicate the distribution of charges on each balloon.



- (3)
- 3.2 Balloons A and B are slowly brought closer together. What will you observe? Explain your answer. (2)
- 3.3 Balloons B and C are slowly brought closer together. What will you observe? Explain your answer by re-drawing the two balloons and show the distribution of the charges on the balloons. Also indicate the forces the balloons experience with arrows. (3)

4. On three occasions, the following charge-interactions between balloons K, L and M are observed. In each case it is known that balloon L is charged negatively. Based on the observations shown below, what can you conclusively confirm about the charge on balloon K and M for each scenario?

4.1			Balloon	Conclusive evidence that the charge is +, – or neutral
			K	
			L	Negatively (-) charged
			M	
4.2			Balloon	Conclusive evidence that the charge is +, – or neutral
			K	
			L	Negatively (-) charged
			M	
4.3			Balloon	Conclusive evidence that the charge is +, – or neutral
			K	
			L	Negatively (-) charged
			M	

(3 x 2 = 6)

5.



Brain Teaser

The following findings were made after investigating the charge on several objects:

- Object C attracts object B.
- Object D repels object C.
- Object E attracts object D, but repels object F.
- Object F attracts object A.

It is known that object A is negatively charged, and object B is electrically neutral. What can you conclude (without any doubt) about the charge on objects C, D, E and F? Explain your answer.

(4)

6. Lightning strikes are usually observed during thunderstorms.

6.1 How does lightning occur?

(2)

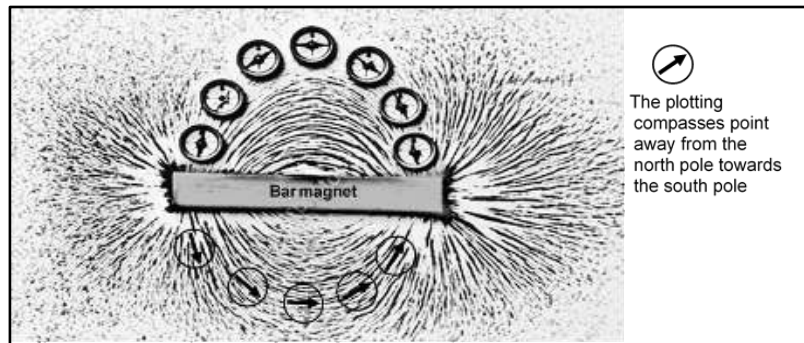
6.2 Name three safety precautions you can take to keep yourself safe during a lightning and thunderstorm.

(3)

[30]

INFORMAL ACTIVITY – FORCES (PART 3): Magnetic force

1. Iron filings are sprinkled around a bar magnet and plotting compasses are used to determine the direction of the magnetic field.

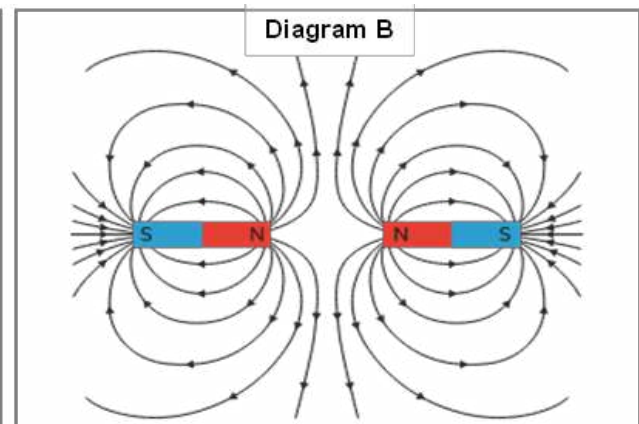
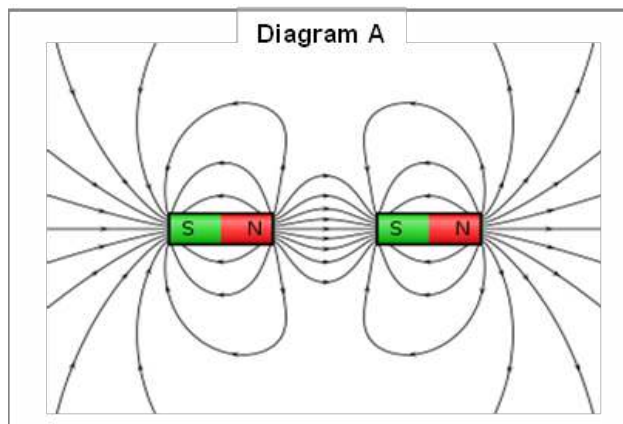


Re-draw the bar magnet in your classwork book and draw the magnetic field around the bar magnet. Label the magnetic poles and indicate the direction of the magnetic field. (4)

Properties of magnetic field lines:

- Magnetic field lines begin and end at the edges of the magnet (are drawn from the surface of the magnet).
- Magnetic field lines are denser where the magnetic field is stronger (i.e., near the poles).
- Magnetic field lines never touch or cross one another.
- The direction of a magnetic field is from north to south and is indicated by an arrow on the line.
- Magnetic field lines are solid crisp lines. No sketching.

2. Two magnets are placed next to each other and the magnetic field BETWEEN them is investigated.

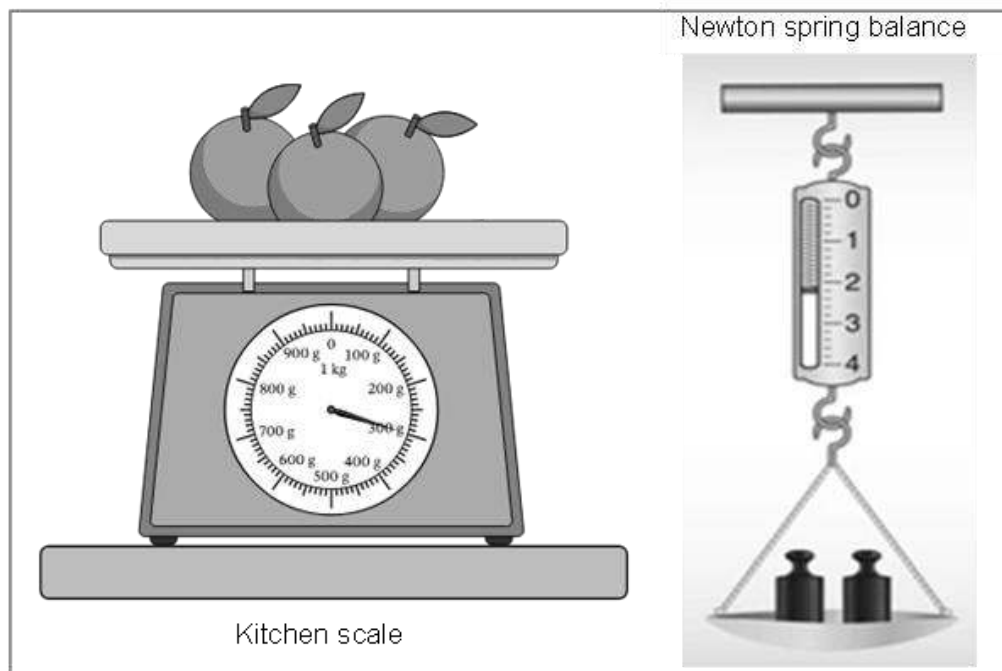


- 2.1 In which diagram are two like poles facing each other? (1)
- 2.2 In which diagram are two unlike poles facing each other? (1)
- 2.3 Based on the magnetic field patterns between the magnets, what can be deduced about the nature of the magnetic poles and the type of force between them? (4)

[10]

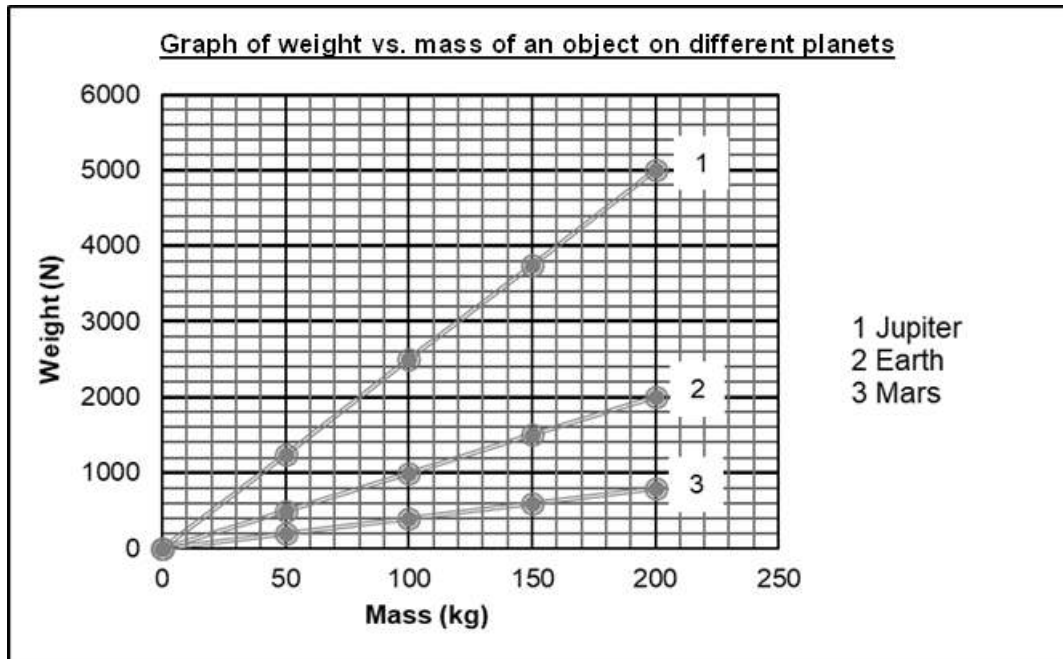
INFORMAL ACTIVITY – FORCES (PART 4): Gravitational force

1. Study the diagrams below.



- 1.1 Which apparatus measures mass? (1)
- 1.2 Which apparatus measures weight? (1)
- 1.3 Use the diagram and take the exact weight reading of the two mass pieces hanging in the scale pan. (1)
- 1.4 What is the mass of the three apples? (1)
- 1.5 Calculate the weight of the three apples if the following is given:
weight = mass x gravitational acceleration and $g = 9,8 \text{ m.s}^{-2}$. (2)

2. The graph below shows the relationship between the mass and the weight of an object on the planets, Mars, Earth, and Jupiter.



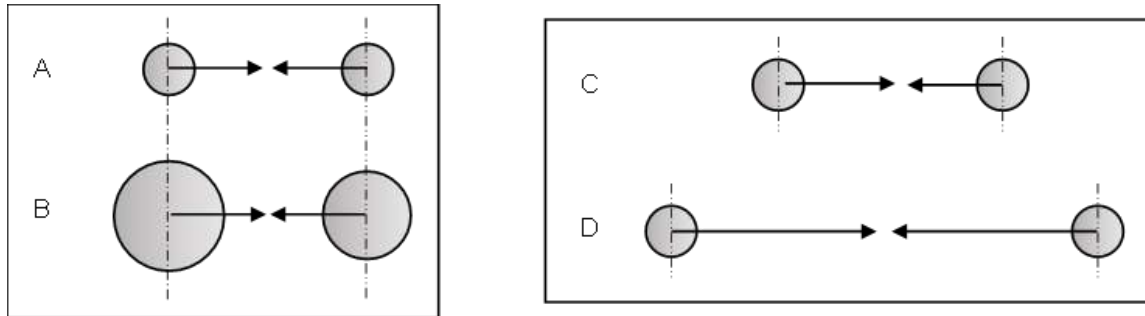
- 2.1 Define: (1)
- 2.1.1 Mass (1)
- 2.1.2 Weight (1)
- 2.2 Use the graph and determine the weight of a 150 kg mass on: (1)
- 2.2.1 Mars (1)
- 2.2.2 Earth (1)
- 2.2.3 Jupiter (1)
- 2.3 Which planet has the strongest gravitational force? (1)
- 2.4 Explain why Mars, Earth and Jupiter do not have the same gravitational force on a 150 kg object. (2)
- 2.5 Identify the following variables when comparing the weight of a 150 kg object on each of the three planets. (1)
- 2.5.1 Independent variable (1)
- 2.5.2 Dependent variable (1)
- 2.5.3 Controlled variable (1)
- 2.6 What is the relationship between mass and weight? (1)

2.7 Consider the following statement:

“I have realised that I should go on a diet to lose some weight, after measuring my weight on a bathroom scale.”

Indicate the scientific misconception(s) in this statement. (2)

2.8 Study the diagrams below showing different planets.



2.8.1 Name the two factors that affect gravitational force. (2)

2.8.2 Explain why the gravitational force between the planets in B is stronger than the gravitational force between the planets in A. (1)

2.8.3 Why is the gravitational force between the planets in D smaller than the gravitational force between the planets in C? (1)

2.8.4 Which variable is controlled in C and D? (1)

[25]

Circuits and current electricity - Background knowledge (GRADE 8)

- A circuit is a system for transferring electrical energy.
- An electric current is the flow of charge (kinetic energy).
- Cells or batteries store chemical substances (potential energy). When the chemicals react during chemical reactions, energy is produced and transferred to the charges which start to move and an electric current is produced.
- Electric cells supply the energy needed for electrons to move around an electric circuit.
- Electric current is the flow of charges (kinetic energy).
- A CLOSED circuit is needed to make a device work, such as making a bulb light up.
- A circuit has several components connected and current flows from one terminal at the source of energy (cell/battery), along conducting material (wires), through the device (bulb, resistor, buzzer), back to the other terminal of the source of energy (cell/battery).

GRADE 9 CONTENT - ELECTRIC CELLS AS ENERGY SYSTEMS

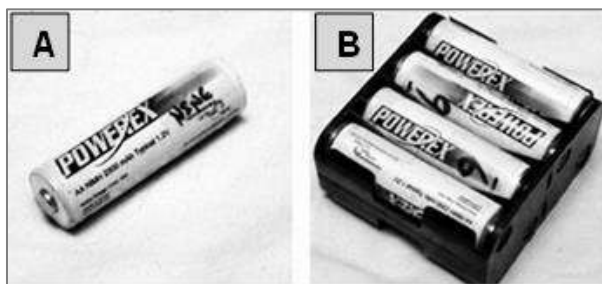
- A cell is a system in which certain chemical reactions can cause the flow of electricity through an external circuit.
- A cell is a source of electrical energy.
- A battery is a group of cells that are connected together.

INFORMAL ACTIVITY – ELECTRIC CELLS

1. Give the correct WORD or TERM for each of the following descriptions:

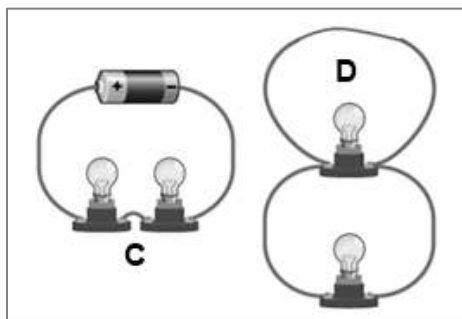
- | | | |
|-----|---|-----|
| 1.1 | The component in an electric circuit which converts chemical energy to electrical energy. | (1) |
| 1.2 | The flow of charge. | (1) |
| 1.3 | Two or more cells connected to each other. | (1) |
| 1.4 | The circuit component that supplies the energy for charges to move. | (1) |

2. Study photographs A and B.



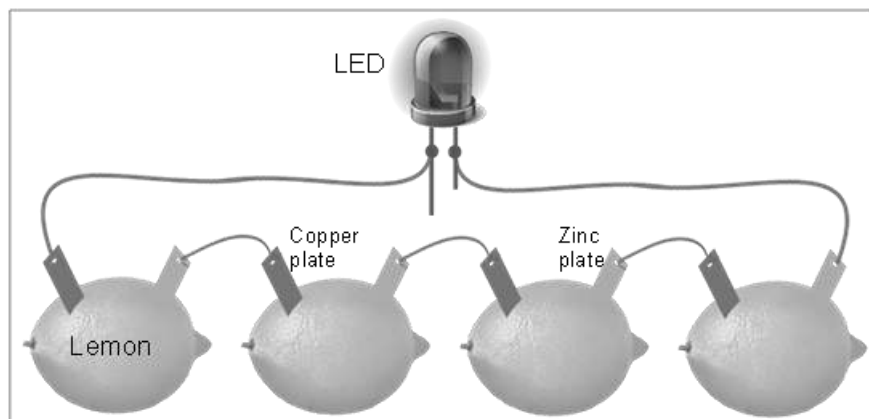
- | | | |
|-----|---|-----|
| 2.1 | Which photograph represents a battery? Explain your answer. | (2) |
| 2.2 | Describe the function of a battery in an electric circuit. | (2) |

3. Consider the two circuit diagrams, C and D:



In which circuit will the bulbs NOT glow. Explain why. (2)

4. A cell consists of electrodes and a chemical called the electrolyte. In the diagram below, a LED is connected to four lemons, each containing a copper plate and a zinc plate, all connected in series with conducting wires.



- 4.1 Which part of the set-up in the diagram above represents:
- 4.1.1 An electrode? (1)
 - 4.1.2 The electrolyte? (1)
 - 4.1.3 A cell? (1)
 - 4.1.4 A battery? (1)
 - 4.1.5 The positive and negative terminals of the cell or battery? (1)
- 4.2 What does LED stand for? (1)
- 4.3 Explain why the LED is glowing. (3)
- 4.4 Why will the LED glow dimmer if some of the lemons are removed? (1)

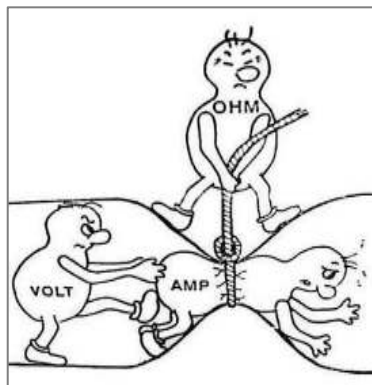
[20]

RESISTANCE

Uses of resistors

- Conductors (even good conductors) heat up when current passes through them: some energy is 'lost' / 'wasted' as heat. All conductors have some resistance.
- A resistor is a conducting material selected to control the current or to provide useful energy transfer, such as in bulbs, rheostats, motors, light sensitive diodes, light emitting diodes.

Simplest explanation of the relationship between electric current (measured in ampere), potential difference (measured in volt) and resistance (measured in ohm):



Factors that affect resistance in a circuit

- **TYPE OF MATERIAL:**
Different conducting materials have different resistance to an electric current.
- **THICKNESS OF THE CONDUCTOR:**
Thinner wires have more resistance than thicker wires.
- **LENGTH OF THE CONDUCTOR:**
Longer wires have more resistance than shorter wires.
- **TEMPERATURE OF THE CONDUCTOR:**
Generally hotter conductors (metals) have higher resistance than colder conductors.

INFORMAL ACTIVITY – RESISTANCE (PART 1)

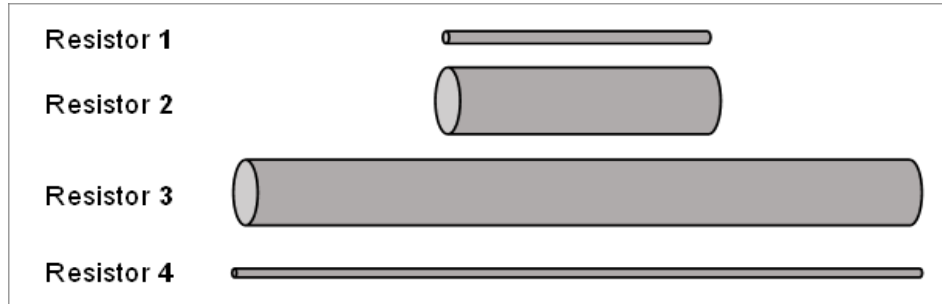
Only write the number and the letter of the correct answer.

1. What is resistance?
A The flow of electrons.
B A measure of potential difference.
C A combination of cells to form a battery.
D Opposing the flow of charges. (1)
2. What is the measuring unit for resistance?
A Ω (Ohm)
B V (Volt)
C A (Ampere)
D W (Watt) (1)
3. Which of the following factors do not affect the resistance of a conducting wire?
A Length and type of material.
B Thickness and length.
C Type of a material and temperature.
D Potential difference and current strength. (1)
4. How does an increase in temperature affect the resistance of a wire?
A It increases resistance.
B It decreases resistance.
C It does not have any effect on resistance.
D It depends on the length of the wire. (1)
5. A length of copper wire is cut in half. By what factor does the resistance change?
A $\frac{1}{4}$ B $\frac{1}{2}$ C 2 D 4 (1)
6. Which statement is FALSE?
A The thicker the resistor, the higher the resistance.
B The longer a resistor, the higher the resistance.
C The hotter a resistor, the higher the resistance.
D The thinner a resistor, the higher the resistance. (1)
7. Which statement is TRUE?
A Wires made of different metals will have the same resistance if they have the same length, thickness, and temperature.
B Thick, short wires have less resistance than thin, long wires.
C Hot wires have less resistance than colder wires.
D All metal wires have the same resistance. (1)

[7]

INFORMAL ACTIVITY – RESISTANCE (PART 2)

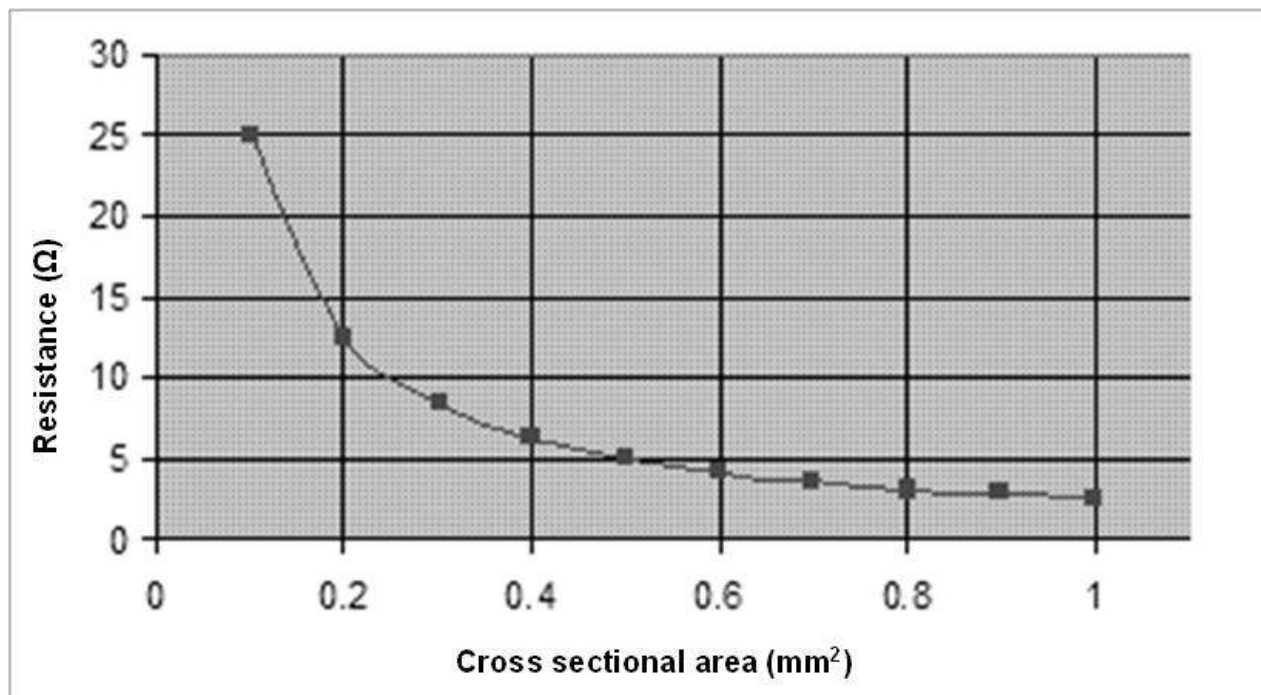
1. Name the four factors affecting the resistance of a resistor and briefly discuss how each factor affects the resistance of the resistor. (8)
2. The resistance of different wires is investigated. Study the copper resistors below, all at room temperature.



- 2.1 Mention the two controlled variables. (2)
 - 2.2 Arrange resistors 1, 2 and 4 from lowest to highest resistance. (2)
 - 2.3 Briefly explain your answer in 2.2. (3)
3. An investigation was conducted to answer the following investigative question:

How does the thickness (cross-sectional area) of a resistor affect its resistance?

Below, the graph illustrating the results for this investigation:



- 3.1 Use the graph to complete the following table. Only write down the number and the correct value.

Cross sectional area (mm ²)	Resistance (Ω)
0,2	12,5
0,4	3.1.1
0,6	3.1.2
0,8	3,5
1	3.1.3

(3)

- 3.2 Answer the investigative question by writing down the conclusion based on the results.

(2)

[20]

INFORMAL PRACTICAL ACTIVITY – RESISTANCE

Aim: To determine the relationship between the length of a conductor and the resistance of the conductor.

***NOTE:** A decrease in the total current strength in a conductor as measured with an ammeter correlates with an increase in the resistance of the conductor.

Procedure:

Set up an electric circuit which consists of 2 cells, a switch, an ammeter connected in series and a voltmeter connected across a 30 mm conducting wire (e.g., nichrome wire). Complete the circuit for a **short time** by closing the switch. Record the ammeter and voltmeter readings. Repeat the experiment with two more lengths (60 mm and 120 mm) of the same type of wire, with the same cross-sectional area (thickness).

Circuit diagrams:

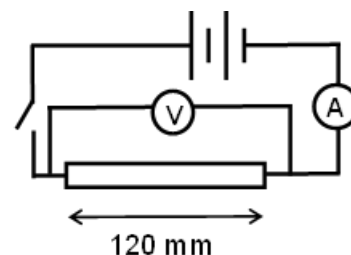
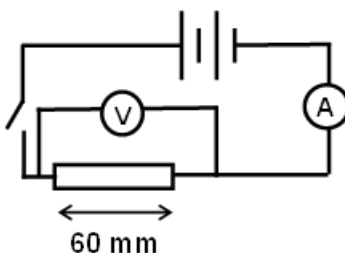
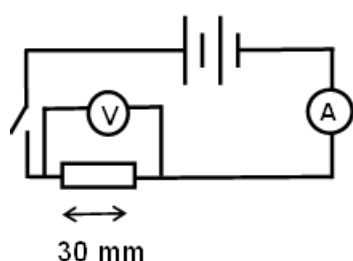


Table of results:

Length of conductor (mm)	Potential difference "Voltmeter reading" Volt (V)	Current strength "Ammeter reading" Ampere (A)	Resistance is calculated by dividing the voltmeter reading by the ammeter reading. $R = \frac{V}{I}$ (unit is ohm, Ω)
30	2	1,0	2
60	2	0,5	4
120	2	0,25	8

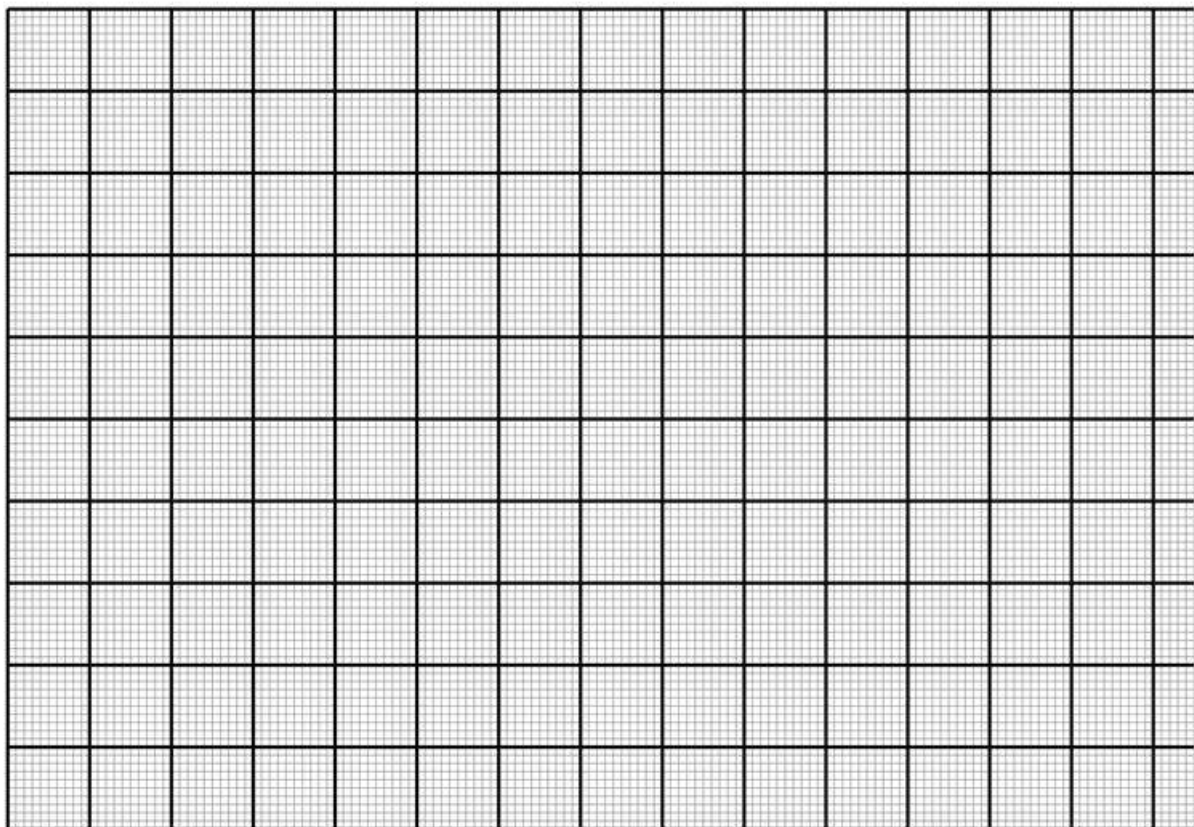
- 1.1 Use the results in the table and draw a graph that represents the relationship between the length of a conductor (nichrome wire) and the resistance of a conductor. Make use of the graph paper provided.

Supply the graph with:

- a suitable heading.
- labels on both axes.
- units on both axes.

(7)

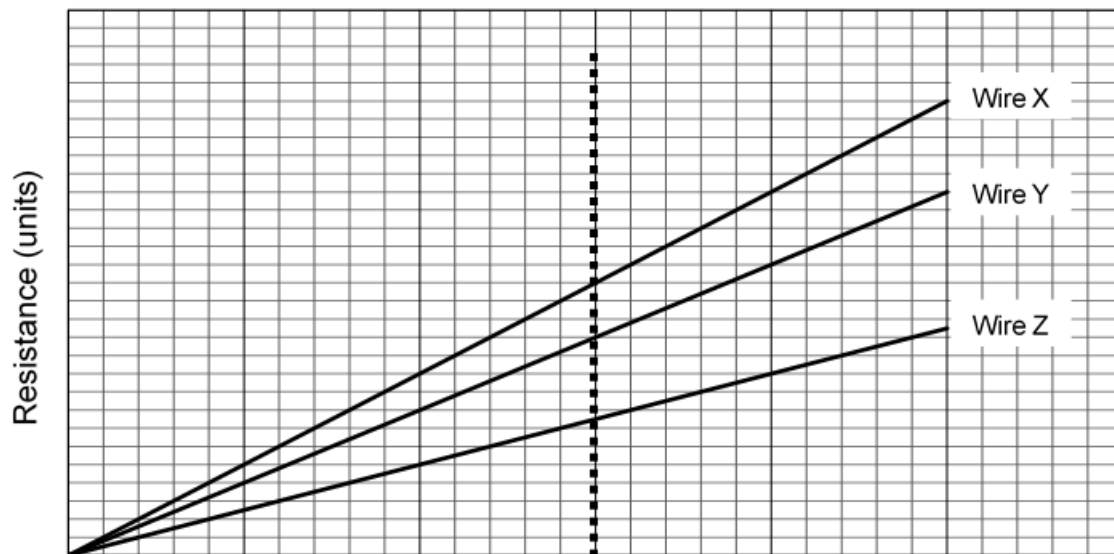
Heading: _____



- 1.2 Formulate an investigative question. (2)
- 1.3 Write down a hypothesis based on the information given in the aim of this experiment. (2)
- 1.4 When drawing a graph based on the results of the investigation it is important to identify the dependent and independent variables. Name the dependent and independent variables. (2)
- 1.5 Name all the controlled variables in this investigation. These are the variables that were kept constant during this investigation. (3)
- 1.6 Explain the difference between a dependent and an independent variable. (2)
- 1.7 Do the results of this investigation confirm your hypothesis? Give a reason for your answer. (An analysis of the graph can lead you to an answer.) (2)
- 1.8 Use the graph to answer the following questions:
- 1.8.1 What is the shape of the graph? (1)
- 1.8.2 Determine the resistance of the same nichrome wire used in this activity, but with a length of 45 mm. (1)
- 1.8.3 Determine the length of a piece of nichrome wire with a resistance of $7\ \Omega$. (1)
- 1.9 Consider the shape of the graph and derive the relationship that exists between the length of a conductor and the resistance of the conductor. (1)
- 1.10 Based on the relationship between the length of a conductor and the resistance of a conductor which you have established in question 1.9, predict what will happen to the overall resistance of the conductor when the nichrome wire is extended to twenty times its original length. (1)
- 1.11 Choose the correct answer from the following possibilities and write only the LETTER representing the correct answer.
- What will happen to the ammeter reading in a series circuit with one bulb when an identical bulb is added in series to the circuit?
- A Remains the same
B Increases
C Decreases
D Doubles (1)
- 1.12 Explain your answer in question 1.11 by referring to the factor which influenced the overall resistance of the circuit when connecting an additional bulb in series. (2)



2. The graph below shows the effect of different types of wires of the same length on the resistance in a circuit.

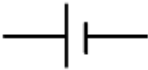
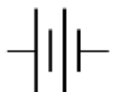
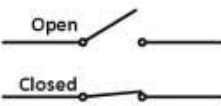
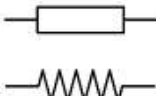
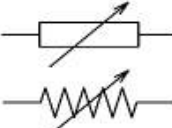


- 2.1 What is the independent variable? (1)
- 2.2 Select the wire which is the best conductor. Write only X, Y or Z. (1)
- 2.3 Motivate your choice in question 2.2. (2)
- 2.4 Write down THREE other factors that affects resistance. (3)
- [35]**

SERIES AND PARALLEL CIRCUITS

Background knowledge - GRADE 8

Components of a circuit

COMPONENT	SYMBOL	FUNCTION
Cell		Source of energy. Converts chemical potential energy to electrical energy.
Battery (Two or more cells in series.)		Source of energy. Converts chemical potential energy to electrical energy.
Bulb		Source of light. Converts electrical energy to light (and heat) energy.
Open switch Closed switch		Switches control electrical circuits. Open switch breaks the circuit and prevents the flow of current. Closed switch completes the circuit and allows the current to flow in the circuit.
Resistor		Resists or opposes the flow of electrical current. Resistors control the amount of electric current flowing in a circuit. Resistors (bulb filaments, heating wires, elements in kettles/heaters/geysers/stoves) converts electrical energy to heat energy.
Variable resistor		A resistor whose resistance can be adjusted higher or lower to allow less or more current to flow.
Conduction wire		Carries electric current over a distance.
Ammeter		Measures current strength in ampere (A).
Voltmeter		Measures potential difference in volt (V).

Series circuits

A series circuit provides only ONE PATHWAY for the current passing through it.

The current is the same everywhere in the circuit but every time a resistor is added in series, the overall current in the circuit decreases.

Parallel circuits

A parallel circuit provides TWO OR MORE PATHWAYS for the current passing through it, but the overall current increases when more resistors are added in parallel.

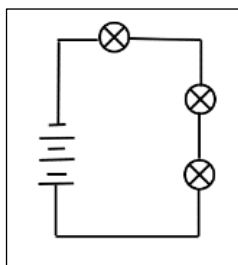


Series and Parallel Circuits

Comparison of series and parallel circuits:

Series circuits:

- S1. A series circuit provides only one pathway for the current passing through it. The current is the same when measured at any point in the circuit.
- S2. For **cells** connected in series, the total voltage (potential difference) across the battery is the sum of the voltages of each individual cell.
 $V_{\text{total}} = V_1 + V_2 + V_3 + \dots$
- S3. For **resistors** connected in series, the total voltage across the battery is the same as the sum of the voltages across each of the resistors.
 $V_{\text{total}} = V_1 + V_2 + V_3 + \dots$
 Resistors in series are potential dividers.
- S4. A resistor with a higher resistance will have a higher voltage across it.
- S5. A resistor with a lower resistance will have a lower voltage across it.
- S6. The total current DECREASES with each resistor added in series because the total resistance INCREASES.
- S7. If one light bulb fuses (filament breaks) or if the circuit is broken, the rest/all the bulbs go off.

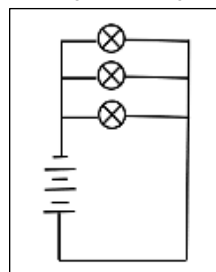


When one bulb is removed from its socket, the other bulbs in series "goes out".

NOTE: "TOTAL" MEANS THE TOTAL CURRENT IN THE CIRCUIT OR THE TOTAL RESISTANCE IN THE CIRCUIT.

Parallel circuits:

- P1. A parallel circuit provides two or more pathways for the current passing through it.
- P2. For **cells** (of same voltage) connected in parallel, the voltage across them is the same as for one cell.
 $V_{\text{battery}} = V_1 = V_2 = V_3 = \dots$
- P3. For **resistors** connected in parallel, the voltage is the same across each resistor connected in parallel.
 $V_{R1} = V_{R2} = V_{R3} = \dots$
- P4. The total current through the battery is the same as the sum of the currents through the resistors.
 Resistors in parallel are current dividers.
- P5. The total current in the circuit INCREASES with each resistor added in parallel because the total resistance DECREASES.
- P6. The lighting system in our homes is usually connected in parallel. If one light bulb fuses (filament breaks), the rest of the lights remain on because they are each connected in their own parallel pathway to the mains circuit.

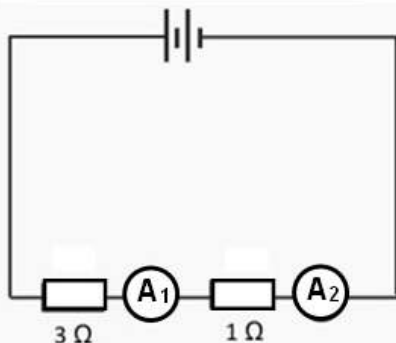


When one bulb is removed from its socket, the other bulbs in the parallel branches remain lit.

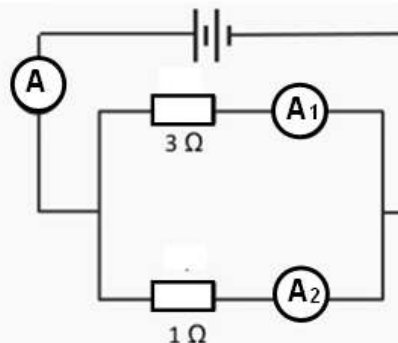
- P7. For two circuits/resistors with the same total voltage the current will be bigger in a circuit/resistor with low resistance.
- P8. For two circuits/resistors with the same total voltage the current will be smaller in a circuit/resistor with high resistance.

Compare the Circuits' Current

SERIES CIRCUIT



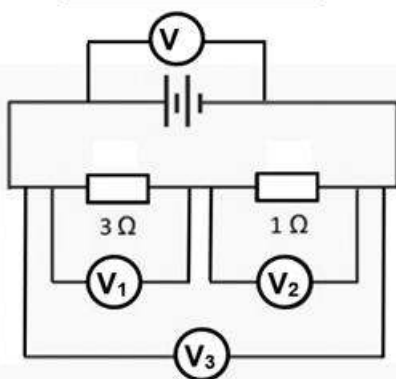
PARALLEL CIRCUIT



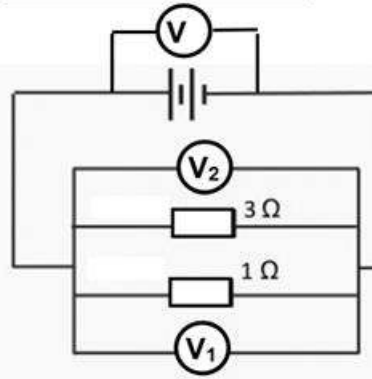
Current has only one path to flow.	Current splits into different paths.
Reading on A_1 = Reading on A_2	Reading on A = Reading on $A_1 + A_2$.
Same current flows through all resistors.	Main current is shared between the two resistors.
	Resistors in parallel are current dividers.

Compare the Circuits' Potential Difference

SERIES CIRCUIT



PARALLEL CIRCUIT



Reading on V = Reading on V_3 = Reading on $V_1 + V_2$	Reading on V = Reading on V_1 = Reading on V_2
Potential difference is shared by the two resistors.	Potential difference is the same across each resistor.
Resistors in series are potential dividers.	

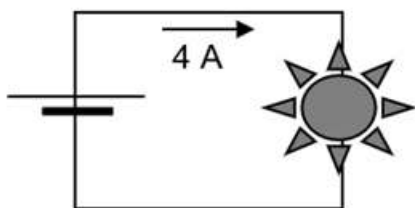
Note:

To measure voltage, a **voltmeter** must be connected in **parallel** across a resistor or battery.

To measure current, an **ammeter** needs to be connected in **series** with the resistor or battery.

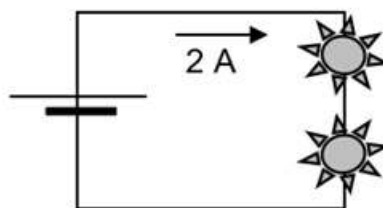
Compare the brightness of bulbs:

1.



One cell and one bulb in series.

- Bulb glows bright.



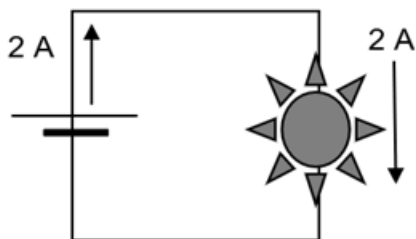
One cell and two bulbs in series.

- Bulbs glow dimmer.

Explanation:

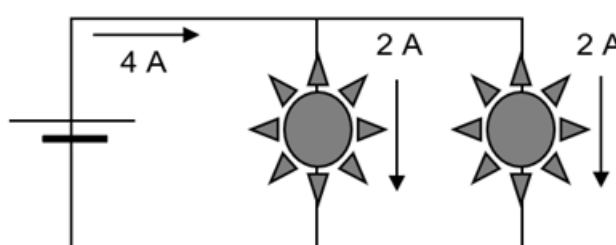
When a second bulb is connected in series, the overall resistance of the circuit will increase, therefore the total current which flows through all the components (bulbs) will decrease.

2.



One cell and one bulb in series.

- Bulb glows bright.



One cell and two bulbs in parallel.

- Brightness remains the same.

Explanation:

When a second bulb is connected in parallel, the **overall resistance** of the circuit **decreases**, therefore the **total current** in the circuit **increases**. This larger total current (4 A) divides into two branches in the parallel circuit. A current of 2 A flows through each branch.

INFORMAL ACTIVITY – MEASURING INSTRUMENTS IN CIRCUITS

Tabulate the differences between an ammeter and a voltmeter by completing the table below.

Instrument	Symbol in a circuit diagram	Physical quantity it measures	Measuring unit	How it is connected in a circuit	Resistance of the instrument (High or low)
Ammeter		Current strength		In series	
Voltmeter			Volt (V)		High

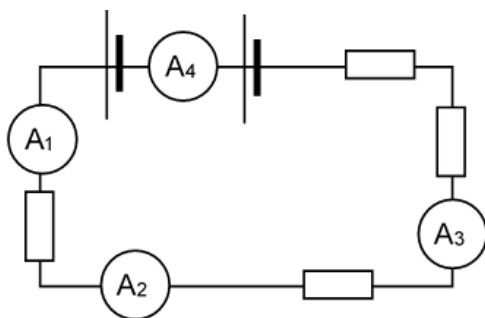
[5]

INFORMAL ACTIVITY – SERIES AND PARALLEL CIRCUITS

- In the following questions, provide a reason for your answer. Choose the NUMBER of the applicable reason from the comparison of series and parallel circuits (page 74).
- For series circuits choose a reason from S1 to S7; for parallel circuits, choose a reason from P1 to P8, or a combination of reasons.
- *Tip: To keep track of the given information, write the reading on a meter next to it on the diagram in pencil.*

PART 1: SERIES CIRCUITS

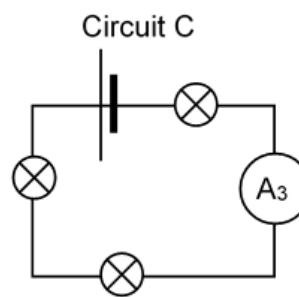
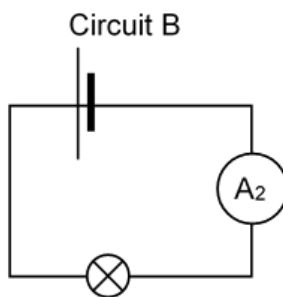
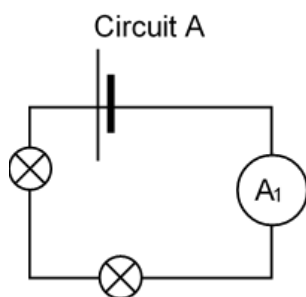
1. In the circuit diagram below, the reading on ammeter A_1 is 2 A. Give the readings on ammeters A_2 , A_3 and A_4 .



Reading	Value with unit	Reason: Number or phrase
A_1	2A	
A_2		
A_3		
A_4		

(4)

2. In the circuit diagrams below, all the cells and bulbs are identical.



- 2.1 Arrange the ammeter readings from highest to lowest. _____

Reason: _____ (2)

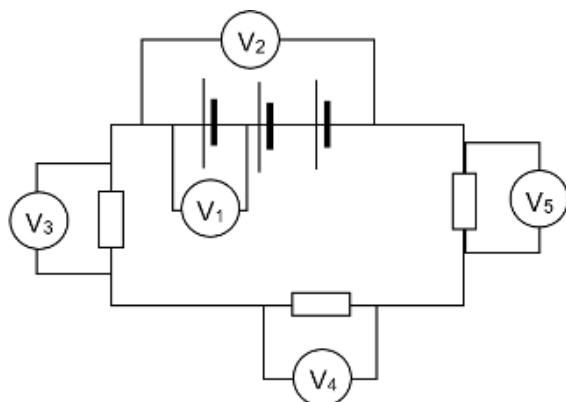
- 2.2 Arrange circuits A, B and C in order from dimmest bulbs to brightest.

Reason: _____ (2)

- 2.3 What will happen in Circuit C if one of the bulbs fuses? Give a reason.

_____ (2)

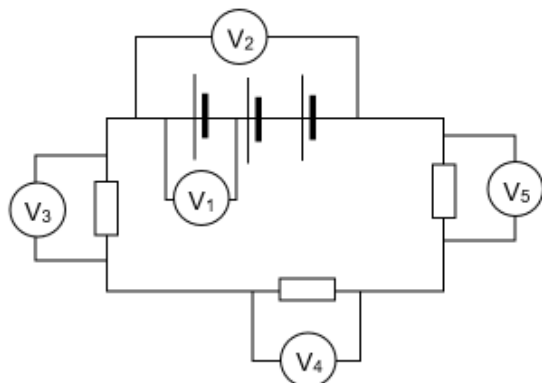
3. In the circuit diagram below, the cells and bulbs are identical. The reading on V_1 is 1,5 V. Determine the readings on the other voltmeters.



Reading	Value with unit	Reason: Number or phrase
V_1	1,5 V	Voltage of 1 cell.
V_2		
V_3		
V_4		
V_5		

(6)

4. In the circuit diagram below, the cells are identical, but the **resistors differ**. The reading on V_2 is 6 V. The reading on V_3 is 1 V and the reading on V_5 is 2 V. Determine the readings on the other voltmeters.



Reading	Value with unit	Reason: Number or phrase
V_1		
V_2	6 V	Voltage of battery of 3 cells.
V_3	1 V	
V_4		
V_5	2 V	

(4)

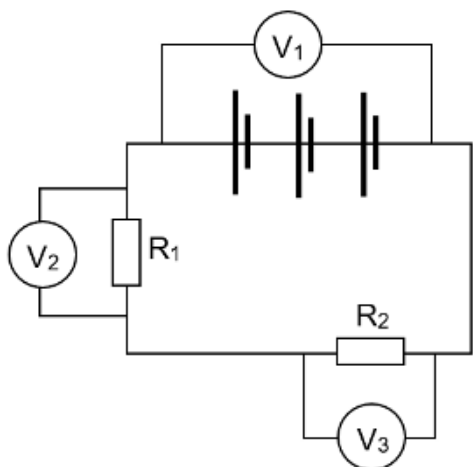
- 4.1 Which voltmeter is connected across the resistor with the highest resistance? _____

Reason: _____ (2)

- 4.2 Which voltmeter is connected across the resistor with the lowest resistance? _____

Reason: _____ (2)

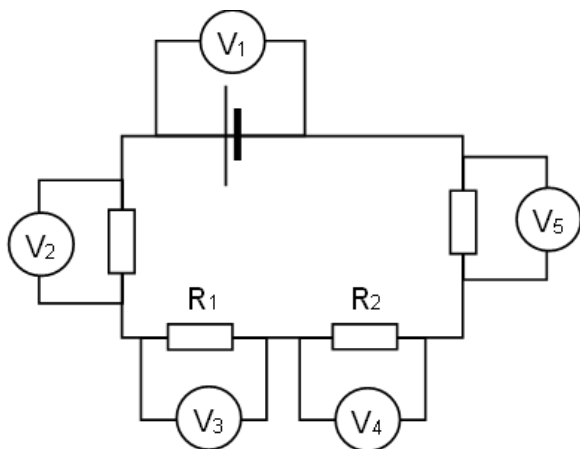
5. In the next circuit, the reading on V_1 is 12 V and the reading on V_3 is 8 V. Determine the reading on V_2 . Which resistor, R_1 or R_2 , has the highest resistance? Which resistor has the lowest resistance? Provide reasons.



Reading	Value with unit	Reason: Number or phrase
V_1	12 V	Voltage across the battery.
V_2		
V_3	8 V	Given.
Resistor with highest resistance		
Resistor with lowest resistance		

(6)

6. Complete the table by filling in the missing values. Resistors R_1 and R_2 are identical.



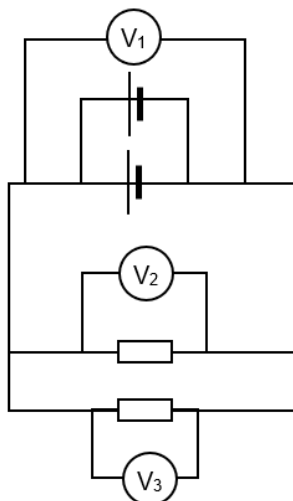
Reading	Value with unit	Reason: Number or phrase
V_1	9 V	Voltage of cell.
V_2	2 V	Given.
V_3		Reason: Show calculation:
V_4		
V_5	3 V	Given.

(5)

[35]

PART 2: PARALLEL CIRCUITS

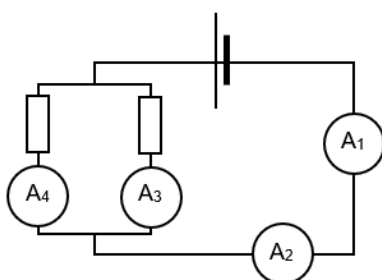
1. The potential difference (voltage) of one cell is 1,5 V. Determine the readings on V_1 , V_2 and V_3 , with reasons.



Reading	Value with unit	Reason: Number or phrase
V_1		
V_2		
V_3		

(5)

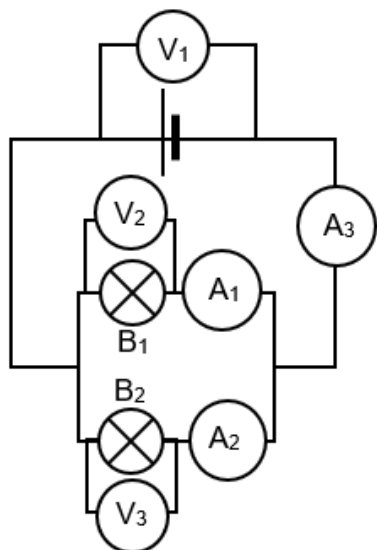
2. In the circuit below, the resistors are identical. The reading on A_2 is 4 A. Determine the readings on ammeters A_1 , A_3 and A_4 , with reasons.



Reading	Value with unit	Reason: Number or phrase
A_1		
A_2	4 A	Given.
A_3		Reason: Calculation:
A_4		

(6)

3. The reading on V_1 is 3V. The reading on A_1 is 0,5 A and the reading on A_3 is 2 A. Find the missing readings.



Reading	Value with unit	Reason: Number or phrase
A_1	0,5 A	Given.
A_2		
A_3	2 A	Given.
V_1	3 V	Voltage of cell.
V_2		
V_3		

(5)

- 3.1 Which bulb has the lowest resistance? Give a reason.

(2)

- 3.2 Which bulb has the highest resistance? Give a reason.

(2)

- 3.3 What will be observed if bulb B_1 fuses? Give a reason.

(2)

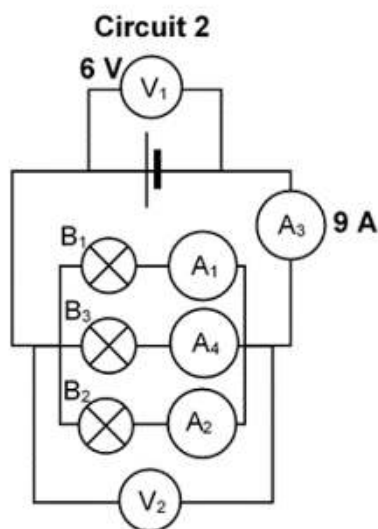
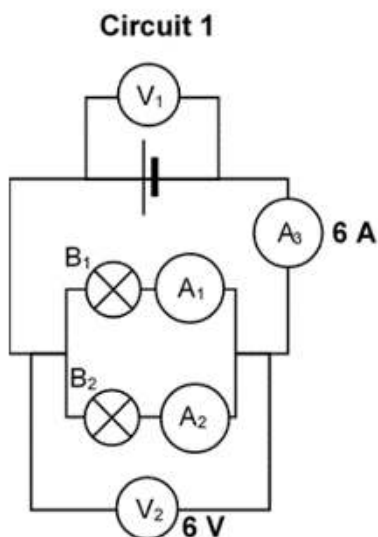
- 3.4 Will the reading on V_3 increase, decrease or remain the same after B_1 has fused? Give a reason for your answer.

(2)

- 3.5 Will the reading on A_3 increase, decrease, or remain the same after B_1 has fused? Give a reason for your answer.

(2)

4. Circuits 1 and 2 are connected as indicated. All bulbs and cells are identical. Fill in the missing ammeter and voltmeter readings on the diagrams.



- 4.1 Underline the correct word in brackets. Fill in the number of the correct reason.
- (a) The **total resistance** in Circuit 2 is (smaller / bigger) than in Circuit 1, because in Circuit 2 there are (more / less) bulbs in parallel. Reason number P _____. (3)
- (b) The **total current** in Circuit 2 is (smaller / bigger) than in Circuit 1, because in Circuit 2 the total resistance is (more / less). Reason number P _____. (3)
- (c) The **total voltage** in Circuit 2 is the same as in Circuit 1, because the cells are identical. The voltage across the 3 bulbs in Circuit 2 is (smaller / bigger / the same) as the voltage across the two bulbs in Circuit 1. Reason number P _____. (2)

- 4.2 Use the information in 4.1 and compare the readings in Circuit 1 with the readings in Circuit 2. Provide reasons for the differences or similarities.

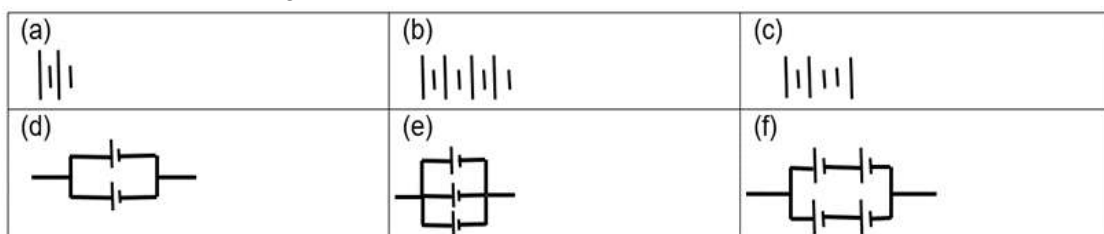
Reading	Circuit 1	Circuit 2	Compare the readings in Circuit 1 with the readings in Circuit 2 and explain the differences or similarities.
A_1			All bulbs are identical. In Circuit 1: Lower current of 6 A is divided equally between _____ bulbs, so the current through each bulb is _____. In Circuit 2: Higher current of 9 A is divided equally between _____ bulbs, so the current through each bulb is _____.
A_2			
A_3	6 A	9A	Why is the total current in Circuit 2 more than in Circuit 1? Give the numbers of TWO reasons.
A_4			
V_1		6 V	
V_2	6 V		

(16)
[50]

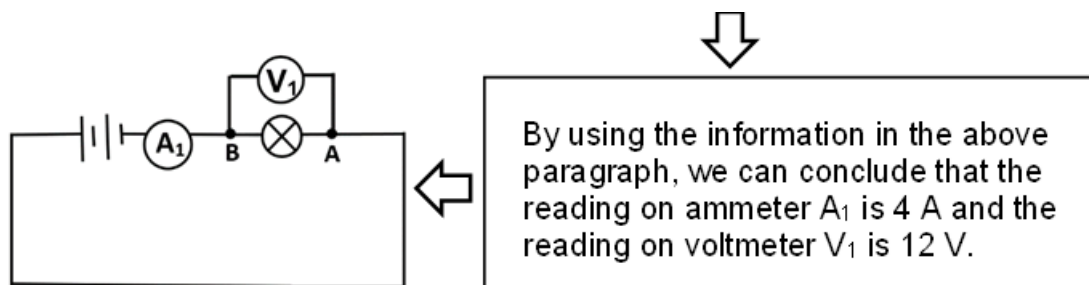


ADDITIONAL EXERCISES – SERIES AND PARALLEL CIRCUITS

1. Give one **advantage** and one **disadvantage** of connecting cells in series. (2)
2. Give one **advantage** and one **disadvantage of** connecting cells in parallel. (2)
3. When working with electrical circuits when do we refer to a battery instead of a cell? (1)
4. Determine the maximum potential difference of each of the following batteries. Each cell has a voltage of 2 V. (6)

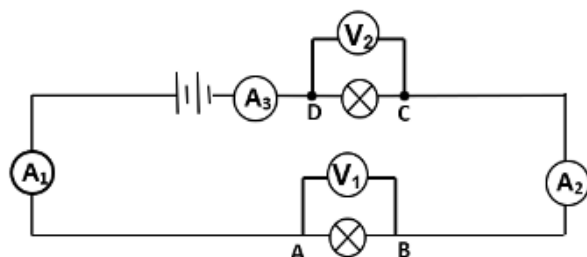


5. You are provided with eight 1,5 V cells. Draw diagrams like those in question 4 to show how you would connect these eight cells to... (All eight cells must be used in each case.) (1)
 - 5.1 create a 12 V battery. (1)
 - 5.2 make a 6 V battery. (1)
6. All bulbs in the following circuit diagrams have the same resistance and all cells can supply a potential difference of 6 V. The total current in a circuit diagram made up of two cells in series and one bulb connected in series with the cells is 4 A.



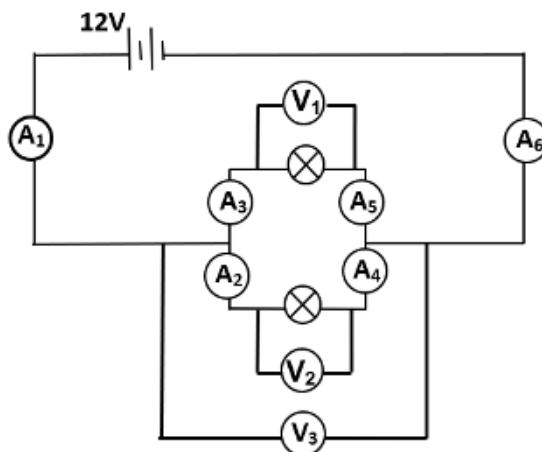
Use the information above and determine the readings on all the voltmeters and ammeters in circuits 6.1 and 6.2 below. Give reasons for your answers.

6.1



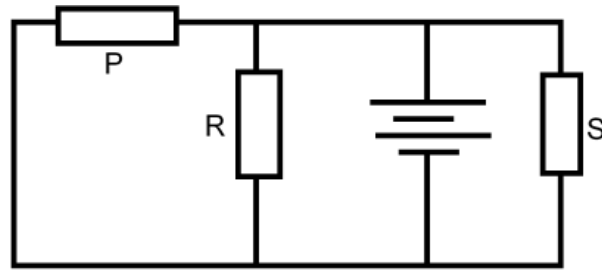
(5)

6.2



(6)

7.1 Study the diagram and answer the questions that follow.



7.1.1 In which way are components P, R and S connected? (1)

7.1.2 Give the name for component **S** in the circuit. (1)

7.1.3 What is the function of component **S**? (1)

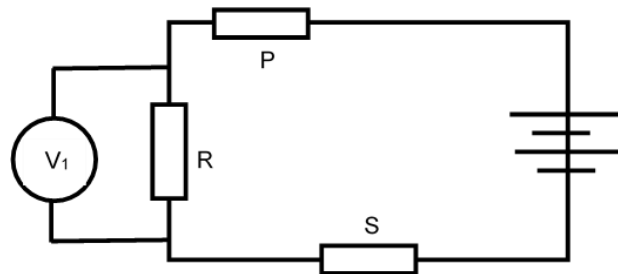
7.1.4 ONE cell has a potential difference of 1,5 V. What is the voltage across **P** and **R**? (1)

7.1.5 Redraw the circuit above in your answer book and show:

(a) An ammeter measuring the main current. (1)

(b) A voltmeter measuring the voltage of component **P**. (1)

7.2 The components of the circuit above were REARRANGED and connected as shown in the circuit below. Components P, R and S are identical, and one cell still has a potential difference of 1,5 V.



7.2.1 Determine the reading on V_1 . (2)

7.2.2 What conclusion can be made about resistors connected in this way? (1)

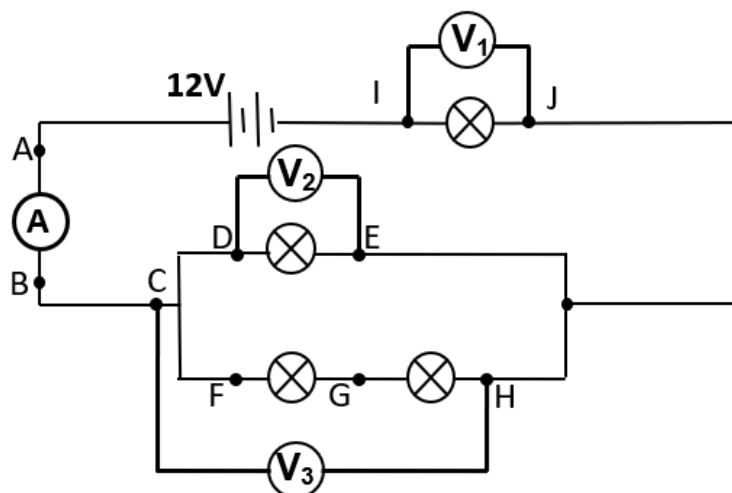
7.2.3 What would happen to the reading on V_1 if another resistor is added in series to the circuit? Only write INCREASE, DECREASE or STAY THE SAME. (1)

7.2.4 Motivate your answer in QUESTION 7.2.3. (1)

[35]

ENRICHMENT EXERCISE

8. Consider the circuit diagram below:



The battery can supply a potential difference of 12 V. The voltmeter reading on V_1 is 3 V.

8.1 Determine the voltmeter readings on V_2 and V_3 . (3)

A voltmeter connected between G and H shows a reading of 1,5 V.

8.2 Determine the voltmeter reading on a voltmeter connected between F and G. (2)

[5]

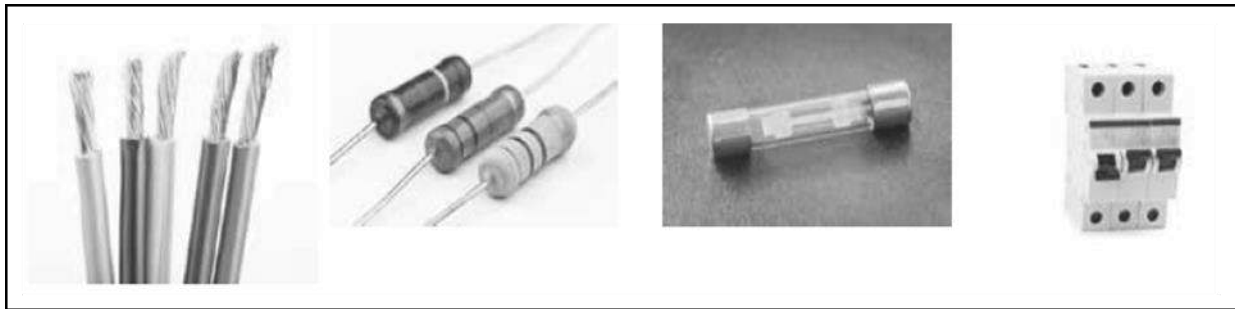
SAFETY WITH ELECTRICITY

Safety practices

- Parallel connections can cause overload on mains circuits.
- Circuit breakers, fuses and earth leakage systems are used as SAFETY DEVICES.
- Many appliances have a 3-pin plug as a safety device to connect to the main circuit.
- THE 3-PIN PLUG has a live wire, neutral wire, and an earth wire.
- The earth wire is connected to the metal case of the appliance, such as in a kettle. The earth wire is connected via the wall plug to an earth cable in the ground.
- The earth cable has almost zero resistance, so if the metal casing of an appliance becomes charged due to a fault, the charge is safely discharged to the ground.
- Illegal connections to the ESKOM mains supply can be dangerous and are regarded as energy theft.

INFORMAL ACTIVITY – SAFETY PRACTICES

1. Study the following items. Only give the LETTER of the correct answer.

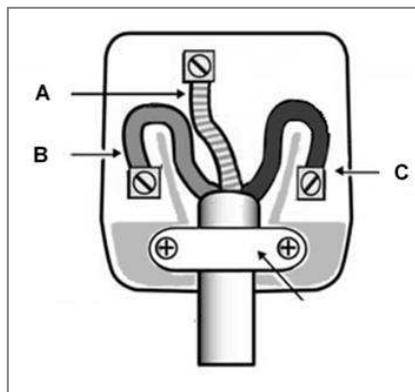


Identify the items from left to right as shown above.

- A Fuses, resistors, LED, circuit breaker.
 B Conductors, insulators, light bulb, switch.
 C Connectors, resistors, fuse, circuit breaker.
 D Connectors, resistors, circuit breaker, switch.

(1)

2. Shown below, a 3 pin-plug.



- 2.1 Label A, B and C in the drawing to show the correct wiring.

(3)

- 2.2 What is the colour of wire A?

(1)

[5]

ENERGY AND THE NATIONAL ELECTRICITY GRID

Electricity generation

- A power station is a system for generating electricity.
- Most power stations in South Africa use coal as a fuel to boil water.
- The steam from the water turns a turbine which turns a generator, which produces electricity.
- There are other alternative sources of energy besides coal, that can be used to drive turbines and generators including wind, falling water (hydroelectric), sun-heated steam, nuclear fission, waves in the sea.

Nuclear power in South Africa

- A nuclear power station such as Koeberg in the Cape, uses radioactive fuel. The radioactivity produces heat through nuclear fission. The heat is then used to boil water to produce steam.
- The steam from the water turns a turbine which turns a generator, that produces electricity.
- The electricity is then channelled into the national electricity grid.
- Spent nuclear fuel (nuclear waste) is still radioactive and remains so for many hundreds of years, therefore it needs to be properly disposed of, so it is not a danger to life for years to come.

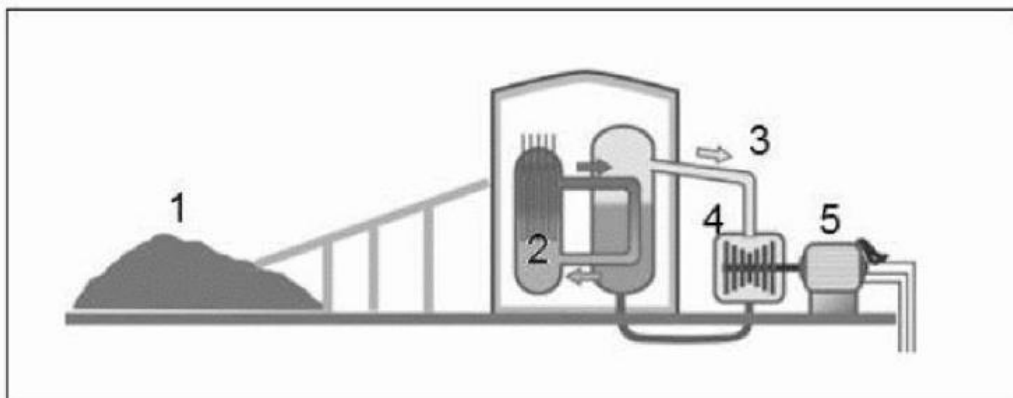
National electricity grid

- The national grid is a network of interacting parts (a system).
- Change in one part of the grid affects other parts of the grid.
- Power stations feed electrical energy into the national grid at high voltages.
- Power lines carry electricity at high voltages.
- Transformers step down the voltage for local distributors and consumers: 15% of energy is wasted due to heating of transmission lines and transformers.
[No details are required of alternating current or step-down transformers].
- Power surges and grid overload can disrupt the power supply.



INFORMAL ACTIVITY – ENERGY AND THE NATIONAL ELECTRICITY GRID

1. Study the diagram below and read the passage before answering the questions.



This diagram shows a typical coal-fired power station producing electricity.

Coal (1) is burnt to generate heat which boils water under high pressure in a boiler (2). This produces high pressure steam which is taken through pipes (3) to the turbine (4) where it is used to turn the turbine at high speeds. From the turbine, the steam enters the condenser where it is cooled back into liquid water. The water is then returned to the boiler.

The turbine shaft is used to rotate the large magnets within coils of wire which form the main parts of the generator (5). The energy needed to spin the magnet in the coils of wire comes from the heat produced by burning the coal. A giant power station can burn about 350 tons of coal per hour.

- 1.1 What causes the turbine to rotate? (1)
- 1.2 List two DISADVANTAGES of coal-fired power stations. (2)
- 1.3 Suggest FIVE alternative sources of energy that can be used for the generation of electricity, other than coal. (5)
- 1.4 State TWO similarities and TWO differences between a coal fired power station and a nuclear power station. (4)

[12]

Find more activities:

- SIYAVULA textbooks at www.curious.org.za
- FS Resources hub at www.mindstream.co.za

THE COST OF ELECTRICAL POWER

The cost of power consumption

- Electrical power is the RATE of electrical energy supply.
- Electrical power is measured in units called watts (W) or kilowatts (kW).
[One watt of power is equal to one joule of energy supplied in one second (1 watt = 1 joule per second).]
- Consumers pay for the quantity of electrical power they use.
- Quantity of electrical energy used is measured in kWh (kilowatt hours).
- 1 kWh = 1 UNIT of electrical energy.
- The cost to the consumer is calculated in the following way:

Cost = Power rating of the appliance x Number of hours it was used x Unit price of electricity

- The energy consumption of different appliances (such as incandescent and compact fluorescent lamps) varies. There are also alternative appliances/systems such as solar heating panels for heating water.

General equation:

The general equation used for calculating the cost of electricity used by electric appliances:

$$\text{Cost} = \text{Power rating of the appliance in kW} \times \text{Number of hours the appliance was used} \times \text{Unit price of electricity}$$

The electricity that we buy from a supplier is sold in UNITS. The number of units of electricity consumed by an appliance can be determined by:

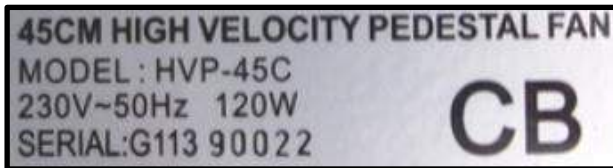
$$\text{Units consumed (kWh)} = \text{Appliance power rating (kW)} \times \text{Hours used (h)}$$

$$\text{Cost} = \text{Units consumed (kWh)} \times \text{Unit price of electricity (R/kWh)}$$



INFORMAL ACTIVITY - THE COST OF ELECTRICAL POWER CONSUMPTION

1. Calculate the cost of using a 2 500 W electric dryer for 30 minutes when the cost of electricity is R 2,40/kWh. (**TIP:** Do the necessary conversions!) (5)
2. The power rating of an electric frying pan and a fan is indicated on the labels found on these two appliances.

Fan**Frying Pan**

- 2.1 Convert the power rating for BOTH the fan and the frying pan to kW. (2)
- 2.2 Determine the number of electricity units used by the frying pan when it is operating for 4 hours. (2)
- 2.3 Calculate the cost of electricity when the frying pan is used for four hours. You can assume that the unit cost of electricity is R 1,94 /kWh. (2)
- 2.4 Calculate the number of hours that the fan can operate using the same amount of electricity that the frying pan uses in 4 hours. (3)
3. For a family of four, an ordinary electric geyser with a power rating of 2 600 W uses electricity for 4,4 hours a day. A solar geyser with electric back-up uses 4,42 kWh per day. The cost of a unit of electrical power is R 1,22 / kWh.

Calculate the amount of money that can be saved per day if the solar geyser with electric back-up is used instead of the ordinary electric geyser. (7)
4. A total of 45 computers, each with a power rating of 120 W, were installed at school X for use in February 2020. The computers will be operating from Monday to Friday from 07:45 until 11:00. The unit rate at the school is R 0,91/kWh.

Calendar for February 2020 (South Africa)

Sun	Mon	Tue	February Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

Phases of the Moon: 2 ☾ 9 ☾ 16 ☾ 23 ☾

- 4.1 What is the measuring unit for electrical power? (1)
- 4.2 Calculate the total number of hours the computers will be used in February 2020. (3)
- 4.3 Calculate the total power rating of the 45 computers. (3)
- 4.4 Calculate the cost of electricity for using the 45 computers during February 2020, using the formula:

Cost = power rating of appliance x number of hours x unit price of electricity

- (2)
- 4.5 School **Y** will have the same computer centre set-up, but they plan to operate for 2,5 hours per day from Monday to Saturday in February 2020, starting from Monday the 3rd of February. Use calculations to prove that the **TOTAL** number of operating hours will be **60 hours**. (2)
- 4.6 Based on the number of operating hours, which school (**X** or **Y**) will have the **LOWEST** running cost for the computer centre? (1)
- 4.7 Use the cost formula given above to show that the operating cost of the computer centre at school **Y**, will be **R 294,84**. (2)
- [35]**

END OF TERM 3



ANNEXURE A**DRAWING SKILLS IN NATURAL SCIENCES****Drawings and diagrams:**

Drawings and diagrams are essential in all scientific subjects. A drawing or diagram is not just a picture – it is an easy-to-understand representation of what is seen or observed. For e.g., when a specimen is studied under a microscope a learner will understand better but what is seen or observed must also be represented in an accurate drawing or diagram for future reference.

Learners should only be able to draw elementary/simple diagrams. **NO** complicated diagrams or drawings like food webs, the heart, the alimentary canal, etc. necessary. Rather provide learners with a copy of complicated diagrams for them to label, not draw.

Guidelines for drawings and diagrams**Drawings and diagrams must:**

- have a heading or caption, above or below the diagram (except if the structure must be identified in a question).
 - be drawn in pencil (a sharpened pencil for drawing solid and clear lines).
 - be labelled in pen.
 - be positioned more to left-hand side of the page, so that there is adequate space on the right-hand side for the labels.
 - be large enough; at least 50 to 60 mm in length and breadth up to half an A4-page. (All structures in the drawing/diagram should be clearly visible).
 - be two-dimensional; three-dimensional drawings NOT necessary.
 - only be shaded (coloured in), where necessary.
 - be accurate and precise.
- **Circuit diagrams** must be drawn in pencil, using a ruler, with NO gaps between the components.

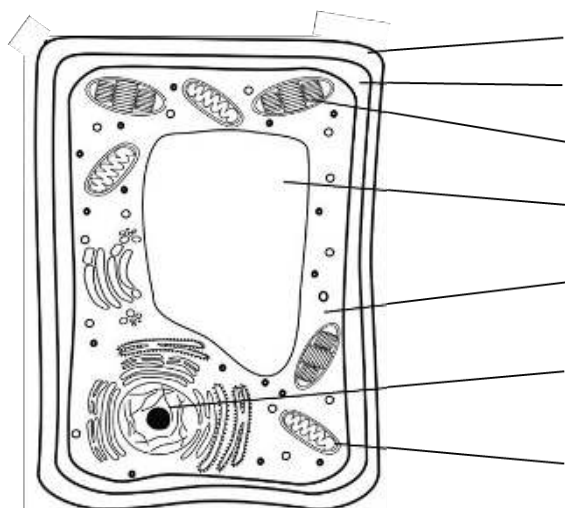
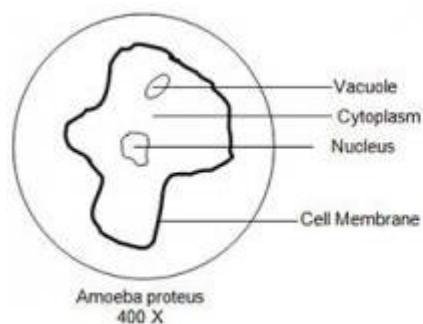
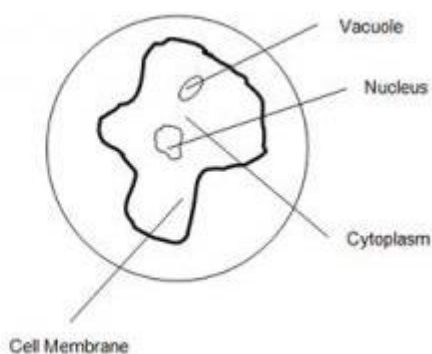
Label lines must:

- be drawn with a ruler in pencil (not freehand).
 - not cross each other.
 - just be a LINE, without arrowheads.
 - touch the specific part/structure that is labelled.
 - be aligned, one beneath the other, on the right-hand side of diagram.
 - preferably be on the right-hand side of diagram, except if there are too many labels.
 - allow for enough space between lines to fit in the labels and to write legibly.
 - be written horizontally (not skew).
- *In a question paper:*
- parts must be labelled with words or LETTERS but NOT numbers.
 - letters should be arranged alphabetically and clockwise around the drawing.
 - only required parts must be labelled (do not label any part NOT required by the question) unless a learner is asked to choose between two parts.



Study the examples:

Drawing/diagram to the left of the page to allow for labels and functions that must be provided.

1. **The plant cell**2. **Correct****Incorrect****Criteria for the marking of diagrams:**

Criteria	Marks
Correct heading / caption	1
Correct part with correct label	1 mark each
Optional:	
Correct diagram	1
Labels and label lines clear and neat	1

Introduction to graphs.

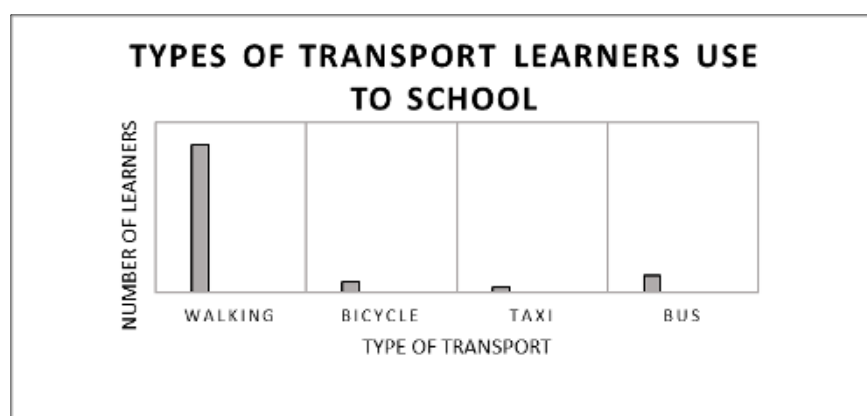
Scientists use different types of graphs to represent their findings in a concise way. Learners (depending on grade/phase) should be able to at least draw a bar, line and/or a pie graph/diagram.

- The **title/heading and labels** of the graph and axes done **in ink** (pen).
- The axes, plotting and line/bars done **in pencil** and drawn with a **ruler**.

Bar graph

A bar graph is a pictorial representation of data (discrete variables) that uses bars to compare different categories of data. Bars do not touch each other, hence there are spaces between bars. Bars can be arranged in any order.

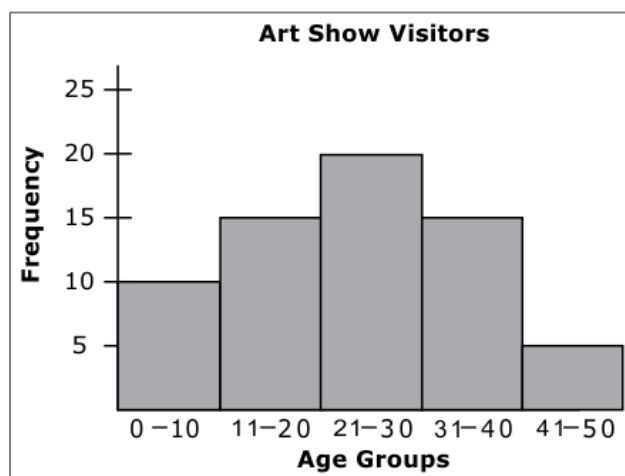
Example:



Histogram

A histogram refers to a graphical representation, that displays data by way of bars to show the frequency of numerical data (non-discrete variables). Bars show data that is related in some way to the other bars. Bars touch each other, hence there are no spaces between bars. The order of the bars cannot be changed.

Example:



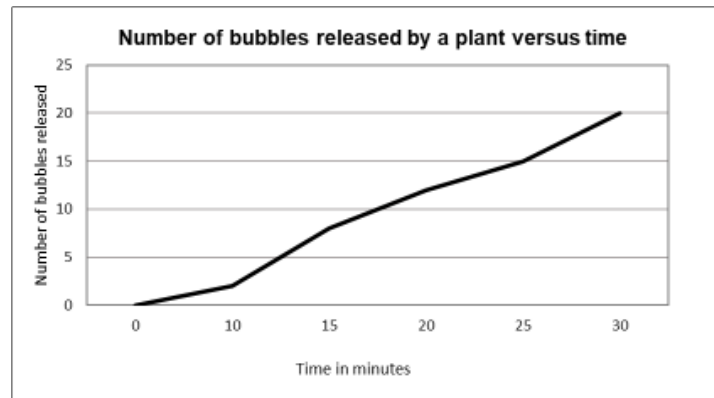
Line graph

This graph is used when the relationship between the independent and dependent variables are represented in a continuous way (line).

The independent variable (x-axis) is the variable the scientist controls.

The dependant variable (y-axis) is the evidence collected by the scientist (result/outcome).

Example:

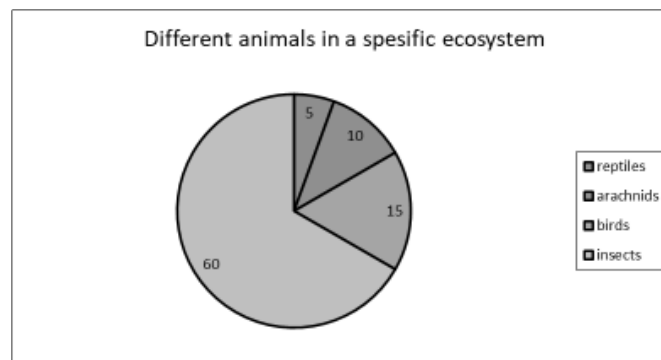


Pie chart

A pie chart shows data as a percentage or as a relative proportion of the total of the circle.

This is a circle divided into sectors (think of a pizza / pie). The complete circle should represent 100% of what it represents.

Example:



Criteria for the marking of a graph

Criteria	Marks
Title/heading of graph containing BOTH variables	1
Type of graph	1
Title/label and scale on x-axis	1
Title/label and scale on y-axis	1
Plotting of half of the points / bars correctly	1
Plotting of other half of the points / bars correctly	1
TOTAL MARK	6

NOTE:

Correct **measuring units** must also be indicated on the x- and/or y-axis where applicable e.g., Time (s), Length (m), etc.