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NATURAL SCIENCES GRADE 9

MEMORANDUM

CONTENT MANUAL (BASIC CONCEPTS WITH ACTIVITIES) ATP 2022

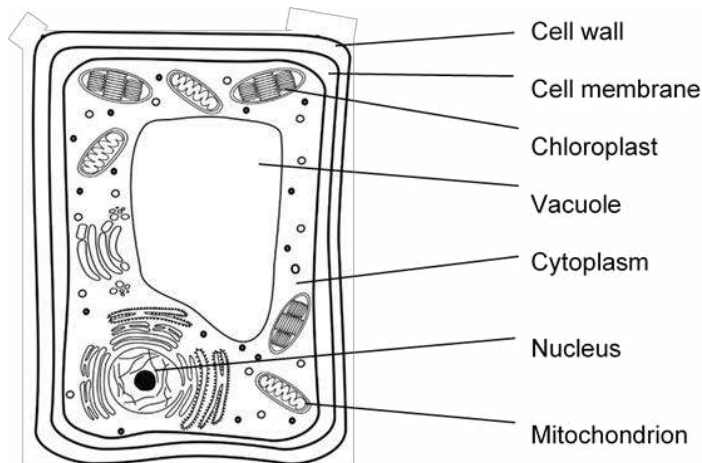
TERM 1

Strand: Life and Living

Informal activity – Plant cell

1. Name the smallest unit of all living organisms. *Cell* ✓ (1)

2. Label the plant cell below.



(1 x 7 = 7)

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

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

(7)

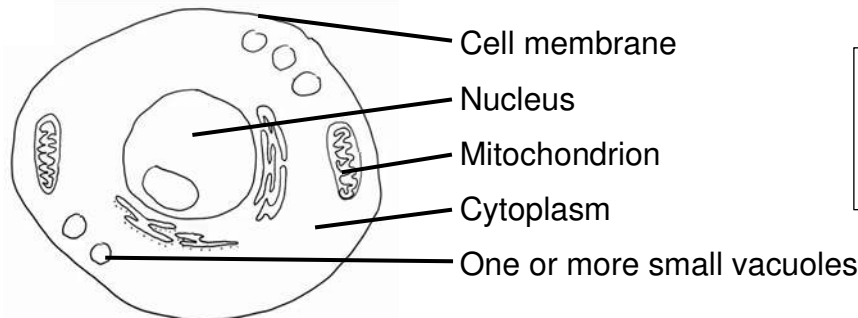
4. Name TWO **parts/organelles** VISIBLE in the diagram that prove that this is a PLANT cell.
Cell wall, ✓ chloroplasts, ✓ one big vacuole ✓ (ANY TWO) (2)

5. Which component of a plant cell is responsible for its regular shape? *Cell wall* ✓ (1)

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

Informal activity – Animal cell

1. Make a simple line drawing of an ANIMAL cell. Clearly label the diagram.
(Draw in pencil, label in pen. Use a ruler to draw label lines. All labels on the right.)



1 mark for each label.
1 mark for irregular shape.

- (6)
2. Explain why animal cells do not need chloroplasts.
Animals do not have to produce their own food, because they feed off other organisms (plants / animals).✓ (1)
3. Of which organelle is there either a few small ones, or none? *Vacuole(s)* ✓ (1)
4. Compare a plant cell to an animal cell.

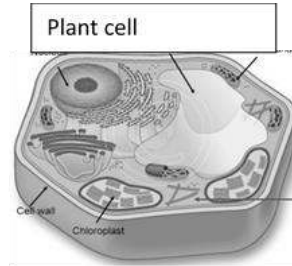
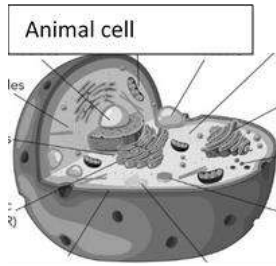
4.1 TABULATE the differences in the table below:

	Plant cell	Animal cell
Cell wall	<i>Cell wall present.</i>	<i>Cell wall absent.</i>
Shape	<i>Regular shape.</i>	<i>Irregular shape.</i>
Chloroplasts	<i>Chloroplasts present.</i>	<i>Chloroplasts absent.</i>
Vacuoles	<i>One large vacuole.</i>	<i>A few small vacuoles, or none.</i>

(FOUR corresponding differences) (4)

- 4.2 Similarities: Name the organelles / components present in both plant- and animal cells. *Cell membrane, ✓ cytoplasm, ✓ nucleus, ✓ mitochondria*✓ (4)
5. Explain why animal cells do not need cell walls as much as plant cells do.
Animal bodies are supported by an (endo)skeleton / exoskeleton (shell).✓
Plants not, therefore, need to be supported by the cellulose cell walls.✓ (2)
6. Explain why animal cells need more mitochondria than plant cells.
Animals need more energy than plants because they consume more energy when moving around, looking for food, looking after their young, etc.✓ (1)

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



1 mark for both
labels correct.

(1)
[20]

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

- 1.1 Animal cell✓ (1)
- 1.2 No cell wall present. / Only a cell membrane present. / Irregular shape. ✓
No chloroplasts present. ✓
Cell does not contain one large vacuole. / A few small vacuoles present.✓ (ANY TWO) (2)
- 1.3 Many chemical reactions take place in the cytoplasm.✓
OR
Cellular activities take place in the cytoplasm.✓ (1)
- 1.4 B – Cell membrane✓
D - Nucleus✓ (2)
- 1.5 It does not contain chloroplasts for photosynthesis. ✓ (1)
- 1.6 Mitochondria are the power stations of the cell / release energy✓ through cellular respiration.
Animals need a lot of energy for movement, looking for food, maintaining body temperature, etc. (for life processes), therefore, they contain many mitochondria to provide adequate amounts of energy. ✓ (2)
[9]

Informal activity – Levels of biological organisation: Cell to organism

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

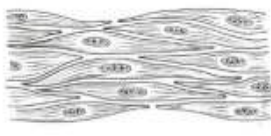
Cell → tissue → organ → system → organism ✓ (1)

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.	<i>Multicellular</i> ✓
Microscopic	Organisms that consist of a single cell.	<i>Unicellular</i> ✓
Unicellular	Something that can be seen with the naked eye.	<i>Macroscopic</i> ✓
Multicellular	Something too small to be seen with the naked eye.	<i>Microscopic</i> ✓

(4)

3. Complete the empty blocks with the correct information:

Diagram	Label	Description
	Cell	<i>Smallest unit of all living things. / All living things are made up of cells. ✓</i>
	<i>Tissue</i> ✓	A group of cells that all have the same structure and perform the same function.
	Organ	<i>A group of different tissues that perform a single function. ✓</i>
	System	<i>A group of different organs that work together to perform a bodily function for the organism. ✓</i>
	<i>Organism</i> ✓	Made up of a number of systems which all work together.

(5)
[10]

Informal activity - The male and female reproductive organs

1.1 Male✓ (1)

1.2

Label	Name of the part	Function
A	Vas deference or sperm duct✓	Carries the semen from the testes to (the urethra in) the penis.✓
B	Penis✓	Enters the vagina to deliver the semen (to the cervix) during ejaculation.✓
C	Urethra✓	Carries the semen to the outside (into the vagina) during ejaculation.✓
D	Testes✓	Produce sperm and testosterone.✓
E	Scrotum✓	Holds and protects the testes and keeps the testes at a constant temperature✓ (35°C).

(10)

2.1 Female✓ (1)

2.2

Label	Name of the part	Function
A	Fallopian tube or oviduct✓	Tube through which the (mature) ovum travels from the ovary to the uterus.✓
B	Uterus✓	Carries and protects the baby.✓
C	Ovary✓	Produces oestrogen and contains the ova.✓
D	Cervix✓	Closed to protect the inside of the uterus.✓
E	Vagina✓	Tube that connects the uterus to the outside of the body. / Acts as canal for the penis to fit into to deliver the semen.✓ (Also the birth canal during childbirth.)

(10)

3. Puberty✓ (1)

4.1 Pituitary gland✓ (1)

4.2 Testes (singular: testis) ✓ (1)

4.3 Ovaries (singular: ovary) ✓ (1)

5. Menstruation✓

Breast development✓

Pubic hair / Facial hair / Underarm hair✓

Deepening of the male voice✓

Body shape changes✓

Body odour and acne develop✓

(ANY FOUR)

(4)

[30]

Informal activity – The stages of reproduction

1. Ovulation: The release of a mature ovum✓ from the ovary✓ into the oviduct. (2)
 2. 3✓ (1)
 3. Fertilisation✓ (1)
 4. Zygote✓ (1)
 5. Menstruation✓ (1)
 6. When fertilisation does not take place, ✓ the thick layer of blood in the uterus is passed out through the vagina. ✓ (2)
 - 7.1 Placenta✓ (1)
 - 7.2 Implantation✓ (1)
 - 7.3 Contraceptives✓ (1)
 - 8.1 28 days / 28 – 30 days✓ (1)
 - 8.2 40 weeks✓ (1)
 - 9.1 Pregnancy / gestation✓ (1)
 - 9.2 Foetus✓ (1)
 - 9.3 Embryo – Early developmental stage. ✓
Foetus – The human embryo after 8 weeks of development. ✓ (2)
 10. Infertility✓
Foetal alcohol syndrome✓
Sexually transmitted diseases✓ (3)
- [20]**

Informal activity – Digestive System**QUESTION 1**

- 1.1 N
- 1.2 E
- 1.3 G
- 1.4 I
- 1.5 J
- 1.6 K
- 1.7 A
- 1.8 M
- 1.9 F
- 1.10 C
- 1.11 B
- 1.12 H
- 1.13 L
- 1.14 D
- 1.15 O

(1 x 15 = 15)

QUESTION 2

- 2.1 The physical breaking down, crushing and mashing of food.✓ (1)
- 2.2 1✓ - Mouth✓
3✓ – Stomach✓
4✓ – Small intestine✓ (6)
- 2.3.1 Carbohydrates✓ (1)
- 2.3.2 Total no. of kJ = 660 + 1 100 = 1 760 kJ✓
Yes,✓ dinner adheres to the required minimum kilojoules. (2)
- 2.4.1 China✓ (1)
- 2.4.2 Amount of starch eaten per day.✓ (1)
- 2.4.3 Number of people with cancer of the large intestine.✓ (1)
- 2.4.4 The number of people with cancer of the large intestine increases as the amount of starch eaten per day decreases.

OR

The number of people with cancer of the large intestine decreases as the amount of starch eaten per day increases.

Marking criteria	Marks
Both variables are mentioned.	1
The RELATIONSHIP between the variables is indicated.	1

(2)
[30]

Informal Activity: Circulatory and Respiratory Systems**QUESTION 1**

- 1.1.1 Arteries have thick muscular walls to withstand the high pressure✓ at which blood is pumped out of the heart. (1)

1.1.2

	Arteries	Veins
Direction of blood	Transport blood away from the heart.	Transport blood towards the heart.
Type of blood transported	Transport oxygenated blood (except the pulmonary arteries).	Transport deoxygenated blood (except the pulmonary veins)✓

(TWO **corresponding** differences) (2)

- 1.2.1 A – Aorta✓ (1)
B - Pulmonary artery / Artery to the lungs✓ (1)

- 1.2.2 Deoxygenated blood✓ (1)
[6]

QUESTION 2

- 2.1.1 Respiratory✓ system (1)
Circulatory✓ system (2)

- 2.1.2 A – Trachea ✓ (1)
B – Lung ✓ (2)

- 2.1.3 Heart ✓ (1)

- 2.1.4 H ✓ (1)

- 2.2.1 Gaseous exchange ✓ (**NOT diffusion; it was given in the question.**) (1)

- 2.2.2 Cellular respiration ✓ (1)

- 2.2.3 Deoxygenated blood ✓ (1)
[9]

QUESTION 3

- 3.1 Diaphragm✓ (1)

- 3.2 X - Oxygen/O₂✓ (1)
Y - Carbon dioxide/ CO₂✓ (2)

- 3.3.1 The lining of the bronchial tubes will be swollen.✓ (1)
OR
The bronchial tubes will be filled with mucus.✓ (1)

- 3.3.2 Cough,✓ fatigue,✓ shortness of breath,✓ chest discomfort,✓ fever.✓ (ANY ONE) (1)

TOTAL: **20**

TERM 2**Strand: Matter and Material****Informal activity 1 - Periodic Table**

1.1	Na - Sodium✓	1.2	Al - Aluminium✓	
1.3	Be – Beryllium✓	1.4	P - Phosphorus✓	
1.5	Mg - Magnesium✓	1.6	Ne - Neon✓	
1.7	Li - Lithium✓	1.8	I - Iodine✓	
1.9	F - Fluorine✓	1.10	Ar - Argon✓	(1 x 10 = 10)

2.1	Iron - Fe✓	2.2	Boron - B✓	
2.3	Potassium - K ✓	2.4	Copper - Cu✓	
2.5	Carbon - C✓	2.6	Nitrogen - N✓	
2.7	Hydrogen - H✓	2.8	Chlorine – Cl or Cl✓	
2.9	Calcium - Ca✓	2.10	Zinc - Zn✓	
2.11	Helium - He✓	2.12	Bromine - Br✓	
2.13	Sulphur / Sulfur - S✓	2.14	Silicon - Si✓	
2.15	Oxygen - O✓			(1 x 15 = 15)

3.1	Group 2, Period 4 – Ca✓ Calcium✓	(2)
3.2	Group 14, Period 3 – Si✓ Silicon✓	(2)
3.3	Group 17, Period 2 – F✓ Fluorine✓	(2)

4.1	Lithium: metal✓	4.2	Chlorine: non-metal✓	
4.3	Aluminium: metal✓	4.4	Silicon: semi-metal✓	
4.5	Sulfur: non-metal✓	4.6	Boron: semi-metal✓	(1 x 6 = 6)

5.1	Periodic Table✓	
5.2	Groups✓	
5.3	Periods✓	(1 x 3 = 3)
		[40]

Informal activity 2 - Periodic Table (PART 2)

- | | | |
|------|--|--------------------|
| 1.1 | Metals✓ | |
| 1.2 | Non-metals✓ | |
| 1.3 | Semi-metals✓ | (1 x 3 = 3) |
| 2.1 | 12✓ | (1) |
| 2.2 | The atom contains 12 protons✓ and 12 electrons. ✓
OR
The number of protons is equal✓ to the number of electrons.✓ | (2) |
| 2.3 | Group 2✓ Period 3✓ | (2) |
| 2.4 | Magnesium✓ Mg✓ | (2) |
| 2.5 | C✓ | (1) |
| 3.1 | Al or Al✓ | |
| 3.2 | Aluminium✓ | |
| 3.3 | 13✓ | |
| 3.4 | 27✓ | |
| 3.5 | 13✓ | |
| 3.6 | 13✓ | |
| 3.7 | $27 - 13 = 14$ ✓ | |
| 3.8 | Metal✓ | |
| 3.9 | Conductor✓ | |
| 3.10 | Metallic lustre✓ | (10) |
| 4.1 | Non-metal✓ | |
| 4.2 | P✓ | |
| 4.3 | Phosphorus✓ | |
| 4.4 | 15✓ | |
| 4.5 | 31✓ | |
| 4.6 | 15✓ | |
| 4.7 | 15✓ | |
| 4.8 | $31 - 15 = 16$ ✓ | |
| 4.9 | Group 15✓ Period 3✓ | |
| 4.10 | Brittle✓ | (11) |
| 5. | $^{23}_{11}\text{Na}$ Na✓ 23✓ 11✓ | (3)
[35] |

Informal activity 3 – Compounds

1.

	What the compound is made of	Chemical formula	Name
1.1	2 H atoms and 1 O atom	H ₂ O	Water
1.2	1 C atom and 1 O atom	CO✓	Carbon monoxide✓
1.3	1 C atom and 2 O atoms	CO ₂ ✓	Carbon dioxide✓
1.4	1 N atoms and 3 H atoms	NH ₃ ✓	Ammonia
1.5	1 S atom and 3 O atoms	SO ₃ ✓	Sulfur trioxide✓
1.6	1 C atom and 4 H atoms	CH ₄ ✓	Methane

(8)

2.1 C✓

2.2 A✓

2.3 D✓ (two identical atoms)

2.4 F✓ (two different atoms)

2.5 B✓

2.6 E✓

(6)

3.1 CaSO₄ - Calcium sulphate✓

3.2 CO – Carbon monoxide✓

3.3 SiO₂ – Silicon dioxide✓3.4 (NH₄)₂CO₃ – ammonium carbonate✓3.5 SO₃ – Sulfur trioxide✓3.6 Fe₂O₃ – Iron oxide✓

3.7 KBr – Potassium bromide✓

(7)

4.1 Magnesium oxide - MgO✓

4.2 Sodium chloride - NaCl✓

4.3 Potassium hydroxide - KOH✓

4.4 Calcium carbonate – CaCO₃✓4.5 Lithium nitrate - LiNO₃4.6 Carbon dioxide – CO₂✓4.7 Magnesium sulphate – MgSO₄✓

(7)

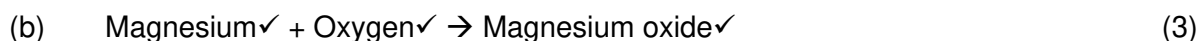
5. Al₂O₃ (2Al³⁺ and 3O²⁻ to result in 6+ and 6- to cancel charges out)

(1)

6. Ca(NO₃)₂ (Ca²⁺ and 2NO₃⁻ for ionic charges to cancel out)

(1)

[30]

Informal activity 4 – Writing and balancing of chemical equations

2.1



$\checkmark$ Two separate carbon atoms; $\checkmark$ One oxygen molecule

$\checkmark$ Two $\checkmark$ carbon monoxide molecules

(4)



[45]

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

- 1.1 Oxygen✓ (1)
- 1.2.1 Sulfur✓ (1)
- 1.2.2 Non-metal✓ (1)
- 1.2.3 Sulfur dioxide✓ (1)
- 1.2.4 Gas✓ (1)
- 1.2.5 $S + O_2 \rightarrow SO_2$ (Both reactants✓; Product✓) (2)
- 1.3.1 Metal✓ (1)
- 1.3.2 Bright / blinding white✓ (1)
- 1.3.3 Magnesium✓ + Oxygen✓ $\rightarrow$ Magnesium oxide✓ (3)
- 1.3.4 $2Mg + O_2 \rightarrow 2MgO$ (Both reactants✓; Product✓; Balancing✓) (3)
- 2.1.1 Carbon✓ and oxygen✓ (2)
- 2.1.2 $C + O_2 \rightarrow CO_2$ (Both reactants✓; Product✓) (2)
- 2.1.3 (Rapid) chemical reaction of a substance✓ with oxygen, ✓ (involving the production of heat and light). (2)
- 2.2 Veld fires release greenhouse gases like CO_2 and SO_2 into the atmosphere
OR
Veld fires cause air pollution. ✓
- The gases released, like CO_2 and SO_2 , dissolve in atmospheric water to form acid rain.✓ (2)
- 2.3.1 Month✓ (1)
- 2.3.2 Average number of (veld) fires✓ (1)
- 2.3.3 200✓ (1)
- 2.3.4 August✓ and September✓ (2)
- 2.3.5 In August and September the veld is extremely dry✓ after the winter months and fires can start easily due to lightning (natural factors) or human behaviour. ✓ (2)

[30]

Informal activity 6 – Rusting

1.1

Rusting	Combustion
A slow reaction of a substance/metal with oxygen.	A rapid reaction of a substance with oxygen.

✓Drawing of the table

✓✓One corresponding difference

(3)

1.2 Metal / Iron✓

Oxygen✓

Water / moisture✓

(3)

1.3 Iron oxide✓

(1)

1.4 $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$

✓Both reactants; ✓Product; ✓Balancing

(3)

2.1 During rusting, corrosion✓ takes place which weakens✓ the metal/chain.

(2)

2.2 Oil will keep oxygen and moisture✓ away from the metal✓ and will prevent rusting.

(2)

2.3 Galvanising **OR** Electroplating✓

(1)

[15]**Informal activity 7 – The concept of pH value with informal practical investigation**

1.1 Indicator✓

(1)

1.2 pH-scale **OR** pH✓

(1)

1.3 Universal indicator✓

(1)

1.4 Neutral / Neutral substance✓

(1)

1.5 Base **OR** Alkali✓

(1)

1.6 Acid✓

(1)

2.1 **Table of the pH-values of different household substances**
OR
Acidity / Alkalinity of different household substances

Household substance	Colour of universal indicator	pH	Acid, Base or Neutral
Examples:			
Lemon juice	Red to orange	2 to 3	Acid
Distilled water	Green	7	Neutral
Baking soda	Blue	9	Base
Ammonia / Handy Andy	Blue to purple	11	Base, etc.

Marking criteria:

- ✓✓ Suitable heading for table, containing BOTH variables
- ✓ Table with four columns, with correct headings
- ✓ Five to ten household substances listed in the table
- ✓ Colour of universal indicator correct for the selected substances
- ✓ pH correct for the selected substances
- ✓ Correct classification of acids, bases, and neutrals

(7)

2.2 Household substance✓

(1)

2.3 pH **OR** Acid / Base / Neutral✓

(1)

[15]

Informal activity 8 – Neutralisation and pH

- | | | |
|-----|--|-------------|
| 1.1 | C | |
| 1.2 | E | |
| 1.3 | B | |
| 1.4 | A | |
| 1.5 | H | |
| 1.6 | G | |
| 1.7 | I | |
| 1.8 | D | |
| 1.9 | F | (9 x 1 = 9) |
| | | |
| 2.1 | acidic | |
| 2.2 | basic | |
| 2.3 | neutralisation | |
| 2.4 | below (Reason: strong acid reacts with weak base.) | |
| 2.5 | above (Reason: strong base reacts with weak acid.) | |
| 2.6 | H ₂ SO ₄ | (6 x 1 = 6) |
| | | [15] |

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

- | | | |
|-------|---|-------------|
| 1.1 | MgO✓ | (1) |
| 1.2 | Basic oxide✓ | (1) |
| 1.3 | Red litmus turns blue, therefor magnesium oxide is basic / a base. ✓ | (1) |
| 1.4 | Non-metal oxide✓ | (1) |
| 1.5 | Acidic oxides.✓
Blue litmus turns red in the solution, indicating that it is acidic.✓ | (2) |
| 2.1 | Blue / purple.✓ Magnesium is a metal and metal oxides are basic oxides.✓ | (2) |
| 2.2 | Hydrochloric acid makes the basic magnesium oxide solution less basic/more acidic✓ until it becomes neutral.✓ | (2) |
| 2.3.1 | MgO✓ | (1) |
| 2.3.2 | HCl✓ | (1) |
| 2.4 | salt✓ + water✓ | (2) |
| 2.5 | MgO + 2HCl → MgCl ₂ + H ₂ O
✓Reactants ✓MgCl ₂ ✓H ₂ O ✓Balancing | (4) |
| 2.6 | Magnesium chloride✓
Water✓ | (2) |
| 2.7 | Neutralisation✓ | (1) |
| 3. | MgO✓ + H ₂ SO ₄ ✓ → MgSO ₄ ✓ + H ₂ O✓ | (4) |
| | | [25] |

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

- 1.1 Aluminium sulphate✓ (1)
- 1.2 Blueberries grow well in acidic soil.
To make the soil with a pH of 8 more acidic / less basic, ✓ an acidic compound like aluminium sulphate must be added to the soil.✓ (2)
- 1.3 Calcium carbonate✓ (1)
- 1.4 To increase the pH of the soil with a pH of 5, a basic compound like calcium carbonate must be added✓ to the soil to make it less acidic / more basic.✓ (2)
- [6]

Practical Task / Investigation**Marks: 20****Acids, bases, and the use of an indicator during neutralisation****PART 1****Table of results: (For universal indicator)**

Test tube	Colour	pH	Acid, base or neutral
1 (Vinegar)	Red	A value below 7	Acid
2 (Distilled water)	Green	7	Neutral
3 (Bicarbonate of soda)	Blue/Purple	A value above 7	Base

Conclusion:

1. (Distilled) water✓ (1)
2. Vinegar✓ (1)
3. Bicarbonate of soda✓ (1)

4. **Definition of an indicator:**

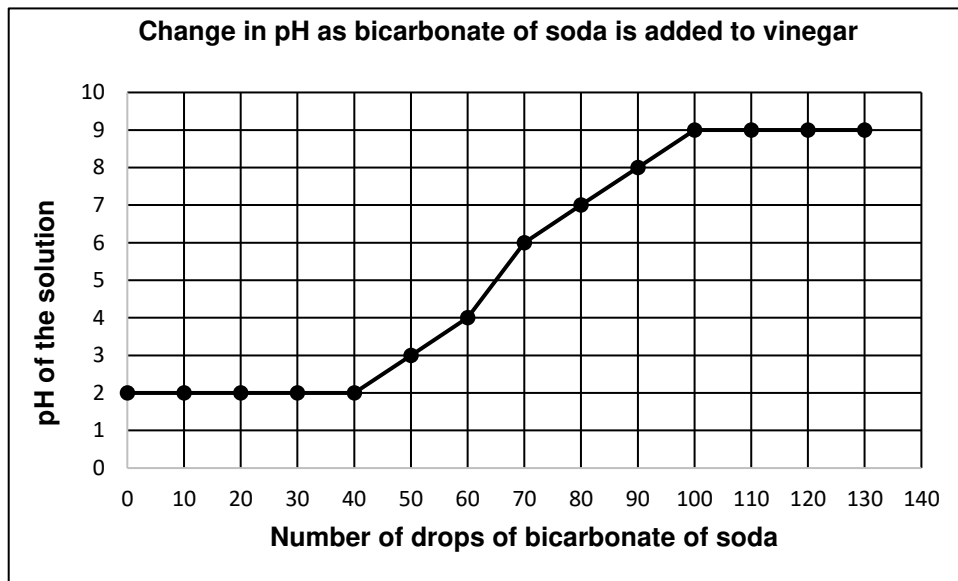
An indicator indicates whether a substance is an acid✓ or a base✓ through a colour✓ change. (2)

PART 2**VERY IMPORTANT:**

The teacher **MUST** do a test run before the learners do this experiment. Results may vary a lot due to the different concentrations of the solutions. Either determine own results or use the given results to draw the graph.

Table of results for universal indicator: (Can also determine own results.)

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:

Marking criteria for graph	Marks
Half of points plotted correctly	✓
Rest of points plotted correctly	✓
Line of best fit drawn through the points	✓

(3)

Conclusion:

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. (2)

Acids and bases (neutralise / destroy) each other.

Questions:

- Carbon dioxide **OR** CO_2 ✓ (1)
- Acid + metal carbonate $\rightarrow$ Salt✓ + H_2O ✓ + CO_2 ✓ (3)
- 80 drops✓ (Answer depends on the results / graph.) (1)
- From the table of results:** After 80 drops of bicarbonate of soda have been added to the vinegar, the pH of the solution was 7,✓ the solution was green, the colour of a neutral solution. ✓ (The number of drops depends on the results.)

OR

From the graph: A pH of 7 was reached after 80 drops✓ of bicarbonate of soda have been added to the solution, indicating a neutral solution. ✓
(The number of drops depends on the results.) (2)

5.1 Number of drops of bicarbonate of soda (NaHCO_3)

OR

Volume/Amount of bicarbonate of soda✓ (1)

5.2 pH✓ of the solution (1)

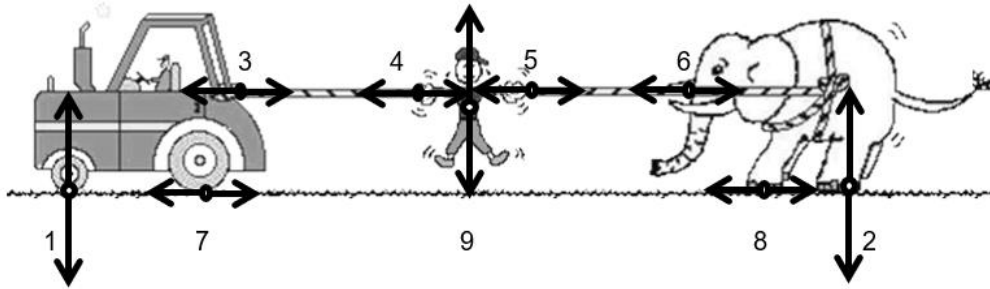
6. Bicarbonate of soda is a base and it will neutralise✓ the acid that was injected into the skin during the bee sting. (1)

TOTAL: 20

TERM 3**Strand: Energy and Change****INFORMAL ACTIVITY – FORCES (PART 1)**

1. Force 1 – Pull force✓
Force 2 – Push force✓
Force 3 – Twist force✓ (3)

2.



Label	Description
1 (given)	Downward force of tractor/wheel on ground - Upward force of ground on tractor/wheel
2	Downward force of elephant/foot on ground - Upward force of ground on elephant/foot
3	Force of tractor on rope - Force of rope on tractor
4 or 5	Force of rope on man - Force of man on rope
6	Force of elephant on rope - Force of rope on elephant
7 or 8	Force of wheel/foot on ground (backward) - Force of ground on wheel/foot (forward)
9	Force of earth on man – Force of man on earth

Any 3 force pairs from number 2 to 9✓ with correct labels✓ (3 x 2 = 6)

3. A: A force can change the shape✓ and size✓ of an object.
B: A force can change the direction✓ and speed✓ of an object.
C: Force can change the speed/velocity and direction✓ of an object. A force can also cause objects to rotate✓ (the wheels of the bicycle). (3 x 2 = 6)
- 4.1 The apple falls towards the earth due to (a magnetic force / **gravitational force**✓) which is a (contact force / **field force**✓). (2)
- 4.2 The force the earth exerts on the apple is EQUAL to the force the apple exerts on the earth. ✓ (1)
- 5.1. Friction✓ (1)
5.2. Contact force✓ (1)
- 6.1 Compression✓ (1)
6.2 Tension✓ (1)
- 7.1.1 B✓ (1)
7.1.2 C✓ (1)
7.1.3 D✓ (1)
7.1.4 A✓ (1)

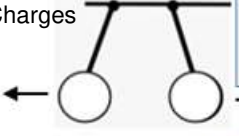
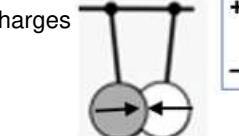
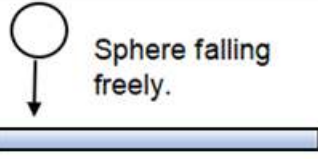
7.2 $F_{\text{net}} = 120 \text{ N} - 44 \text{ N} = 76 \text{ N}$; ✓ to the right ✓ (3)

7.3 Forces B and D are not balanced forces because the force exerted by the man on the cart (B) is greater ✓ than the force of friction on the cart (D). ✓ B and D are opposite in direction but not equal in magnitude. (Forces A and C are equal in magnitude and opposite in direction and therefor are balanced forces.)

OR

A net force ✓ of 76 N to the right ✓ is exerted on the cart (meaning the cart will accelerate/move faster to the right). (2)

8.

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?)
✓ Charges  + and + OR - and -	8.1 FF	8.2 EF
✓ Charges  + and - OR - and +	8.3 FF	8.4 EF ✓ 8.2, 8.4 Electrostatic force
 Sphere falling freely.	8.5 FF	8.6 GF ✓
 ✓ Poles	8.7 FF	8.8 MF
 ✓ Poles	8.9 FF	8.10 MF
 ✓ Poles	8.11 FF	8.12 MF

✓ All field forces

✓ 8.8, 8.10, 8.12 Magnetic force

(9)
[40]

INFORMAL ACTIVITY – FORCES (PART 2): Electrostatic force

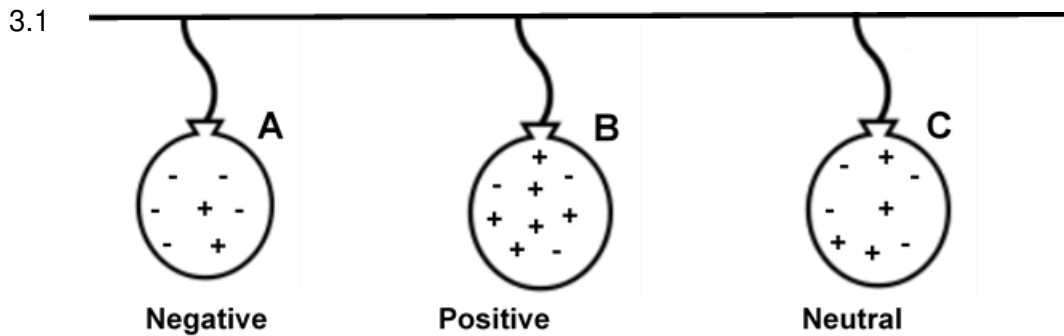
1.1 gained✓ excess✓ (2)

1.2 lost✓ shortage✓ (2)

NOTE: Since protons cannot move in and out of the nucleus, an atom/object can never have an excess or a shortage of protons.

2.1 Friction✓ (1)

2.2. An object is neutral when it has an equal number✓ of positively charged protons and negatively charged electrons.✓ (2)

**Marking criteria:**

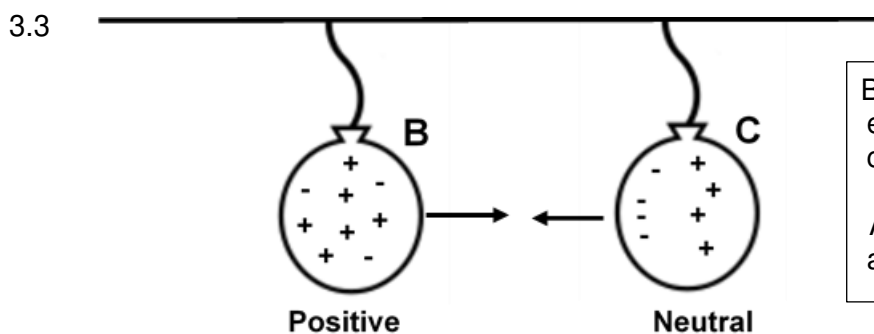
A (negative) - excess of e^- (more e^- than p^+)✓

B (positive) - shortage of e^- (less e^- than p^+)✓

C (neutral) - equal number of e^- and p^+ ✓

(3)

3.2 The two balloons will attract✓ each other.
Explanation: Oppositely charged objects / unlike charges attract each other.✓ (2)



Balloon C: negative charges / electrons accumulate on the side closest to B.✓

Arrows indicate the force of attraction between the balloons.✓

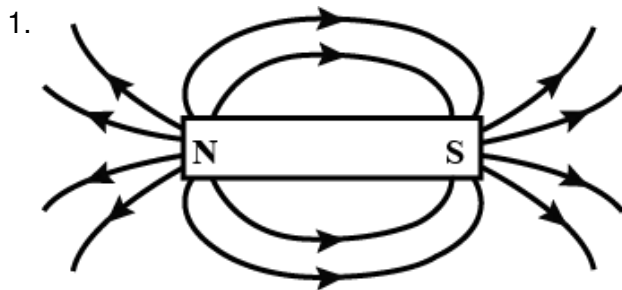
The two balloons will **attract**✓ each other.

The electrons on balloon C are attracted by balloon B which is positively charged. The electrons on balloon C will move and accumulate on the side closest to balloon B. Balloon B, which is positively charged will attract the newly formed, negative side of balloon C.

(3)

- 4.1 K is positively (+) charged, because it is attracted by L which is negatively (-) charged.✓
M is negatively (-) charged because it is repelled by L which is also negatively (-) charged.✓ (2)
- 4.2 K is positively (+) charged, because it is attracted by L which is negatively (-) charged.✓
M is positively (+) charged because it is repelled by K which is positively (+) charged.✓ (2)
- 4.3. M is positively (+) charged because it is attracted by L which is negatively (-) charged.✓
K is negatively (-) charged because it is attracted by M which is positively (+) charged.✓ (2)
5. **Given: A is negatively (-) charged, and B is neutral.**
(TIP: Start from F attracts A and work your way upwards.)
- Object F is positively (+) charged because it is attracted by A which is charged negatively (-).✓
- Object E is positively (+) charged because it is repelled by object F, which is positively (+) charged.✓
- Object D is charged negatively (-) because it is attracted by object E, which is charged positively (+).✓
- Object C is charged negatively (-) because it is repelled by object D which is charged negatively (-).✓ (4)
- 6.1 A lightning strike occurs when there is a massive discharge (release of charge)✓
between the thunder cloud and the ground.✓ (2)
- 6.2 Stay indoors / seek shelter. ✓
Stay in your car. ✓
Stay away from windows and metal objects. ✓
If you are outside, don't stand next to tall objects like trees or metal objects. ✓
Get out and away of any bodies of water like dams, swimming pools, etc. ✓
Avoid using electronic equipment. ✓
(Any THREE SCIENTIFICALLY correct precautions) (3)

[30]

INFORMAL ACTIVITY – FORCES (PART 3): Magnetic force

- ✓Shape of magnetic field is correct.
 - ✓All field lines touch the surface of the magnet.
 - ✓N and S pole in correct positions.
 - ✓Direction of magnetic field indicated from N → S.
- Subtract mark if field lines cross each other.

(4)

- 2.1 B✓ (1)
- 2.2 A✓ (1)
- 2.3 In A: Two unlike poles (N and S)✓ attract.✓
In B: Two like poles (N and N or S and S)✓ repel.✓ (4)

[10]

INFORMAL ACTIVITY – FORCES (PART 4): Gravitational force

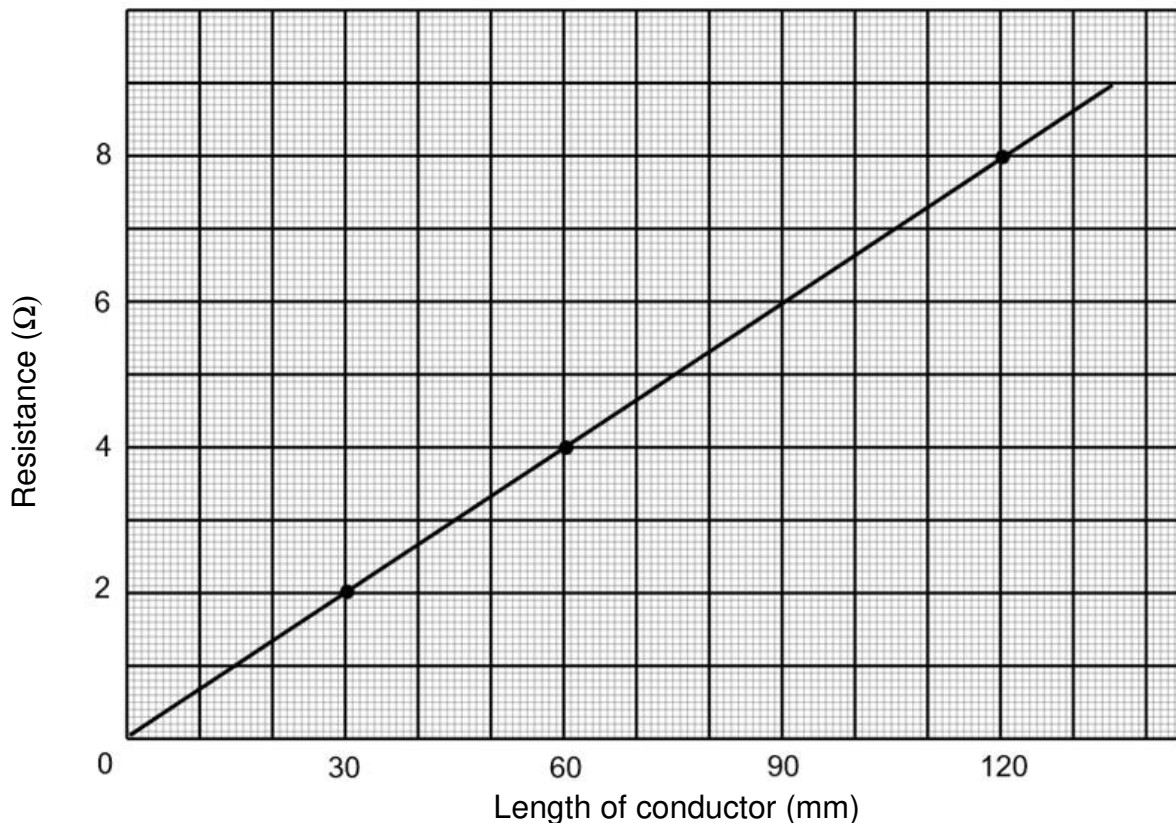
- 1.1 Kitchen scale✓ (1)
- 1.2 Newton spring balance✓ (1)
- 1.3 2,2 N✓ (Accept: 2,1 – 2,3 N) **Answer WITH unit for 1 mark** (1)
- 1.4 300 g✓ (1)
- 1.5 Convert 300 g to 0,3 kg
- $w = m \times g = 0,3 \times 9,8 \checkmark = 2,94 \text{ N} \checkmark$ (2)
- 2.1.1 Mass is the amount of matter✓ that an object consists of. (1)
- 2.1.2 Weight of an object is the gravitational force exerted on it by the Earth✓ (or the Moon or any other planet). (1)
- 2.2.1 600 N✓ (1)
- 2.2.2 1500 N✓ (1)
- 2.2.3 3 750 N✓ (**Accept:** 3 700 N) (1)
- 2.3 Jupiter✓ (1)
- 2.4 The greater the mass of the planet,✓ the greater the gravitational force on an object.✓
The masses of the three planets differ. (2)
- 2.5.1 Planet✓ (1)
- 2.5.2 Weight✓ (1)
- 2.5.3 Mass of the object✓ (1)
- 2.6 Weight increases with an increase in mass.✓
OR
Mass and weight are directly proportional to each other.✓ (1)
- 2.7 A bathroom scale measures mass in kg, not weight in Newton (N).✓
A person loses mass (amount of matter) when going on a diet, not weight.✓ (2)
- 2.8.1 Mass of the objects✓
Distance between the (centres of the) objects✓ (2)
- 2.8.2 The mass of the planets in B is bigger than in A, therefore the gravitational force between them is stronger.✓ (Distance between the planets in A and B is the same.) (1)
- 2.8.3 The distance between the planets in D is bigger than in C.✓ (1)
- 2.8.4 Mass✓ (of the planets) (1)
- [25]**

INFORMAL ACTIVITY – ELECTRIC CELLS

- 1.1 Cell / Battery✓ (1)
- 1.2 Electric current✓ (1)
- 1.3 Battery✓ (1)
- 1.4 Cell / Battery✓ (1)
- 2.1. B✓ It consists of a few cells/4 cells functioning together as a battery.✓ (2)
- 2.2. A battery provides the energy needed✓ for electrons (current) to move (flow)✓ in an electric circuit. (2)
3. D✓ Circuit D has no cell / battery / source of electrical energy; ✓ therefore, no current is flowing through the circuit. (2)
- 4.1.1 Copper plate / Zinc plate / Metal plate✓ (1)
- 4.1.2 Lemon juice / Acid inside the lemons✓ (1)
- 4.1.3 One lemon with the zinc and copper electrodes✓ (1)
- 4.1.4 The four lemons with the electrodes, connected to each other✓ (1)
- 4.1.5 The two electrodes / copper and zinc electrodes✓
(Learners do not have to know that Zn is the - terminal and Cu the + terminal.) (1)
- 4.2 Light emitting diode✓ (1)
- 4.3 Energy is released✓ during the chemical reaction taking place between the electrodes and the electrolyte inside the lemons.✓ The charges in the connecting wires flow through the complete circuit and provide the LED with energy. ✓ (3)
- 4.4 With less lemons, less energy will be released, and the LED will glow dimmer. ✓
OR
With less lemons, the potential difference of the battery will decrease, and the LED will glow dimmer. ✓ (1)
- [20]**

INFORMAL PRACTICAL ACTIVITY – RESISTANCE

1.1 Heading: Graph of the relationship between the resistance and the length of a conductor



Marking criteria	Marks
Suitable heading, containing both variables.	✓
Suitable scale on x-axis.	✓
Suitable scale on y-axis.	✓
Label on x-axis with unit.	✓
Label on y-axis with unit.	✓
Correct plotting of three points (30; 2), (60; 4), (120; 8)	✓
Best fit straight line drawn through the three points and the origin.	✓

(7)

1.2 What is the relationship between the length of a conductor and the resistance of the conductor?

Marking criteria	Marks
Both variables are mentioned. (Length and resistance.)	✓
The relationship between the variables is clearly indicated.	✓

(2)

1.3 Possible hypothesis:

If the length of the conductor increases, then the resistance of the conductor will also increase.

Marking criteria	Marks
Both variables are mentioned. (Length and resistance.)	✓
A possible relationship between the variables is clearly indicated.	✓

(2)

- 1.4. **Dependent variable:** Resistance of the conductor✓
Independent variable: Length of the conductor✓

(2)

- 1.5 Cross sectional area (thickness) of the conductor✓
 Temperature of the conductor✓
 Type of material from which the conductor is made✓

(3)

- 1.6. An **independent variable** is the variable which is controlled by the person who conducts the investigation.✓
 The **dependent variable** is the variable that changes in response to the independent variable. The dependent variable is the variable that is being measured in an investigation. ✓

(2)

- 1.7 Yes,✓ the hypothesis made in question 1.3 is confirmed by the graph.
 The graph is a straight line with a constant gradient and passes through the origin. The data confirms that the resistance of the conductor (nichrome wire) increases with an increase in the length of the conductor. ✓

(2)

- 1.8.1 Straight line✓ with a constant gradient.

(1)

- 1.8.2 $3\ \Omega$ ✓ (Use the graph to read off the value)

(1)

- 1.8.3 105 mm✓ (Use the graph to read off the value)

(1)

- 1.9 The length of a conductor is directly proportional to the resistance of the conductor. ✓

(1)

- 1.10 The overall resistance will also increase 20 times. ✓

(1)

- 1.11 C✓

(1)

- 1.12 When you add a bulb in series, you are increasing the total length of the resistor, ✓ which in turn increases the total resistance of the circuit. ✓
 Increasing the total resistance will decrease the total current in the circuit.

(2)

- 2.1 Type of wire✓

(1)

- 2.2 Z✓

(1)

- 2.3 For the variable on the x-axis (length / thickness / temperature), Z has the lowest resistance✓ in comparison with wires X and Y,✓ making it the best conductor of the three.

(2)

- 2.4 Temperature✓
 Length✓
 Thickness✓ (of a wire/conductor).
 (Do **not accept** type of conductor; it was given in the question.)

(3)

[35]

INFORMAL ACTIVITY – MEASURING INSTRUMENTS IN CIRCUITS

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	Ampere (A) ✓	In series	Low ✓
Voltmeter		Potential difference ✓	Volt (V)	In parallel ✓	High

[5]

INFORMAL ACTIVITY – SERIES AND PARALLEL CIRCUITS**PART 1: SERIES CIRCUITS**

1.

Reading	Value with unit	Reason: Number or phrase
A ₁	2A	S1 ✓ (from the table of comparison between series and parallel circuits on page 74 of manual.) (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.)
A ₂	2A ✓	
A ₃	2A ✓	
A ₄	2A ✓	

(4)

2.1

A₂ ; A₁ ; A₃ ✓

S6 ✓ (From the table of comparison: The total current DECREASES with each resistor added in series because the total resistance INCREASES.)

Less bulbs in series; smaller total resistance; bigger total current.

More bulbs in series; bigger total resistance; smaller total current.

(2)

2.2

C ; A ; B ✓

S6 ✓

More bulbs in series; bigger total resistance; smaller current; dimmer bulbs.

Less bulbs in series; smaller total resistance; bigger current; brighter bulbs.

(2)

2.3

The other two bulbs will also stop glowing. ✓

S1 and S7. ✓

Only one pathway for the current to flow; if circuit is broken, no current can flow and all bulbs stop glowing.

(2)

3.

Reading	Value with unit	Reason: Number or phrase
V ₁	1,5 V	Voltage of 1 cell.
V ₂	4,5 V ✓	S2 ✓ (1,5 x 3 = 4,5 V)
V ₃	1,5 V ✓	S3 ✓ (4,5 ÷ 3 = 1,5 V)
V ₄	1,5 V ✓	
V ₅	1,5 V ✓	

(6)

4.

Reading	Value with unit	Reason: Number or phrase
V_1	2 V✓	S2✓ ($6 \text{ V} \div 3 = 2 \text{ V}$)
V_2	6 V	Voltage of battery of 3 cells.
V_3	1 V	S3✓ $6 - (2 + 1) = 3 \text{ V}$
V_4	3V✓	
V_5	2 V	

(4)

4.1 V_4 ✓ S4✓ (A resistor with a higher resistance will have a higher voltage across it.)

(2)

4.2 V_3 ✓ S5✓ (A resistor with a lower resistance will have a lower voltage across it.)

(2)

5.

Reading	Value with unit	Reason: Number or phrase
V_1	12 V	Voltage across the battery.
V_2	4V✓	S3✓ ($12 - 8 = 4 \text{ V}$)
V_3	8 V	Given
Resistor with highest resistance	R_2 ✓	S4✓
Resistor with lowest resistance	R_1 ✓	S5✓

(6)

6.

Reading	Value with unit	Reason: Number or phrase
V_1	9 V	Voltage of cell.
V_2	2 V	Given.
V_3	2 V✓	Reason: S3✓ Calculation: $V_{3+4} = 9 - 5 = 4 \text{ V}$ ✓ $V_3 = V_4 = 4 \div 2 = 2 \text{ V}$ ✓
V_4	2 V✓	
V_5	3 V	Given.

(5)
[35]

PART 2: PARALLEL CIRCUITS

1.

Reading	Value with unit	Reason: Number or phrase
V_1	1,5 V✓	P2✓
V_2	1,5 V✓	P3✓
V_3	1,5 V✓	

(5)

2.

Reading	Value with unit	Reason: Number or phrase
A_1	4 A✓	S1✓
A_2	4 A	Given.
A_3	2 A✓	Reason: P4✓
A_4	2 A✓	Calculation: $4\text{ A} \div 2 = 2\text{ A}$ ✓

(6)

3.

Reading	Value with unit	Reason: Number or phrase
A_1	0,5 A	Given.
A_2	1,5 A✓	P4✓ $2 - 0,5 = 1,5\text{ A}$
A_3	2 A	Given.
V_1	3 V	Voltage of cell.
V_2	3 V✓	P3✓
V_3	3 V✓	

(5)

3.1 B_2 ✓ P7✓ (Lower resistance; bigger current.) (2)3.2 B_1 ✓ P8✓ (Higher resistance; smaller current.) (2)3.3 B_2 will continue to glow.✓ P6✓ (and P1) (2)

3.4 Remain the same.✓ P3✓ (2)

3.5 Decrease✓ P5✓
 B_1 fused; less resistors in parallel; bigger total resistance; smaller total current. (2)4.1 (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 **P5**. ✓ (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 **P5**. ✓ (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 3**.✓ (2)

4.2

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	3 A✓	3 A✓	All bulbs are identical. In Circuit 1: Lower current of 6 A is divided equally between <u>2</u>✓ bulbs, so the current through each bulb is <u>3 A</u>.✓ In Circuit 2: Higher current of 9 A is divided equally between <u>3</u>✓ bulbs, so the current through each bulb is <u>3 A</u>.✓
A ₂	3 A✓	3 A✓	
A ₃	6 A	9A	Why is the total current in Circuit 2 more than in Circuit 1? Give the numbers of TWO reasons. P7✓ Circuit 2 has more resistors in parallel; less total resistance; higher total current. P5✓ The total current in the circuit INCREASES with each resistor added in parallel because the total resistance DECREASES.
A ₄		3 A✓	P4✓
V ₁	6 V✓	6 V	Cells are identical; cells have same voltage.✓
V ₂	6 V	6 V✓	P3✓

(16)
[50]

ADDITIONAL EXERCISES – SERIES AND PARALLEL CIRCUITS**1. Cells in series****Advantage:**

Cells connected in series produce a current with a high potential difference (voltage). ✓

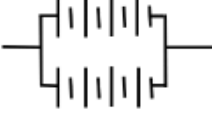
Disadvantage:

Cells connected in series will not last as long as cells connected in parallel. ✓ (2)

2. Cells in parallel**Advantage:** Cells connected in parallel will last for a long time. ✓**Disadvantage:** Cells connected in parallel will produce a current with a lower potential difference (voltage). ✓ (2)

3. A battery is a number of / group of electrical cells working together as a unit. ✓ (1)

4. A 4 V ✓
 B 8 V ✓
 C 2 V (2 cells oppose each other) ✓
 D 2 V ✓
 E 2 V ✓
 F 4 V ✓ (6)

5.1.  ✓ (1)5.2.  ✓ (1)6.1 $A_1 = A_2 = A_3 = 2 \text{ A}$ ✓The total resistance of the circuit is twice as large as in the “example” circuit, because of the additional bulb connected in series. ✓ The total current will therefore be half of the initial current: $4 \text{ A} / 2 = 2 \text{ A}$. ✓ The reading on all the ammeters will be the same because this is a series circuit; the current can follow only one pathway.

$$V_1 = V_2 = \frac{12\text{V}}{2} = 6 \text{ V}; \text{ ✓ Resistors/bulbs in series are potential dividers. } \text{ ✓ (5)}$$

6.2 $V_1 = V_2 = 12 \text{ V}; \text{ ✓ Resistors connected in parallel are not potential dividers. The voltage is the same across each resistor connected in parallel. } \text{ ✓}$

$$A_1 = 8 \text{ A}$$

The total resistance of the parallel circuit is half the resistance of the initial circuit containing a single bulb connected in series, therefore the total current will be double ✓ the initial total current.

$$A_6 = A_1 = 8 \text{ A} \text{ ✓ Both } A_1 \text{ and } A_6 \text{ measure total current.}$$

$$A_2 = A_3 = A_4 = A_5 = (8\text{A}/2) = 4\text{A} \text{ ✓}$$

The two bulbs have the same resistance therefore, the total current is divided equally into two branches. ✓ (6)

7.1.1 Parallel ✓ (the current divides into three branches) (1)

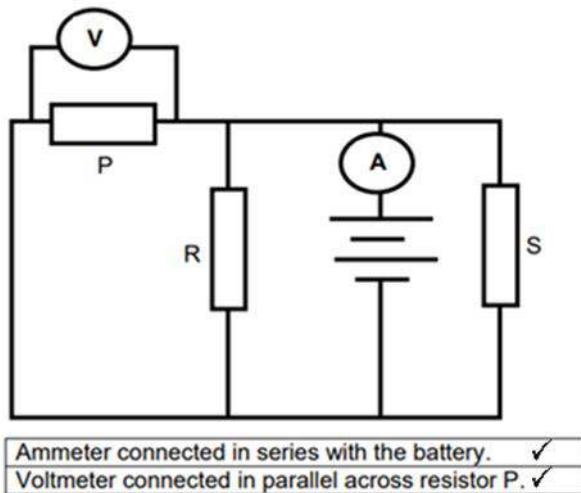
7.1.2 Resistor ✓ (1)

7.1.3 It restricts/controls/resists the flow of current. ✓ (1)

7.1.4 $2 \times 1,5 \text{ V} = 3\text{V}$ ✓

(1)

7.1.5



(2)

7.2.1 $\frac{3\text{V}}{3} = 1 \text{ V}$ ✓

(2)

7.2.2 (Resistors in series) are potential dividers. ✓

OR

The total potential difference (voltage) is divided between resistors in series. ✓

OR

The sum of the voltages across the individual resistors in series adds up to the voltage across the battery. ✓

(1)

7.2.3 Decrease ✓

(1)

7.2.4 Adding one more resistor in series will cause the total voltage / V_{battery} to be shared amongst more resistors / 4 resistors, instead of 3. ✓(1)
[35]**ENRICHMENT EXERCISE**8.1. The voltage available to the parallel branches (V_2 and V_3) can be determined by deducting V_1 from the total available voltage, supplied by the battery:

$12 \text{ V} - 3 \text{ V} = 9 \text{ V}$ ✓

 $V_2 = V_3 = 9 \text{ V}$; ✓ The voltage is the same across the two parallel branches.

(3)

8.2. $V_{\text{FG}} = V_3 - V_{\text{GH}}$
 $V_{\text{FG}} = 9 \text{ V} - 1,5 \text{ V}$ ✓
 $V_{\text{FG}} = 7,5 \text{ V}$ ✓

(2)
[5]

INFORMAL ACTIVITY – SAFETY PRACTICES

1. C✓ (1)
- 2.1 A = Earth wire✓
B = Neutral wire✓ (blue)
C = Live wire✓ (brown) (3)
- 2.2 Yellow and green✓ (1)
[5]

INFORMAL ACTIVITY – ENERGY AND THE NATIONAL ELECTRICITY GRID

- 1.1 Steam✓ (1)
- 1.2 Emission of harmful greenhouse gases, e.g., CO₂(g) and SO₂(g). ✓
The mining of coal destroys the habitat of many living organisms. ✓
Depletion of coal which is a non-renewable energy source. ✓ (ANY TWO) (2)
- 1.3 Examples include:
Solar energy✓
Hydro energy✓
Nuclear energy✓
Wind energy✓
Tidal energy✓
Biomass energy✓ (ANY FIVE) (5)
- 1.4

Similarities	Differences
In both power stations, water is heated, and steam is produced for the propulsion of turbines. ✓	The energy sources differ: Coal is used in coal fired power plants. In nuclear power plants, enriched uranium is used. ✓
In both power stations, electricity is produced by rotating turbines which drive generators. ✓	Coal fired power plants emit a huge amount of harmful gasses. No harmful gas is emitted by nuclear power plants. ✓

(4)
[12]**INFORMAL ACTIVITY - THE COST OF ELECTRICAL POWER CONSUMPTION**

1. **Cost = Power rating x the number of hours x the unit price of electricity✓**
Cost = 2,5 kW✓ X 0,5 h✓ X R 2,40 / kWh✓
Cost = R 3,00✓ (5)
- 2.1 **Fan:** 120 W = 120/1000 = 0,12 kW✓
Frying pan: 1400 W = 1400/100 = 1,4 kW✓ (2)
- 2.2 **Units consumed (kWh) = Appliance power rating (kW) x Hours used (h)**
Units consumed = 1,4 kW X 4 h✓ = 5,6 kWh✓ (2)

2.3 Cost = Units consumed (kWh) x Unit price of electricity (R/kWh)

$$\text{Cost} = 5,6 \text{ kWh} \times \text{R } 1,94 / \text{kWh} \checkmark = \text{R } 10,86 \checkmark \text{ (Unrounded answer: } 10,864) \quad (2)$$

2.4 Units consumed (kWh) = Appliance power rating (kW) x Hours used (h)

$$5,6 \text{ kWh} \checkmark = 0,12 \text{ kW} \times \text{Hours used (h)} \checkmark$$

$$\text{Hours used} = 46,67 \text{ h} \checkmark$$

OR**Cost = Power rating of the appliance x Number of hours x Unit price of electricity**

$$10,86 \checkmark = 0,12 \times \text{Number of hours} \times 1,94 \checkmark$$

$$\text{Number of hours} = 10,864 \div (0,12 \times 1,94) = 46,67 \text{ h} \checkmark$$

$$\text{(If } 10,86 \text{ is used, the answer will be } 46,65 \text{ h)} \quad (3)$$

3. Ordinary geyser:**Cost = Power rating x the number of hours x the unit price of electricity**✓

$$\text{Cost} = 2,6 \text{ kW} \times 4,4 \text{ h} \times \text{R } 1,22 / \text{kWh} \checkmark$$

$$\text{Cost} = \text{R } 13,96 \checkmark$$

Solar Geyser:**Cost = Units consumed (kWh) x Unit price of electricity (R/kWh)**

$$\text{Cost} = 4,42 \text{ kWh} \times \text{R } 1,22 \text{ per unit} \checkmark$$

$$\text{Cost} = \text{R } 5,39 \checkmark$$

$$\text{Money saved by using a solar geyser} = \text{R } 13,96 - \text{R } 5,39 \checkmark = \text{R } 8,57 \checkmark \quad (7)$$

$$4.1 \quad \text{Kilowatt/kW OR Watt/W} \checkmark \quad (1)$$

$$4.2 \quad 3,25 \checkmark \times 20 \checkmark = 65 \text{ h} \checkmark \text{ (Note: 15 minutes} = 0,25\text{h)} \quad (3)$$

$$4.3 \quad \text{Total power rating} = 45 \checkmark \times 120/1000 \checkmark = 5,4 \text{ kW} \checkmark \text{ OR } 45 \checkmark \times 120 \checkmark = 5\,400 \text{ W} \checkmark \quad (3)$$

$$4.4 \quad \text{Cost} = 5,4 \times 65 \times 0,91 \checkmark = \text{R } 319,41 \checkmark \quad (2)$$

$$4.5 \quad 2,5 \times 24 \checkmark = 60 \text{ h} \checkmark \quad (2)$$

$$4.6 \quad \text{Y} \checkmark \quad (1)$$

$$4.7 \quad \text{Cost} = 5,4 \times 60 \times 0,91 \checkmark = \text{R } 294,84 \checkmark \quad (2)$$

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