education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

GRADE 11

PHYSICAL SCIENCES

CONTROLLED TEST SEPTEMBER 2022

QUESTION PAPER (1)

MARKS: 100

TIME : 2:00 HOURS

This question paper consists of 17 pages including the data sheets

INSTRUCTIONS AND INFORMATION

1. This question paper consists of SIX questions. Answer ALL the questions in the ANSWER BOOK.

2. Start EACH question on a NEW page in the ANSWER BOOK.

3. Number the answers correctly according to the numbering system used in this question paper.

4. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.

5. You may use a non-programmable calculator.

6. You may use appropriate mathematical instruments.

7. You are advised to use the attached DATA SHEETS.

8. Show ALL formulae and substitutions in ALL calculations.

9. Round off your final numerical answers to a minimum of TWO decimal places.

10. Give brief motivations, discussions et cetera where required.

11. Write neatly and legibly.

QUESTION 1

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A – D) next to the question number (1.1 – 1.8) in the ANSWER BOOK, for example 1.9 D.

1.1 Consider the emf induced in a coil when a magnet is moved into the coil . Which of the following graphs correctly describes the relationship between the induced emf and the number of turns(N) in the coil?

A
emf
Number of turns

B
emf
Number of turns

C
emf
Number of turns

D
emf
Number of turns
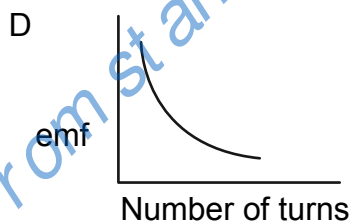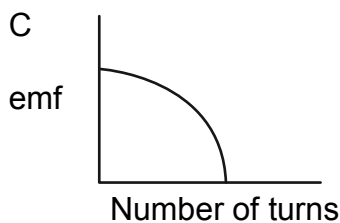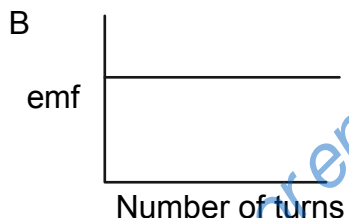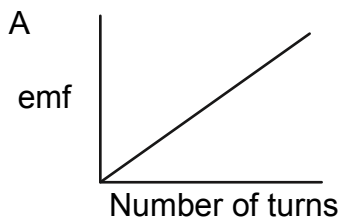
(2)

1.2 Three identical light bulbs are connected in a circuit as shown below. The resistances of the battery and connecting wires can be ignored.
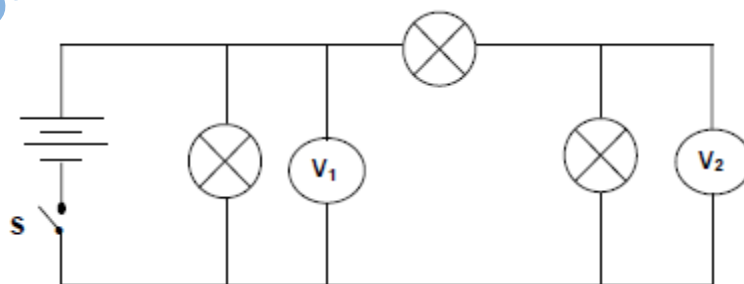
Which ONE of the following statements is CORRECT when switch **S** is closed? The reading on V_1 is …

3

A   half that on V_2.

B   equal to that on V_2.

C   twice that on V_2.

D   three times that on V_2.   (2)

1.3   The following electric circuit contains three light bulbs and a battery.
The battery has negligible internal resistance.
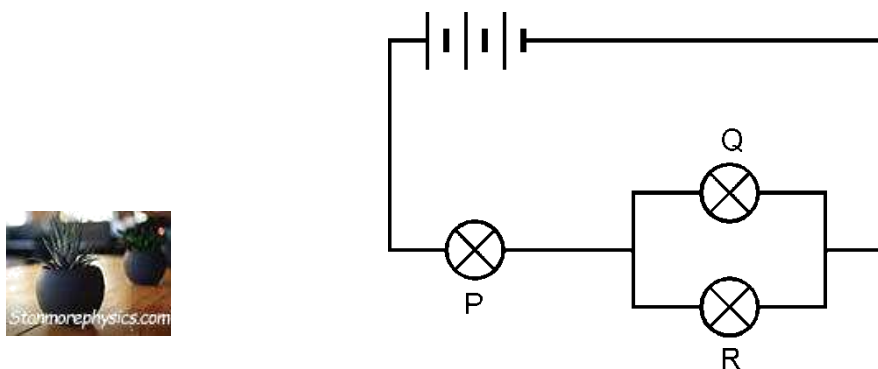
The filament of light bulb R breaks and the bulb stops working.
Therefore, light bulbs P and Q will …

	Light bulb P	Light bulb Q
A	burn more brightly	burn less brightly
B	burn unchanged	burn more brightly
C	burn less brightly	burn more brightly
D	burn less brightly	burn less brightly

1.4   Which one of the following statements regarding the Kinetic Molecular Theory of ideal gases is INCORRECT?

A   Gas molecules collide elastically.

B   All molecules have the same kinetic energy.

C   Gas molecules are in random motion.

D   Attractive and repulsive forces can be neglected.   (2)

4

1.5 Which ONE of the following statements CORRECTLY describes the characteristics of an endothermic reaction?

A ΔH is positive and the products have less potential energy than the reactants.

B ΔH is positive and the products have more potential energy than the reactants.

C ΔH is negative and the products have less potential energy than the reactants.

D ΔH is negative and the products have more potential energy than the reactants (2)

1.6 Given the balanced equation:

$Mg(s) + 2HCl\ (aq)\ \rightarrow\ MgCl_2(s)\ +\ H_2\ (g) + 1\ 200\ J \cdot mol^{-1}$
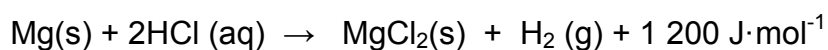
The reaction is ...

A endothermic and 1 200 kJ·mol^{-1} of energy is absorbed.

B endothermic and 1 200 kJ·mol^{-1} of energy is released.

C exothermic and 1 200 kJ·mol^{-1} of energy is absorbed

D exothermic and 1 200 kJ·mol^{-1} of energy is released. (2)

1.7 Which one of the following acids is an example of a diprotic acid?

A HCl

B HNO_3

C H_2SO_4

D H_3PO_4 (2)

1.8   In the equation $H_2CO_3 + H_2O \rightleftharpoons HCO_3^- + H_3O^+$, the Lowry–Brønsted bases are …

A H_2O and H_3O^+

B HCO_3^- and H_3O^+

C H_2CO_3 and HCO_3^-

D HCO_3^- and H_2O (2)

[16]

QUESTION 2

2.1   A current passes through a straight conductor **L-M** as shown in the diagram below.
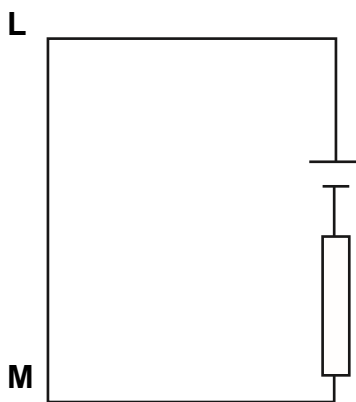
2.1.2   Draw a diagram of the magnetic field that forms around the wire **L-M**.   (3)

2.1.3   Write down the rule which is used to identify the direction of the magnetic   (1)
field.

2.2   The setup of apparatus below was used to demonstrate Faraday's law of electromagnetic induction.

Magnet   **Solenoid**

S   **N**

T

X   Y

G

Galvanometer

2.2.1   State *Faraday's law of electromagnetic induction* in words.   (2)
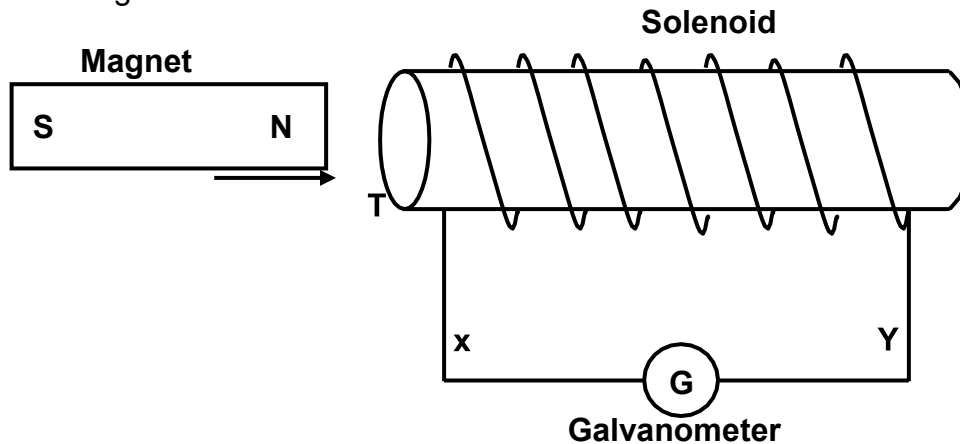
2.2.2   Write down the polarity (North pole or South pole) of the end of the solenoid at point **T** as the bar magnet approaches the solenoid.   (1)

2.2.3   Why does the galvanometer needle deflect as the magnet is brought closer to the solenoid?   (2)

2.2.4   The bar magnet is then held stationary inside the solenoid. Write down what will be observed on the galvanometer. Give a reason for the answer.   (2)

2.2.5   In which direction will the induced current flow? Write only FROM **X** to **Y** or FROM **Y** to **X**?   (1)

2.2.6   State TWO ways in which the magnitude of the induced current can be increased.   (2)
                                                                                          [15]

QUESTION 3

The circuit below shows the 8 V battery with negligible internal resistance and resistance of the connecting wires. When switch **S** is closed, the reading on ammeter **A** is 2, 2 A, while the reading on voltmeter **V$_2$** is 4, 4 V.
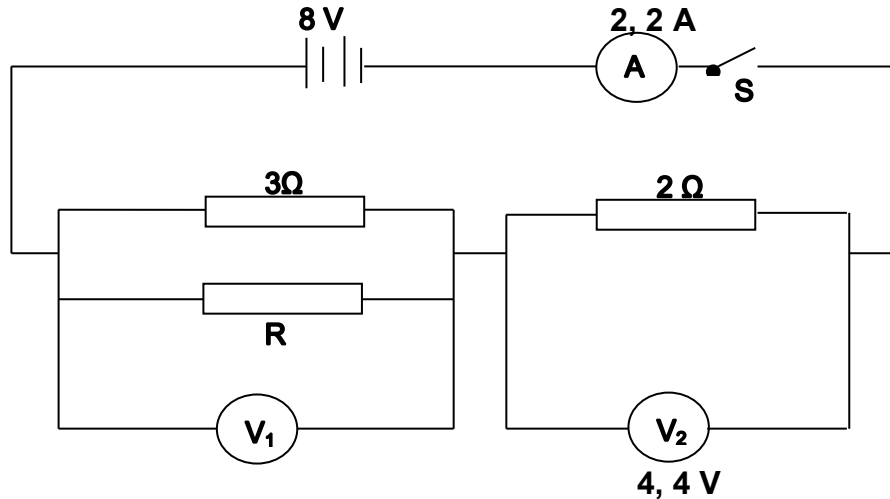

3.1   State Ohm's law in words.   (2)

3.2   Calculate:

      3.2.1   The reading on voltmeter **V$_1$**.   (2)

      3.2.2   The value of the resistor **R**.   (5)

      3.2.3   The energy dissipated in the **2 Ω** resistor within 5 seconds.   (3)

3.3   Will the ammeter reading INCREASE, DECREASE or REMAIN THE SAME if the 3 Ω resistor is removed from the circuit? Give a reason for the answer.   (2)

3.4   Students carried out an investigation to determine whether or not conductor **Z** is Ohmic. They set up a circuit as shown in the circuit diagram below. The internal resistance of the battery was negligible.
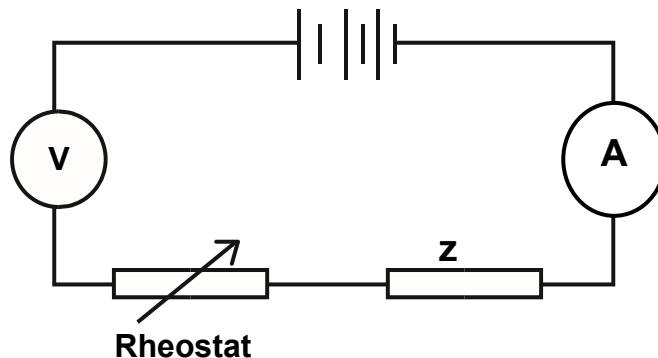
3.4.1   Define the term *Ohmic conductor*.   (1)

3.4.2   Identify and write down ONE error made by the students when connecting the circuit shown in the diagram above.   (1)

3.5   The students corrected the error mentioned in question 3.4.2 and then collected the following ammeter and voltmeter readings during their investigation.

Ammeter reading (A)	Voltmeter reading (V)
0,2	0,55
0,4	1,10
0,6	1,65
0,8	2,20
1,0	3,30
1,2	5,00

3.5.1   Plot a graph of potential difference (y-axis) versus current (x-axis) on graph paper provided. Draw a line which best fits ALL the plotted points.   (4)

3.5.2   Write down the name of the physical quantity represented by the gradient of the graph.   (1)

3.5.3   Is conductor **Z** an ohmic conductor (for all currents) in this investigation? Give a reason for the answer.   (2)
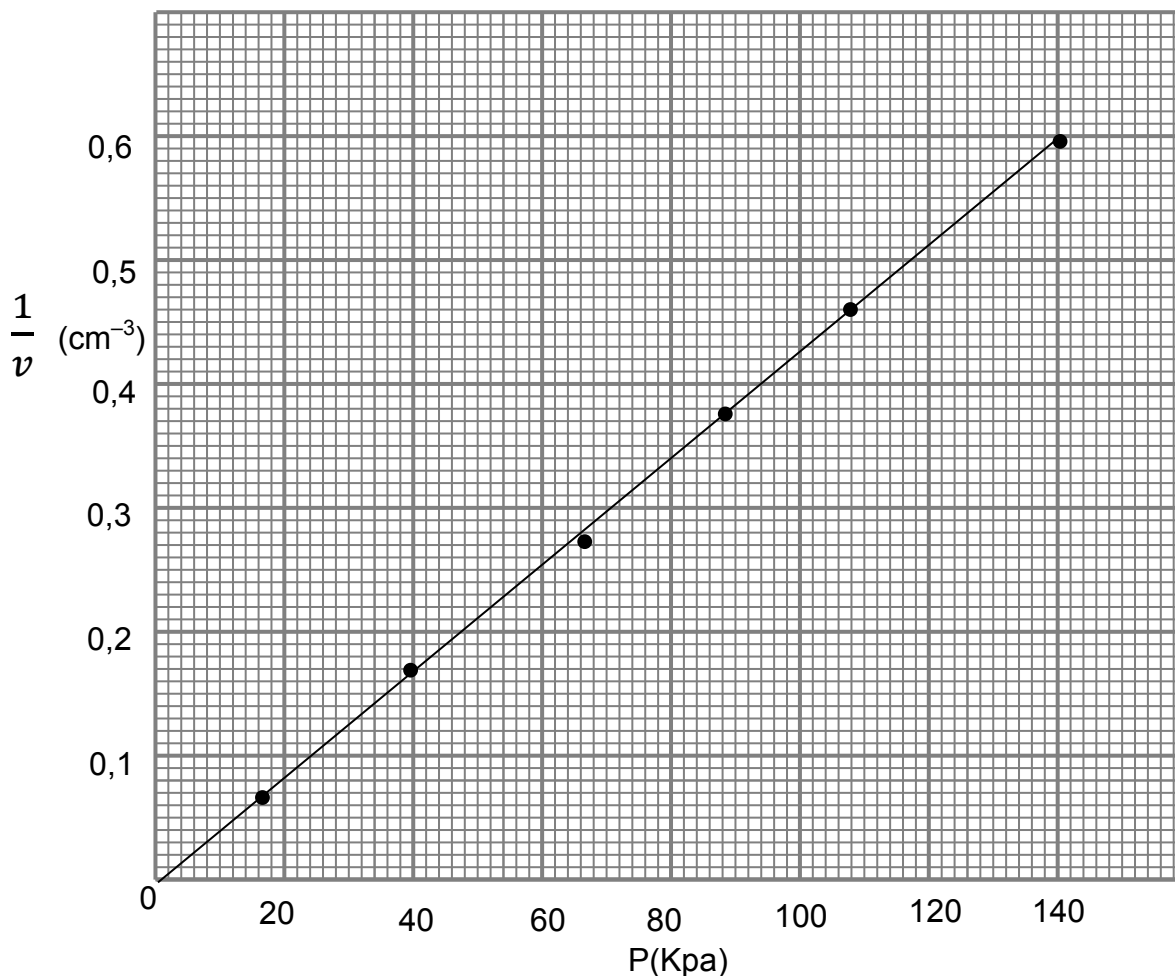
[23]

QUESTION 4

The setup of apparatus below was used in an investigation to verify an ideal gas law..
A fixed mass of nitrogen was used in each investigation, and the results obtained are
shown in the graph below.
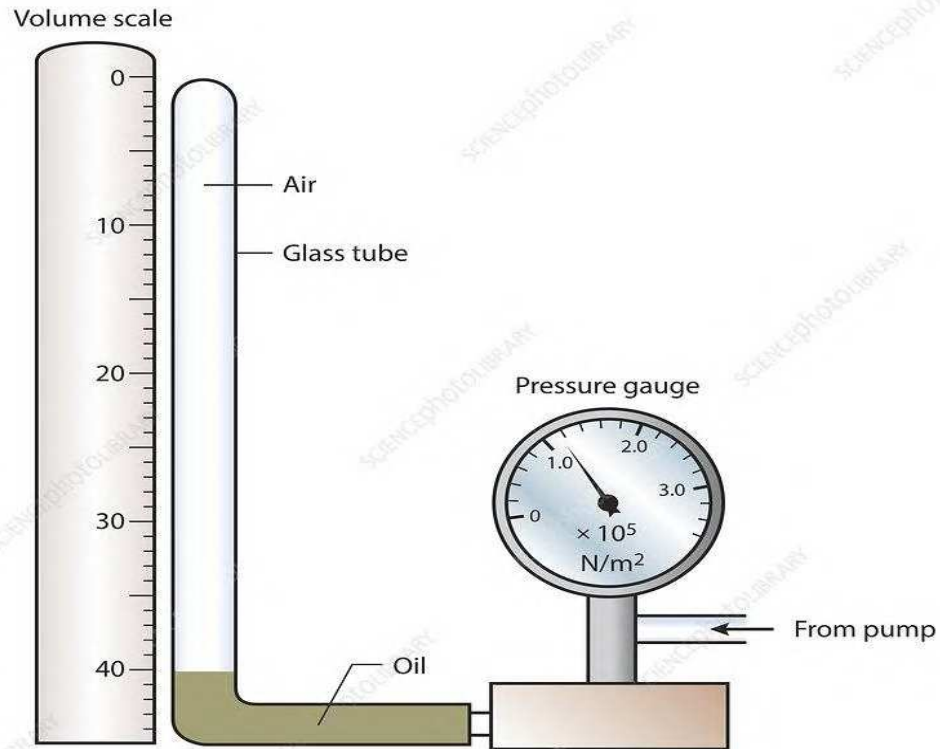
INVERSE OF VOLUME VERSUS PRESSURE

4.1   For this investigation, write down:

    4.1.1   The investigative question.   (2)

    4.1.2   The independent variable.   (1)

    4.1.3   ONE variable that were kept constant.   (1)

4.2   Using the graph, write down:

    4.2.1   The name of the ideal gas law which was being investigated, and state
           the law in words.   (3)

    4.2.2   The volume of the gas in cm^3 when the pressure is 112Kpa.   (1)

    4.2.3   The physical quantity that can be determined from the gradient of the graph.   (1)

4.3 Under which temperature condition does nitrogen gas deviates from ideal gas behavior? Write only HIGH or LOW. Give an explanation for the answer. (3)

[12]

QUESTION 5

Ethanol, CH_3CH_2OH is a useful bio-fuel. The chemical equation and the potential energy versus course of of reaction graph below illustrates the Combustion reaction of ethanol.

$$CH_3CH_2OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$$
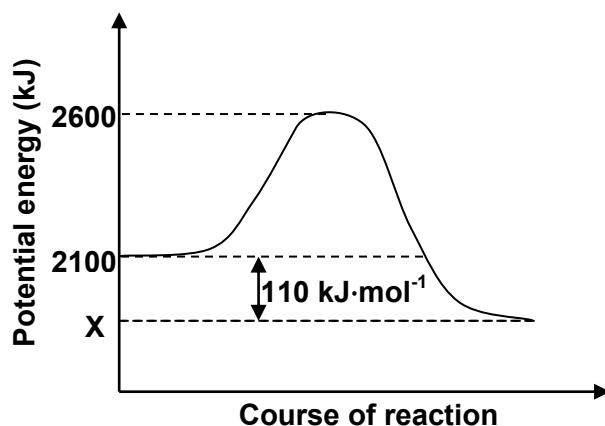
5.1 Is this reaction ENDOTHERMIC or EXOTHERMIC?
Use the information on the graph to give a reason for the answer. (2)

5.2 Use the information on the graph to calculate:

5.2.1 The potentail of energy at point **X**. (3)

5.2.2 The activation energy of the reverse reaction. (2)

5.3 Carbon dioxide reacts with water in green leaves to form glucose.
The reaction is illustrated by the unbalanced chemical equation below.

Chemical equation; CO_2 (g) + H_2O(l) + energy $\longrightarrow$ $C_6H_{12}O_6$ (s) + O_2(g)	
Temperature before the reaction (°C)	26
Temperature after the reaction (°C)	22

5.3.1 Copy the chemical equation from the table above and balance it. (1)

5.3.2 Define the term heat of reation. (2)

Using the table above:

5.3.3 Determine whether the reaction is ENDOTHERMIC or EXOTHERMIC.
Use the information in the table above to give a reason for the answer. (2)

5.3.4 Determine whether the heat of reaction is POSITIVE or NEGATIVE. (1)

5.3.5 Sketch a potential energy per mole versus reaction coordinate graph for the above reaction. Clearly label the axes and indicate the following on the graph:
- Heat of reaction (as ΔH)
- Activation energy for the forward reaction (as E_A)
- Activated complex (as AC) (5)

[18]

QUESTION 6

When sulphuric acid reacts with water, it ionises in two steps, as shown in the two chemical equations below.

1: $H_2SO_4(aq) + H_2O(\ell) \rightarrow$ **Q** $+ HSO_4^-(aq)$

2: $HSO_4^-(aq) + H_2O(\ell) \rightarrow$ _____ + _____
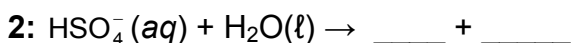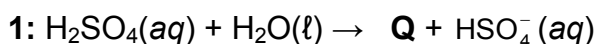
6.1 Using the knowledge of the Lowry-Brønsted theory:

6.1.1 State whether substance **Q** in equation **1** is an ACID or A BASE.
Give a reason for the answer. (2)

6.1.2 Complete **equation 2** and balance it. (2)

6.2 Water acts as acid when it reacts with ammonia, NH_3 and as a base when it reacts with H^+ ions.

Write down a balanced chemical equation for the reaction between;

6.2.1 Water and ammonia. (2)

6.2.2 Water and H^+ ions. (2)

6.3 The acid- base reactions are illustrated by the chemical equations in the table below

Reaction	Chemical equation
1	X (aq) + NH_3 (g) $\rightleftharpoons$ NH_4^+ (aq) +Cl^- (aq)
2	HSO_4^- (aq) + NH_4^+ (aq) $\rightleftharpoons$ H_2SO_4 (aq) + NH_3 (aq)
3	HSO_4^- (aq) $\rightleftharpoons$ H^+ (aq) + SO_4^{2-} (aq)
4	CH_3COOH (aq) + NaOH $\rightarrow$ Y (aq) + H_2O (l)

6.3.1 Define the term a *base* according to *Bronsted-Lowry theory.* (2)

From the table above, write down:

6.3.2 The NAME of substance **X** in reaction **1**. (1)

6.3.3 ONE conjugate acid-base pair in reaction **2**. (1)

6.3.4 The reaction (**1**, **2** or **3**) that illustrates Arrhenius theory.
Give a reason for the answer. (2)

6.3.5 The formula of a substance that acts as an ampholyte in the above
reactions. (1)

6.3.6 The formula of substance **Y** in reaction **4**. (1)

[16]

TOTAL:100

DATA FOR PHYSICAL SCIENCES GRADE 11

TABLE 1: ELECTRIC CIRCUITS (PHYSICS)

$R = \dfrac{V}{I}$	$q = I\,\Delta t$	$W = Vq$
$R_s = R_1 + R_2 + \ldots$	$P = \dfrac{W}{\Delta t}$	$W = VI\,\Delta t$
	$P = VI$	$W = I^2R\,\Delta t$
$\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \ldots$	$P = I^2R$	$W = \dfrac{V^2 \Delta t}{R}$
	$P = \dfrac{V^2}{R}$	

TABLE 2: (CHEMISTRY)

$\dfrac{p_1 V_1}{T_1} = \dfrac{p_2 V_2}{T_2}$	$pV = nRT$
$n = \dfrac{m}{M}$	$n = \dfrac{N}{N_A}$
$n = \dfrac{V}{V_m}$	$c = \dfrac{n}{V}$ OR/*OF* $c = \dfrac{m}{MV}$

TABLE 3: THE PERIODIC TABLE OF ELEMENTS / TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

KEY/SLEUTEL

- Atomic number / Atoomgetal
- Symbol / Simbool
- Electronegativity / Elektronegatiwiteit
- Approximate relative atomic mass / Benaderde relatiewe atoommassa

Example:

Atomic number / Atoomgetal	29
Electronegativity / Elektronegatiwiteit	1,9
Symbol / Simbool	Cu
Approximate relative atomic mass / Benaderde relatiewe atoommassa	63,5

Main table (Atomic number, Symbol, Electronegativity, Approximate relative atomic mass)

Group 1 (I)	Group 2 (II)	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9	Group 10	Group 11	Group 12	Group 13 (III)	Group 14 (IV)	Group 15 (V)	Group 16 (VI)	Group 17 (VII)	Group 18 (VIII)
1 H 2,1 1																	2 He 4
3 Li 1,0 7	4 Be 1,5 9											5 B 2,0 11	6 C 2,5 12	7 N 3,0 14	8 O 3,5 16	9 F 4,0 19	10 Ne 20
11 Na 0,9 23	12 Mg 1,2 24											13 Aℓ 1,5 27	14 Si 1,8 28	15 P 2,1 31	16 S 2,5 32	17 Cℓ 3,0 35,5	18 Ar 40
19 K 0,8 39	20 Ca 1,0 40	21 Sc 1,3 45	22 Ti 1,5 48	23 V 1,6 51	24 Cr 1,6 52	25 Mn 1,5 55	26 Fe 1,8 56	27 Co 1,8 59	28 Ni 1,8 59	29 Cu 1,9 63,5	30 Zn 1,6 65	31 Ga 1,6 70	32 Ge 1,8 73	33 As 2,0 75	34 Se 2,4 79	35 Br 2,8 80	36 Kr 84
37 Rb 0,8 86	38 Sr 1,0 88	39 Y 1,2 89	40 Zr 1,4 91	41 Nb 1,6 92	42 Mo 1,8 96	43 Tc 1,9	44 Ru 2,2 101	45 Rh 2,2 103	46 Pd 2,2 106	47 Ag 1,9 108	48 Cd 1,7 112	49 In 1,7 115	50 Sn 1,8 119	51 Sb 1,9 122	52 Te 2,1 128	53 I 2,5 127	54 Xe 131
55 Cs 0,7 133	56 Ba 0,9 137	57 La 1,1 139	72 Hf 1,6 179	73 Ta 1,5 181	74 W 1,7 184	75 Re 1,9 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tℓ 1,8 204	82 Pb 1,8 207	83 Bi 1,9 209	84 Po 2,0	85 At 2,5	86 Rn
87 Fr 0,7	88 Ra 0,9 226	89 Ac															

Lanthanides

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175

Actinides

90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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QUESTION NO 3.5.1   NAMES OF THE LEARNER:_____