KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES

COMMON TEST

SEPTEMBER 2022

TIME: 2 hours

MARKS: 100

This question paper consists of 11 pages, two data sheets and
one graph sheet.

INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Write your name on the **ANSWER BOOK.**

2. This question paper consists of **SEVEN** questions. Answer ALL the questions in the ANSWER BOOK.

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

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

5. Leave ONE line between two subsections, for example between QUESTION 2.1 and QUESTION 2.2.

6. You may use a non-programmable calculator.

7. You may use appropriate mathematical instruments.

8. You are advised to use the attached DATA SHEET.

9. Show ALL formulae and substitutions in ALL calculations.

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

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

QUESTION 1 : MULTIPLE CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A - D) next to the question number (1.1 — 1.6) in the ANSWER BOOK, for example 1.7 D.

1.1   The north pole of a magnet is moved into a coil consisting of 20 turns of insulated conducting wire. Which ONE of the following changes will INCREASE the induced emf?

   A   Increasing the time taken for the magnet to move into the coil.
   B   Decreasing the number of turns in the coil.
   C   Moving the south pole of the magnet into the coil.
   D   Increasing the speed at which the magnet is moved into the coil.   (2)

1.2   In the circuit below, the four bulbs P, Q, R and S are identical.
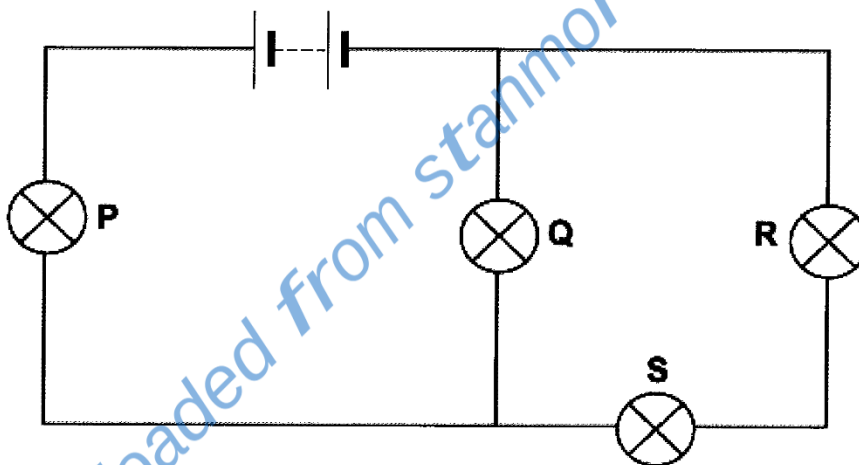
Which ONE of the following pairs of bulbs has equal brightness?

   A   S and R
   B   Q and R
   C   P and Q
   D   Q and S   (2)

1.3 The circuit diagram below shows two bulbs A and B connected in series, a battery, an ammeter, and a voltmeter connected across resistor B. The battery, ammeter and conducting wires have negligible resistance, while the voltmeter has very high resistance.
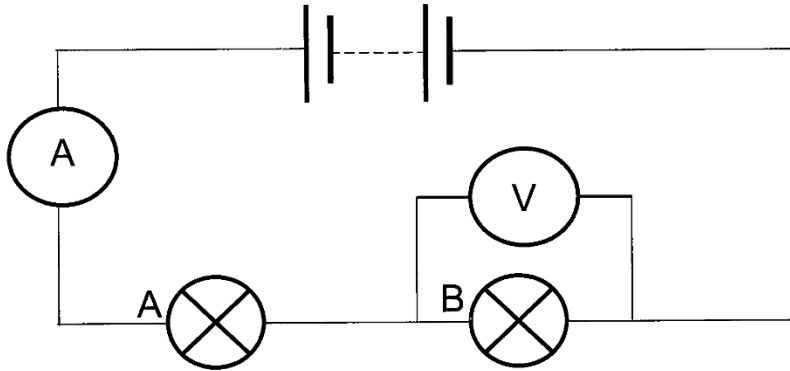
How will the readings on the ammeter and the voltmeter change if the resistance of the bulb B increases, while that of bulb A remains the same?

|	Ammeter	Voltmeter
A	Increases	Decreases
B	Decreases	Decreases
C	Remains the same	Increases
D	Decreases	Increases

(2)

1.4 Which ONE of the following combinations of acids represent a polyprotic and a monoprotic acid respectively?

A H_2SO_4 and H_3PO_4
B H_3PO_4 and HNO_3
C H_2O and H_2CO_3
D CH_3COOH and HNO_3

(2)

Please Turn Over

1.5 Which ONE of the following graphs CORRECTLY represents the deviation of a real gas from ideal gas behaviour?

A

p

1/v

B

p

1/v

C

p

1/v

D

p

v
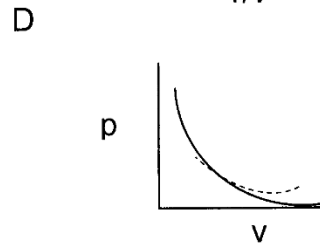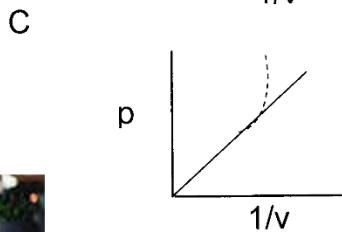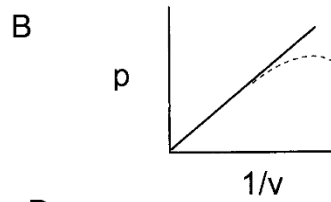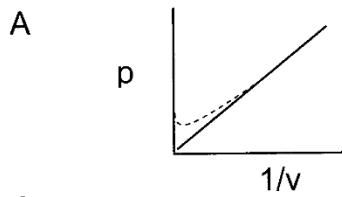
(2)

1.6 The decomposition of water can be represented by the following chemical equation:

$$2H_2O\ (g) \longrightarrow 2H_2(g)\ +\ O_2\ (g) \quad \Delta H\ =\ +571,8\ kJ \cdot mol^{-1}$$
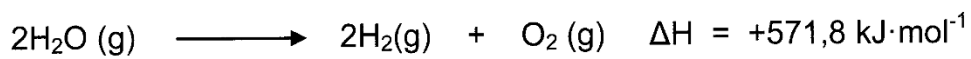
What is the heat of reaction for the formation of the two moles of H_2?

A +571,8 kJ
B -571,8 kJ
C -1143,6 kJ
D +1143,6 kJ

(2)

[12]

QUESTION 2

The diagram below shows a bar magnet that is dropped vertically downwards into a stationary coil. The direction of the current induced in the coil is shown.
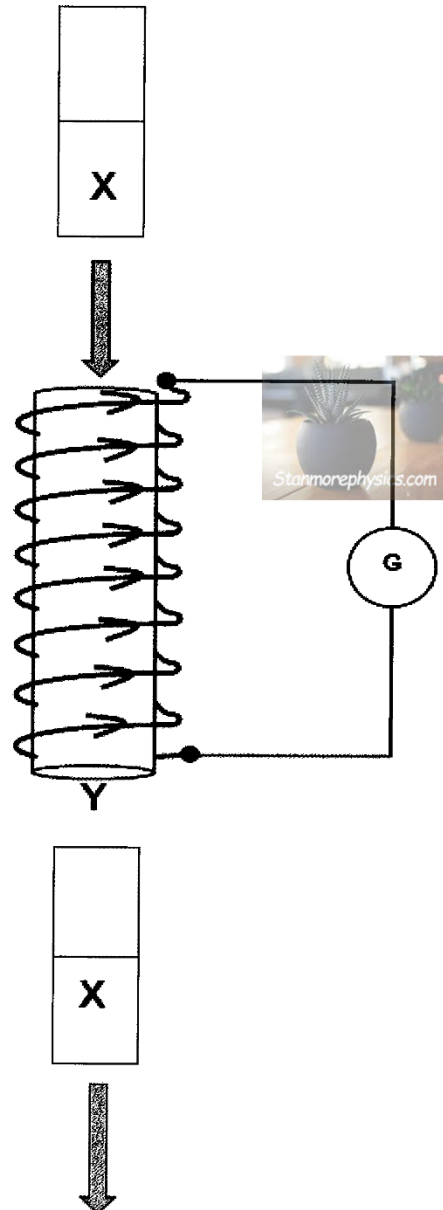
2.1   State Faraday's law of electromagnetic induction in words.   (2)

2.2   Determine the polarity of the bar magnet at X.
        Choose from NORTH POLE or SOUTH POLE.   (2)

2.3   What is the polarity of the coil at Y as the bar magnet exits the coil?
        Choose from NORTH POLE or SOUTH POLE.   (2)

                                                                                        [6]

QUESTION 3

A group of learners carried out an experiment to verify Ohm's law.
The following components were used: A battery, a resistor R of unknown resistance, a rheostat, an ammeter, a voltmeter, a switch and conducting wire.

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

3.2   Sketch a circuit diagram to show how the above apparatus should be connected
      for this investigation.   (4)

3.3   Five readings were taken, indicated by the five points plotted in the graph below.

Current vs Potential difference
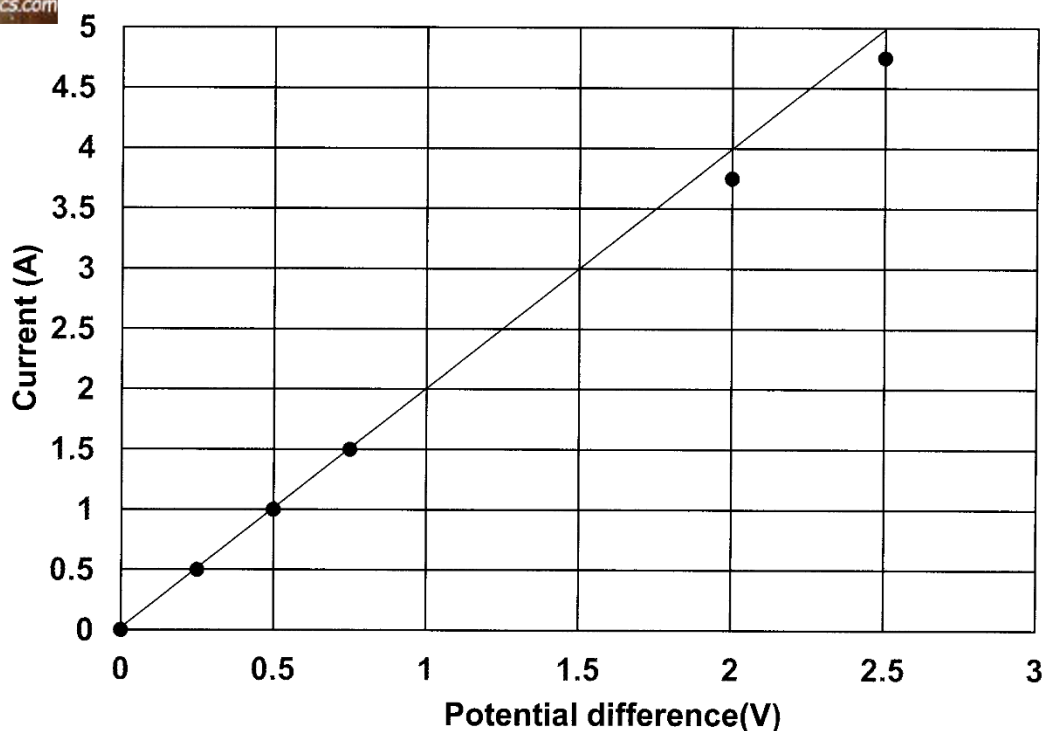
3.3.1   What is the mathematical relationship between current strength and
        potential difference?   (1)

3.3.2   Is the graph drawn correctly? Give a reason for the answer.   (2)

3.3.3   Calculate the resistance of resistor R using the graph.   (2)

3.3.4   What physical quantity does the product of the current and the potential
        difference represent for any point on the graph?   (2)

                                                                                                      [13]

NSC-Grade 11

QUESTION 4

In the circuit below, the emf of the battery is unknown and its internal resistance is negligible. Four resistors, R_1, R_2, R_3, and R_4 are connected as shown in the diagram.
The resistance of R_1, R_2, and R_3 are 3,5 Ω, 3 Ω and 10Ω respectively, and the ammeter reads 1,25 A.
The resistance of R_4 is unknown.
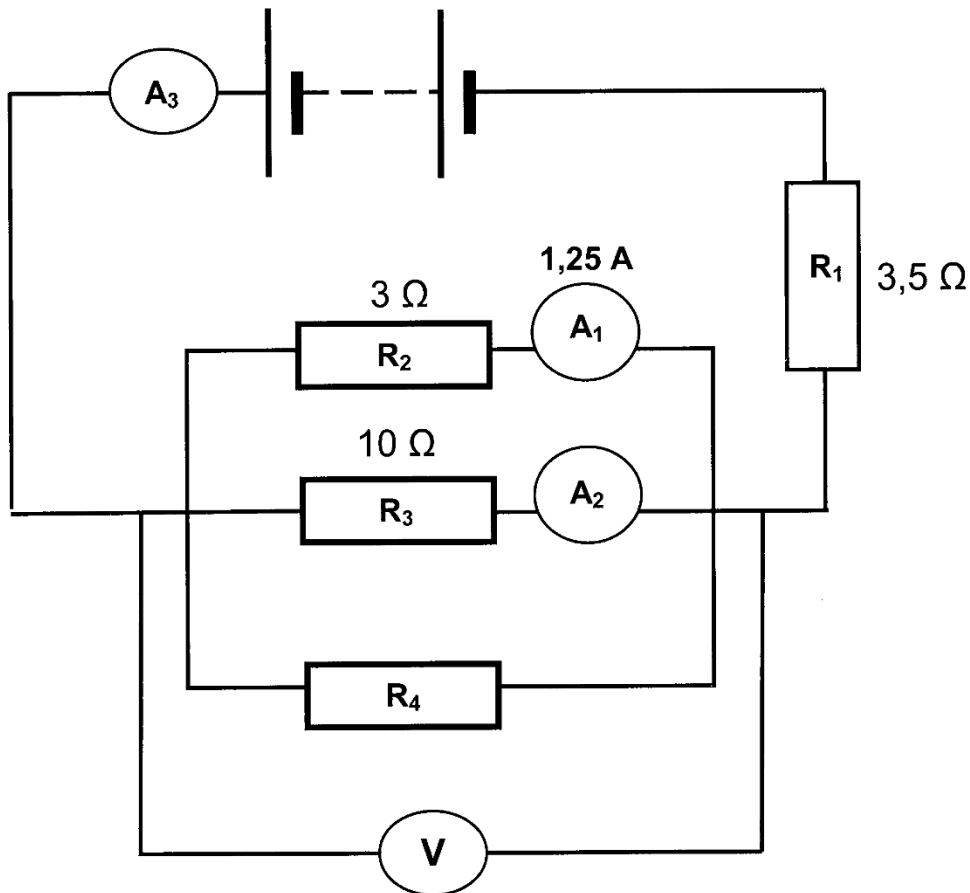
4.1 Calculate the reading on:

   4.1.1 voltmeter V   (3)

   4.1.2 ammeter A_2 (2)

4.2 1200 C of charge flows through resistor R_1 in 5 minutes.

   Calculate

   4.2.1 The reading on ammeter A_3.   (3)

   4.2.2 The resistance of resistor R_4.   (4)

   4.2.3 The emf of the battery.   (3)

                            Please Turn Over

4.3   An iron is rated " 230 V , 2200 W "

4.3.1   What information about the iron does the rating "2200 W" provide when it is
        connected to a 230 V source?   (2)

4.3.2   If the iron is connected to a 220 V source for 30 minutes, calculate the amount of
        electrical energy transferred to the iron.   (5)

4.3.3   If the cost of electricity is R 2,56 per kWh, calculate the cost of using the iron for
        30 minutes.   (3)

                                                                                        [25]

QUESTION 5

An investigation was done to determine the relationship between volume and pressure of a
fixed mass of dry gas. The table below shows the results of the investigation.

Volume(cm^3)	Pressure(kPa)	pV
5	25,0	125
10	12,5	125
13	10,0	130
20	6,25	125
25	5,0	125
30	4,20	126
35	3,50	123

5.1   NAME and STATE in words the law being investigated here.   (3)

5.2   Write down an investigative question for this investigation.   (2)

5.3   Apart from the mass of gas, what other physical quantity must be kept constant   (1)
        during this investigation?

5.4   Use the attached graph paper on page 14 to draw a graph of VOLUME versus
        PRESSURE for the gas.   (4)

5.5   The product of the pressure and volume (pV) for each reading is approximately
        constant. Show that the unit for pV is the JOULE.   (3)

5.6   When the pressure is extremely high, the pressure-volume relationship deviates
        from the law referred to in Question 5.1.
        Explain why this deviation occurs.   (3)

5.7   Calculate the pressure exerted by the gas when the volume of the gas is
        increased to 45 cm^3.   (3)

                                                                                        [19]

Please Turn Over

QUESTION 6

Cold packs and Hot packs are commonly used to treat injuries to reduce swelling in muscles. Study the reactions taking place in the packs, and the graph below and answer the questions that follow.

Cold pack: $NH_4NO_3(s) + H_2O \longrightarrow NH_4^+(aq) + NO_3^-(aq)$

Hot Pack: $4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s)$
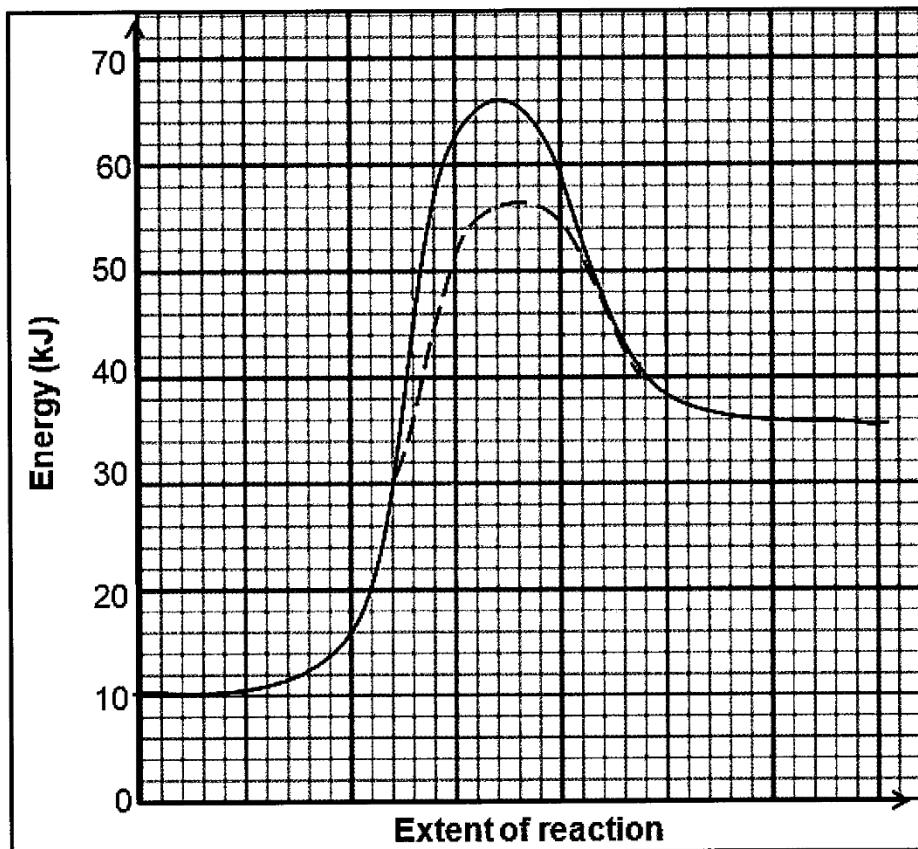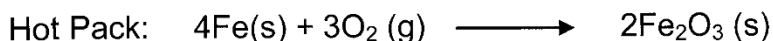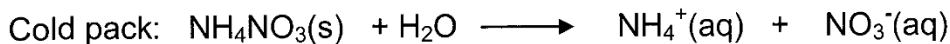
6.1 Define the term *activation energy.* (2)

6.2 Provide values from the graph for the following:

    6.2.1 Activation energy for the reaction in the absence of a catalyst. (1)

    6.2.2 Energy of products. (1)

    6.2.3 ΔH (2)

6.3 Does the graph represent the reaction for the Hot pack or the Cold pack? Give a reason for the answer. (2)

6.4   Define a catalyst?   (2)

6.5   The reaction mixture is heated. How will this affect the activation energy for the
      reaction at this higher temperature? Choose from INCREASES, DECREASES or
      NO EFFECT   (1)
                                                                                                          [11]

QUESTION 7

7.1   Phosphoric acid (H_3PO_4) reacts with water through the following three step
      reaction.

      Step 1. H_3PO_4 + H_2O $\rightleftharpoons$ $H_2PO_4^-$ + H_3O^+

      Step 2. $H_2PO_4^-$ + H_2O $\rightleftharpoons$ HPO_4^{2-} + H_3O^+

      Step 3. HPO_4^{2-} + H_2O $\rightleftharpoons$ PO_4^{3-} + H_3O^+
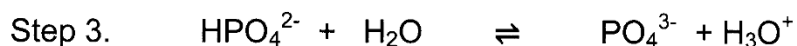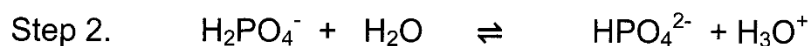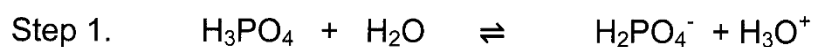
7.1.1   Why is H_3PO_4 a Lowry-Bronsted Acid?   (2)

7.1.2   Define the term *ampholyte*.   (2)

7.1.3   Identify TWO substances that act as ampholytes in the reactions above.   (2)

7.1.4   Write down ONE conjugate acid-base pair for **step 2**.   (2)

7.2   Complete and balance the following reactions:

7.2.1 CH_3COOH + NaOH $\longrightarrow$ (3)

7.2.2 $HC\ell$ + $CaCO_3$ $\longrightarrow$ (3)
                                                                                                          [14]

TOTAL MARKS: 100

DATA FOR PHYSICAL SCIENCES GRADE 11

PHYSICS :

FORMULAE : TABLE 1

$I = \dfrac{Q}{\Delta t}$	$R = \dfrac{V}{I}$
$\dfrac{1}{R} = \dfrac{1}{r_1} + \dfrac{1}{r_2} + \dfrac{1}{r_3} + \ldots$	$R = r_1 + r_2 + r_3 + \ldots$
$W = Vq$ $W = VI\Delta t$ $W = I^2 R \Delta t$ $W = \dfrac{V^2 \Delta t}{R}$	$P = \dfrac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \dfrac{V^2}{R}$

CHEMISTRY :

FORMULAE : TABLE 2

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

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/SLEUTEL

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

Example:
29
Cu
1,9
63,5

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	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 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 139	72 Hf 1,6 179	73 Ta 181	74 W 184	75 Re 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
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

NAME OF SCHOOL: _____

NAME OF LEARNER : _____ **GR 11** ____

QUESTION 5.4 ANSWER SHEET

TEAR-OFF SHEET
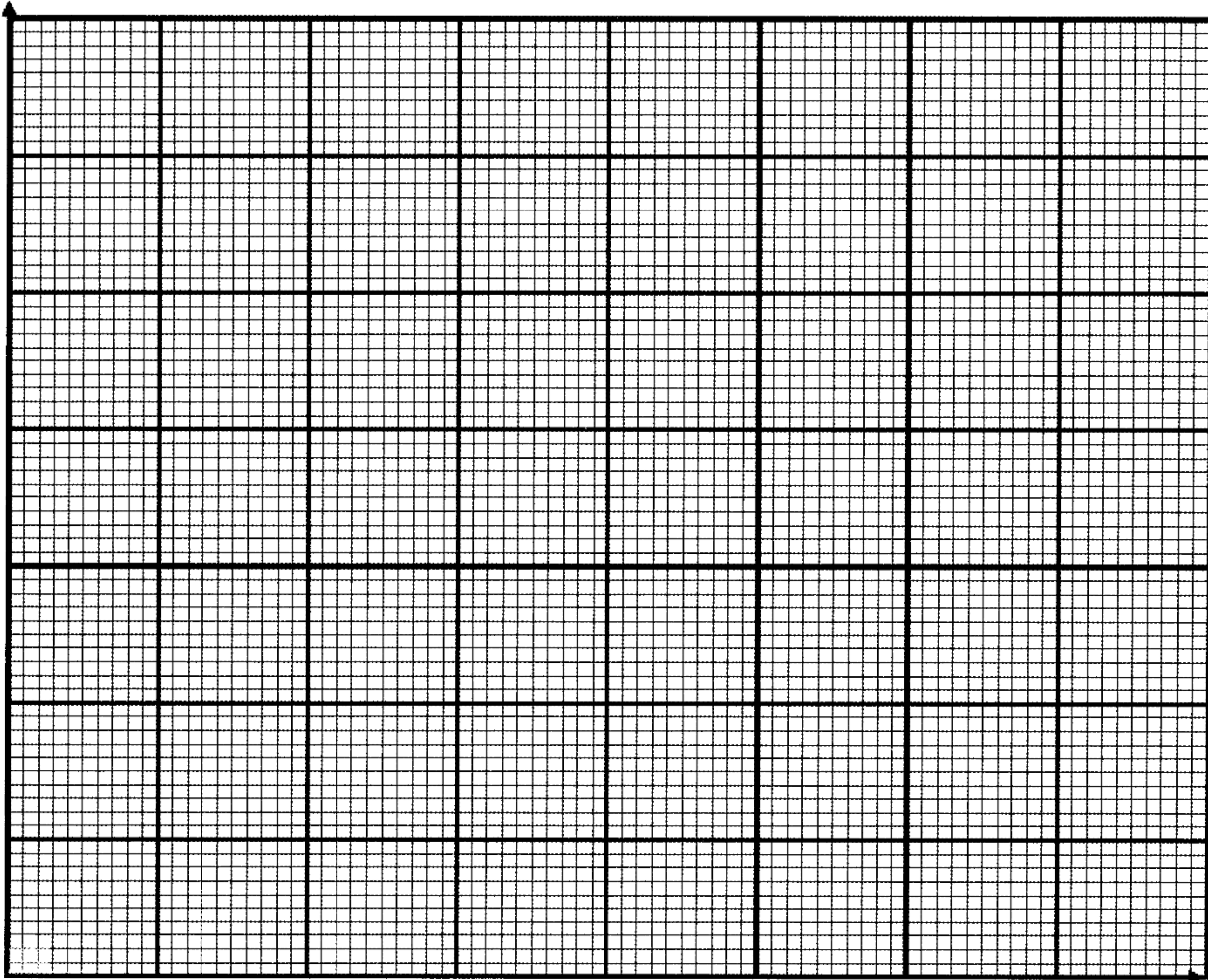
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MARKING GUIDELINE

Stanmorephysics.com

NB: This marking guideline consists of 7 pages.

QUESTION ONE

1.1   D ✓✓
1.2   A✓✓
1.3   D ✓✓
1.4   B✓✓
1.5   C✓✓
1.6   D✓✓   **[12]**

QUESTION TWO

2.1   The magnitude of the induced emf across the ends of a conductor is
       directly proportional to the rate of change in the magnetic flux linkage with
       the conductor. ✓✓   (2)
2.2   North / N ✓✓   (2)
2.3   Positive marking from Question 2.2
       North✓✓   (2)

                                                                                                 [6]

QUESTION 3

3.1   The potential difference across a conductor is directly proportional to the
       current in the conductor ✓at constant temperature. ✓   (2)

3.2
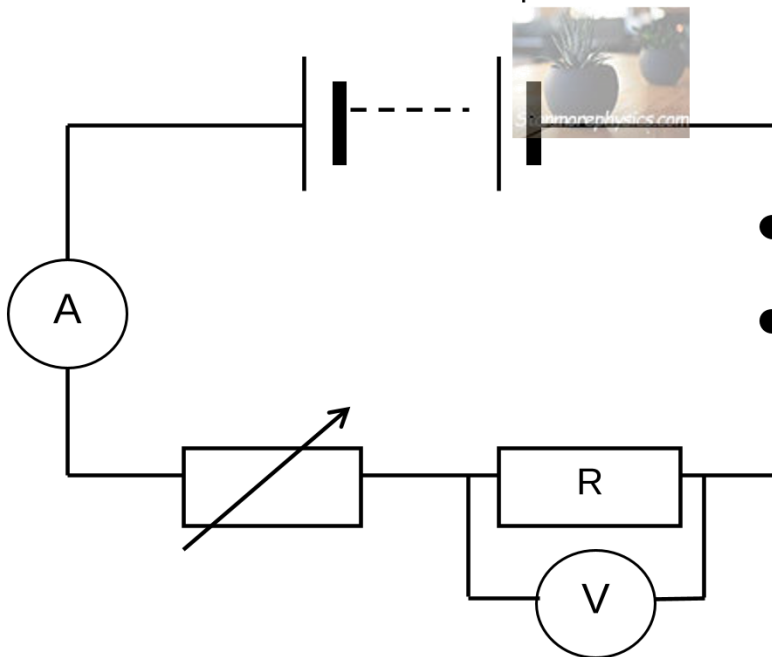
Marking Rubric

No	Criteria	Mark
1	All components included in diagram	1
2.	Ammeter connected in series to resistor R	1
3.	Voltmeter connected in parallel to R	1
4.	All components are connected correctly.	1

(4)

3.3.1 Directly proportional✓   (1)

3.3.2 No✓,the line is not drawn through the average of the plotted points. ✓   (2)

3.4.3 $\dfrac{1}{R} = \dfrac{\Delta I}{\Delta V}$

$\qquad = \dfrac{2 - 0}{1 - 0}$ ✓

R = 0,5 Ω ✓   (2)

3.4.4 Power✓ ✓   (2)

[13]

QUESTION 4

4.1.1 V= I·R ✓ = 1,25 x 3 ✓= 3,75 V✓   (3)

Positive marking from question 4.1.1

4.1.2 $R = \dfrac{V}{I}$

$10 = \dfrac{3,75}{I}$ ✓

I = 0,375 A✓   (2)

4.2.1 $Q = I\Delta t$ ✓

$1200 = I \cdot 300$ ✓

$I = 4\,A$ ✓   (3)

4.2.2 **Positive marking from Question 4.1 and 4.2**

I$_R$ = 4 $-(1,25+0,375)$✓

$\qquad$ = 2,375 A

$R = \dfrac{V}{I}$

$R = \dfrac{3,75}{2,375}$ ✓✓

$\qquad$ = 1,58 Ω /1,579 Ω✓   (4)

4.2.3 V= I·R

$\qquad$ = 4 x 3,5✓

$\qquad$ = 14 V

EMF = 14 + 3,75✓

$\qquad$ = 17,75 V✓   (3)

4.3.1   2200 J of energy is dissipated by the iron per second ✓✓   (2)

4.3.2

$$P = \frac{V^2}{R} \quad \checkmark$$

$$2200 = \frac{230^2}{R} \quad \checkmark$$

$$R = 24{,}045 \ \Omega$$

$$W = \frac{V^2}{R} \Delta t \quad \checkmark$$

$$= \frac{220^2}{24{,}045} (1800) \quad \checkmark$$

$$= 3{,}62 \times 10^6 \text{ J} \checkmark$$ (5)

4.3.3   Energy used in kWh : $3{,}62 \times 10^6$ J = 1,01 kWh ✓

1 kWh costs R 2,56
Cost of using the iron =1,01 x 2,56 ✓
                            = R 2,59 ✓   (3)

[25]

QUESTION 5

5.1   Boyles Law✓   (3)
        The volume of an enclosed mass of gas is inversely proportional to the
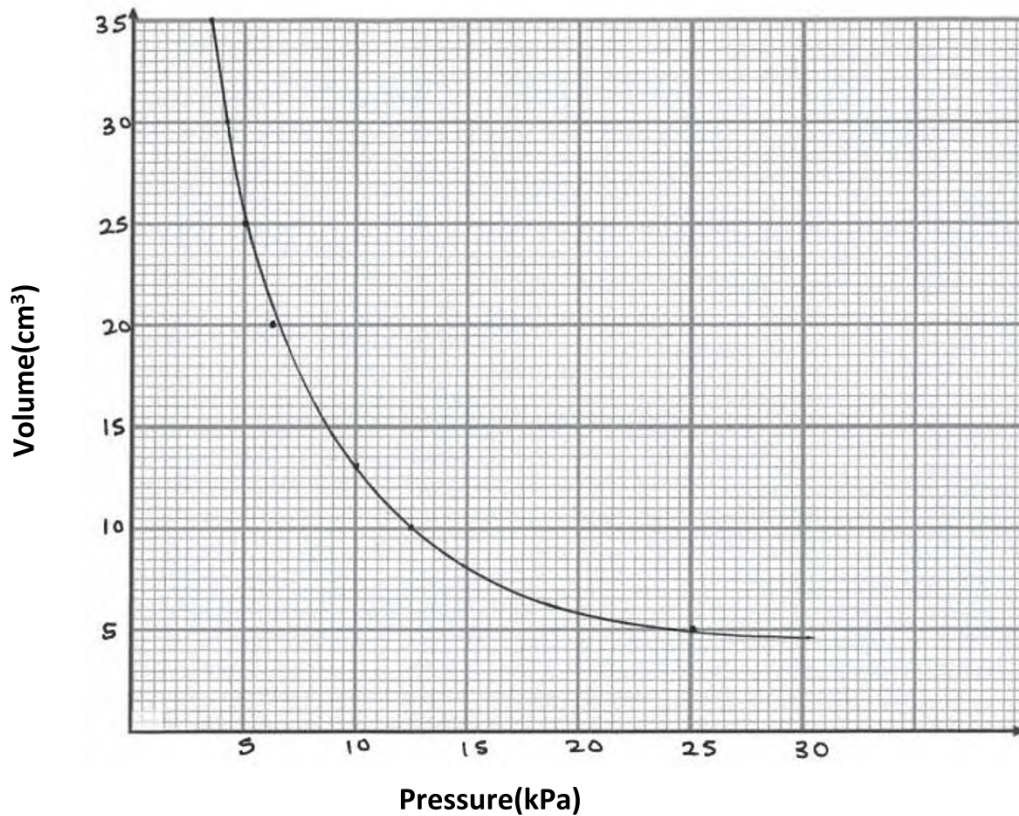   pressure exerted by the gas when the temperature remains constant.✓✓

5.2   What is the relationship between volume and pressure for a fixed mass of
        gas.✓✓   (2)
        Marking criteria:
        • Identifying the two variables (pressure and volume).
        • Correctly phrased as a question.

5.3   Temperature (of the gas)✓
5.4   Graph of Volume vs Pressure

Pressure(kPa)

Marking Rubric

No	Criteria	Mark
1	All points correctly plotted -1 if more than 2 points plotted incorrectly	2
2	Volume on y-axis and Pressure on x-axis	1
3	Line of best fit curve drawn	1

(4)

5.5   Pressure x Volume
        = N.m^{-2} ✓ x m^3 ✓
        = N.m
        = J ✓   (3)

5.6   At very high pressure, the gas becomes less compressible. ✓
        The volume occupied by the gas is so small that intermolecular distance
        between the molecules decreases.✓Thus an attractive force is observed
        between molecules and gas may become a liquid.✓   (3)

5.7 $P_1V_1 = P_2V_2$ ✓

         (3.5)(35)   = (P_2)(45) ✓
                                                                                        (3)
                 P_2 = 2,72 cm^3 ✓

                                                                                       [19]

QUESTION 6

6.1   The minimum energy needed for a reaction to take place.✓✓   (2)

6.2.1   56 kJ✓   (1)

6.2.2   36 kJ✓   (1)

6.2.3   ΔH = $E_{products}$ - $E_{reactants}$

             = 36 -10   ✓

             = +26 kJ✓   (2)

6.3   Cold pack✓
        Energy is absorbed./ Reaction is endothermic/ ΔH > 0✓   (2)

6.4   Substance that speeds up the reaction✓ by decreasing the activation
        energy.✓   (2)
6.5   No effect ✓   (1)
                                                                                       [11]

QUESTION 7

7.1.1   It is a proton donor. ✓✓   (2)

7.1.2   Is a substance that can act as an acid or a base. ✓✓   (2)

7.1.3 $H_2PO_4^-$ ✓ and HPO_4^{2-} ✓   (2)

7.1.4 $H_2PO_4^-$ and HPO_4^{2-} ✓✓   (2)

   or H_2O and H_3O^+

7.2.1 $CH_3COOH + NaOH$ ✓ $\longrightarrow$ CH_3COONa + H_2O ✓   ✓bal   (3)

7.2.2 $2HCl$ + $CaCO_3$ ✓ $\longrightarrow$ $CaCl_2$ + CO_2 + H_2O ✓   ✓bal   (3)

                                                                                                                    [14]

                                                            TOTAL MARKS: 100