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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.

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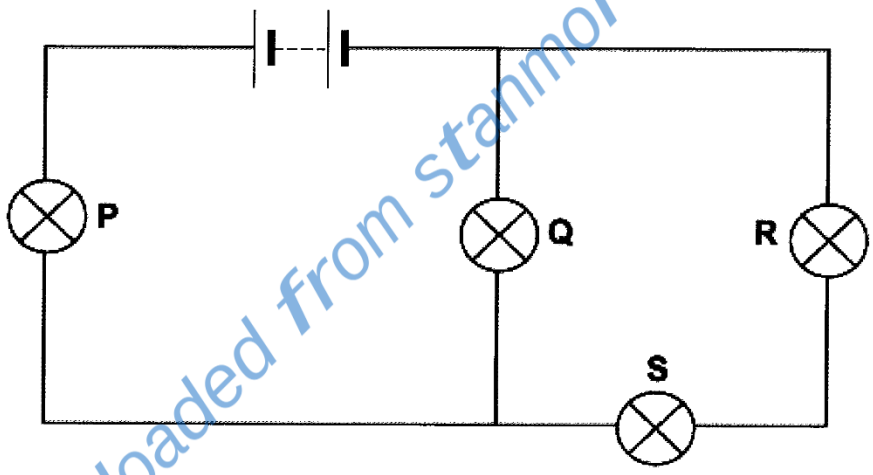
QUESTION 1 : MULTIPLE CHOICE QUESTIONS

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.

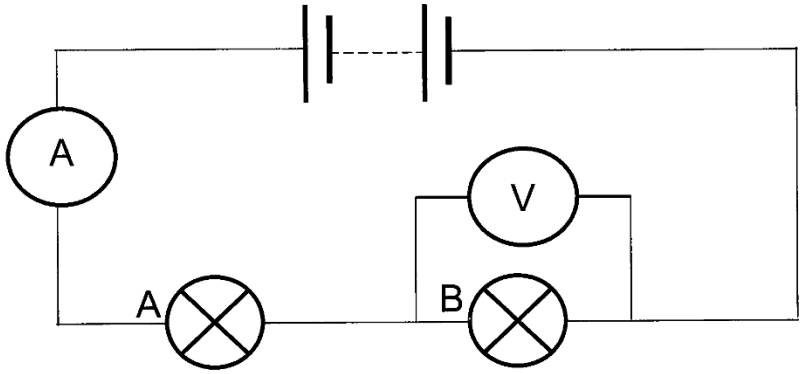


Which ONE of the following pairs of bulbs has equal brightness?

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

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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?

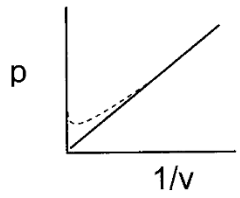
A H_2SO_4 and H_3PO_4
B H_3PO_4 and HNO_3
C H_2O and H_2CO_3
D CH_3COOH and HNO_3

(2)

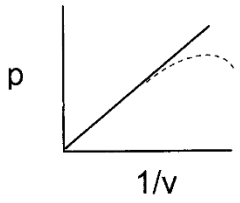
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1.5 Which ONE of the following graphs CORRECTLY represents the deviation of a real gas from ideal gas behaviour?

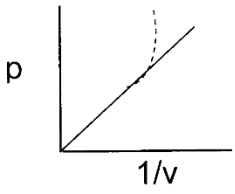
A



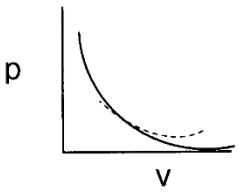
B



C



D





(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

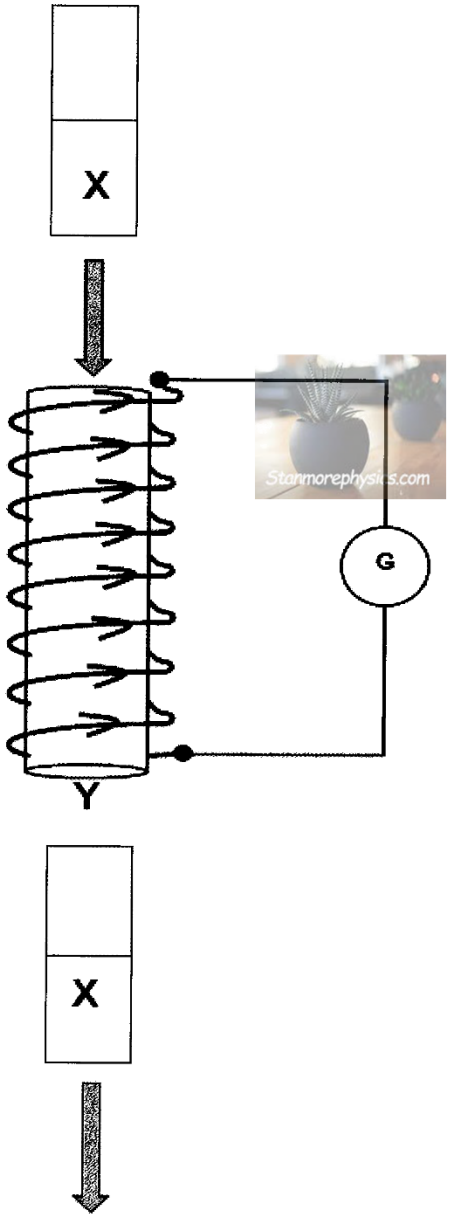
(2)

[12]

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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]

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QUESTION 3

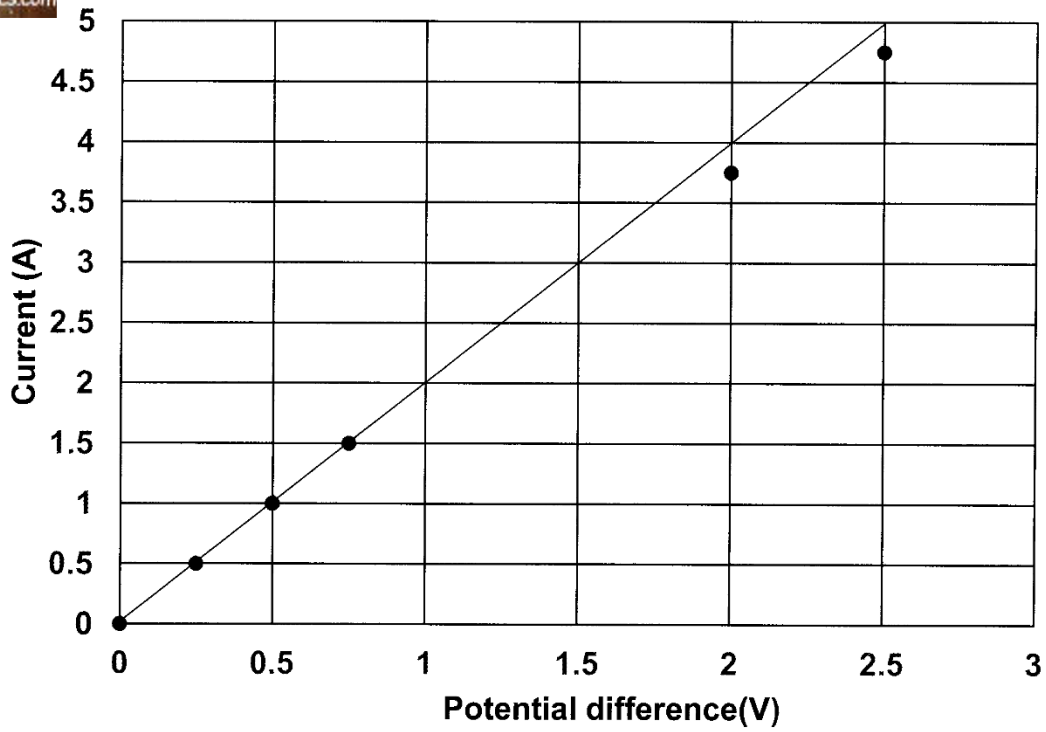
A group of learners carried out an experiment to verify Ohm's law.
The following components were used: A battery, a resistor R of unknown resistance, a rheostat, an ammeter, a voltmeter, a switch and conducting wire.

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.

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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)

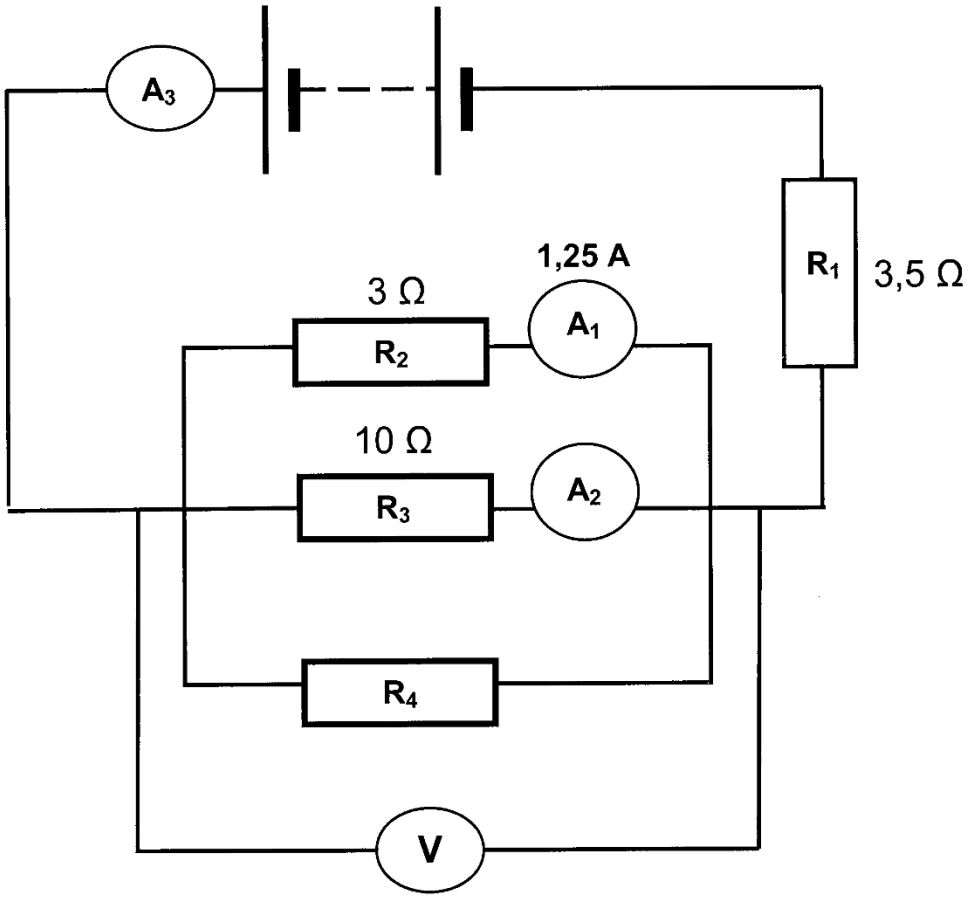
3.3.3 Calculate the resistance of resistor R using the graph. (2)

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]

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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 A_1 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)

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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 during this investigation? (1)

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]

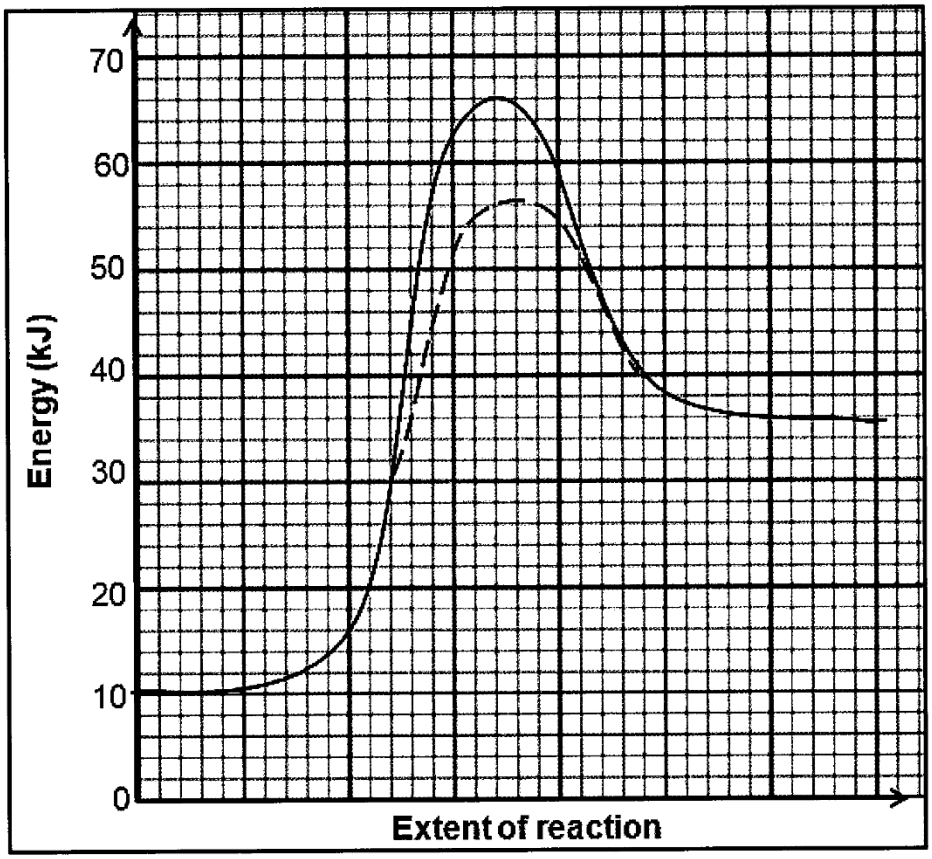
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QUESTION 6

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)

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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)

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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

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DATA FOR PHYSICAL SCIENCES GRADE 11

PHYSICS :

FORMULAE : TABLE 1

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



CHEMISTRY :

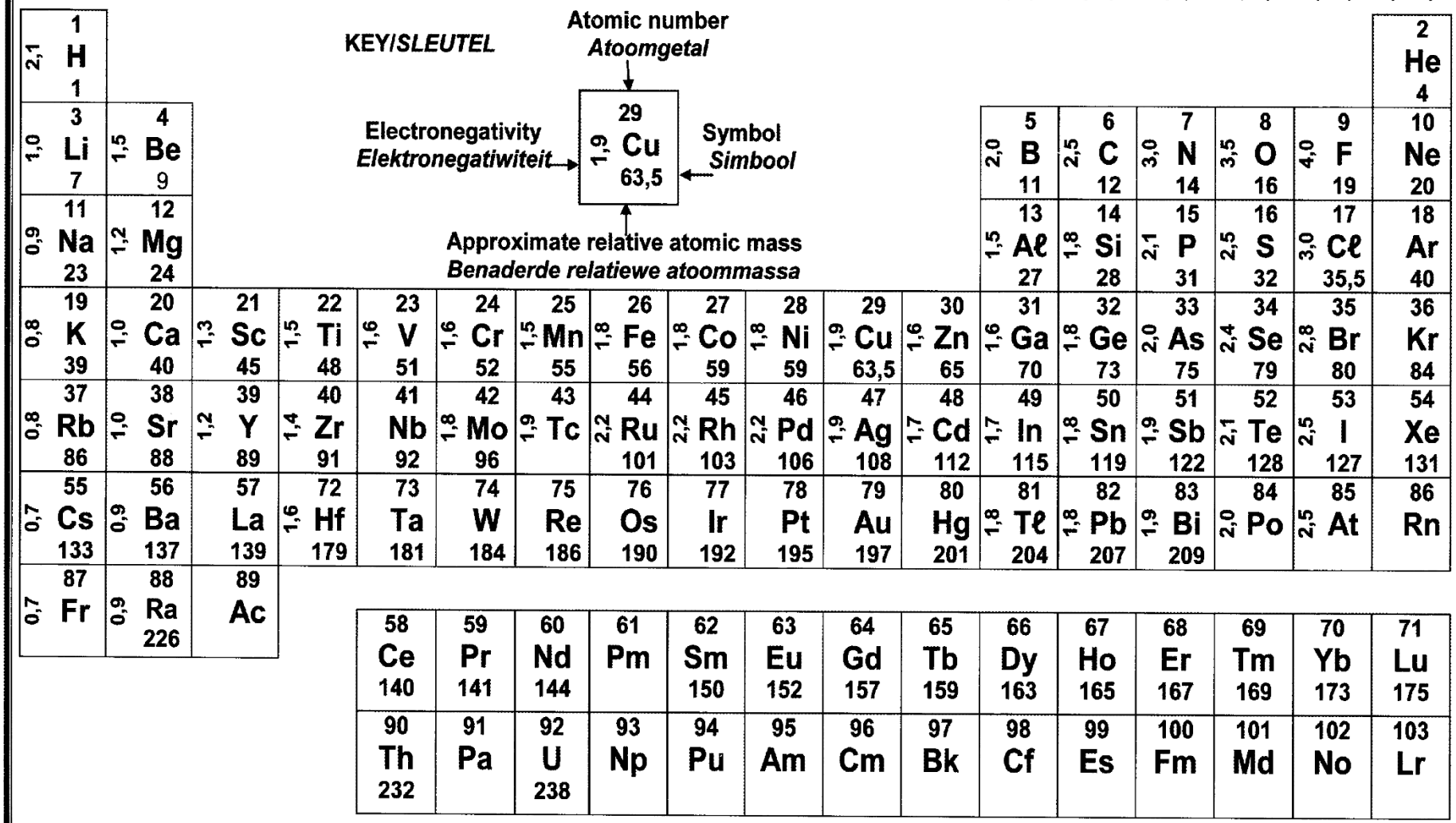
FORMULAE : TABLE 2

$\frac{p_1V_1}{T_1}=\frac{p_2V_2}{T_2}$	$pV=nRT$
$n=\frac{m}{M}$	$n=\frac{N}{N_A}$
$n=\frac{V}{V_m}$	$c=\frac{n}{V}$ OR/*OF* $c=\frac{m}{MV}$

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TABLE 3: THE PERIODIC TABLE OF ELEMENTS



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)
2,1 H 1																	2 He 4
1,0 Li 7	1,5 Be 9											2,0 B 11	2,5 C 12	3,0 N 14	3,5 O 16	4,0 F 19	10 Ne 20
0,9 Na 23	1,2 Mg 24											1,5 Aℓ 27	1,8 Si 28	2,1 P 31	2,5 S 32	3,0 Cℓ 35,5	18 Ar 40
0,8 K 39	1,0 Ca 40	1,3 Sc 45	1,5 Ti 48	1,6 V 51	1,6 Cr 52	1,5 Mn 55	1,8 Fe 56	1,8 Co 59	1,8 Ni 59	1,9 Cu 63,5	1,6 Zn 65	1,6 Ga 70	1,8 Ge 73	2,0 As 75	2,4 Se 79	2,8 Br 80	36 Kr 84
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	41 Nb 92	1,8 Mo 96	1,9 Tc	2,2 Ru 101	2,2 Rh 103	2,2 Pd 106	1,9 Ag 108	1,7 Cd 112	1,7 In 115	1,8 Sn 119	1,9 Sb 122	2,1 Te 128	2,5 I 127	54 Xe 131
0,7 Cs 133	0,9 Ba 137	57 La 139	1,6 Hf 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	1,8 Tℓ 204	1,8 Pb 207	1,9 Bi 209	2,0 Po	2,5 At	86 Rn
0,7 Fr	0,9 Ra 226	89 Ac															

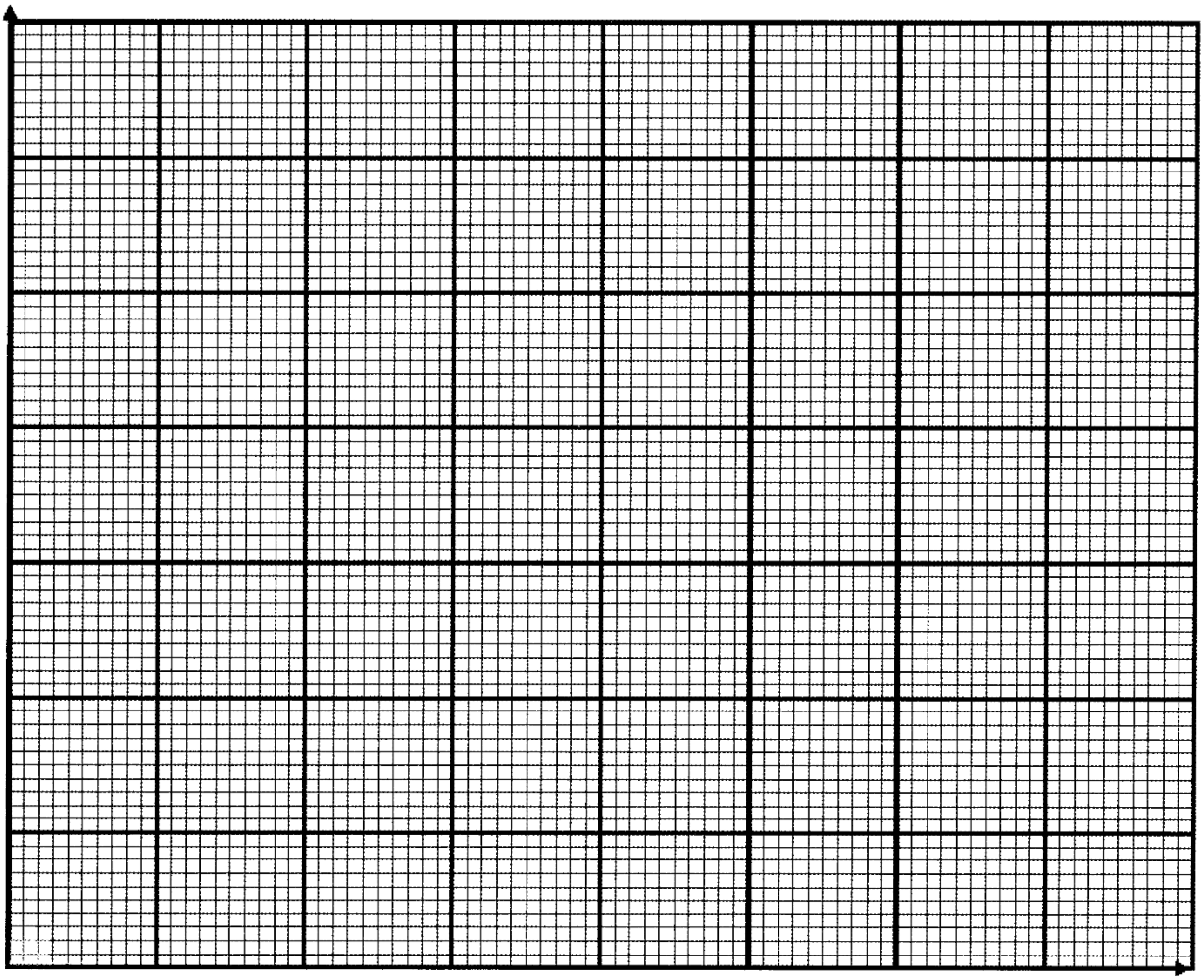
58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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QUESTION 5.4 ANSWER SHEET





TEAR-OFF SHEET

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