



GRADE 10

PHYSICAL SCIENCES (P2)

Stanmorephysics.com

OCTOBER 2022

MARKS: 100

TIME: 2 HOURS

This question paper consists of 13 pages, including 2 data sheets

INSTRUCTIONS AND INFORMATION

1. Write your FULL NAME and SURNAME on the ANSWER SCRIPT.
2. The question paper consists of 8 questions. Answer ALL the questions in the ANSWER SCRIPT.
3. Start EACH question on a new page in the ANSWER SCRIPT.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE-line open between two sub-questions 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 SHEETS.
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 explanations, motivations, et cetera where required.
12. Write neatly and legibly.

QUESTION 1 MULTIPLE CHOICE QUESTIONS

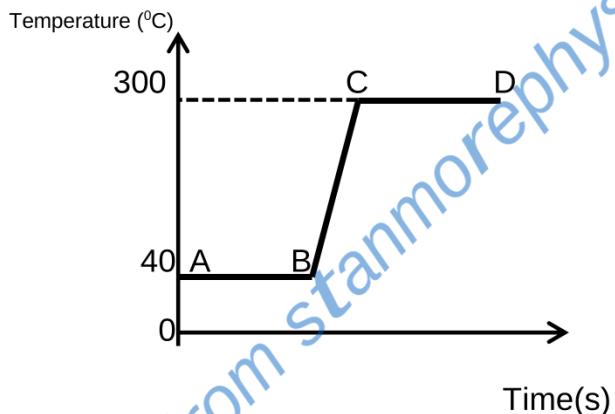
Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A-D) next to the question numbers (1.1 to 1.7) in the ANSWER BOOK, e.g. 1.11 E. Each question has only ONE correct answer.

1.1 Which one of the following is a mixture?

- A Diamond
- B Distilled water
- C Vinegar
- D Sodium chloride

(2)

1.2 The heating curve (not drawn to scale) of a compound is shown below.



What would be the physical state of the substance at 100°C ?

- A. Solid
- B. Liquid
- C. Gas
- D. Solid to liquid

(2)

1.3 When atom X of an element in Group 17 (VII) ionises to become X^- the...

- A mass number of X increases.
- B atomic number of X decreases
- C number of electrons decreases
- D number of electrons increases

(2)

1.4 The molecular formula of a certain carbon compound is $C_4 H_{10} O_2$.
Which one of the following can be the empirical formula of this compound?

- A C_2H_6O
- B $C_2H_4O_2$
- C C_2H_5O
- D $C_2H_6O_2$

(2)

1.5 Which one of the following elements has the highest ionisation energy?

- A Potassium
- B Lithium
- C Caesium
- D Sodium

(2)

1.6 Which one of the following statements is correct? 1 mole is equal to...

- i) 44 g of CO_2
 - ii) 32 g of O_2
 - iii) 14g of N_2
- A. i and iii
 - B. i and ii
 - C. iii
 - D. i,ii and iii

(2)

1.7 Consider the Aufbau diagram of an element below.

$\uparrow\downarrow$		3s
$\uparrow\downarrow$	$\uparrow\downarrow$	2p
$\uparrow\downarrow$		2s
$\uparrow\downarrow$		1s

The element is a/an...

- A. halogen
- B. noble gas
- C. alkali metal
- D. alkaline-earth metal.

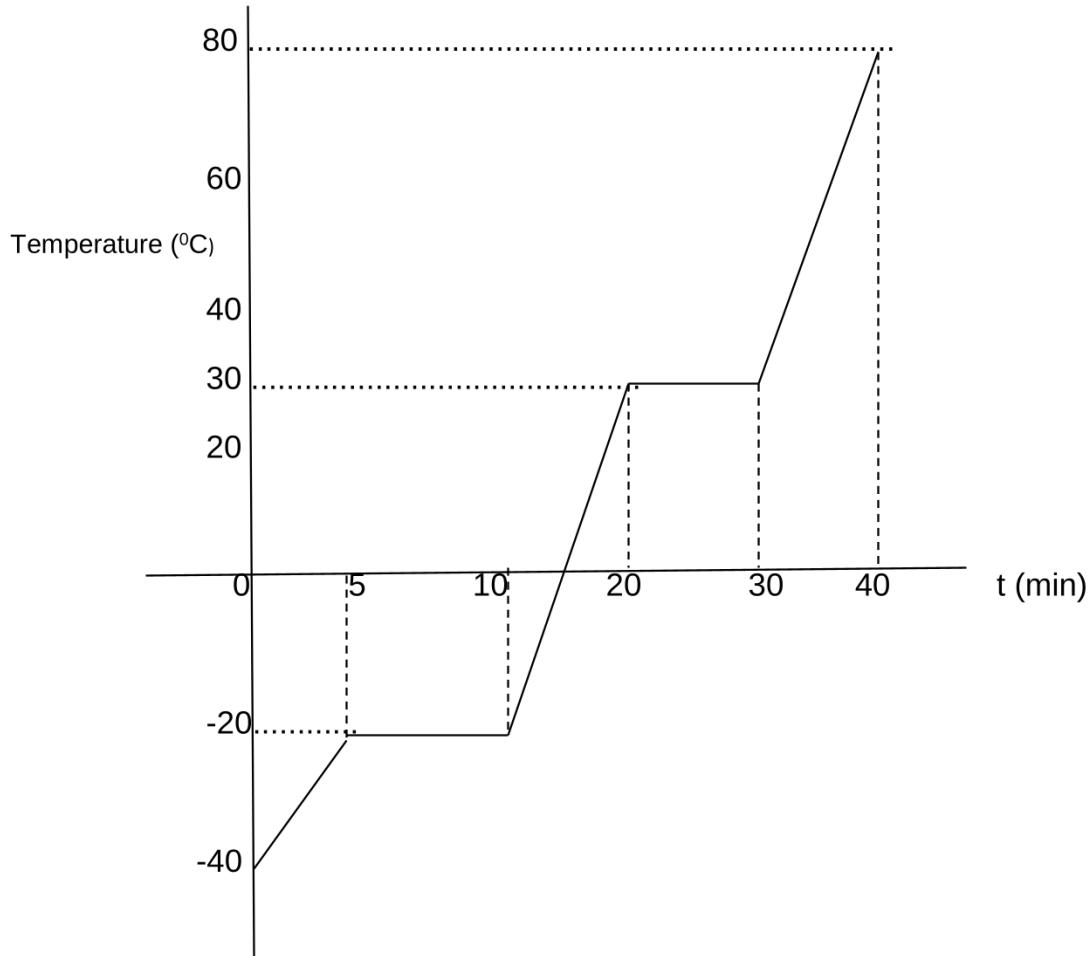
(2)

[14]



QUESTION 2

The graph below shows the heating curve of a pure substance under standard pressure.



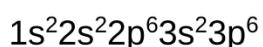
- 2.1 Define the term temperature. (2)
- 2.2 What is the boiling point of this substance? (1)
- 2.3 During which time interval/s will the ...
- 2.3.1 forces of attraction between the particles be at their weakest? (1)
 - 2.3.2 particles vibrate at their fixed positions (1)
 - 2.3.3 average kinetic energy of the particles remains the same (2)
 - 2.3.4 Give a reason for your answer ion 2.3.3 (2)
- [9]

QUESTION 3

- 3.1 An element X has two isotopes. The percentage abundance and atomic masses are given below.

	Percentage abundance	Atomic mass
Isotope -1	60.4%	69.5252
Isotope -2	39.6 %	70.9249

- 3.1.1 Define the term **isotope**. (2)
- 3.1.2 Calculate the relative atomic mass of element X. (3)
- 3.1.3 Write down the symbol for element X (1)
- 3.2 The number of protons and electrons, the mass number and the atomic number of Aluminium (Al) and its ion Al³⁺ are shown in the table below.
- Some of these values in the table have been omitted. Write down the letters **(a-e)** on the ANSWER BOOK and next to each letter the number omitted.
- | | NUMBER OF PROTONS | NUMBER OF ELECTRONS | MASS NUMBER | ATOMIC NUMBER |
|------------------|-------------------|---------------------|-------------|---------------|
| Al | 13 | (a) | 27 | (b) |
| Al ³⁺ | (c) | (d) | (e) | 13 |
- (5)
- 3.3 The sp notation of an unknown element X is shown below.



For element X, write down the:

- 3.3.1 Number of valence electrons. (1)
- 3.3.2 Period where this element is found on the periodic table. (1)
- 3.3.3 Highest energy level in which electrons occur. (1)
- 3.3.4 Symbol (1)

- 3.4 Write down the type of bond that forms between Chlorine and Aluminium (1)
- 3.5 Draw the Aufbau diagram for Chloride ion (Cl^-). (3)
- 3.6 Draw Lewis dot diagram to show the bond formation between Aluminium and Chlorine (4)

[23]

QUESTION 4

- 4.1 A section of the periodic table is shown below.

H							He
Li	Be		C	N	O	F	Ne
Na	Mg		Al	Si		Cl	Ar
K	Ca	Transition metals					

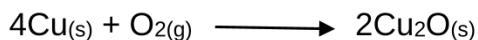
Write down the **SYMBOL** as shown above, of the element that ..

- 4.1.1 is an alkaline earth metal in period 3 (1)
- 4.1.2 will form a anion with a charge of -2 (1)
- 4.1.3 has the smallest atomic radius (1)
- 4.1.4 has the highest electro negativity (1)
- 4.1.5 is a metalloid (1)
- 4.2 The electron affinity of chlorine (Cl) is $349 \text{ kJ}\cdot\text{mol}^{-1}$.
- 4.2.1 Define the term '**electron affinity**'. (2)
- 4.2.2 The electron affinity of element Cl can be represented by the following incomplete equation:
- $$\text{Cl(g)} + \dots \rightarrow \dots + 400 \text{ kJ}\cdot\text{mol}^{-1}$$
- Copy the equation above into the ANSWER BOOK and complete it by filling in the blank spaces. (2)
- 4.3 Atoms of Francium (Fr) have the lowest **energy required to remove an electron from its atom to form positive ions**.
- Write down ONE word or term for the underlined phrase. (1)
- 4.4 Write down the formula of the compound formed when:
- 4.4.1 Li combines with O (2)
- 4.4.2 Ca combines with F (2)

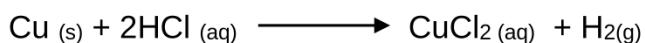
[14]

QUESTION 5

Consider the following reaction:



- 5.1 Write down the chemical name of Cu_2O . (2)
- 5.2 Classify the above reaction as ***synthesis*** or ***decomposition*** reaction (1)
- 5.3 Using a calculation prove that the law of conservation of mass is valid for the above reaction. (3)
- 5.4 20g of Cu completely react with 250cm³ of hydrochloric acid solution of unknown concentration according to the following balanced equation.



- 5.4.1 Define the term concentration. (2)
- 5.4.2 Calculate the concentration of the hydrochloric acid solution. (6)

[14]

QUESTION 6

During a demonstration to show the difference between physical and chemical change, the following experiments are carried out:

Experiment 1: Iron filings are heated with sulphur



Experiment 2: Iron filings are mixed with sulphur powder

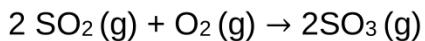
- 6.1 Which one of the above experiments is an example for a **chemical change?**
Experiment 1 or 2? (1)

- 6.2 Give a reason for your answer in 6.1 (1)
- 6.3 Write down a balanced equation for the change in experiment 2. (3)
- 6.4 Name a method to reverse the change in experiment 2? (1)

[6]

QUESTION 7

The formation of sulphur trioxide (SO_3) is represented by the following balanced equation.



- 7.1 Identify the element in the above equation (1)
- 7.2 Draw the Lewis dot diagram of the oxygen molecule (O_2). (2)
- 7.3 During the above reaction 10 g O_2 (oxygen) react completely with Sulphur dioxide (SO_2). Calculate the:
- 7.3.1 Number of moles of O_2 reacted (3)
 - 7.3.2 Theoretical yield of $\text{SO}_3(\text{g})$ (4)
 - 7.3.3 Percentage yield if 40g of SO_3 is produced at the end of the reaction. (3)

[13]**QUESTION 8**

An inorganic compound has the following percentage composition. 43.39% Sodium (Na), 11.32% Carbon (C) and 45.28% Oxygen(O)

- 8.1 Define the term empirical formula. (2)
- 8.2 Determine the empirical formula of this compound. (5)

[7]**TOTAL:100**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	p°	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molére gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T°	273 K
Charge on electron <i>Lading op elektron</i>	e	$1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Avogadro-konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$

(I)	(II)			(III)	(IV)	(V)	(VI)	(VII)	(VIII)
1 H 1									2 He 4
2,1 Li 3 7	4 Be 9								10 Ne 20
11 Na 23	12 Mg 24								18 Ar 40
19 K 39	20 Ca 40	21 Sc 45	22 Ti 48	23 V 51	24 Cr 52	25 Mn 55	26 Fe 56	27 Co 59	28 Ni 59
37 Rb 86	38 Sr 88	39 Y 89	40 Zr 91	41 Nb 92	42 Mo 96	43 Tc 101	44 Ru 103	45 Rh 106	46 Pd 108
55 Cs 133	56 Ba 137	57 La 139	72 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195
87 Fr 226	88 Ra 226	89 Ac							
			58 Ce 140	59 Pr 141	60 Nd 144	61 Pm 150	62 Sm 152	63 Eu 152	64 Gd 157
			90 Th 232	91 Pa 238	92 U 238	93 Np 238	94 Pu 239	95 Am 243	96 Cm 247
									65 Tb 159
									66 Dy 163
									67 Ho 165
									68 Er 167
									69 Tm 169
									70 Yb 173
									71 Lu 175
									72 At 223



OR TAMBO INLAND DISTRICT

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MARKING GUIDELINES

MARKS: 100



These marking guidelines consists of 6 pages.

QUESTION 1

- 1.1 C✓✓
- 1.2 B✓✓
- 1.3 D✓✓
- 1.4 C✓✓
- 1.5 B✓✓
- 1.6 B✓✓
- 1.7 D✓✓

[14]

QUESTION 2

- 2.1 Measure of the average kinetic energy of the particles in a substance✓✓ (2)
 - 2.2 30⁰C✓ (1)
 - 2.3.1 30-40 minutes ✓ (1)
 - 2.3.2 0-5 minutes ✓ (1)
 - 2.3.3 5-10✓ and 20-30 minutes ✓ (2)
 - 2.3.4 During a phase change the heat energy supplied is used to overcome the intermolecular forces.✓ Therefore the average kinetic energy of the particles remains the same. ✓ (2)
- [9]

QUESTION 3

- 3.1.1 Atoms with the same atomic number ✓but different mass number.✓ (2)
- 3.1.2 Relative atomic mass = (69.5252 x 60.4) ✓+ (70.9249 x 39.6) ✓
=
$$\frac{100}{70.08} \checkmark$$
 (3)
- 3.1.3 Ga ✓ (1)

- 3.2 a) 13✓ (1)
- b) 13 ✓ (1)
- c) 13✓ (1)

d) 10✓ (1)

e) 27✓ (1)

3.3.1 8 ✓ (1)

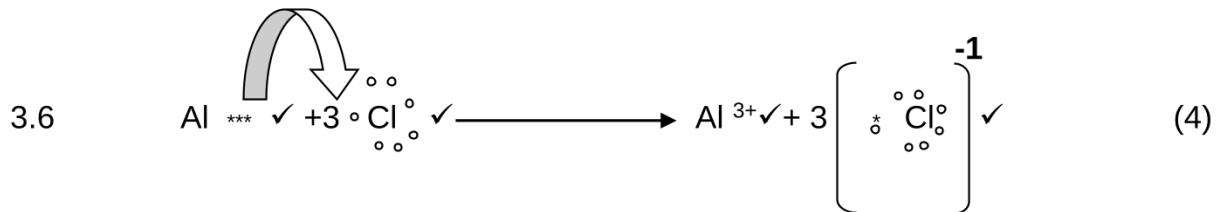
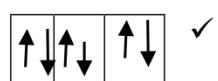
3.3.2 Period -3 ✓ (1)

3.3.3 3 ✓ (1)

3.3.4 Ar ✓ (1)

3.4 Ionic bond ✓ (1)

3.5



QUESTION 4

- 4.1.1 Mg ✓
4.1.2 O ✓
4.1.3 H ✓
4.1.4 F ✓
4.1.5 Si ✓ (5)

4.2.1 Energy released when an electron is added to an atom in the gaseous state to form an anion. ✓✓ (2)



4.3 Ionisation energy ✓ (1)

4.4.1 Li₂O ✓✓ (2)

4.4.2 CaF₂ ✓✓ (2)

[14]

QUESTION 5

5.1 Copper(I) oxide. ✓✓ (2)

5.2 Synthesis reaction ✓ (1)

5.3 $(4 \times 63.5) + (2 \times 16) \checkmark = (4 \times 63.5) + (2 \times 16) \checkmark$

$$286 \text{ g.mol}^{-1} = 286 \text{ g.mol}^{-1} \checkmark \quad (3)$$

5.4.1 Number of moles of the solute per litre of the solution. ✓✓ (2)

5.4.2 $n = \frac{m}{M} \checkmark = \frac{20}{63.5} \checkmark = 0.3149 \text{ mole}$

 $n (\text{HCl}) = 2 \times 0.3149 = 0.6299 \text{ mole} \checkmark$

$$c = \frac{n}{V} \checkmark$$

$$c = \frac{0.6299}{0.25} \checkmark = 2.59 \text{ mol.dm}^{-3} \checkmark \quad (6)$$

[14]

QUESTION 6

6.1 Experiment 1 ✓ (1)

6.2 New substances are formed ✓/ Bonds are broken and new bonds are formed (1)

6.3 $\text{Fe}_{(s)} + \text{S}_{(s)} \longrightarrow \text{FeS}_{(s)}$ ✓ Balancing ✓ (3)

6.4 Separate the iron filings using a magnet✓ (1)

[6]

QUESTION 7

7.1 O_2 ✓ (1)

7.2  6 valence electrons ✓
Sharing 2 pairs ✓ (2)

7.3.1 $n = \frac{m}{M} \checkmark = \frac{10}{32} \checkmark = 0.3125 \text{ moles} \checkmark$ (3)

7.3.2 $n(\text{SO}_3) \text{ produced} = 2 \times 0.3125 \checkmark = 0.625 \text{ moles}$

$m(\text{SO}_3) \text{ produced} = n \times M \checkmark = 0.625 \times 80 \checkmark = 50 \text{ g} \checkmark$ (4)

7.3.3 $\% \text{ yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100 \checkmark = \frac{40}{50} \times 100 \checkmark = 80\% \checkmark$ (3)

[13]

QUESTION 8

8.1 The simplest whole number ratio of elements in a compound. ✓✓ (2)

8.2

Element	g/100g	n = m/M	Simplest ratio
Na	43.39	$43.39 / 23 = 1.8867 \checkmark$	2
C	11.32	$11.32 / 12 = 0.9433 \checkmark$	1
O	45.28	$45.28 / 16 = 2.83 \checkmark Stanmorephysics.com$	3

Empirical formula is $\text{Na}_2\text{CO}_3 \checkmark$ (5)

[7]

[TOTAL 100 MARKS]