



**HILLCREST HIGH SCHOOL**  
**PHYSICAL SCIENCE**  
**GRADE 10**  
**PAPER 2 - CHEMISTRY**



**NOVEMBER 2021**  
**TIME: 2 HRS**

**TOTAL : 100**

**INSTRUCTIONS**

1. Answer ALL the questions Q 1 to Q 8
2. This question paper consists of TWO sections:
3. SECTION A (10)  
SECTION B (90)
4. Answer SECTIONS A and B in the ANSWER BOOK.
5. Non-programmable calculators may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Leave a line between each answer and rule off after each question
8. Data sheets are attached for your use.
9. Give brief motivations, discussions, et cetera where required.
10. Answers must be rounded off to **two decimal** places.

## SECTION A

### QUESTION 1: MULTIPLE-CHOICE

(2 x 5 = 10)

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 – 1.5) in the ANSWER BOOK.

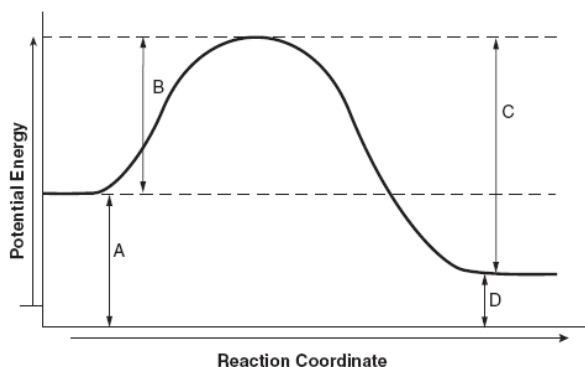
- 1.1 Which statement is true regarding the properties of molecules of hydrofluoric acid (HF)?

	nature of the bond between the H and F atoms in the molecules	nature of the intermolecular force between the HF molecules
A	Hydrogen bond	Ion - dipole
B	Ionic bond	London
C	Polar covalent bond	Hydrogen bond
D	Metallic	Dipole – dipole

- 1.2 A potential energy diagram for a chemical reaction is shown below.

Which letters represent the activation energy of the forward and reverse reactions, respectively?

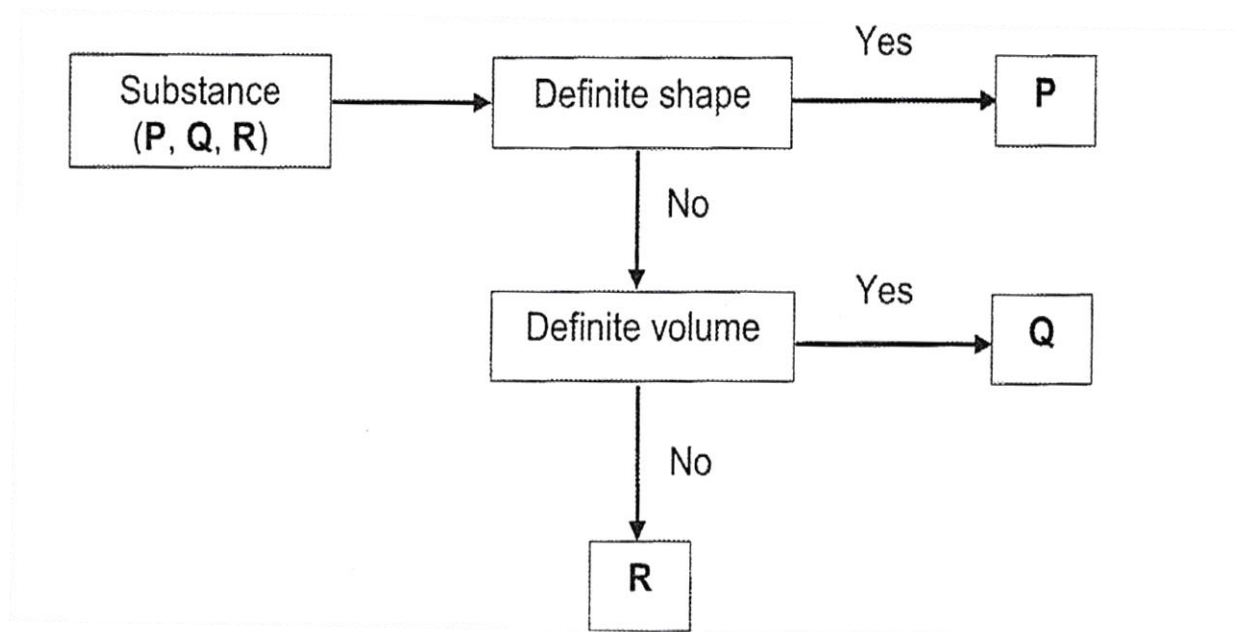
- A. A and C  
 B. B and C  
 C. A and D  
 D. B and D



- 1.3 For the reaction  $\text{HPO}_4^{2-} + \text{H}_2\text{O} \rightarrow \text{H}_2\text{PO}_4^{1-} + \text{OH}^-$   
 Which statement is true?

A	$\text{HPO}_4^{2-}$	is the conjugate base of	$\text{H}_2\text{O}$
B	$\text{H}_2\text{O}$	is the conjugate base of	$\text{OH}^-$
C	$\text{H}_2\text{PO}_4^-$	is the conjugate acid of	$\text{OH}^-$
D	$\text{H}_2\text{PO}_4^-$	is the conjugate acid of	$\text{HPO}_4^{2-}$

1.4 Use the flow diagram to classify these substances **P** , **Q** and **R**



	P	Q	R
A	marble	oil	oxygen
B	alcohol	iron	nitrogen
C	oxygen	water	marble
D	nitrogen	marble	alcohol

1.5 If 30 g of reactant A reacts completely with 25 g of reactant B, which ONE of the Following statements is CORRECT?

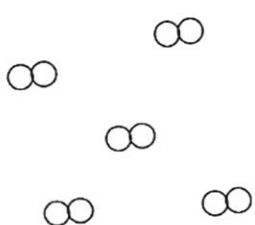
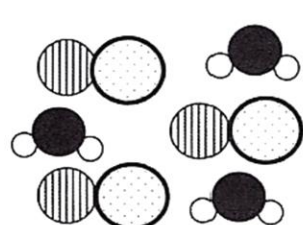
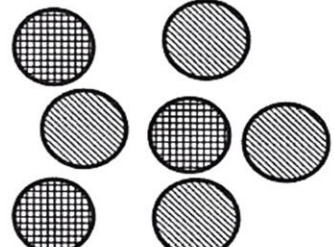






- A The total mass of the products plus any unreacted reactants will be less than 55 g
- B The total mass of the products plus any unreacted reactants will be 55 g
- C The total mass of the products plus any unreacted reactants will be greater than 55 g
- D The total mass of products will be equal to 55 g

**SECTION B**

**QUESTION 2**

**(6)**

The diagram below shows three different substances **P** , **Q** and **R**

SUBSTANCE P		SUBSTANCE Q		SUBSTANCE R	
					
KEY					
	Hydrogen		Chlorine		
	Oxygen		Sulphur		
	Sodium		Iron		

Use the information to answer the questions that follow.

- 2.1 Write down the letter that represents
  - 2.1.1 a heterogeneous mixture (1)
  - 2.1.2 a homogeneous mixture (1)
- 2.2 Indicate whether the pure substance shown is an element or a compound. (1)
- 2.3 Which physical methods would you use to separate Q into its components. (2)
- 2.4 Write down the name of the physical property that determines which method of separation you would use to separate R into their components. (1)

**QUESTION 3****(10)**

3.1. A pot of boiling water is placed in a freezer and left there overnight.

Draw a graph to show the relationship between temperature ( $^{\circ}\text{C}$ ) versus time (in minutes) for the water in the pot.

On your graph, indicate the relevant values on the y – axis only. (4)

3.2 Explain the changes taking place overnight in the water in terms of;

3.2.1 the energy and movement of the particles (2)

3.2.2. the forces of attraction between particles . (1)

3.3. Solid carbon dioxide is known as dry ice. Under normal circumstances dry ice sublimates as it warms up.

3.3.1 Define the term sublimation. (2)

3.3.2 Is sublimation an example of a physical or a chemical change? (1)

**QUESTION 4****(8)**

The first ionisation energies of the first twenty elements are given below.

<b>H</b> 1 311						<b>He</b> 2 372	
<b>Li</b> 520	<b>Be</b> 899	<b>B</b> 801	<b>C</b> 1 066	<b>N</b> 1 402	<b>O</b> 1 314	<b>F</b> 1 681	<b>Ne</b> 2 081
<b>Na</b> 496	<b>Mg</b> 738	<b>Al</b> 578	<b>Si</b> 786	<b>P</b> 1 012	<b>S</b> 1 001	<b>Cl</b> 1 251	<b>Ar</b> 1 521
<b>K</b> 419	<b>Ca</b> 590						

4.1 How does the first ionisation energy change **from right to left** in a period. Only write down INCREASE, DECREASE or REMAIN THE SAME. (1)

4.2 Explain why the first ionisation energy for sodium is smaller than that of argon. Refer to atomic radius when explaining. (3)

4.3 Predict whether the second ionization energy for potassium will be lower or higher than  $419 \text{ kJ.mol}^{-1}$ . Justify your answer with a valid reason. (4)

**QUESTION 5****(10)**

Information about four elements, represented by A, B, C and D, are given in the table below.

ELEMENT	ATOMIC NUMBER	MASS NUMBER
A	2	4
B	11	23
C	1	1
D	9	19

- 5.1. Which element (A, B, C, D)
- 5.1.1 has 7 valence electrons. (1)
- 5.1.2. is the most stable (1)
- 5.2. Write down the electron structure (s,p notation) for an ion of element B (2)
- 5.3 Represent a molecule of element D with a Lewis (dot) Diagram. (2)
- 5.4 Two of the above elements are in the same group in the periodic table. Write down only the letters, from the above table that corresponds to these elements. (1)
- 5.5. Write down a balanced chemical equation for the reaction between element C and D. (3)

**QUESTION 6****(4)**

- 6.1 Name the following compounds using Stock notation where necessary.
- 6.1.1  $\text{KMnO}_4$  (1)
- 6.1.2  $\text{Fe}_3(\text{PO}_4)_2$  (1)
- 6.2 Write formula for the following compounds.
- 6.2.1 ammonium dichromate (1)
- 6.2.2 lead (IV) sulphate (1)

**QUESTION 7****(44)**

- 7.1 Rubidium occurs naturally in two isotopic forms, namely Rb - 85 and Rb - 87. Rubidium also has a relative atomic mass of 85,468 a.m.u
- 7.1.1 Define the term 'isotope'. (2)
- 7.1.2 Calculate the percentage abundance of the Rb-87 isotope. (4)
- 7.2 Calculate the
- 7.2.1 mass of 4,5 moles of sulfur (IV) oxide. (3)
- 7.2.2 number of hydrogen atoms 75 g of ethane (C<sub>2</sub>H<sub>6</sub>) (5)
- 7.3 A grade 11 learner makes up a standard solution of sodium carbonate by dissolving 4,25g of the powder into 200cm<sup>3</sup> of distilled water.
- 7.3.1 Define the term 'standard solution'. (1)
- 7.3.2 Calculate the concentration of the sodium carbonate solution. (4)
- 7.4 An organic compound is composed of 52,12% carbon, 13,13% hydrogen and 34,73% oxygen by mass.
- 7.4.1 Determine the empirical formula of the compound. (5)
- 7.4.2 If the sample has a molar mass of 138g.mol<sup>-1</sup>, determine the molecular formula of the compound. (3)
- 7.5 Sulphuric acid (H<sub>2</sub>SO<sub>4</sub>) reacts with ammonia gas (NH<sub>3</sub>) to produce the fertilizer ammonium sulphate according to the equation
- $$\text{H}_2\text{SO}_4 + \text{NH}_3 \rightarrow (\text{NH}_4)_2\text{SO}_4$$
- 7.5.1 Copy and balance the equation. (2)
- 7.5.2 What theoretical yield of fertilizer that can be produced from 0,17 kg of ammonia? (4)
- 7.5.3 It was found that 0,5kg of fertilizer was produced in the reaction. Calculate the percentage yield. (3)

7.6 Hydrated zinc sulphate has a formula  $ZnSO_4 \cdot nH_2O$ . (where  $n$  is a whole number).  
 A sample containing 13,2g of hydrated zinc sulphate was heated until all the water had evaporated.  
 The final mass of the anhydrous (dry) powder was found to be 7,4g.

7.6.1 Calculate the mass of the water that evaporated? (2)

7.6.2 Find the value of  $n$ , and hence determine the formula and the name for the hydrated salt (6)

**QUESTION 8 (8)**

8.1 Consider the following substances:

(i)  $HNO_3$

(ii)  $K_2CO_3$

Substance (i) is mixed with a solution of substance (ii)

8.1.1 write a balanced equation for the reaction (2)

8.1.2. the name of the salt that forms in this reaction (2)

8.1.3 calculate the volume of carbon dioxide that forms when 345g of (ii) reacts with an excess of  $HNO_3$  at STP. (4)

**TOTAL 100**

**FORMULA SHEET**

$n = \frac{m}{M}$	
$n = \frac{No}{NA}$	$N_A = 6.02 \times 10^{23}$
$n = \frac{V}{Vm}$	$V_o = 22.4 \text{ dm}^3$
$C = \frac{n}{V}$	

