

Instructions

1. This paper consists of sections *A*, *B* and *C* with a total of ten (10) questions.
2. Answer all questions.
3. Sections *A* carries sixteen (16) marks, section *B* fifty-four (54) marks and section *C* thirty (30) marks.
4. Non-programmable calculators may be used.
5. The following constants may be used.

Atomic masses: $H = 1$, $C = 12$, $O = 16$, $Na = 23$, $Mg = 24$

Avogadro's number = 6.02×10^{23}

GMV at s.t.p = 22.4 dm^3

1 litre = $1 \text{ dm}^3 = 1000 \text{ cm}^3$

QUESTION NUMBER	QUESTION CHOSEN: PUT A TICK (✓)	FOR EXAMINER'S USE ONLY	
		MARKS	EXAMINER'S SIGNATURE
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10			
TOTAL MARKS			

SECTION A (16 Marks)
Answer **all** questions in this section.

1. For each of the items (i) - (x), choose the correct answer from the given alternatives and write its letter in the answer booklet provided.
- (i) **A student was trying to obtain copper sulphate crystals by reacting copper oxide with dilute sulphuric acid. Instead of blue crystals, his final product was a white compound. What mistake did the student make?**
- A. Adding excess copper oxide
 - B. Heating the filtrate to dryness
 - C. Using dilute sulphuric acid instead of concentrated sulphuric acid
 - D. Using excess dilute sulphuric acid
 - E. Not using a catalyst
- (ii) **In the titration of a monoprotic acid with a solution of sodium hydroxide of known concentration, what quantities will be equal at the equivalence point?**
- A. concentration of hydroxide solution and hydronium ions.
 - B. number of moles of hydroxide ions added and number of moles of hydronium ion initially present.
 - C. number of moles of hydroxide solution added and volume of acid solution initially present.
 - D. number of moles of hydroxide ion added and the number of moles of monoprotic acid initially present.
 - E. volume of sodium hydroxide solution added and volume of acid solution initially present.
- (iii) **Consider the system at equilibrium: $H_2O_{(l)} \rightleftharpoons H_2O_{(g)}$ for which $\Delta H > 0$. Which change(s) will increase the yield of $H_2O_{(g)}$.**
- A. Increase in temperature
 - B. Increase in the volume of the container
 - C. Decrease in temperature
 - D. Increasing surface area of oxygen
 - E. Increasing surface area of reactants.
- (iv) **Which of the following compounds contains only two elements?**
- A. Magnesium hydroxide
 - B. Magnesium nitride
 - C. Magnesium phosphate
 - D. Magnesium sulphite
 - E. Magnesium sulphate.
- (v) **Which substance contains approximately 6×10^{23} atoms at S.T.P?**
- A. 22.4 dm^3 of oxygen gas
 - B. 41 g of aluminium nitride (AlN)
 - C. 12 dm^3 of oxygen gas
 - D. 40 g of magnesium oxide (MgO)

E. 4 g of sodium hydroxide (NaOH)

(vi) The table below shows the physical properties of three substances

Substances	Melting point/°C	Ability to conduct electricity in solid state	Solubility in water
X	801	Nil	Soluble
Y	3652	Good	Insoluble
Z	3550	Nil	Insoluble

What are the substances X, Y and Z?

	X	Y	Z
A.	lead	diamond	silicon dioxide
B.	diamond	graphite	sodium
C.	sodium chloride	graphite	diamond
D.	sodium chloride	diamond	graphite
E.	graphite	diamond	lead

(vii) Which of the following statement is true about water gas?

- A. It is poisonous.
- B. Contains hydrogen.
- C. Is the same as biogas.
- D. Contains hydrogen and nitrogen.
- E. Contains carbon monoxide and hydrogen.

(viii) Which of the following statements is not true about hydrogen gas?

- A. It is a neutral gas, almost insoluble in water
- B. It is a reducing agent
- C. It burns in air to form steam
- D. It diffuses more rapidly than carbon dioxide
- E. It is prepared by action of dilute nitric acid on zinc metal

(ix) Which among the following pair of substances are allotropes?

- A. H_2O and H_2O_2
- B. ^{12}C and ^{14}C
- C. P_4 and P_8
- D. H_2 and $2H^+$
- E. H^+ and H_3O^+

(x) You are told that 2.5 mole of oxygen gas has the same mass as 1 mole of SO_n . What is the value of n?

- A. 1
- B. 2
- C. 3

- D. 4
E. 5

2. Match the items in List A with the responses in List B by writing the letter of the correct response beside the item number in the answer booklet provided.

LIST A	LIST B
(i) Nitrogen (ii) Methane (iii) Carbon dioxide (iv) Chlorine (v) Sulphur dioxide (vi) Ammonia	A. The glowing splint is rekindled. B. A white precipitate is formed. C. The moist red litmus paper turns blue. D. Extinguishes a glowing splint E. The purple acidified potassium manganate (VII) turns colourless. F. Burns with a blue flame G. Extinguishes a glowing splint. H. Unreactive and does not support combustion. I. The moist blue litmus paper turns red and is then bleached.

SECTION B (54 Marks)

Answer **all** questions from this section.

3. (a) (i) In the fractional distillation of liquid air, which gas is distilled over first? Why?
 (ii) Give two uses of the gas identified in (i) above.
 (b) (i) The easiest way to obtain a solute from a solution is by evaporating all the solvent. Give two reasons why chemists often avoid using this method.
 (ii) Suggest three conditions to be considered in solvent extraction process.
4. A 0.64 moles of hydrogen gas combined with 0.32 moles of oxygen gas to form steam
 (a) Which reactant was in excess?
 (b) Calculate the mass of reactant left in the container.
 (c) How many moles of steam were produced?
 (d) Find the volume of steam produced at STP.
5. An experiment was conducted to find out the relationship between solubility of potassium nitrate in water against temperature. The following data were recorded:

Mass of the salt (g)	10	30	50	65	87	113
Volume of water (cm ³)	150	150	150	150	150	150
Temperature (°C)	0	20	30	40	50	60

With reference to the experiment:

- (a) Provide the statement of the problem
 (b) Give the hypothesis
 (c) Identify
 (i) The dependent variable

- (ii) The independent variable
 - (iii) The controlled variable
 - (d) Make an interpretation of the data given.
 - (e) Make conclusion
6. (a) Explain three reasons behind gentle heating versus strong heating of metal nitrates solutions towards crystallisation.

(b) Products formed by the action of heat on nitrates of **A**, **B** and **C** are listed below.

Nitrate of metal	Products
A	Metal oxide, nitrogen dioxide and oxygen
B	Metal, nitrogen dioxide and oxygen
C	Metal nitrite and oxygen

- Arrange the metals A, B and C in order of decreasing reactivity.
- Give names of the metals; A, B and C

(c) Describe how the nitrate of C can be prepared from potassium hydroxide.

- Explain the difference in electrical conductivity of sodium metal and solid sodium chloride.
 - A student wants to electroplate a nickel jug with silver metal. Draw a simplified labelled diagram showing the cell doing this experiment.
 - One of the applications of electrolysis is extraction of metals. **Write the electrodes reactions and determine the mass of sodium metal** produced during extraction process, if 500 Faradays of electricity were allowed to pass through electrolyte.
- What does the statement “*a reaction has reached equilibrium*” mean with regard to the following?
 - Forward and reverse reaction rates
 - The amounts or concentrations of the reactants and the products.
 - The following is thermochemical equation for the reaction;

$$\text{C}_{(\text{s})} + \text{H}_{2(\text{g})} \rightarrow \text{C}_2\text{H}_{2(\text{g})} \quad \Delta H = + 53.2 \text{ kJ mol}^{-1}$$
 Draw the energy level diagram for the reaction
 - The following equation represents a reaction between potassium and iodine;

$$2\text{K}_{(\text{s})} + \text{I}_{2(\text{s})} \rightarrow 2\text{KI}_{(\text{s})}$$
 - Identify the oxidizing agent, and the reducing agent. Give reasons
 - Write the balanced half reaction equations for the oxidation and reduction reactions.

SECTION C (30 Marks)

Answer **All** questions from this section.

- Explain why carboxylic acid has high melting point and boiling point compared to their corresponding alcohol?
 - With help of chemical equations, state two chemical properties of carboxylic acid.
 - Write down the molecular structures and I.U.P.A.C names of all isomers whose molecular formula is $\text{C}_4\text{H}_9\text{Cl}$.
 - Compound A($\text{C}_4\text{H}_{10}\text{O}$) is oxidized with acidified potassium dichromate to give compound B. When it is dehydrated with conc H_2SO_4 , compound A gives compound C which undergoes hydrogenation to give compound D, that is capable of undergoing a substitution reaction. Identify the compounds B, C and D, and write their structures
- Give the explanation on the ammonia gas based on the following
 - The raw materials and process used in the production of the gas
 - How ammonia gas is collected in the laboratory, and why this method is used?
 - The effect of ammonia gas on litmus paper.
 - Two chemical properties of ammonia gas.
 - Two uses of ammonia gas.
 - Two environmental impacts of excessive ammonia gas release into the atmosphere and water bodies