

General Instructions

1. Section I is compulsory. Attempt any four questions from Section II.
2. The intended marks for questions or parts of questions are given in brackets.

SECTION I (40 Marks) Attempt all questions from this Section

Question 1

(a) Answer the questions below, relating your answers only to salts in the following list: sodium chloride, anhydrous calcium chloride, copper sulphate-5-water. [5]

- i. What name is given to the water in the compound copper sulphate-5-water?
- ii. If copper sulphate-5-water is heated, the water is driven off leaving anhydrous copper sulphate.
 - (1) What is the colour of anhydrous copper sulphate?
 - (2) By what means, other than heating could you dehydrate copper sulphate-5-water and obtain anhydrous copper sulphate?
- iii. What is deliquescence?
- iv. Which one of the salts in the given list is deliquescent?

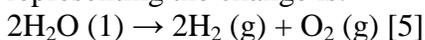
(b) State what you see when: [5]

- i. A piece of moist blue litmus paper is placed in a gas jar of chlorine.
- ii. A piece of moist red litmus paper is placed in a gas jar of ammonia.
- iii. Silver nitrate solution is added to dilute hydrochloric acid.
- iv. Zinc oxide is heated.
- v. A glowing splint is introduced into a gas jar containing oxygen.

(c) Write correctly balanced equations for the following reactions: [5]

- i. Molten sodium and chlorine.
- ii. Nitrogen and oxygen when lightning strikes
- iii. Iron and dilute sulphuric acid
- iv. Decomposition of hypochlorous acid in sunlight.
- v. Action of heat on potassium nitrate.

(d) Water can be split into hydrogen and oxygen under suitable conditions. The equation representing the change is:



- i. If a given experiment result in 2500 cm³ of hydrogen being produced, what volume of oxygen is liberated at the same time under the same conditions of temperature and pressure?
- ii. The 2500 cm³ of hydrogen is subjected to a 2½ times increase in pressure (temperature remaining constant). What volume will the hydrogen now occupy?
- iii. Taking the volume of hydrogen calculated in (d) (ii), what change must be made in the Kelvin (absolute) temperature to return the volume to 2500 cm³ (pressure remaining constant)?

(e) The compound Na₂B₄O₇·10H₂O is commonly known as borax. When litmus is added to a solution of borax it turns blue. [5]

1. What can you say about the pH of borax solution?
2. Calculate the percentage of boron (B) in borax.
(H = 1, B = 11, O = 16, Na = 23) (Answer correct to 1 decimal place).

(f) [5]

1. Sodium hydroxide solution can be used to distinguish between iron (II) sulphate solution and iron (III) sulphate solution because these solutions give different coloured precipitates with sodium hydroxide solution. Give the colour of the precipitate formed with :
(1) Iron (II) sulphate solution; (2) Iron (III) sulphate solution.
2. What will you see when barium chloride solution is added to iron (II) sulphate solution?
3. How will the action of dilute hydrochloric acid on sodium carbonate and sodium sulphite enable you to distinguish between these two compounds?

(g) Choosing only words from the following list, write down the appropriate words to fill in the blanks: From (i) to (v) below:

anions, anode, cathode, cations, electrode, electrolyte, nickel, voltameter. [5]

To electroplate an article with nickel requires an (i) which must be a solution containing (ii) ions. The article to be plated is placed as the (iii) of the cell in which the plating is carried out. The (iv) of the cell is made from pure nickel. The ions which are attracted to the negative electrode and discharged are called (v)

(h) The following questions relate to the Nitrogen Cycle. [5]

- i. What are the soluble nitrogen compounds absorbed by the roots of plants?
- ii. What kind of plants directly absorb nitrogen from the atmosphere?

- iii. What term is applied to the conversion of atmospheric nitrogen to useful compounds of nitrogen?
- iv. Compounds such as ammonium nitrate, urea and super-phosphate are used to replace nitrogen and other elements lost from the soil as a result of cultivation. What is the common name given to these compounds?
- v. What insoluble substance is used in making super-phosphate?

SECTION II (40 marks)
Attempt any four questions

Question 2

(a) [4]

- i. Name the oxide of sulphur which reacts with water to give sulphuric acid.
- ii. In the Contact Process, the direct reaction between the oxide of sulphur and water is avoided. In this process, what does the oxide of sulphur react with instead of water and what is the name of the product?
- iii. Give the name and formula of the acid salt which can give sodium ions and sulphate ions in solution.

Question 2

(b) The metal zinc is extracted from the ore zinc blende: [3]

- i. Name the zinc compound in zinc blende.
- ii. Zinc blende when roasted in air gives off a gas which, if allowed to escape, would constitute an atmospheric pollutant. What is this gas?
- iii. What particular polluting effect does this gas have?

(c) Write correctly balanced equations for the reaction of dilute sulphuric acid with each of following: [3]

- i. Copper carbonate,
- ii. Lead nitrate solution,
- iii. Zinc hydroxide.

Question 3

(a) The following reactions are carried out:

A : Nitrogen + Metal \rightarrow Compound X

B : X + Water \rightarrow Ammonia + Another compound.

C : Ammonia + Metal oxide \rightarrow Metal + Water + Nitrogen. [4]

- i. One metal that can be used for reaction A is magnesium.
 1. State the conditions for the reaction.

2. Write the formula of the compound X formed when nitrogen and magnesium react together
- Write the correctly balanced equation for reaction B where X is the compound formed between nitrogen and magnesium.
 - What property of ammonia is demonstrated by reaction C?
- (b) Industrially, ammonia is obtained by direct combination between nitrogen and hydrogen. [3]
- Write the correctly balanced equation for the direct combination of nitrogen and hydrogen.
 - Which of the metals-iron, platinum, copper-catalyse this direct combination?
 - Is the formation of ammonia promoted by the use of high pressure or low pressure?
- (c) [3]
- Is ammonia more dense or less dense than air?
 - What property of ammonia is demonstrated by the Fountain experiment?
 - Write the correctly balanced equation for the reaction between ammonia and sulphuric acid.

Question 4

(a) [6]

- The compound A has the following percentage composition by mass: carbon 26.7%, oxygen 71.1%, hydrogen 2.2%. Determine the empirical formula of A. (Work to one decimal place)
(H = 1; C = 12; O = 16).
 - If the relative molecular mass of A is 90, what is the molecular formula of A?
 - The compound A is weak acid. What is meant by this statement?
- (b) Ammonia burns in oxygen and the combustion that takes place in the presence of a catalyst; may be represented by:
- $$2\text{NH}_3 + 2\frac{1}{2}\text{O}_2 \rightarrow 2\text{NO} + 3\text{H}_2\text{O} \quad [4]$$
- What mass of steam is produced when 1.5 g of nitrogen monoxide is formed?
 - What volume of oxygen, at S.T.P. is required to form 10 moles of products?
[H = 1; N = 14; O = 16; 1 mole of a gas occupies 22.4 dm³ (22.4 litre) at S.T.P.]

Question 5

(a) [4]

The table below compares some properties of metals and non-metals. Write down the missing statements from (i) to (iv): Metal Non-Metal

- i.
- ii. Malleable
- iii. Form positive ions
- iv.
 - (a) Poor conductors of heat
 - (b)
 - (c)
 - (d) Form acidic oxides

(b) [2]

- i. Metals are generally solid at room temperature. Name the metal which is liquid at room temperature (say 25°C).
- ii. Which allotrope of the non-metal carbon conducts electricity?

(c) [4]

- i. How many valence electrons are present in:
 - a. Metals
 - b. Non-metals?
- ii. Name all the particles found in a solution of sodium chloride.

Question 6

(a) [5]

- i. Ethane and chlorine react together to form monochloroethane (ethyl chloride).
 - a. Write down the structural formula of ethane.
 - b. What type of reaction has taken place between ethane and chlorine?
- ii. The type of reaction between ethene and chlorine is different from that between ethane and chlorine.
 - a. What is the type of reaction between ethene and chlorine?
 - b. What feature of the ethene structure makes such a reaction possible?
 - c. Name the product of the reaction between ethene and chlorine.

(b) Ethane burns completely in air or oxygen to give carbon dioxide (and water vapour). With a limited supply of air/oxygen, carbon monoxide is formed. The same gases are found in automobile exhaust gases. Both gases can be considered as atmospheric pollutants. [5]

- i. Write the equation for the complete combustion of ethane.
- ii. What danger is associated with carbon monoxide?

- iii. What effect is associated with too much carbon dioxide in the atmosphere?
- iv. Burning acetylene (ethyne) in oxygen under appropriate conditions produces a very hot flame. What is the hot flame used for?

Question 7

(a) Solution P has p^H of 13, solution Q has a p^H of 6 and solution R has a p^H of 2. [3]

- i. Which solution will liberate ammonia from ammonium sulphate on heating?
- ii. Which solution is a strong acid?
- iii. Which solution contains solute molecules as well as ions?

(b) From the list of substance given below, choose the pair required to prepare the salts from (i) to (iii) in the laboratory and write down the relevant equations.

The substances are:

Chlorine, iron, lead nitrate solution, sodium nitrate solution, iron (III) carbonate, lead carbonate, iron (III) hydroxide, sodium hydroxide solution and dilute hydrochloric acid.

The salt are: [6]

- i. Sodium chloride.
- ii. Lead chloride.
- iii. Anhydrous iron (III) chloride.

(c) All ammonium salts are decomposed on heating. What other property do ammonium salts have in common? [1]