ICSE Paper 2005

CHEMISTRY

SECTION-I (40 Marks)

(Compulsory : Attempt all questions.)

Question 1.

(a) *Write balanced equations for the following reactions :*

(i) *Potassium hydrogen carbonate and dilute Sulphuric acid.*

(ii) *Copper oxide and dilute Hydrochloric acid.*

(iii) *Manganese (IV) oxide and concentrated Hydrochloric acid.*

(iv) *Sulphur and hot concentrated Nitric acid.*

(v) *Sodium nitrate and concentrated Sulphuric acid.* **[5]**

(b) *The volumes of gases A, B, C and D are in the ratio 1 : 2 : 2 : 4 under the same conditions of temperature and pressure.*

(i) *Which sample of gas contains the maximum number of molecules ?*

(ii) *If the temperature and the pressure of gas A are kept constant, then what will happen to the volume of A when the number of molecules is doubled ?*

(iii) *If this ratio of gas volumes refers to the reactants and products of a reaction, which gas law is being observed ?*

(iv) *If the volume of A is actually 5·6 dm^3 at s.t.p., calculate the number of molecules in the actual volume of D at s.t.p. (Avogadro's Number is 6×10^{23}).*

(v) *Using your answer from (iv), state the mass of D if the gas is Dinitrogen oxide (N_2O). (N = 14; O = 16).* **[5]**

(c) (i) *Explain why Copper, though a good conductor of electricity, is a non-electrolyte.*

(ii) *Name the gas released at the cathode when acidulated water is electrolysed.*

(iii) *Explain why solid Sodium chloride does not allow electricity to pass through.*

(iv) *Fill in the blanks :*

(1) *As we descend the electrochemical series containing cations, the tendency of the cations to get ..... (oxidized/reduced) at the cathode increases.*

(2) *The (higher/lower) ..... the concentration of an ion in a solution, the greater is the probability of its being discharged at its appropriate electrode.* **[5]**

(d) *Parts (i) to (v) refer to changes in the properties of elements on moving left to right across a period of the Periodic Table. For each property, choose the letter corresponding to the correct answer from the choices A, B, C and D.*

(i) *The non-metallic character of the elements :*

(A) *decreases* (B) *increases*

(C) *remains the same* (D) *depends on the period.*

(ii) *The electronegativity :*

(A) *depends on the number of valence electrons.*

(B) *remains the same*

(C) *decreases* (D) *increases*

(iii) *The ionization potential :*

(A) *goes up and down* (B) *decreases*

(C) *increases* (D) *remains the same.*

(iv) *The atomic size :*

(A) *decreases* (B) *increases*

(C) *remains the same*

(D) *sometimes increases and sometimes decreases*

(v) *The electron affinity of the elements in groups 1 to 7 :*

(A) *goes up and then down* (B) *decreases and then increases*

(C) *increases* (D) *decrease.* **[5]**

(e) *The questions (i) to (v) refer to the following salt solutions listed A to F :*

(A) *Copper nitrate* (B) *Iron (II) sulphate*

(C) *Iron (III) chloride* (D) *Lead nitrate*

(E) *Magnesium sulphate* (F) *Zinc chloride*

(i) *Which two solutions will give a white precipitate when treated with dilute Hydrochloric acid followed by Barium chloride solution ?*

(ii) *Which two solutions will give a white precipitate when treated with dilute Nitric acid followed by Silver nitrate solution ?*

(iii) *Which solution will give a white precipitate when either dilute Hydrochloric acid or dilute Sulphuric acid is added to it ?*

(iv) *Which solution becomes a deep/inky blue colour when excess of Ammonium hydroxide is added to it ?*

(v) *Which solution gives a white precipitate with excess Ammonium hydroxide solution ?* **[5]**

(f) *A to F below relate to the source and extraction of either Zinc or Aluminium :*

(A) *Bauxite* (B) *Coke*

(C) *Cryolite* (D) *Froth floatation*

(E) *Sodium hydroxide solution* (F) *Zinc blende.*

(i) *Write down the three letters each from the above list which are relevant to :*

(1) *Zinc* (2) *Aluminium*

(ii) *Fill in the blanks using the most appropriate words from A to F :*

(1) *The ore from which Aluminium is extracted must first be treated with ..... so that pure Aluminium oxide can be obtained.*

(2) *Pure Aluminium oxide is dissolved in ..... to make a conducting solution.*

(iii) *Write the formula of Cryolite.* **[5]**

(g) *Match the descriptions (i) to (v) below with the appropriate term from the list A to J :*

(A)	*Acidic oxide*	(B)	*Alkali*	(C)	*Amphoteric oxide*
(D)	*Basic oxide*	(E)	*Deliquescence*	(F)	*Efflorescence*
(G)	*Electrolysis*	(H)	*Electrolyte*	(I)	*Homologous series*
(J)	*Hydrocarbons*				

(i) *The property of spontaneously giving up water of crystallization to the atmosphere.*

(ii) *A liquid or solution, which conducts electricity with accompanying chemical change.*

(iii) *A compound, which is soluble in water and the only negative ions in the solution are Hydroxide ions.*

(iv) *An oxide, which forms salts when it reacts with both acids and alkalis.*

(v) *A set of compounds having the same general formula, similar methods of preparation and similar chemical properties.* **[5]**

(h) *The bleaching action of Chlorine is permanent whereas the bleaching action of Sulphur dioxide is temporary. In this context :* **

(i) *Give a reason why Chlorine is not used to bleach silk.*

(ii) *State the similarity in the use of Sulphur dioxide and Chlorine as bleaching agents.*

(iii) *Explain the bleaching action of Sulphur dioxide with the help of chemical equations.*

(iv) *Why is bleaching by Sulphur dioxide only temporary ?* **[5]**

Answer

(a) (i) $2KHCO_3 + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O + 2CO_2\uparrow$

(ii) $CuO + 2HCl \longrightarrow CuCl_2 + H_2O$

(iii) $MnO_2 + 4\ HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2$

(iv) $S + 6HNO_3 \longrightarrow H_2SO_4 + 6NO_2 + 2H_2O$

(v) $NaNO_3 + H_2SO_4 \longrightarrow NaHSO_4 + HNO_3$

(b) (i) D

(ii) Volume will get doubled.

(iii) Gay Lussac's law of combining volumes.

(iv)

gases	A		D
vol.	1	:	4
	5·6 dm^3	:	$4 \times 5{\cdot}6\ dm^3$ at s.t.p.
			$22{\cdot}4\ dm^3$ (molar volume)
			6×10^{23} molecules.

(v) $6 \times O^{23}$ molecules is Avogadro's Number of molecules contained in one gram mole of the substance.

If gas D is N_2O then,

One gram mole of $N_2O = 2 \times 14 + 16$

$= 44$ g. **Ans.**

** *Answer has not given due to out of present syllabus.*

(c) (i) Because copper metal is solid and does not have mobile ions whereas an electrolyte should dissociate into opposited charged ions to carry the electric current.

(ii) Hydrogen.

(iii) Because in solid sodium chloride Na^+ and Cl^- ions are not free to carry the electric current.

(iv) (1) reduced. (2) higher.

(d) (i) (B) (increases) (ii) (D) (increases) (iii) (C) (increases)

(iv) (A) (decreases) (v) (C) (increases)

(e) (i) B and **E** (Iron II sulphate and Magnesium sulphate).

(ii) C and **F** (Iron III chloride and Zinc chloride).

(iii) D (lead nitrate)

(iv) A (Copper sulphate)

(v) D (Lead nitrate)

(f) (i) (1) B, D, F (2) A, C, E

(ii) (1) Sodium hydroxide (2) Cryolite

(iii) Na_2AlF_6

(g) (i) —(F) Efflorescence (ii) —(H) Electrolyte

(iii) —(B) Alkali (iv) —(C) Amphoteric oxide

(v) —(I) Homologous Series.

Section—II (40 Marks)

*(Attempt any **four** questions.)*

Question 2.

(a) *Draw the structural formula of a compound which two carbon atoms is each of the following cases :*

(i) *An alkane with a carbon to carbon single bond.*

(ii) *An alcohol containing two carbon atoms.*

(iii) *An unsaturated hydrocarbon with a carbon to carbon triple bond.* **[3]**

(b) *Ethane, Ethene, Ethanoic acid, Ethyne, Ethanol*

From the box given above, name :

(i) *The compound with —OH as the part of its structure.*

(ii) *The compound with —COOH as the part of its structure.*

(iii) *Homologue of Homologous series with general formula C_nH_{2n}.* **[3]**

(c) *Write the equations for the following laboratory preparations :*

(i) *Ethane from Sodium propionate.*

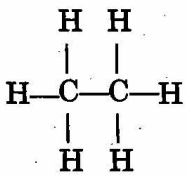
(ii) *Ethene from Iodoethane.*

(iii) *Ethyne from Calcium carbide.*

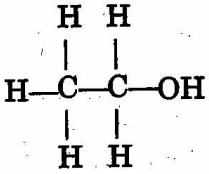
(iv) *Methanol from Iodomethane.* **[4]**

Answer

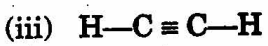
(a) (i)



(ii)



(iii)



(b) (i) Ethanol (ii) Ethanoic acid (iii) Ethene

(c) (i) $CH_3CH_2COONa + NaOH \xrightarrow[\Delta]{CaO} C_2H_6 + Na_2CO_3$

(ii) $CH_3CH_2I + KOH_{(alc.)} \longrightarrow C_2H_4 + KI + H_2O$

(iii) $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$

(iv) $CH_2I + KOH_{(aq)} \longrightarrow CH_3OH + KI$

Question 3.

(a) *What is observed when :*

(i) *Hydrogen sulphide gas is passed through Lead acetate solution.***

(ii) *Neutral litmus solution is added to Sodium hydrogen carbonate solution.*

(iii) *A small piece of Iron is placed in Copper sulphate solution.* **[3]**

(b) *The preparation of Lead sulphate from Lead carbonate is a two-step process. (Lead sulphate cannot be prepared by adding dilute Sulphuric acid to Lead carbonate).*

(i) *What is the first step that is required to prepare Lead sulphate from Lead carbonate ?*

(ii) *Write the equation for the reaction that will take place when this first step is carried out.*

(iii) *Why is the direct addition of dilute Sulphuric acid to Lead carbonate an impractical method of preparing Lead sulphate ?* **[3]**

(c) *Fill in the blanks with suitable words :*

An acid is a compound which when dissolved in water forms Hydronium ions as the only (1) ..... *ions. A base is a compound which if soluble in water contains* (2) ..... *ions. A base reacts with an acid to form a* (3) ..... *and water only. This type of reaction is known as* (4) ..... . **[4]**

Answer

(a) (ii) Litmus turns blue.

(iii) A red shiny metal ppts.

(b) (i) Lead carbonate is first treated with dil. HNO_3.

(ii) $PbCO_3 + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O + CO_2$.

(iii) Lead carbonate and lead sulphate both are insoluble in water. When dil. H_2SO_4 is added to lead carbonate, lead sulphate formed deposits on the remaining lead carbonate stopping the further reaction.

Or

From an insoluble salt, another insoluble salt cannot be prepared by direct addition of a dilute acid.

(c) (1) Positive (2) Hydroxide (3) Salt (d) Neutralisation.

Question 4.

(a) *Compound X consists of molecules.*

Choose the letter corresponding to the correct answer from the choices A, B, C and D given below :

(i) *The type of bonding in X will be :*

(A) *ionic* (B) *electrovalent*

(C) *covalent* (D) *molecular*

(ii) *X is likely to have a :*

(A) *low melting point and high boiling point.*

(B) *high melting point and low boiling point.*

** *Answer has not given due to out of present syllabus.*

(C) *low melting point and low boiling point.*

(D) *high melting point and high boiling point.*

(iii) *In the liquid state, X will :*

(A) *become ionic* (B) *be an electrolyte*

(C) *conduct electricity* (D) *not conduct electricity.* **[3]**

(b) *Electrons are getting added to an element Y.*

(i) *Is Y getting oxidized or reduced ?*

(ii) *What charge will Y have after the addition of electrons ?*

(iii) *Which electrode will Y migrate to during the process of electrolysis ?* **[3]**

(c) (i) *Acids dissolve in water to produce positively charged ions. Draw the structure of these positive ions.*

(ii) *Explain why Carbon tetrachloride does not dissolve in water.*

(iii) *Elements Q and S react together to form an ionic compound. Under normal conditions, which physical state will the compound QS exist in ?*

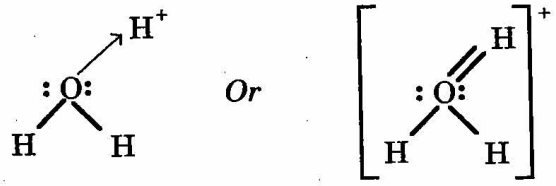
(iv) *Can Q and S, both be metals ? Justify your answer.* **[4]**

Answer

(a) (i) (C) (ii) (C) (iii) (D)

(b) (i) Reduced (ii) Negative (iii) Anode

(c) (i)



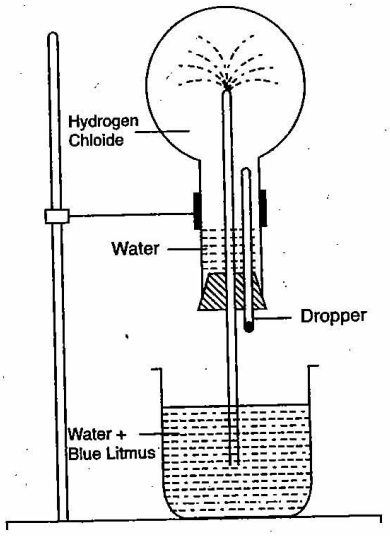
(ii) Because carbon tetrachloride is non-polar covalent compound whereas water is a polar covalent solvent.

(iii) Solid state.

(iv) No. Because to form an ionic compound if one element gives electrons the other should accept electrons metals can only lose electrons and provide +ve ions.

Question 5.

(a)



(i) *Name the experiment illustrated above.*

(ii) *Which property of Hydrogen chloride is demonstrated by this experiment ?*

(iii) *State the colour of the water that has entered the round-bottomed flask.* **[3]**

(b) *A, B, C and D summarize the properties of Sulphuric acid depending on whether it is dilute or concentrated. Choose the property (A, B, C or D), depending on which is relevant to each of the preparations (i) to (iii) :*

(A) *Dilute acid (typical and properties)* (B) *Non-volatile acid*

(C) *Oxidizing agent* (D) *Dehydrating agent*

(i) *Preparation of Hydrogen Chloride.*

(ii) *Preparation of Ethene from Ethanol*

(iii) *Preparation of Copper sulphate from Copper oxide.* **[3]**

(c) *In the manufacture of Iron, a mixture of Limestone, Coke and Iron ore is added to the blast furnace. In this context :*

(i) *State the purpose of adding Limestone to the furnace.*

(ii) *Give the equation for the reduction of the Iron ore.*

(iii) *Name the substance which is collected along with Cast iron at the bottom of the furnace.*

(iv) *Write the chemical equation for the formation of the substance named in* (iii) *above.* **[4]**

Answer

(a) (i) Fountain experiment

(ii) High solubility of hydrogen chloride in water.

(iii) red

(b) (i) (B) non-volatile acid

(ii) (D) dehydrating agent

(iii) (A) dilute acid.

(c) (i) To act as a flux.

(ii) $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

(iii) Fusible slag (calcium silicate)

(iv) $CaO + SiO_2 \longrightarrow CaSiO_3$

Question 6.

(a) (i) *Dilute Nitric acid is generally considered a typical acid except for its reaction with metals. In what way is dilute Nitric acid different from other acids when it reacts with metals ?*

(ii) *Write the equation for the reaction of dilute Nitric acid with Copper.*

(iii) *Account for the yellow colour that appeals in concentrated Nitric acid when it is left standing in an ordinary glass bottle.* **[3]**

(b) (i) *Which feature of the Ammonia molecule leads to the formation of the Ammonium ion when Ammonia dissolves in water ?*

(ii) *Name the other ion formed when Ammonia dissolves in water.*

(iii) *Give one test that can be used to detect the presence of the iron produced in (b) (ii).* **[3]**

(c) (i) *Write the equations for the following reactions which result in the formation of Ammonia :*

(1) *A mixture of Ammonium chloride and slaked Lime is heated.*

(2) *Aluminium nitride and water.*

(ii) *Calculate the percentage of Nitrogen in Aluminium nitride. (Al = 27, N = 14).* **[4]**

Answer

(a) (i) It acts as an oxidising agent so hydrogen gas is not liberated instead.

No gas and water are formed.

(ii) $3Cu + 8HNO_3 \longrightarrow 3\ Cu(NO_3)_2 + 4H_2O + 2NO$

(iii) Conc. HNO_3 is unstable to heat. So on standing in an ordinary glass bottle it absorbs heat from the surrounding and gets decomposed liberating NO_2 gas which turns conc. nitric acid yellow.

(b) (i) In ammonia molecule there is one lone pair of electrons available on nitrogen atom. This loan pair of electron leads to the formation of ammonium ion.

(ii) Hydroxide ion (OH^-)

(iii) It will give reddish brown ppt with aqueous $FeCl_3$.

(c) (i) (1) $2NH_4Cl + Ca(OH)_2 \longrightarrow CaCl_2 + 2NH_3 + 2H_2O$

(2) $Al\ N + 3H_2O \longrightarrow Al(OH)_3 + NH_3$

(ii) Al N

27 + 4 = 41

$$\% \text{ of nitrogen} = \frac{14 \times 100}{41} = 34{\cdot}14\%$$ **Ans.**

Question 7.

(a) *The equations given below relate to the manufacture of Sodium carbonate (Molecular weight of Na_2CO_3 = 106).*

(1) $NaCl + NH_3 + CO_2 + H_2O \longrightarrow NaHCO_3 + NH_4Cl$

(2) $2NaHCO_3 \longrightarrow Na_2CO_3 + H_2O + CO_2$

Questions (a) and (b) are based on the production of 21.2g of Sodium carbonate.

(a) *What mass of Sodium hydrogen carbonate must be heated to give 21.2 g of Sodium carbonate (Molecular weight of $NaHCO_3$ = 84) ?* **[3]**

(b) *To produce the mass of Sodium hydrogen carbonate calculate in (a), what volume of Carbon dioxide, measured at s.t.p., would be required ?* **[3]**

(c) (i) *Define the following terms :*

(1) *Atomic weight.* (2) *Catenation*

(ii) *Calcium, Copper, Lead, Aluminium, Zinc, Chromium, Magnesium, Iron.*

Choose the major metals from the list given above to make the following alloys :

(1) *Stainless steel.* (2) *Brass.* **[4]**

Answer

(a)

$$\underset{2\,(23+1+12+48)}{2\,NaHCO_3} \longrightarrow \underset{(23\times 2+12+48)}{Na_2CO_3} + H_2O + CO_2$$

$$\underset{2\times 84}{168} \qquad\qquad \underset{106}{106}$$

$\because$ 106g of Na_2CO_3 is obtained from 168 g of $NaHCO_3$.

$\therefore$ 21·2g of Na_2CO_3 is obtained from $\frac{168}{106} \times 21{\cdot}2 = 33{\cdot}6$ g.

(b)

$$\underset{\substack{1\text{ mole}\\ 22{\cdot}4\text{ l at stp}}}{NaCl + NH_3 + CO_2 + H_2O} \longrightarrow \underset{\substack{1\text{ mole}\\ 84\text{ g}}}{NaHCO_3} + NH_4Cl$$

$\because$ 84 g of $NaHCO_3$ requires 22·4 l of CO_2

$\therefore$ 33·6 g of $NaHCO_3$ requires $= \frac{22{\cdot}4}{84} \times 33{\cdot}6$

$= 8{\cdot}96\ l.$

(c) (i) (1) **Atomic Weight :** It is the number of times an elements' atom is heavier than 1/12th mass of an atom of carbon C^{12} isotope.

(2) **Catenation :** Property of elements to join together to form long chains is called catenation.

(ii) (1) Iron, Chromium

(2) Copper and Zinc.