ICSE BOARD

Class X Chemistry

Board Paper – 2017 (Solution)

Section I

1.

(a)

(i) The energy required to remove an electron from a neutral isolated gaseous atom and convert it to a positively charged gaseous ion is called ionisation potential.

(ii) The compound that does not have a lone pair of electrons is carbon tetrachloride.

(iii) When a metal oxide is dissolved in water, the solution formed has a high concentration of OH^-.

(iv) Potassium sulphite on reacting with hydrochloric acid releases SO_2 gas.

(v) The compound formed when ethane reacts with hydrogen is C_2H_6.

(b)

(i) (4) Copper chloride

$CuCl_2 + 2NH_4OH \rightarrow Cu(OH)_2\downarrow + 2NH_4Cl$

With excess of NH_4OH, the ppt. dissolves.

(ii) (3) alkyne

Alkyne has general molecular formula C_nH_{2n-2}.

(iii) (2) consist of molecules

Ionic compound has a high melting point, is always soluble in water and conducts electricity when it is in the molten state. Covalent compounds consist of molecules.

(iv) (3) an alkali

Lower range of pH scale (1 to 6) represents acidic nature, while upper range of pH scale (8 to 14) represents alkaline nature. Therefore, to increase the pH value of a neutral solution (pH = 7), we should add an alkali.

(v) (1) direct combination

Anhydrous $FeCl_3$ cannot be prepared by simply heating hydrated ferric chloride $FeCl_3.6H_2O$, because on heating, $FeCl_3.6H_2O$ produces Fe_2O_3, H_2O and HCl.

$$2[FeCl_3.6H_2O] \xrightarrow{\Delta} Fe_2O_3 + 9H_2O + 6HCl$$

Direct combination of elements means heating two elements together.

$$\text{Metal} + \text{Non metal} \rightarrow \text{Salt (Soluble / Insoluble)}$$
$$2Fe + 3Cl_2 \rightarrow 2FeCl_3$$

(c)

(i) **Cation** that does not form a precipitate with ammonium hydroxide but forms one with sodium hydroxide: **Ca^{2+}**

(ii) The **electrolyte** used for electroplating an article with silver: **Sodium argentocyanide or potassium argentocyanide**

(iii) The **particles** present in a liquid such as kerosene that is a non-electrolyte: **Molecules**

(iv) An **organic compound** containing –COOH functional group: **Carboxylic acid**

(v) A **solid** formed by a reaction of two gases, one of which is acidic and the other basic in nature: **Salt**

(d)

(i) $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO\uparrow$

(ii) $3CuO + 3NH_3 \rightarrow 3Cu + 3H_2O + N_2\uparrow$

(iii) $CH_3I + 2[H] \rightarrow CH_4 + HI$

(iv) $S + 2H_2SO_4 \rightarrow 3SO_2 + 2H_2O$

(v) $2NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O + 2NH_3\uparrow$

(e)

(i) On addition of ethyl alcohol to acetic acid in the presence of conc. H_2SO_4 at high temperature, sweet smelling ethyl acetate ester is produced, and the process is known as esterification.
$C_2H_5OH + CH_3COOH \rightarrow CH_3COOC_2H_5 + H_2O$

(ii) Dilute hydrochloric acid decomposes iron(II) sulphide to produce iron(II) chloride and hydrogen sulphide having rotten egg smell.
$FeS + 2HCl \rightarrow FeCl_2 + H_2S$

(iii) When ferrous sulphate reacts with sodium hydroxide, dirty green gelatinous ppt. of ferrous hydroxide is formed along with colourless sodium sulphate.
$FeSO_4 + 2NaOH \rightarrow Fe(OH)_2\downarrow + Na_2SO_4$

(iv) Since ammonia is not a supporter of combustion, it extinguishes a burning splint and does not burn in air.

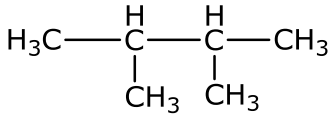
(v) Concentrated sulphuric acid removes water of crystallisation from blue-coloured hydrated copper sulphate to form white anhydrous copper sulphate.

$$\underset{\text{Blue}}{CuSO_4.5H_2O} \xrightarrow{H_2SO_4} \underset{\text{Dirty white}}{CuSO_4} + 5H_2O$$

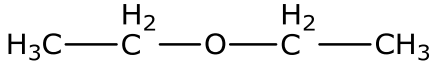
(f)

(i)

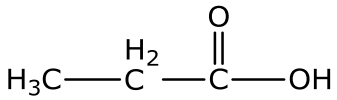
1. 2, 3-dimethyl butane



2. diethyl ether



3. propanoic acid



(ii)

1. The process of crushing ores into a fine powder in big crushers and ball mills is known as **pulverisation**.
2. Heating of the ore in the absence of air to a high temperature that is high but insufficient to melt the ore is known as **calcination**.

(g)

(i)

Given :

Mass of sodium = 4.6 g

Atomic mass of $Na = 23$

Number of gram atoms = ?

$$\text{Number of gram atoms of Na} = \frac{\text{Mass of Na}}{\text{Atomic mass of Na}}$$

$$= \frac{4.6\,g}{23\,g} = 0.2\,g \text{ molecules of Sodium}$$

(ii)

Given :

Atomic mass of H = 1

Atomic mass of $O = 16$

Atomic mass of $S = 32$

Atomic mass of $Cu = 64$

$$\text{Molar mass of } CuSO4.5H_2O = (64) + (32) + (9 \times 16) + (10 \times 1)$$

$$= 250$$

$$\text{Molar mass of five water molecules} = (10 \times 1) + (5 \times 16)$$

$$= 90$$

$$\text{Percentage of water of crystallisation} = \frac{90 \times 100}{250} = 36\,\% \text{ water of crystallisation}$$

(iii)

Given :

Empirical formula $= XY_2$

Vapour density = Empirical formula weight

Molecular formula = ?

Molecular weight = n(Empirical formula weight)

$$= 2 \times \text{V.D.}$$

n(Empirical formula weight) $= 2 \times$ V.D.

Since, Vapour density = Empirical formula weight

$n = 2$

Molecular formula = 2(Empirical formula)

$$= 2(XY_2)$$

Molecular formula = X_2Y_4

(h)

	Atomic number
(i) A solid non-metal belonging to the third period.	15
(ii) A metal of valency 1.	19
(iii) A gaseous element with valency 2.	8
(iv) An element belonging to Group 2.	4
(v) A rare gas.	2

Section II

2.

(a)

(i) He < Ne <Ar
(ii) P < Na < Li
(iii) Br < Cl < F
(iv) Li < Na < P

(b)

(i) Polar covalent bond
(ii) Ionic bond

(c)

(i) Ammonium hydroxide when added to copper sulphate drop-wise forms a pale blue ppt. of copper hydroxide which dissolves in excess of ammonium hydroxide to form a deep blue solution of tetrammine copper sulphate.

$$CuSO_4 + 2NH_4OH \longrightarrow Cu(OH)_2 + (NH_4)_2SO_4$$

pale blue ppt. colourless in solution

With excess of NH_4OH ppt. dissolves

$$Cu(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH \longrightarrow [Cu(NH_3)_4]SO_4 + 4H_2O$$

Tetrammine Copper (II) sulphate

Sodium hydroxide when added to copper sulphate drop-wise forms a pale blue ppt. of copper hydroxide which is insoluble in excess of sodium hydroxide solution.

$$CuSO_4 + 2NaOH \longrightarrow Cu(OH)_2 + Na_2SO_4$$

pale blue ppt. colourless

(ii) Sulphuric acid precipitates the insoluble sulphate from lead nitrate solution.

$$Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4 + 2HNO_3$$

Lead nitrate reacts with hydrochloric acid to give a white ppt. of lead chloride.

$$Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$$

(d)

(i) KCl

(ii) $ZnCO_3$

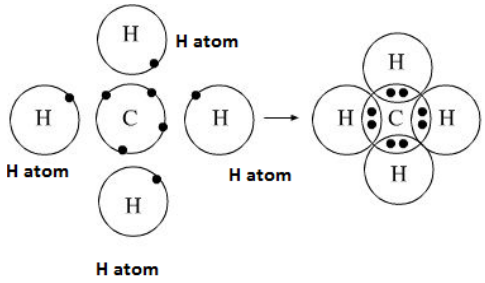
3.

(a)

(i) Formation of methane molecule:

Atom	Electronic configuration	Nearest noble gas	To attain stable electronic configuration of nearest noble gas
Carbon	$^{12}_{6}C$ [2,4]	Neon [2,8]	Carbon needs four electrons to complete the octet.
Hydrogen	$^{1}_{1}H$ [1]	Helium [2]	Hydrogen needs one electron to complete the duplet.

One atom of carbon shares four electron pairs, one with each of the four atoms of hydrogen.



(ii) Magnesium atom loses 2 electrons to attain a stable electronic configuration and becomes a cation.

Example: $Mg \xrightarrow{-2e^-} Mg^{2+}$

2, 8, 2 → 2, 8

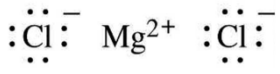
A non-metallic atom like chlorine gains 1 electron to attain a stable electronic configuration and becomes an anion.

Example: $Cl \xrightarrow{+e^-} Cl^-$

2, 8, 7 → 2, 8, 8

Cations and anions are oppositely charged particles which attract one another to form an electrovalent bond leading to the formation of an electrovalent compound.

Here magnesium donates one electron each with two chlorine atoms resulting in the formation of magnesium chloride.



(b)

(i) Observations:
Anode: Dark reddish brown fumes of bromine evolve at the anode.
Cathode: Greyish white metal lead is formed on the cathode.

(ii) Observations:
Anode: Nothing gets deposited on the anode because the copper anode dissolves during the reaction as Cu^{2+} ions are formed.
Cathode: Reddish brown Cu is deposited.

(c)

(i) OH^-

(ii) Ag^+

4.

(a)

(i) A = $NaHSO_4$ + HCl
B = upward displacement of air

(ii) C = Mg_3N_2 + H_2O
D = Quicklime
E = downward displacement of air

(b)

(i) $C + 2H_2SO_4 \longrightarrow CO_2 + 2H_2O + 2SO_2 \uparrow$

(ii) $Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2 \uparrow$

(iii) $C_{12}H_{22}O_{11} \xrightarrow{H_2SO_4} 12C + 11H_2O$

(c)

$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$ oleum or pyrosulphuric acid

$H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$

5.

(a)

(i)

Given:

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

Volume of air = 1000 cm^3

Percentage of oxygen in air = 20%

From the given information,

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

1 vol 5 vols 3 vols 4 vols

According to Gay-Lussac's law,

1 vol. of propane consumes 5 vol. of oxygen.

Volume of oxygen = 1000 cm^3 × 20% = 200 cm^3

Therefore,

Volume of propane burnt for every 200 cm^3 of oxygen,

$= \frac{1}{5} \times 200 = 40\,cm^3$

40 cm^3 of propane is burnt.

(ii) Given:

Volume of gas at STP = 11.2 litres

Mass of gas at STP = 24 g

Gram molecular mass = ?

The mass of 22.4 L of a gas at STP is equal to its gram molecular mass.

11.2 L of the gas at STP weighs 24 g

Therefore,

22.4 L of the gas will weigh

$\frac{24}{11.2} \times 22.4 = 48\,g$

Gram molecular mass = 48 g

(b)

Given:

Mass of hydrogen = 1 kg at 298 K and 1 atm pressure

(i) Moles of hydrogen =?

$$\text{Number of moles of hydrogen} = \frac{\text{Mass of hydrogen}}{\text{Gram atomic mass of hydrogen}}$$

$$= \frac{1000\,\text{g}}{1\,\text{g}}$$

$$= 1000\,\text{moles of hydrogen}$$

(ii)

At STP, 1 mole of any gas occupies 22.4 L.

So, at STP, 1000 moles of CO_2 will occupy the same space as that of hydrogen.

Atomic masses of C and O are 12 and 16, respectively.

Molar mass of CO_2 = 12 + 32 = 44 g

1000 moles of CO_2 = 44 × 1000 = 44000 g = 44 kg CO_2

Thus, the cylinder can hold 44 kg CO_2.

(iii) 1 mole of any gas = 6.022×10^{23} molecules

1000 moles of hydrogen = 6.022×10^{26} molecules = X

As the number of moles of hydrogen and CO_2 are the same,

the number of molecules of CO_2 = X = 6.022×10^{26} molecules of CO_2.

(iv) Avogadro's law states that under the same conditions of temperature and pressure, equal volumes of different gases have the same number of molecules.

(c)

(i) $CuO + CO_2 \longrightarrow CuCO_3$

(ii) $2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$

6.

(a)

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

(ii) $4NH_3 + 5O_2 \xrightarrow[800^0C]{Pt} 4NO + 6H_2O + Heat$

(iii) $KNO_3 + H_2SO_4 \xrightarrow{<200^0C} KHSO_4 + HNO_3$

(iv) $NH_3 + HNO_3 \longrightarrow NH_4NO_3$

(b)

(i) Glacial acetic acid
(ii) Acetylene
(iii) Isomerism
(iv) Ketones

(c)

(i) $C_2H_5COONa + NaOH \xrightarrow[300^\circ C]{CaO} Na_2CO_3 + C_2H_6 \uparrow$

(ii) $CH_3CH_2Br + KOH \rightarrow CH_2 = CH_2 + KBr + H_2O$

7.

(a)

(i) Electroplating
(ii) Solder
(iii) Zinc blende
(iv) PbO or CuO

(b)

(i) Components of electrolyte: Cryolite and fluorspar
Role played by each electrolyte is given below:
- Cryolite lowers the fusion temperature from 2050°C to 950°C and enhances conductivity.
- Fluorspar and cryolite act as a solvent for the electrolytic mixture and increase conductivity.

(ii) Powdered coke is sprinkled over the surface of the electrolytic mixture for the following reasons:
- Reduces heat loss by radiation
- Prevents burning of the anode

(c)

(i) Cu
(ii) Pb
(iii) Al