SCIENCE

Paper 2 (Chemistry) — 2017 (SOLVED)

(Two hours)

Answers to this Paper must be written on the paper provided separately.

*You will not be allowed to write during the first **15** minutes.*

This time is to be spent in reading the Question Paper.

The time given at the head of this paper is the time allowed for writing the answers.

***Section I** is compulsory. Attempt **any four** questions from **Section II**.*

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) Fill in the blanks from the choices given in brackets. **[5]**

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

Ans. ionisation potential

(ii) The compound that does not have a lone pair of electrons is ..... . (water, ammonia, carbon tetra chloride).

Ans. carbon tetrachloride

(iii) When a metallic oxide is dissolved in water, the solution formed has a high concentration of ..... . (H^+, H_3O^+, OH^-).

Ans. OH^-

(iv) Potassium sulphite on reacting with hydrochloric acid releases ..... gas. (Cl_2, SO_2, H_2S).

Ans. SO_2

(v) The compound formed when ethene reacts with Hydrogen is ..... . (CH_4, C_2H_6, C_3H_8).

Ans. C_2H_6

(b) Choose the ***correct answer*** from the options given below : **[5]**

(i) A **chloride** which forms a precipitate that is soluble in excess of ammonium hydroxide, is :

(a) Calcium chloride (b) Ferrous chloride (c) Ferric chloride (d) Copper chloride

Ans. (d) Copper chloride

(ii) If the molecular formula of an organic compound is $\mathbf{C_{10}H_{18}}$ it is :

(a) alkene (b) alkane (c) alkyne (d) Not a hydrocarbon

Ans. (c) alkyne

(iii) Which of the following is a common characteristic of a **covalent compound** ?

(a) high melting point (b) consists of molecules

(c) always soluble in water (d) conducts electricity when it is in the molten state

Ans. (b) consists of molecules

(iv) To increase the **pH** value of a neutral solution, we should add :

(a) an acid (b) an acid salt (c) an alkali (d) a salt

Ans. (c) an alkali

(v) **Anhydrous iron (III) chloride** is prepared by :

(a) direct combination (b) simple displacement

(c) decomposition (d) neutralization

Ans. (a) direct combination

(c) Identify the ***substance*** underline, in each of the following cases : **[5]**

(i) **Cation** that does not form a precipitate with ammonium hydroxide but forms one with sodium hydroxide.

Ans. Ca^{2+} or calcium

(ii) The **electrolyte** used for electroplating an article with silver.

Ans. Sodium argentocyanide or potassium argentocyanide.

(iii) The **particles** present in a liquid such as kerosene, that is a non electrolyte.

Ans. Molecules

(iv) An **organic compound** containing — COOH functional group.

Ans. Carboxylic acid

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

Ans. Ammonium chloride

(d) Write a ***balanced chemical equation*** for each of the following : **[5]**

(i) Action of cold and dilute Nitric acid on copper.

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

(ii) Reaction of Ammonia with heated copper oxide.

Ans. $3CuO + 2NH_3 \rightarrow 3Cu + 3H_2O + N_2$

(iii) Preparation of methane from iodomethane.

Ans. $CH_3I + 2[H] \xrightarrow{Zn + dil\ HCl} CH_4 + HI$

(iv) Action of concentrated sulphuric acid on Sulphur.

Ans. $S + 2H_2SO_4 \rightarrow 3SO_2 + 2H_2O$

(v) Laboratory preparation of ammonia from ammonium chloride.

Ans. $2NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O + 2NH_3$

(e) State ***one*** relevant observation for each of the following reactions : **[5]**

(i) Addition of ethyl alcohol to acetic acid in the presence of concentrated Sulphuric acid.

Ans. Pleasant smell of ester.

(ii) Action of dilute Hydrochloric acid on iron (II) sulphide.

Ans. Offensive smelling gas H_2S is evolved.

(iii) Action of Sodium hydroxide solution on ferrous sulphate solution.

Ans. Green ppt of Iron (II) hydroxide is formed.

(iv) Burning of ammonia in air.

Ans. Ammonia burns with a yellowish green flame.

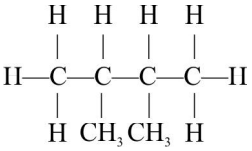
(v) Action of concentrated Sulphuric acid on hydrated copper sulphate.

Ans. Blue copper sulphate turns white.

(f) (i) Draw the ***structural formula*** for each of the following : **[5]**

1. 2, 3 — dimethyl butane
2. diethyl ether
3. propanoic acid

Ans. 1.



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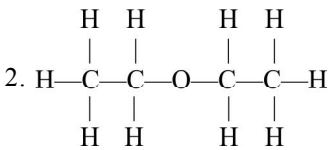

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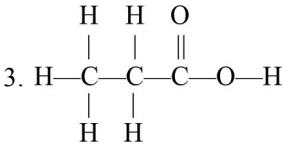


(ii) From the list of terms given, choose the most appropriate term to match the given description.

(*calcination, roasting, pulverisation, smelting*)

1. Crushing of the ore into a fine powder.

2. Heating of the ore in the absence of air to a high temperature

Ans. 1. Pulverisation 2. Calcination

(g) (i) Calculate the number of gram atoms in 4·6 grams of sodium (Na = 23.) **[5]**

Ans. 23 grams of Na is 1 gram atom

4·6 gram of Na is $\frac{1}{\cancel{230}_{10}} \times \overset{2}{\cancel{4{\cdot}6}} =$ **0·2 gram atoms**

(ii) Calculate the percentage of water of crystallization in $CuSO_4 \cdot 5H_2O$.

(H = 1, O = 16, S = 32, Cu = 64)

Ans. $\frac{5 \times 18}{250} \times 100 =$ **36%**

(iii) A compound of X and Y has the empirical formula XY_2. Its vapour density is equal to its empirical formula weight. Determine its molecular formula.

Ans. $n \times$ empirical formula wt $= 2 \times$ V.D.

$n = 2$

Molecular formula $= n$ (emperical formula)

$= 2\ (XY_2)$

$\therefore$ molecular formula $= X_2Y_4$

(h) Match the atomic number 2, 4, 8, 15 and 19 with each of the following : **[5]**

(i) A solid non metal belonging to the third period.

Ans. 15

(ii) A metal of valency 1.

Ans. 19

(iii) A gaseous element with valency 2.

Ans. 8

(iv) An element belonging to Group 2.

Ans. 4

(v) A rare gas.

Ans. 2

SECTION II (40 Marks)

*Attempt any **four** questions from this Section*

Question 2

(a) Arrange the following as per the instruction given in the brackets : **[4]**

(i) He, Ar, Ne (*Increasing order of the number of electron shells*)

Ans. He, Ne, Ar or He < Ne < Ar

(ii) Na, Li, K (*Increasing ionisation energy*)

Ans. K, Na, Li or K < Na < Li

(iii) F, Cl, Br (*Increasing electronegativity*)

Ans. Br, Cl, F or Br < Cl < F

(iv) Na, K, Li (*Increasing atomic size*)

Ans. Li, Na, K or Li < Na < K

(b) State the ***type of bonding*** in the following molecules : **[2]**

(i) Water

Ans. Covalent bonding

(ii) Calcium oxide

Ans. Electrovalent bonding

(c) Answer the following questions : **[2]**

(i) How will you distinguish between Ammonium hydroxide and Sodium hydroxide using copper sulphate solution ?

Ans. When Ammonium hydroxide solution is added to copper sulphate solution it produces blue ppt which dissolves in excess of ammonium hydroxide to give an inky blue solution.

On adding sodium hydroxide to copper sulphate solution blue ppt is formed which does not dissolve in excess of NaOH.

(ii) How will you distinguish between dilute hydrochloric acid and dilute sulphuric acid using lead nitrate solution ?

Ans. On adding lead nitrate solution to hydrochloric acid, white ppt of lead chloride is formed which dissolves in hot water.

On adding lead nitrate solution to dilute sulphuric acid, white ppt of lead sulphate is formed which is insoluble.

(d) Identify the salts **P** and **Q** from the observations given below. **[2]**

(i) On performing the flame test salt **P** produces a lilac coloured flame and its solution gives a white precipitate with silver nitrate solution, which is soluble in Ammonium hydroxide solution.

Ans. Potassium chloride

(ii) When dilute HCl is added to a salt **Q**, a brisk effervescence is produced and the gas turns lime water milky.

When NH_4OH solution is added to the above mixture (after adding dilute HCl), it produces a white precipitate which is soluble in excess NH_4OH solution.

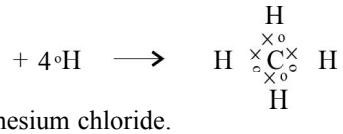
Ans. Zinc carbonate.

***Question* 3**

(a) Draw an ***electron dot diagram*** to show the formation of each of the following compounds : **[4]**

(i) Methane

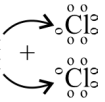
Ans.



(ii) Magnesium chloride.

[H = 1, C = 6, Mg = 12, Cl = 17]

Ans.



(b) State the ***observations*** at the anode and at the cathode during the electrolysis of : **[4]**

(i) fused lead bromide using graphite electrodes.

Ans. Greyish white metal lead is deposited at cathode.

Reddish brown vapours of bromine are seen at anode.

(ii) copper sulphate solution using copper electrodes.

Ans. Brown metal copper is deposited at cathode.

Cu^{2+} ion is liberated at anode.

Colour of $CuSO_4$ solution (blue colour) does not fade.

(c) Select the ion in each case, that would get selectively discharged from the aqueous mixture of the ions listed below : **[2]**

(i) SO_4^{2-}, NO_3^- and OH^-

Ans. OH^-

(ii) Pb^{2+}, Ag^+ and Cu^{2+}

Ans. Ag^+

***Question* 4**

(a) Certain blank spaces are left in the following table and these are labelled as **A, B, C, D** and **E**. Identify each of them. **[5]**

	Lab preparation of	Reactants used	Product formed	Drying agent	Method of collection
(i)	HCl gas	NaCl + H_2SO_4	**A**	conc. H_2SO_4	**B** .....
(ii)	NH_3 gas	**C**	$Mg(OH)_2$ NH_3	**D**	**E** .....

Ans. (i) **A.** **Product formed** $NaHSO_4 + HCl$

B. Downward delivery or upward displacement of air

Ans. (ii) **C.** $Mg_3N_2 + H_2O$

D. Calcium oxide (quick lime)

E. Downward displacement of air

(b) Write ***balanced chemical equation*** to show : **[3]**

(i) The oxidizing action of conc. Sulphuric acid on Carbon.

Ans. $C + 2H_2SO_4 \rightarrow CO_2 + 2H_2O + 2SO_2$

(ii) The behaviour of H_2SO_4 as an acid when it reacts with Magnesium.

Ans. $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

(iii) The dehydrating property of conc. Sulphuric acid with sugar.

Ans. $C_{12}H_{22}O_{11} \xrightarrow{\text{conc. } H_2SO_4} 12C + 11H_2O$

(c) Write balanced chemical equations to show how SO_3 is converted to Sulphuric acid in the ***contact process***. **[2]**

Ans. $SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$

$H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$

***Question* 5**

(a) (i) Propane burns in air according to the following equation : **[4]**

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

What volume of propane is consumed on using 1000 cm^3 of air, considering only 20% of air contains oxygen ?

Ans. Oxygen is 20% of air

i.e. oxygen is $\frac{20}{\cancel{100}} \times \cancel{1000} = 200\ cm^3$

According to equation

5 volume of oxygen uses 1 volume of propane

200 cm^3 of oxygen uses $\frac{1}{\cancel{5}} \times \frac{40}{\cancel{200}}\ cu^3$ of propane

= **40 cm^3** of propane

(ii) The mass of 11·2 litres of a certain gas at s.t.p. is 24 g. Find the ***gram molecular mass*** of the gas.

Ans. 11·2 litres of certain gas at s.t.p. is 24 g

22·4 litres of certain gas of s.t.p. is $\frac{24}{\cancel{11{\cdot}2}} \times \frac{2}{\cancel{22{\cdot}4}}$

$\therefore$ Gram molecular mass of the gas = **48**

(b) A gas cylinder can hold 1 kg of hydrogen at room temperature and pressure : **[4]**

(i) Find the number of moles of hydrogen present.

Ans. 2 grams of hydrogen is 1 mole

1000 grams of hydrogen is $\frac{1}{2} \times 1000 = 500$ moles

(ii) What weight of CO_2 can the cylinder hold under similar conditions of temperature and pressure ?
(H = 1, C = 12, O = 16)

Ans. V.D. of $CO_2 = 22$

$\therefore$ Cylinder will hold 22 kg CO_2.

(iii) If the number of molecules of hydrogen in the cylinder is X, calculate the number of CO_2 molecules in the cylinder under the same conditions of temperature and pressure.

Ans. X molecules

(iv) State the law that helped you to arrive at the above result.

Ans. Avogadro's law

(c) Write a ***balanced chemical equation*** for the preparation of each of the following salts : **[2]**

(i) Copper carbonate.

Ans. $CuSO_4 + Na_2CO_3 \rightarrow CuCO_3 + Na_2SO_4$

(ii) Ammonium sulphate crystals.

Ans. $2NH_4OH + H_2SO_4 \rightarrow (NH_4)_2SO_4 + 2H_2O$

***Question* 6**

(a) Give a ***balanced chemical equation*** for each of the following : **[4]**

(i) Action of conc. Nitric acid on Sulphur.

Ans. $S + 6HNO_3\,(conc.) \rightarrow H_2SO_4 + 2H_2O + 6NO_2$

(ii) Catalytic oxidation of Ammonia.

Ans. $4NH_3 + 5O_2 \xrightarrow[800°C]{Pt} 4NO + 6H_2O$

(iii) Laboratory preparation of Nitric acid.

Ans. $NaNO_3 + H_2SO_4 \xrightarrow{\text{below } 200°C} NaHSO_4 + HNO_3$

(iv) Reaction of Ammonia with Nitric acid.

Ans. $NH_3 + HNO_3 \rightarrow NH_4NO_3$

(b) Identify the ***term*** or ***substance*** based on the descriptions given below : **[4]**

(i) Ice like crystals formed on cooling an organic acid sufficiently.

Ans. Glacial acetic acid.

(ii) Hydrocarbon containing a triple bond used for welding purposes.

Ans. Ethyne or acetylene.

(iii) The property by virtue of which the compound has the same molecular formula but different structural formulae.

Ans. Isomerism.

(iv) The compound formed where two alkyl groups are linked by $-\overset{\overset{O}{\|}}{C}-$ group.

Ans. Ketone.

(c) Give a ***balanced chemical equation*** for each of the following : **[2]**

(i) Preparation of ethane from Sodium propionate.

Ans. $C_2H_5COONa + NaOH \xrightarrow[\Delta]{CaO} C_2H_6 + Na_2CO_3$

(ii) Action of alcoholic KOH on bromoethane.

Ans. $C_2H_5Br + KOH\,(alc) \rightarrow C_2H_4 + KBr + H_2O$

***Question* 7**

(a) Name the following : **[4]**

(i) The process of coating of iron with zinc.

Ans. Galvanisation.

(ii) An alloy of lead and tin that is used in electrical circuits.

Ans. Solder or fuse metal.

(iii) An ore of zinc containing its sulphide.

Ans. Zinc blende (ZnS)

(iv) A metal oxide that can be reduced by hydrogen.

Ans. Copper oxide.

(b) Answer the following questions with respect to the electrolytic process in the extraction of aluminium : **[3]**

(i) Identify the components of the electrolyte other than pure alumina and the role played by each.

Ans. Cryolite and fluorspar are the component of the electrolyte. Cryolite — lowers the fusion temperature from 2050° to 950°C and enhances conductivity.
Fluorspar — acts as solvent for electrolytic mixture.

(ii) Explain why powdered coke is sprinkled over the electrolytic mixture.

Ans. Powdered coke reduces heat loss by radiation and prevents the burning of anode.

(c) Complete the following by selecting the correct option from the choices given : **[3]**

(i) The metal which does not react with water or dilute H_2SO_4 but reacts with concentrated H_2SO_4 is ..... (Al/Cu/Zn/Fe)

Ans. Cu

(ii) The metal whose oxide, which is amphoteric, is reduced to metal by carbon reduction .....
(Fe/Mg/Pb/Al)

Ans. Pb

(iii) The divalent metal whose oxide is reduced to metal by electrolysis of its fused salt is .....
(Al/Na/Mg/K)

Ans. Mg