SCIENCE
Paper 2 (Chemistry) — 2016 (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 with the choices given in brackets. **[5]**

(i) Metals are good .... (oxidizing agent / reducing agent) because they are electron .... (acceptors / donors).

Ans. reducing agents, donors

(ii) Electrovalent compounds have .... (high / low) melting points.

Ans. high

(iii) Higher the pH value of a solution, the more .... (acidic / alkaline) it is.

Ans. alkaline

(iv) .... (AgCl / $PbCl_2$), a white precipitate is soluble in excess NH_4OH.

Ans. AgCl

(v) Conversion of ethene to ethane is an example of .... (hydration / hydrogenation).

Ans. hydrogenation

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

(i) An element with the atomic number 19 will most likely combine chemically with the element whose atomic number is :

(a) 17   (b) 11   (c) 28   (d) 20

Ans. (a) 17

(ii) The ratio between the number of molecules in 2g of hydrogen and 32g of oxygen is :

(a) 1 : 2   (b) 1 : 0·01   (c) 1 : 1   (d) 0·01 : 1

[Given that H = 1, O = 16]

Ans. (c) 1 : 1

(iii) The two main metals in *Bronze* are :

(a) Copper and zinc   (b) Copper and lead   (c) Copper and nickel   (d) Copper and tin

Ans. (d) Copper and tin

(iv) The particles present in *strong electrolytes* are :

(a) only molecules   (b) mainly ions   (c) ions and molecules   (d) only atoms

Ans. (b) mainly ions

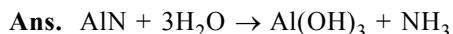(v) The aim of the *Fountain experiment* is to prove that :

(a) HCl turns blue litmus red   (b) HCl is denser than air

(c) HCl is highly soluble in water   (d) HCl fumes in moist air
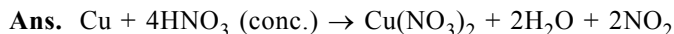
Ans. (c) HCl is highly soluble in water

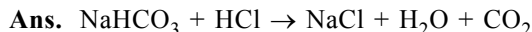**(c)** Write *balanced chemical equations* for each of the following : [5]

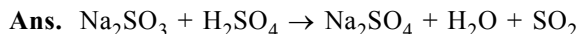   (i) Action of warm water on AlN.

Ans. $AlN + 3H_2O \rightarrow Al(OH)_3 + NH_3$

    (ii) Action of hot and concentrated nitric acid on copper.

Ans. $Cu + 4HNO_3 \text{ (conc.)} \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

    (iii) Action of hydrochloric acid on sodium bicarbonate.

Ans. $NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$

    (iv) Action of dilute Sulphuric acid on sodium sulphite.

Ans. $Na_2SO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + SO_2$

    (v) Preparation of ethanol from ethyl chloride.

Ans. $C_2H_5Cl + KOH \text{ (aq.)} \rightarrow C_2H_5OH + HCl$
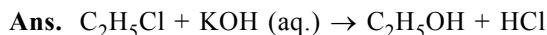
(d) State your *observations* when : [5]

    (i) Dilute Hydrochloric acid is added to Lead nitrate solution and the mixture is heated.

Ans. White ppt. dissolves on heating.

    (ii) Barium chloride solution is mixed with Sodium sulphate solution.

Ans. White ppt. is formed.

    (iii) Concentrated Sulphuric acid is added to Sugar crystals.

Ans. Black spongy mass is formed.

    (iv) Dilute Hydrochloric acid is added to Copper carbonate.

Ans. Gas is evolved which turns lime water milky.

    (v) Dilute Hydrochloric acid is added to Sodium thiosulphate.

Ans. Yellow ppt. of sulphur is formed and gas is evolved.

(e) Identify the *term/substance* in each of the following : [5]

    (i) The tendency of an atom to attract electrons to itself when combined in a compound.

Ans. Electronegativity.

    (ii) The method used to separate ore from gangue by preferential wetting.

Ans. Froth floatation.

    (iii) The catalyst used in the conversion of ethyne to ethane.

Ans. Nickel.

    (iv) The type of reactions alkenes undergo.

Ans. Addition.

    (v) The electrons present in the outermost shell of an atom.

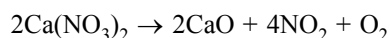**Ans.** Valence electrons.

(f) (i) A gas of mass 32 gms has a volume of 20 litres at S.T.P. Calculate the gram molecular weight of the gas. [5]
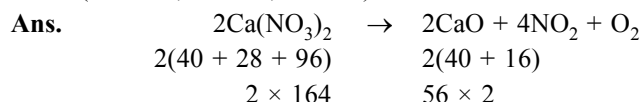
Ans. 20 litres of gas at S.T.P. weighs 32 gms

22·4 litres of gas at S.T.P. weighs $\dfrac{32}{20} \times 22\cdot4 =$ **35·84 g**

    (ii) How much Calcium oxide is formed when 82 g of calcium nitrate is heated ? Also find the volume of nitrogen dioxide evolved :

$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$

(Ca = 40, N = 14, O = 16)

Ans.

$$2Ca(NO_3)_2 \quad \rightarrow \quad 2CaO + 4NO_2 + O_2$$

$$2(40 + 28 + 96) \qquad 2(40 + 16)$$

$$2 \times 164 \qquad\quad 56 \times 2$$

328 g of $Ca(NO_3)_2$ forms 112 g of CaO

82 g of $Ca(NO_3)_2$ forms $\dfrac{\cancel{112}}{\cancel{328}} \times \cancel{82} = \textbf{28 g}$

328 g of $Ca(NO_3)_2$ will evolve $4 \times 22 \cdot 4$ l NO_2

82 g of $Ca(NO_3)_2$ will evolve $\dfrac{\cancel{4} \times 22 \cdot 4}{\cancel{328}\cancel{A}} \times 82 = \textbf{22·4 l}$

**(g)** Match the salts given in Column I with their *method of preparation* given in Column II.　　　　　**[5]**

Column I	Column II
(i) $Pb(NO_3)_2$ from PbO	(a) Simple displacement
(ii) $MgCl_2$ from Mg	(b) Titration
(iii) $FeCl_3$ from Fe	(c) Neutralization
(iv) $NaNO_3$ from NaOH	(d) Precipitation
(v) $ZnCO_3$ from $ZnSO_4$	(e) Combination

Ans.

Column I	Column II
(i) $Pb(NO_3)_2$ from PbO	(a) Neutralization
(ii) $MgCl_2$ from Mg	(b) Simple displacement
(iii) $FeCl_3$ from Fe	(c) Combination
(iv) $NaNO_3$ from NaOH	(d) Titration
(v) $ZnCO_3$ from $ZnSO_4$	(e) Precipitation

(h) (i) Write the IUPAC names of each of the following :　　　　　**[5]**
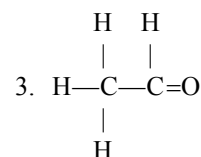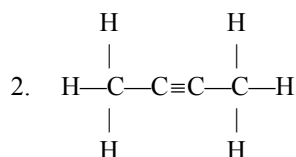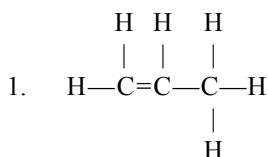
Ans. 1. Prop-1-ene　　　　　2. But-2-yne　　　　　3. Ethanal

(ii) *Rewrite* the following sentences by using the correct symbol > (*greater than*) or < (*less than*) in the blanks given :

1. The ionization potential of Potassium is .... that of Sodium.

2. The electronegativity of Iodine is .... that of Chlorine.

Ans. 1. The ionization potential of Potassium is **<** that of Sodium.

2. The electronegativity of Iodine is **<** that of Chlorine.

SECTION II (40 Marks)
*Attempt any **four** questions from this Section*

Question 2

(a) Use the *letters* only written in the Periodic Table given below to answer the questions that follow :　　　　　**[4]**

(i) State the number of *valence electrons* in atom *J*.

Ans. 5 valence electrons.

(ii) Which element shown forms *ions* with a single negative charge ?

Ans. M

(iii) Which *metallic element* is more reactive than *R* ?

Ans. T

(iv) Which element has its electrons arranged in *four shells* ?

Ans. T

(b) Fill in the blanks by selecting the correct word from the brackets : **[2]**

(i) If an element has a low ionization energy then it is likely to be .... (metallic / non metallic).

Ans. Metallic

(ii) If an element has seven electrons in its outermost shell then it is likely to have the .... (largest / smallest) atomic size among all the elements in the same period.

Ans. Smallest

(c) The following table shows the electronic configuration of the elements W, X, Y, Z :

Element	W	X	Y	Z
Electronic configurations	2, 8, 1	2, 8, 7	2, 5	1

Answer the following questions based on the table above :

(i) What type of Bond is formed between : **[2]**

1. W and X
2. Y and Z

Ans. 1. Electrovalent   2. Covalent

(ii) What is the formula of the compound formed between : **[2]**

1. X and Z
2. W and X

Ans. 1. ZX   2. WX

Question 3

(a) Write a *balanced chemical equation* for each of the following : **[3]**

(i) Burning of ethane is plentiful supply of air.

Ans. $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

(ii) Action of water on Calcium carbide.

Ans. $CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$

(iii) Heating of Ethanol at 170°C in the presence of conc. Sulphuric acid.

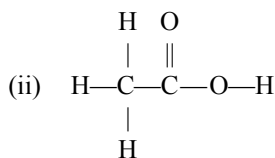**Ans.** $C_2H_5OH \xrightarrow[170°C]{conc.\,H_2SO_4} C_2H_4 + H_2$

(b) Give the structural formulae of each of the following : **[3]**
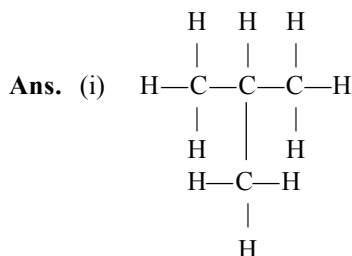
(i) 2-methyl propane   (ii) Ethanoic acid   (iii) Butan-2-ol

Ans. (i)
```
      H   H   H
      |   |   |
  H — C — C — C — H
      |   |   |
      H   |   H
      H — C — H
          |
          H
```

(ii)
```
      H   O
      |   ‖
  H — C — C — O — H
      |
      H
```

(iii)
```
      H   H   H   H
      |   |   |   |
  H — C — C — C — C — H
      |   |   |   |
      H  OH   H   H
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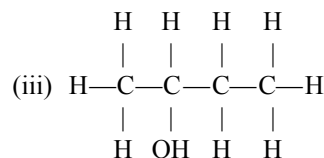
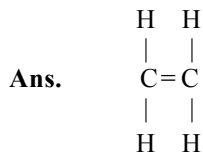**(c)** Equation for the reaction when *compound A* is bubbled through *bromine* dissolved in *carbon tetrachloride* is as follows : **[2]**

$$A \xrightarrow{Br_2/CCl_4} \begin{array}{c} CH_2Br \\ | \\ CH_2Br \end{array}$$

(i) Draw the structure of A.

Ans.

$$\begin{array}{cc} H & H \\ | & | \\ C & = & C \\ | & | \\ H & H \end{array}$$
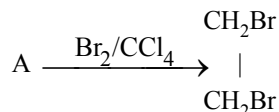
(ii) State your observation during this reaction.

Ans. Brown colour of bromine fades.

(d) Fill in the blanks using the appropriate words given below : **[2]**

[*Sulphur dioxide, Nitrogen dioxide, Nitric oxide, Sulphuric acid*]

(i) Cold, dilute nitric acid reacts with copper to give ....

Ans. Nitric oxide.

(ii) Hot, concentrated nitric acid reacts with sulphur to form ....

Ans. Sulphuric acid.

Question 4

(a) Identify the *gas evolved* and give the *chemical test* in each of the following cases : **[2]**

(i) Dilute hydrochloric acid reacts with sodium sulphite.

Ans. Sulphur dioxide

Test : The gas turns acidified potassium dichromate paper green.

(ii) Dilute hydrochloric acid reacts with iron (II) sulphide.

Ans. Hydrogen sulphide

Test : The gas turns lead acetate paper black and has offensive smell.

(b) State your observations when *ammonium hydroxide solution is added drop by drop and then in excess* to each of the following solution : **[2]**

(i) copper sulphate solution

Ans. Blue ppt is formed which turns dark blue or inky blue on adding excess of NH_4OH.

(ii) zinc sulphate solution

Ans. White gelatinous ppt is formed which dissolves in excess.

(c) Write equations for the *reactions taking place at the two electrodes* (mentioning clearly the name of the electrode) during the electrolysis of : [2]

(i) Acidified copper sulphate solution with copper electrodes.

Ans. Cathode : $Cu^{2+} + 2e^- \rightarrow Cu$

Anode : $Cu - 2e^- \rightarrow Cu^{2+}$

(ii) Molten lead bromide with inert electrodes.

Ans. Cathode : $Pb^{2+} + 2e^- \rightarrow Pb$

Anode : $Br^- - e^- \rightarrow Br$

$Br + Br \rightarrow Br_2$

(d) (i) Name the *product formed* at the *anode* during the electrolysis of acidified water using platinum electrodes. **[2]**

Ans. Oxygen is formed at anode.

(ii) Name the *metallic ions* that should be present in the electrolyte when an article made of copper is to be electroplated with silver.

Ans. Metallic ion is silver

Question 5

    (a) A gas cylinder contains 12×10^{24} molecules of oxygen gas.   **[2]**

        If Avogadro's number is 6×10^{23}; calculate :

        (i) the mass of oxygen present in the cylinder.

    Ans. 6×10^{23} molecules of oxygen weighs 32 g

$$12 \times 10^{24} \text{ molecules of oxygen weighs } \frac{32}{\cancel{6 \times 10^{23}}} \times \cancel{12}^{2} \times 10^{24} = \textbf{640 g}$$

        (ii) the volume of oxygen at S.T.P. present in the cylinder. [O = 16].

    Ans. Volume of 32 g of oxygen at S.T.P. is 22·4 litres.

$$\therefore 640 \text{ g occupies } \frac{22 \cdot 4}{\cancel{32}} \times \cancel{640}^{20} = 448\ l \text{ at S.T.P.}$$

    (b) A gaseous hydrocarbon contains 82·76% of carbon. Given that its vapour density is 29, find its *molecular formula*. [C = 12, H = 1]   **[3]**

Element	Percentage	Atomic weight	Gram atom	Atomic ratio	Ratio
Carbon	82·76	12	$\dfrac{82 \cdot 76}{12} = 6 \cdot 89$	1	2
Hydrogen	17·24	1	$\dfrac{17 \cdot 24}{1} = 17 \cdot 24$	2·5	5

Ans.

        Empirical formula is C_2H_5

$$2 \times \text{V.D} = n \text{ (Empirical formula wt.)}$$
$$2 \times 29 = n\,(24 + 5)$$
$$2 = n$$

 $\therefore$ Molecular formula $= \mathbf{C_4H_{10}}$

    (c) The equation $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$, represents the catalytic oxidation of ammonia. If 100 cm^3 of ammonia is used calculate the *volume of oxygen required* to oxidise the ammonia completely.   **[3]**

    Ans. $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

        4 vol of ammonia require 5 volume of oxygen

$$100 \text{ cm}^3 \text{ of ammonia will require } \frac{5}{\cancel{4}} \times \cancel{100}^{25} = \textbf{125 cm}^3$$

    (d) By drawing an *electron dot diagram* show the formation of *Ammonium ion*. [Atomic no. N = 7 and H = 1]   **[2]**

Ans.

NH_3 Ammonium ion
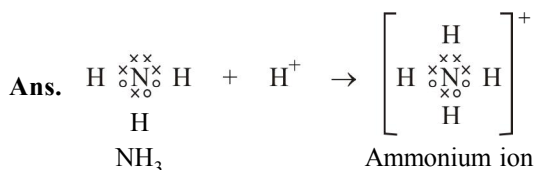
Question 6

    (a) *Name the gas* evolved when the following mixtures are heated :   **[2]**

        (i) Calcium hydroxide and Ammonium chloride.

    Ans. Ammonia.

        (ii) Sodium nitrite and Ammonium chloride.

    Ans. Nitrogen.

    (b) Write *balanced chemical equations* for each of the following :   **[2]**

        (i) When excess of ammonia is treated with chlorine.

    Ans. $8NH_3 + 3Cl_2 \rightarrow 6NH_4Cl + N_2$

        (ii) An equation to illustrate the reducing nature of ammonia.

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

(c) A, B, C and D summarize the properties of *sulphuric acid* depending on whether it is *dilute* or *concentrated*.   **[3]**

A = Typical acid property.   B = Non volatile acid

C = Oxidizing agent   D = Dehydrating agent

Choose the property (A, B, C or D) depending on which is relevant to each of the following :

  (i) Preparation of Hydrogen chloride gas.

Ans. Non volatile acid.

  (ii) Preparation of Copper sulphate from copper oxide.

Ans. Typical acid property.

  (iii) Action of conc. Sulphuric acid on Sulphur.

Ans. Oxidising agent.

(d) Give *reasons* why :   **[3]**

  (i) Sodium chloride will *conduct electricity* only in fused or aqueous solution state.

Ans. Sodium chloride do not have free mobile ions in solid state but in aqueous or fused state it has free mobile ions which are responsible for conductivity.

  (ii) In the electroplating of an article with silver, the electrolyte sodium argento-cyanide solution is preferred over silver nitrate solution.

Ans. Silver nitrate decomposes fast and gives non uniform coating.

  (iii) Although copper is a good conductor of electricity, it is a non-electrolyte.

Ans. Copper do not have free mobile ions.

Question 7

(a) (i) Name the *solution* used to react with *Bauxite* as a first step in obtaining pure aluminium oxide, in the Baeyer's process.   **[5]**

Ans. Caustic soda solution.

  (ii) *Write the equation* for the reaction where the aluminum oxide for the electrolytic extraction of aluminum is obtained by heating aluminum hydroxide.

Ans. $2Al(OH)_3 \xrightarrow{\text{1000°C}} Al_2O_3 + 3H_2O$

  (iii) Name the *compound* added to pure alumina to lower the fusion temperature during the electrolytic reducing of alumina.

Ans. Cryolite and fluorspar.

  (iv) *Write the equation* for the reaction that occurs at the cathode during the extraction of aluminium by electrolysis.

Ans. $Al^{3+} + 3e^- \rightarrow Al$

  (v) Explain why it is preferable to use a number of graphite electrodes as anode instead of a single electrode, during the above electrolysis.

Ans. Graphite rods act as anode, where oxygen reacts to form carbon monoxide and carbondioxide and so they get used up and has to be replaced periodically on using number of graphite rods time span is increased.

(b) *State* what would you *observe* when :   **[2]**

  (i) Washing soda crystals are exposed to the atmosphere ?

Ans. Washing soda crystals are efflorescent so they looses their water of crystallisation and become powdery.

  (ii) The salt ferric chloride is exposed to the atmosphere ?

Ans. Being deliquescent $FeCl_3$ absorb moisture and form solution.

(c) Identify the *cations* in each of the following case :   **[3]**

  (i) NaOH solution when added to the solution (A) gives a reddish brown precipitate.

Ans. Fe^{3+} [iron (III) ions]

  (ii) NH_4OH solution when added to the solution (B) gives white ppt. which does not dissolve in excess.

Ans. Pb^{2+} [(lead ions)]

  (iii) NaOH solution when added to solution (C) gives white ppt. which is insoluble in excess.

Ans. Ca^{2+} [(calcium ions)]