SCIENCE

Paper 2 (Chemistry) — 2020 (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) Choose the ***correct answer*** from the options given below : **[5]**

(i) The element with **highest** ionization potential is :

(a) Hydrogen (b) Caesium (c) Radon (d) Helium

Ans. (d) Helium

(ii) The **inert** electrode used in the electrolysis of acidified water is :

(a) Nickel (b) Platinum (c) Copper (d) Silver

Ans. (b) Platinum

(iii) A compound with **low** boiling point is :

(a) Sodium chloride (b) Calcium chloride (c) Potassium chloride (d) Carbon tetrachloride

Ans. (d) Carbon tetrachloride

(iv) The **acid** which can produce carbon from cane sugar is :

(a) Concentrated Hydrochloric acid (b) Concentrated Nitric acid

(c) Concentrated Sulphuric acid (d) Concentrated Acetic acid

Ans. (c) Concentrated Sulphuric acid

(v) The organic compound having a **triple** carbon-carbon covalent bond is :

(a) C_3H_4 (b) C_3H_6 (c) C_3H_8 (d) C_4H_{10}

Ans. (a) C_3H_4

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

(i) Action of concentrated nitric acid on copper.

Ans. Brown gas is evolved / Bluish solution is formed / A gas with pungent smell is evolved which turns moist potassium iodide paper brown.

(ii) Addition of excess ammonium hydroxide into copper sulphate solution.

Ans. Pale blue precipitate dissolves to form inky blue solution.

(iii) A piece of sodium metal is put into ethanol at room temperature.

Ans. Colourless gas is released which extinguishes a burning splinter with a pop sound.

(iv) Zinc carbonate is heated strongly.

Ans. A colourless odourless gas is released which turns lime water milky/no change in potassium dichromate solution.

or

A residue which is yellow when hot or white when cold is formed.

(v) Sulphide ore is added to a tank containing oil and water, and then stirred or agitated with air.

Ans. Froth/foam is produced/ore floats.

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

(i) Reaction of carbon powder and concentrated nitric acid.

Ans. $C + 4HNO_3 \rightarrow CO_2 + 2H_2O + 4NO_2$

(ii) Reaction of excess ammonia with chlorine.

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

(iii) Reaction of lead nitrate solution with ammonium hydroxide.

Ans. $Pb(NO_3)_2 + 2NH_4OH \rightarrow Pb(OH)_2 + 2NH_4NO_3$

(iv) Producing ethane from bromo ethane using Zn/Cu couple in alcohol.

Ans. $C_2H_5Br + 2[H] \rightarrow C_2H_6 + HBr$

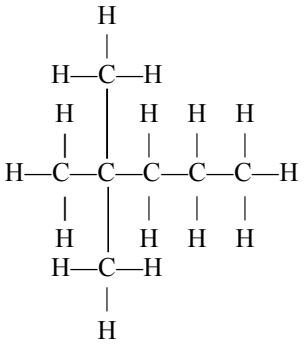
(v) Complete combustion of ethane.

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

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

(1) 2, 2 dimethyl pentane.

Ans.



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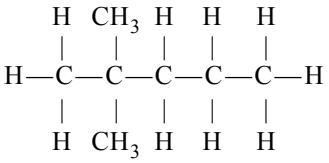
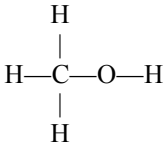


(2) Methanol

Ans. Methanol :



(3) Iso propane

Ans. ISO-propane (wrong) bonus marks given.

(ii) Write the IUPAC name for the following compounds :

(1) Acetaldehyde.

Ans. Acetaldehyde

CH_3CHO ethan-1-al or ethanal

(2) Acetylene

Ans. Acetylene

C_2H_2 eth-1-yne or ethyne

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

(i) Graphite anode is preferred to platinum in the electrolysis of molten lead bromide.

Ans. Platinum is affected by bromine vapours; graphite does not react with Br_2 vapours.

(ii) Soda lime is preferred to sodium hydroxide in the laboratory preparation of methane.

Ans. Soda lime is not deliquescent and does not attack glass / NaOH is deliquescent.

(iii) Hydrated copper sulphate crystals turn white on heating.

Ans. They lose water of crystallisation or get dehydrated.

(iv) Concentrated nitric acid appears yellow, when it is left for a while in a glass bottle.

Ans. Conc. HNO_3 itself decomposes to form reddish brown or brown NO_2 gas which imparts yellow colour.

(v) Hydrogen chloride gas fumes in moist air.

Ans. As it is highly soluble in water, fumes of hydrochloric acid are formed or it absorbs moisture and forms mist.

(f) Calculate : **[5]**

(i) The amount of each reactant required to produce 750 ml of carbon dioxide, when two volumes of carbon monoxide combine with one volume of oxygen to produce two volumes of carbon dioxide.

$$2CO + O_2 \rightarrow 2CO_2$$

Ans. According to the equation :

2 volumes of CO produce 2 volumes of CO_2

$\therefore$ 750 ml of CO_2 will be produced by **750 ml of CO**

2 ml of CO_2 is produced by 1 ml of O_2

750 ml of CO_2 is produced by $\frac{1}{2} \times 750 = 375$ ml of O_2

(ii) The volume occupied by 80 g of carbon dioxide at STP.

Ans. 44 g of CO_2 occupies 22·4 *l* or 22400 ml

$\therefore$ 80 g of CO_2 occupies $80 \times \frac{22{\cdot}4}{44} = 40{\cdot}72$ litres = **40720 ml**

(iii) Calculate the number of molecules in 4·4 g of CO_2. [Atomic mass of C = 12, O = 16]

Ans. 44 g of CO_2 contains $6{\cdot}023 \times 10^{23}$ molecules

$\therefore$ 4·4 g of $CO_2 \rightarrow \frac{6{\cdot}023 \times 10^{23}}{44} \times 4{\cdot}4 =$ **$6{\cdot}023 \times 10^{22}$ molecules**

(iv) State the law associated in question no. (f) (i) above.

Ans. When gases react, they do so in volumes which bear a simple whole number ratio to one another and to the volumes of the products, if gaseous, provided the temperature and pressure of the reacting gases and their products remain constant.

(g) Give **one word or a phrase** for the following statements. **[5]**

(i) The chemical bond formed by a shared pair of electrons, each bonding atom contributing one electron to the pair.

Ans. Covalent bond

(ii) Electrode used as cathode in electrorefining of impure copper.

Ans. Pure copper

(iii) The substance prepared by adding other metals to a base metal in appropriate proportions to obtain certain desirable properties.

Ans. Alloy

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

Ans. Electronegativity

(v) The reaction in which carboxylic acid reacts with alcohol in the presence of conc. H_2SO_4 to form a substance having a fruity smell.

Ans. Esterification

(h) Fill in the blanks with the choices given in brackets : **[5]**

(i) The polar covalent compound in gaseous state that does not conduct electricity is ..... . **(carbon tetra chloride, ammonia, methane)**

Ans. ammonia

(ii) A salt prepared by displacement reaction is ..... . **(ferric chloride, ferrous chloride, silver chloride)**

Ans. ferrous chloride

(iii) The number of moles in 11 g of nitrogen gas is ..... . **(0·39, 0·49, 0·29)** [atomic mass of N = 14]

Ans. 0·39

(iv) An alkali which completely dissociates into ions is ..... . **(ammonium hydroxide, calcium hydroxide, lithium hydroxide)**

Ans. lithium hydroxide

(v) An alloy used to make statues is ..... . **(bronze, brass, fuse metal)**

Ans. bronze

SECTION II (40 Marks)

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

Question 2

(a) The following table represents the elements and the atomic numbers of three elements. **[3]**

With reference to this, answer the following using only the alphabets given in the table.

Element	P	Q	R
Atomic number	13	7	10

(i) Which element combines with hydrogen to form a basic gas ?

Ans. Q

(ii) Which element has a zero electron affinity ?

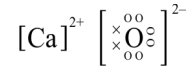
Ans. R

(iii) Name the element which forms an ionic compound with chlorine.

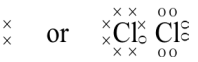
Ans. P

(b) Draw the electron dot diagram for the compounds given below. Represent the electrons by (•) and (×) in the diagram. [Atomic no. : Ca = 20, O = 8, Cl = 17, H = 1]. **[3]**

(i) Calcium oxide

Ans. 

(ii) Chlorine molecule

Ans. 

(iii) Water molecule

Ans. 

(c) Choose the correct word which refers to the process of electrolysis from A to E, to match the description (i) to (iv) :

A. Oxidation B. Cathode C. Anode D. An electrolyte E. Reduction **[3]**

(i) Conducts electricity in aqueous or in molten state.

Ans. D. An electrolyte

(ii) Loss of electron takes place at anode.

Ans. A. Oxidation

(iii) A reducing electrode.

Ans. B. Cathode

(iv) Electrode connected to the positive end or terminal of the battery.

Ans. C. Anode

Question 3

(a) Baeyer's process is used to concentrate bauxite ore to alumina. **[3]**

Give **balanced chemical equations** for the reaction taking place for its converstion from bauxite to alumina.

Ans. (i) $Al_2O_3 \cdot 2H_2O + 2NaOH\ (conc.) \xrightarrow{150°C-200°C} 2NaAlO_2 + 3H_2O$

(ii) $NaAlO_2 + 2H_2O \xrightarrow{50°C–60°C} NaOH + Al(OH)_3$

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

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

(i) pH of acetic acid is greater than dilute sulphuric acid. So acetic acid contains ..... concentration of H^+ ions. **(greater, same, low)**

Ans. Low

(ii) The indicator which does not change colour on passage of HCl gas is ..... . **(methyl orange, moist blue litmus, phenolphthalein)**

Ans. Phenolphthalein

(iii) The acid which cannot act as an oxidizing agent is ..... . **(conc. H_2SO_4, conc. HNO_3, conc. HCl)**

Ans. conc. HCl

(c) Match the gases given in column I to the identification of the gases mentioned in column II. **[4]**

Column I	Column II
(i) Hydrogen sulphide	A. Turns acidified potassium dichromate solution green.
(ii) Nitric oxide	B. Turns lime water milky.
(iii) Carbon dioxide	C. Turns reddish brown when it reacts with oxygen.
(iv) Sulphur dioxide	D. Turns moist lead acetate paper silvery black.

Ans. (i) D (ii) C (iii) B (iv) A or A and B

***Question* 4**

(a) Differentiate between the following pairs based on the information given in the brackets. **[3]**

(i) Conductor and electrolyte (conducting particles)

Ans. Conductor — Conduction due to mobile electrons.

Electrolyte — Conduction due to free mobile electrons.

(ii) Cations and anions (formation from an atom)

Ans. Cations are formed by the loss of electrons from an atom. OR Oxidation of an atom.

Anions are formed by the gain of electrons by an atom.

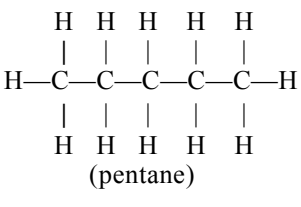
(iii) Acid and Alkali (formation of type of ions)

Ans. Acid — Forms hydrogen (H^+) or hydronium (H_3O^+) ions in solution.

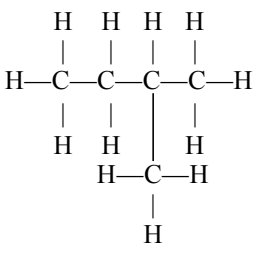
Alkali — Forms hydroxyl or hydroxide ions (OH^-) in solution.

(b) Draw the structures of isomers of pentane. **[3]**

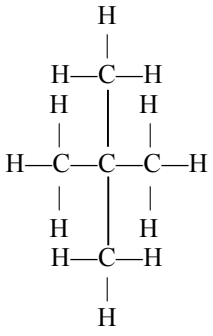
Ans. Pentane (isomers)



(pentane)



(2-methyl butane)



(2, 2 dimethylpropane)

(c) Hydrogen chloride gas is prepared in the laboratory using concentrated sulphuric acid and sodium chloride. Answer the questions that follow based on this reaction : **[4]**

(i) Give the balanced chemical equation for the reaction with suitable condition(s) if any.

Ans. $NaCl + \underset{\text{(conc.)}}{H_2SO_4} \xrightarrow{<200°C} NaHSO_4 + HCl$

(ii) Why is concentrated sulphuric acid used instead of concentrated nitric acid ?

Ans. Conc. H_2SO_4 is non volatile so can displace more volatile acid.

(iii) How is the gas collected ?

Ans. Upward displacement of air. OR Downward delivery.

(iv) Name the drying agent not used for drying the gas.

Ans. Quick lime/calcium oxide (CaO).

***Question* 5**

(a) Distinguish between the following pairs of compounds using a reagent as a chemical test : **[3]**

(i) Calcium nitrate and zinc nitrate solution.

Ans. Add ammonium hydroxide solution.
No observation — Calcium nitrate solution.
White precipitate soluble in excess of NH_4OH — Zinc nitrate solution.

(ii) Ammonium sulphate crystals and sodium sulphate crystals.

Ans. Add any alkali/base and heat.
Pungent colourless gas released which turns red litmus blue (ammonia) — Ammonium sulphate.
If no pungent gas released — Sodium sulphate.

(iii) Magnesium chloride and magnesium nitrate solution.

Ans. Add silver nitrate solution.
If white precipitate is formed — Magnesium chloride solution.
No precipitate — Magnesium nitrate solution.

(b) Calculate the percentage of : **[3]**

(i) Fluorine (ii) Sodium and (iii) Aluminium

in sodium aluminium fluoride $[Na_3AlF_6]$, to the nearest whole number.
[Atomic mass : Na = 23, Al = 27, F = 19]

Ans. Na_3AlF_6

Molecular mass = $23 \times 3 + 27 + 19 \times 6 = 210$

$$\text{Percentage of fluorine} = \frac{114}{210} \times 100 = 54\%$$

$$\text{Percentage of sodium} = \frac{69}{210} \times 100 = 33\%$$

$$\text{Percentage of aluminium} = \frac{27}{210} \times 100 = 13\%$$

(c) (i) State the volume occupied by 40 g of methane at STP, if its vapour density (V.D.) is 8. **[4]**

Ans. 16 g methane occupies 22·4 litres

$\therefore$ 40 g will occupy $\frac{22{\cdot}4}{16} \times 40 = 56$ litres

(ii) Calculate the number of moles present in 160 g of NaOH. [Atomic mass : Na = 23, H = 1, O = 16]

Ans. Molecular mass of NaOH = 40

No. of moles = $\frac{160}{40}$ = **4 moles**.

Question **6**

(a) Identify the salts **P, Q, R** from the following observations : **[3]**

(i) Salt P has light bluish green colour. On heating, it produces a black residue. Salt P produces brisk effervescence with dil. HCl and the gas evolved turns lime water milky, but no action with acidified potassium dichromate solution.

Ans. Copper carbonate

(ii) Salt Q is white in colour. On strong heating, it produces buff yellow residue and liberates reddish brown gas. Solution of salt Q produces chalky white insoluble precipitate with excess of ammonium hydroxide.

Ans. Lead nitrate

(iii) Salt R is black in colour. On reacting with concentrated HCl, it liberates a pungent greenish yellow gas which turns moist starch iodide paper blue black.

Ans. Manganese dioxide

(b) Identify the substance underlined in each of the following : **[3]**

(i) The <u>electrode</u> that increases in mass during the electro-refining of silver.

Ans. Cathode or pure silver strip or reducing electrode

(ii) The <u>acid</u> that is a dehydrating as well as a drying agent.

Ans. Concentrated sulphuric acid

(iii) The <u>catalyst</u> used to oxidize ammonia into nitric oxide.

Ans. Platinum

(c) Copy and complete the following paragraph using the options given in brackets : **[4]**

Alkenes are a homologous series of (i) ..... **(saturated / unsaturated)** hydrocarbons characterized by the general formula (ii) ..... **(C_nH_{2n+2} / C_nH_{2n})**. Alkenes undergo (iii) ..... **(addition / substitution)** reactions and also undergo (iv) ..... **(hydrogenation / dehydrogenation)** to form alkanes.

Ans. (i) unsaturated (ii) C_nH_{2n} (iii) Addition (iv) Hydrogenation

Question **7**

(a) Write balanced chemical equations, for the preparation of the given salts (i) to (iii) by using the methods A to C respectively : **A. Neutralization B. Precipitation C. Titration** **[3]**

(i) Copper sulphate

Ans. $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$

OR

$Cu(OH)_2 + H_2SO_4 \rightarrow CuSO_4 + 2H_2O$

(ii) Zinc carbonate

Ans. $ZnCl_2 + Na_2CO_3 \rightarrow ZnCO_3 + 2NaCl$

(iii) Ammonium sulphate

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

(b) Name the following elements : **[3]**

(i) An alkaline earth metal present in group 2 and period 3.

Ans. Magnesium

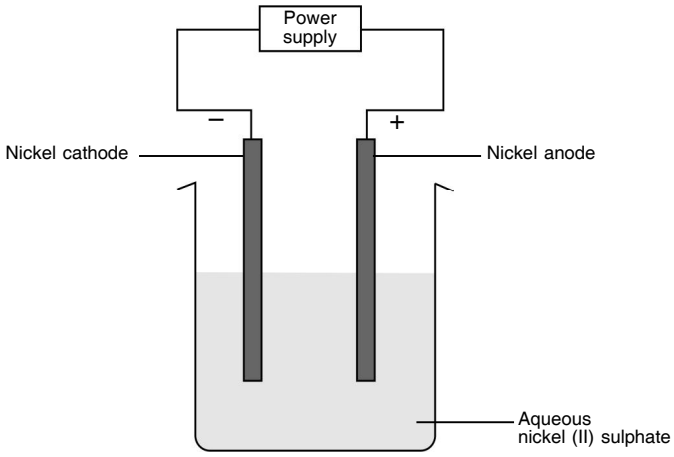
(ii) A trivalent metal used to make light tools.

Ans. Aluminium

(iii) A monovalent non-metal present in fluorspar.

Ans. Fluorine

(c) An aqueous solution of nickel (II) sulphate was electrolyzed using nickel electrodes. Observe the diagram and answer the questions that follow : **[4]**



(i) What do you observe at the cathode and anode respectively ?

Ans. Cathode — Silvery metal deposited or coated or sticks / or mass increases
Anode — Mass decreases.

(ii) Name the cation that remains as a spectator ion in the solution.

Ans. Hydrogen ion

(iii) Which equation for the reaction at the anode is correct ?

1. $Ni \rightarrow Ni^{2+} + 2e^-$
2. $Ni + 2e^- \rightarrow Ni^{2+}$
3. $Ni^{2+} \rightarrow Ni + 2e^-$
4. $Ni^{2+} + 2e^- \rightarrow Ni$

Ans. 1. $Ni \rightarrow Ni^{2+} + 2e^-$