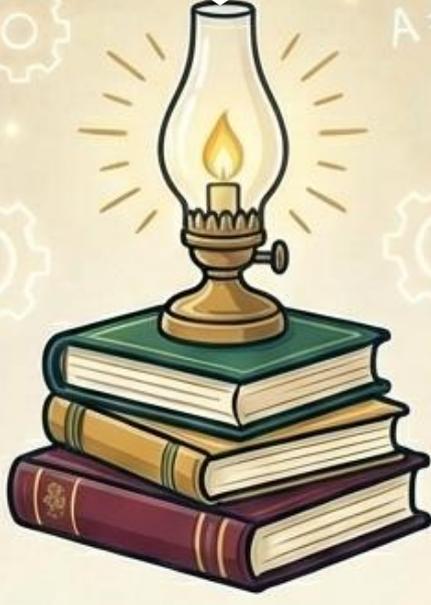




$$A = \frac{m}{(m^2 + c)^2}$$



NIOS PYQ's SOLUTIONS

$$fa = bc^2$$

$$\sqrt{h-x^2}$$

PREVIOUS YEARS' QUESTIONS & ANSWERS



APRIL-2024

Your Path to Success

SECTION - A / खंड - अ

A.
B.
C.



SET - A

Que 1 – The linear molecule, which has net dipole moment zero, is

- (A) HCl (B) CO₂
(C) H₂O (D) N₂O

Answer – (B) CO₂

Que 2 – Which of the following colligative properties can be used to determine molar mass of proteins with maximum precision?

- (A) Depression in freezing point
(B) Osmotic pressure
(C) Relative lowering of vapour pressure
(D) Elevation of boiling point

Answer – (B) Osmotic pressure

Que 3 – Which of the following is an extensive property?

- (A) Temperature (B) Pressure
(C) Density (D) Volume

Answer – (D) Volume

OR / अथवा

Bond dissociation enthalpy is applicable only for the:

- (A) gaseous molecules (B) molecules in liquid state
(C) molecules in solid state (D) gaseous atoms

Answer – (A) gaseous molecules



Que 4 – The conjugate acid of NH_2^- is

- (A) NH_4^- (B) NH_2OH
(C) NH_3 (D) N_2H_4

Answer – (C) NH_3

OR / अथवा

Which of the following has the highest pH value?

- (A) 1 M HCl (B) 1 M NaOH
(C) 1 M Na_2CO_3 (D) 1 M $\text{C}_2\text{H}_5\text{OH}$

Answer – (B) 1 M NaOH

Que 5 – The H—O—H bond angle in H_2O is:

- (A) 106° (B) 109.28°
(C) 120° (D) 104.5°

Answer – (D) 104.5°

OR / अथवा

The thermal stability of the following alkaline earth metal carbonates follows the order

- (A) $\text{BeCO}_3 > \text{BaCO}_3 > \text{CaCO}_3 > \text{MgCO}_3$
(B) $\text{MgCO}_3 > \text{CaCO}_3 > \text{BaCO}_3 > \text{BeCO}_3$
(C) $\text{CaCO}_3 > \text{BaCO}_3 > \text{MgCO}_3 > \text{BeCO}_3$
(D) $\text{BaCO}_3 > \text{CaCO}_3 > \text{MgCO}_3 > \text{BeCO}_3$

Answer – (D) $\text{BaCO}_3 > \text{CaCO}_3 > \text{MgCO}_3 > \text{BeCO}_3$

Que 6 – Which of the following properties is not exhibited by sulphur dioxide?



- (A) Acidic nature (B) Oxidizing properties
(C) Dehydrating agent (D) Reducing properties

Answer – (C) Dehydrating agent

OR / अथवा

The gas produced by oxyacetylene flame, which prevents the oxidation of metals during welding and cutting, is

- (A) hydrogen (B) oxygen
(C) ethene (D) carbon dioxide

Answer – (D) carbon dioxide

Que 7 – Lanthanoids and actinoids resemble in their

- (A) electronic configuration (B) prominent oxidation state
(C) ionization energy (D) formation of complexes

Answer – (B) prominent oxidation state

The aqueous solution of which of the following ions will be colourless?

- (A) Fe^{2+} (B) Mn^{3+}
(C) Ti^{3+} (D) Sc^{3+}

[Atomic number: Sc = 21, Fe = 26, Ti = 22, Mn = 25]

Answer – (D) Sc^{3+}

Que 8 – The temporary electron displacement which takes place in compounds containing multiple covalent bonds developing +ve and -ve charges within the molecule is known as

- (A) resonance (B) electromeric effect
(C) inductive effect (D) hyperconjugation



OR / अथवा

Which of the following enzymes converts glucose into ethyl alcohol?

- (A) Diastase (B) Invertase
(C) Maltase (D) Zymase

Answer – (D) Zymase

Que 12 – Hemiacetals are chemically

- (A) alkoxy alcohols (B) alkyl alcohols
(C) gem-dialkoxy compounds (D) ethylene glycol

Answer – (A) alkoxy alcohols

Que 13 – Which of the following forms a stable diazonium salt at 273–278 K?

- (A) Ethylamine (B) Aniline
(C) Dimethylamine (D) Benzylamine

Answer – (B) Aniline

Sulphonation of aniline at 455–475 K produces

- (A) sulphonic acid (B) benzenediazonium sulphate
(C) anilinium hydrogen sulphate (D) sulphanilic acid

Answer – (D) sulphanilic acid

Que 14 – Chemically enzymes are

- (A) polysaccharides (B) polypeptides
(C) polynucleotides (D) globular proteins

Answer – (D) globular proteins



Que 15 – The polymer which becomes soft on heating or becomes rigid on cooling is known as

- (A) elastomer (B) fibre
(C) thermosetting (D) thermoplastic

Answer – (D) thermoplastic

Que 16 – The washing material which is 100% biodegradable and contains carboxylate ion is

- (A) soap (B) branched alkyl benzene sulphonate
(C) linear alkyl benzene sulphonate (D) lauryl alcohol

Answer – (A) soap

Note: Question Nos. 17 to 28 are objective type questions of 2 marks each. In some of these questions, four sub-parts are given. You have to attempt only two sub-parts out of them in such questions.

Que 17 – Complete the following by the options given below (out of four attempt any two):

atomic mass; formula mass; molar mass; C-6; C-12; C-14; 0.01; 0.001; 0.0001; integral; fractional

- (a) 58.5 g mol^{-1} is _____ the of NaCl.
(b) A mole is the amount of a substance that contains as many entities (atoms, molecules or other particles) as in exactly 12 g of _____ isotope.
(c) 1 mm is equal to _____ m.
(d) Molecular formula is always _____ multiple of the empirical formula.

Answer – (a) molar mass , (b) C-12 , (c) 0.001, (d) integral



Que 18 – Read the passage given below and answer the following questions (out of four attempt any two) :

According to VSEPR theory, the electron pairs around the central atom in a molecule arrange themselves in space in such a way that they minimize their mutual repulsion. The lone pair repulsion is much greater than the bond pair repulsion.

(a) Name the electron pairs around the central atom in a molecule who arrange themselves in space in such a way that they minimize their mutual repulsion.

Answer – The electron pairs are Bond pairs and Lone pairs.

(b) Which parameter of the molecule is linked to mutual repulsion of electron pairs?

Answer – The parameter linked is the Bond Angle.

(c) When the number of electron pairs around the central atom is five, which geometry is predicted for the molecule?

Answer – For five electron pairs, the geometry is Trigonal Bipyramidal.

(d) Which electron pair is known as the lone pair of electrons in a molecule?

Answer – The electron pair not involved in bonding is the Lone pair.

Que 19 – Write True (T) for correct statement and False (F) for incorrect statement (out of four attempt any two) :

(a) Benzene-chloroform mixture exhibits positive deviation from Raoult's law.

(b) Boiling point is a colligative property.

(c) Vapour pressure of a liquid is the pressure exerted by the vapour of the liquid in any condition/ situation.

(d) Two liquids are miscible when they dissolve in each other in all proportions.

Answer – (a) false, (b) false, (c) false, (d) true.



Que 20 – Write True (T) for correct statement and False (F) for incorrect statement (out of four attempt any two) :

- (a) In a galvanic cell, electrons always flow from cathode to anode.
- (b) Salt bridge is a contact between two half-cells without any mixing of electrolytes.
- (c) Higher the valency of the ion, greater is its conducting power.
- (d) Conductivity of a cell is the product of conductance and cell constant.

Answer – (a) False, (b) True, (c) True, (d) True.

Que 21 – Write True (T) for correct statement and False (F) for incorrect statement(out of four attempt any two) :

- (a) The reaction of lithium with water is less vigorous than that of sodium.
- (b) Melting and boiling points of alkali metals increase down the group.
- (c) Calcium imparts brick red colour to the flame.
- (d) Chlorophyll is a complex compound of magnesium.

Answer – (a) True, (b) False, (c) True, (d) True.

Que 22 – Write True (T) for correct statement and False (F) for incorrect statement (out of four attempt any two) :

- (a) Sulphur shows two, four and six valencies in its compounds.
- (b) Fluorine is prepared by electrolysis of hydrogen fluoride.
- (c) Chlorofluorocarbons have very high capacity to retain heat.
- (d) The oxidation state of chlorine in chlorous acid is.

Answer – (a) True, (b) True, (c) True, (d) False.

Que 23 – Write True (T) for correct statement and False (F) for incorrect statement (out of four attempt any two) :

- (a) Copper(I) compounds are white and diamagnetic while copper(II) compounds are coloured and paramagnetic.
- (b) The common oxidation state of Cu, Ag and Au is +2.



(c) Scandium does not exhibit variable oxidation state in its compounds.

(d) Among Al, Zn, Mg and Fe, the densest element is Fe.

Answer – (a) True, (b) False, (c) True, (d) True.

Que 24 – Read the passage given below and answer the following questions (out of four attempt any two):

Coordination compounds are the compounds in which a central metal ion is attached to a group of surrounding ligands by coordinate covalent bond. Ligands can be monodentate or polydentate. Polydentate ligands are also called chelating ligands. The geometries of coordination compounds are linear, tetrahedral, square planar and octahedral.

(a) What is the difference between $[\text{Co}(\text{CN})_6]^{3-}$ and $[\text{CoF}_6]^{3-}$ complexes?

Answer – $[\text{Co}(\text{CN})_6]^{3-}$ is a low spin/inner orbital complex, while $[\text{CoF}_6]^{3-}$ is a high spin/outer orbital complex.

(b) Give a chemical test to distinguish between $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$.

Answer – Use silver nitrate (AgNO_3) or barium chloride (BaCl_2) test; $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ will give a precipitate with AgNO_3 while $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$ will give a precipitate with BaCl_2 .

(c) Name any one chelating agent.

Answer – Ethylenediamine (en) or EDTA.

(d) Identify and name the bidentate ligand in $[\text{Co}(\text{en})_2(\text{H}_2\text{O})(\text{CN})]^-$.

Answer – The bidentate ligand is en, which stands for ethylenediamine.

Que 25 – Read the passage given below and answer the following questions (out of four attempt any two) :

Ethers are organic compounds in which an oxygen atom is bonded to two alkyl groups or aryl groups. Ethers have geometry similar to water and alcohols.



(a) Draw the geometry of an ether molecule.

Answer – (a) The geometry of an ether molecule is bent or V-shaped, similar to water.

(b) Illustrate the basic nature of ethers with a reaction.

Answer – Ethers react with strong mineral acids to form oxonium salts (e.g., $R_2O + HCl \rightarrow [R_2OH]^+Cl^-$).

(c) What is the IUPAC name of methyl propyl ether?

Answer – 1-Methoxypropane.

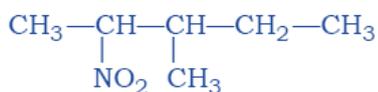
(d) How can ethers be prepared by Williamson's synthesis? Illustrate with an example.

Answer – It involves the reaction of an alkyl halide with a sodium alkoxide (e.g., $CH_3Br + CH_3CH_2ONa \rightarrow CH_3OCH_2CH_3 + NaBr$).

Que 26 – Read the passage and answer any two questions:

Nitro compounds are those derivatives of hydrocarbons in which a hydrogen atom is replaced by a nitro group. These may be aliphatic or aromatic. Nitroalkanes are divided into primary, secondary or tertiary depending upon the attachment of nitro group to primary, secondary or tertiary carbon atom respectively.

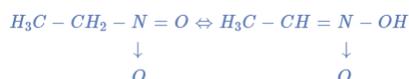
(a) Name the following:



Answer – (a) 2-Nitro-3-methylpentane.

(b) What happens when propane reacts with nitric acid at 680 K? Give the chemical equation.

Answer – Propane reacts with nitric acid in the vapor phase to produce a mixture of nitroalkanes:



(c) Write the reduction of nitrobenzene in alkaline medium.

Answer – Nitrobenzene reduces to azobenzene or hydrazobenzene depending on the specific alkaline conditions.

(d) Compare boiling points of nitro compounds with corresponding alkanes.

Justify your answer.

Answer – Nitro compounds have higher boiling points than corresponding alkanes because they are highly polar and exhibit strong dipole-dipole interactions.

Que 27 – Read the passage and answer any two questions:

Hormones are chemical messengers which are secreted by endocrine glands. They are carried through the blood stream to the target tissues. Vitamins are small organic molecules which are taken in diet and these are required in trace amounts for proper-growth.

(a) Name a female sex hormone and state its function.

Answer – (a) Estrogen or Progesterone; they regulate the female reproductive system and secondary sexual characteristics.

(b) Which disease is caused by deficiency of insulin in humans. Which gland secretes it?

Answer – Diabetes mellitus; it is secreted by the Pancreas.

(c) Which water-soluble vitamin's deficiency causes a disease with symptoms of (i) cracked lips, scaly skin and (ii) anaemia, irritability?

Answer – (i) Vitamin B₂ (Riboflavin) and (ii) Vitamin B₆ (Pyridoxine) or B₁₂.

(d) Name any two vitamins which are fat-soluble.

Answer – Vitamin A and Vitamin D.

Que 28 – Read the passage and answer any two questions:

A polymer is a giant molecule formed by intermolecular linkage between same or different types of smaller molecules called monomers. The process by which the



monomers get linked up is called polymerization. The polymers can be classified on the basis of origin, structure, method of polymerization and molecular forces.

(a) What are the monomers of Terylene?

Answer – (a) Ethylene glycol and Terephthalic acid.

(b) Among Buna-S and Neoprene, which one is a copolymer and why?

Answer – Buna-S is a copolymer because it is formed from two different monomers (1,3-butadiene and styrene), whereas Neoprene is a homopolymer.

(c) In which process of polymerization are by-products obtained?

Answer – Condensation polymerization.

(d) In which categories are polymers classified based on their structure?

Answer – Linear, branched-chain, and cross-linked (or network) polymers.

SECTION - B / खंड - ब



Note: Q. 29 to 43 are the subjective questions. An internal choice has been provided in some of these questions. You have to attempt only one of the given choices in such questions.

Que 29 – Find the mass of 0.252 mol of sodium phosphate, Na_3PO_4 (atomic mass: Na=23.0 amu, P =31.0 amu, O=16.0 amu.

Answer – Molar mass of $\text{Na}_3\text{PO}_4 = 69.0 + 31.0 + 64.0 = 164.0 \text{ g/mol}$

Using the formula: Mass = moles \times molar mass:

Mass = 0.252 mol \times 164.0 g/mol

Mass = 41.328 g \approx 41.3 g

OR / अथवा



A compound is composed of atoms of only two elements, carbon and oxygen. If the compound contains 51.3% carbon, what is its empirical formula?

Answer – Carbon is 51.3% \Rightarrow moles = $\frac{51.3}{12} = 4.275$

And Oxygen is 48.7% \Rightarrow moles = $\frac{48.7}{16} = 3.043$

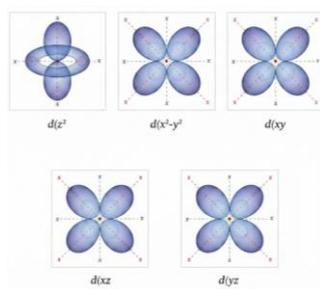
Ratio = $\frac{4.275}{3.043} = 1: 1.4$

Multiplying by 5 to achieve whole numbers

Empirical formula = C_7O_5

Que 30 – Draw the shapes of d-orbitals.

Answer –



Que 31 – What is meant by a coordinate covalent bond? Give an example.

Answer – A coordinate covalent bond is a type of bond where both shared electrons come from the same atom. Example: The formation of the ammonium ion (NH_4^+) where the lone pair of Nitrogen is donated to an H^+ ion.

OR / अथवा

Define a bond angle. What is the bond angle in the following?

(i) N-H bonds in NH_3 (ii) C-H bonds in CH_4

Answer – Bond Angle: The angle formed between two bonds originating from the same atom in a molecule.

(i) N-H bonds in NH_3 : 107° .



(ii) C-H bonds in CH₄: 109.5°.

Que 32 – What are exothermic reactions? Give one example of an exothermic reaction.

Answer – Exothermic reactions are chemical reactions that release energy in the form of heat to the surroundings.

Example: Combustion of methane: $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} + \text{Heat}$.

Que 33 – What is meant by ionic product constant of water? Write its mathematical expression.

Answer – The ionic product constant of water (K_w) is the product of the molar concentrations of hydrogen ions and hydroxide ions in water at a particular temperature.

Mathematical expression: $K_w = [\text{H}^+][\text{OH}^-]$.

Que 34 – Explain the electrolysis of aqueous copper sulphate using platinum electrodes.

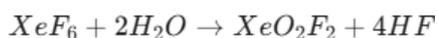
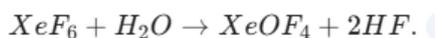
Answer – In the electrolysis of aqueous CuSO₄ using Platinum (inert) electrodes:

At Anode: Water is oxidized to release Oxygen gas: $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$.

At Cathode: Copper ions are reduced to Copper metal: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu(s)}$.

Que 35 – How are xenon oxofluorides obtained? Write the chemical equations involved.

Answer – Xenon oxofluorides like XeOF₄ are obtained by the partial hydrolysis of XeF₆:



Que 36 – How is potassium dichromate obtained from sodium chromate? Write the chemical equations involved.

Answer – Sodium chromate is converted to potassium dichromate in two steps:

Acidification: $2\text{Na}_2\text{CrO}_4 + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{Cr}_2\text{O}_7 + \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$.



Metathesis: $\text{Na}_2\text{Cr}_2\text{O}_7 + 2\text{KCl} \rightarrow \text{K}_2\text{Cr}_2\text{O}_7 + 2\text{NaCl}$.

Que 37 – State Saytzeff's rule. Give a suitable example.

Answer – Saytzeff's Rule: In a dehydrohalogenation reaction, the preferred product is the alkene which has the greater number of alkyl groups attached to the doubly bonded carbon atoms.

Example: Dehydrohalogenation of 2-bromobutane yields 2-butene as the major product rather than 1-butene.

Que 38 – Predict the shape of methane molecule on the basis of VSEPR theory, specifying the underlying postulate of the theory.

Answer – Postulate: Electron pairs around the central atom repel each other and stay as far apart as possible to minimize repulsion.

Shape: In CH_4 , there are 4 bond pairs and 0 lone pairs, resulting in a Tetrahedral geometry.

Que 39 – Calculate the internal energy change in each of the following cases:

(a) A system absorbs 15 kJ of heat and does 5 kJ of work.

(b) 5 kJ of work is done on the system and 15 kJ of heat is given out by the system.

Answer – Using First Law of Thermodynamics: $\Delta U = q + w$.

(a) $q = +15\text{kJ}$ (absorbed),

$w = -5\text{ kJ}$ (done by system):

$\Delta U = 15 + (-5) = 10\text{ kJ}$.

(b) $q = -15\text{ kJ}$ (given out),

$w = +5\text{ kJ}$ (done on system):

$\Delta U = -15 + 5 = -10\text{ kJ}$

Que 40 – (i) Write down the formula of hexaaquacobalt (III) chloride.



(ii) What is meant by inner orbital complex? Explain with the help of an example. (i)

Formula: $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$.

Answer – (i) The chemical formula for hexaaquacobalt (III) chloride is $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$.

(ii) Inner orbital complexes use the $(n-1)d$ orbitals for hybridization (e.g., d^2sp^3). Example:
 $[\text{Co}(\text{NH}_3)_6]^{3+}$.

OR / अथवा

Account for the different magnetic behaviour of hexacyanoferrate (III) ion and hexafluoroferrate(III) ion.

Answer – Hexacyanoferrate (III) $[\text{Fe}(\text{CN})_6]^{3-}$ uses CN^- , a strong field ligand, causing electron pairing (low spin, weakly paramagnetic).

Hexafluoroferrate (III) $[\text{FeF}_6]^{3-}$ uses F^- , a weak field ligand, resulting in no pairing (high spin, strongly paramagnetic).

Que 41 – (i) Why are aldehydes more reactive than ketones towards nucleophilic addition reactions?

(ii) How do ketones react with Grignard reagent? Write the chemical equation involved.

(iii) Write the chemical equation for Hell-Volhard-Zelinsky reaction.

Answer – (i) Aldehydes are more reactive due to lower steric hindrance and the higher partial positive charge on the carbonyl carbon (lesser +I effect from only one alkyl group).

(ii) Ketones react with Grignard reagents ($\text{R}'\text{MgX}$) followed by hydrolysis to form tertiary alcohols.

(iii) HVZ Reaction: Carboxylic acid + $\text{Br}_2/\text{P} \rightarrow \alpha$ -bromo acid.

OR / अथवा



(i) Which one of the following will be the most acidic and why? Butanoic acid, 2-chlorobutanoic acid, 3-chlorobutanoic acid, 4-chlorobutanoic acid

(ii) What is Tollens' test? Write its chemical equation.

(iii) How can you convert $>C=O$ group into $>CH_2$ group?

Answer – (i) Among the given compounds, 2-chlorobutanoic acid is the most acidic because the acidity of carboxylic acids is increased by electron-withdrawing groups (EWG) like Chlorine (-Cl) through the inductive effect (-I effect).

(ii) Tollens' test is a chemical reaction used to distinguish between aldehydes and ketones; aldehydes reduce Tollens' reagent to form a shiny silver mirror on the inner surface of the test tube. It is also known as the "silver mirror test".



(iii) This can be converted by using reactions like the Clemmensen reduction or Wolff-Kishner reduction. These processes involve treating the aldehyde or ketone with specific reagents to completely reduce the oxygen-bonded carbon to a saturated alkane group.

Que 42 – (i) Define molal depression constant for a solvent. How is it expressed?

(ii) Find the freezing point of the solution containing 0.520 g of glucose ($C_6H_{12}O_6$) dissolved in 80.2 g of water ($K_f = 1.86 \text{ K/m}$).

Answer – (i) Molal depression constant (K_f) is the depression in freezing point produced when 1 mole of solute is dissolved in 1 kg of solvent. It is expressed in $K \text{ kg/mol}$ or K/m .

(ii) $\Delta T_f = K_f \times m = 1.86 \times [(0.520 / 180) / (80.2 / 1000)] = 0.067 \text{ K}$.

$T_f = 273.15 - 0.067 = 273.083 \text{ K}$

OR / अथवा

(i) What are abnormal molecular masses? How are they determined?



(ii) Determine the amount of CaCl_2 ($i=2.47$) dissolved in 2.5 litres of water such that its osmotic pressure is 0.75 atm at 27°C . [$R=0.0821 \text{ atm K}^{-1}\text{mol}^{-1}$]

Answer – (i) Abnormal molecular masses are molar mass values that are found to be higher or lower than the expected theoretical values. They are determined when a solute undergoes association or dissociation in a solution, and are calculated using the van't Hoff factor (i).

$$(ii) \Pi = i \left(\frac{n}{V} \right) RT$$

$$\Rightarrow \text{moles} = n = \frac{\Pi V}{iRT}$$

$$\Rightarrow n = \frac{0.75 \times 2.5}{2.47 \times 0.0821 \times 300} = 0.0308 \text{ mol.}$$

Mass of CaCl_2 = moles \times molar mass of CaCl_2

$$\text{Mass} = 0.0308 \times 111 \text{ g/mol} = 3.42 \text{ g}$$

Que 43 – (i) Arrange the following in the increasing order of their covalent character: SiCl_4 , CCl_4 , SnCl_4 , GeCl_4

(ii) How do the bond angles vary among the following hydrides?

NH_3 , PH_3 , AsH_3 , SbH_3

(iii) How does the covalent character of halides of an element change with oxidation state of the element?

(iv) Give the equations for the formation of the following from the elements:

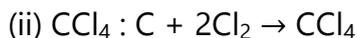
(i) Al_2O_3 (ii) CCl_4

Answer – (i) Increasing covalent character: $\text{SnCl}_4 < \text{GeCl}_4 < \text{SiCl}_4 < \text{CCl}_4$ (based on Fajan's rule: smaller cation size increases covalency).

(ii) Bond angles decrease: NH_3 (107°) $>$ PH_3 (93°) $>$ AsH_3 (92°) $>$ SbH_3 (91°).

(iii) Covalent character increases with the increase in the oxidation state of the element.





OR / अथवा

(i) How does the magnitude of ionization energy of an atom vary along the period in the periodic table? Explain.

(ii) Discuss the trends in the chemistry of p-block elements with respect to the following:

Acidic and basic nature of the oxides

Ionic and covalent nature of the hydrides

(iii) Arrange the following atoms in the order of their increasing ionization enthalpy:

${}_2\text{He}$, ${}_4\text{Be}$, ${}_7\text{N}$, ${}_{11}\text{Na}$

Answer – (i) Ionization energy increases across a period because the nuclear charge increases and the atomic size decreases. This stronger attraction holds electrons more tightly, requiring more energy to remove them

(ii) Oxides: Acidic character increases across a period but decreases down a group as metallic character grows. Basic character decreases across a period but increases down a group as metallic character grows.

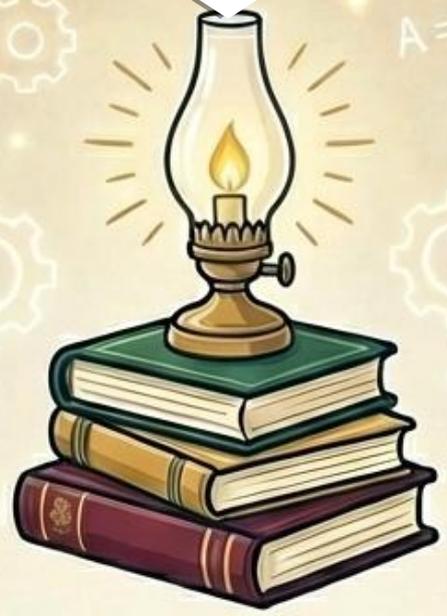
Hydrides: They are primarily covalent; their stability decreases down a group as bond strength weakens.

(iii) ${}_{11}\text{Na} < {}_4\text{Be} < {}_7\text{N} < {}_2\text{He}$





$$A = \frac{m}{(m^2 + c)^2}$$



NIOS PYQ's SOLUTIONS

$$fa = bc^2$$

$$\sqrt{h-x^2}$$

PREVIOUS YEARS' QUESTIONS & ANSWERS



OCTOBER-2024

Your Path to Success

SECTION - A / खंड - अ

A.
B.
C. 

SET - A

Que 1 – One atomic mass unit is equal to:

(A) Mass of one mole of C – 12 atoms

(B) $\frac{\text{Mass of one C-12 atom}}{12}$

(C) Mass of one C – 12 atom $\times 12$

(D) $\frac{\text{Mass of one mole of C 12 atoms}}{12}$

Answer – (B) $\frac{\text{Mass of one C-12 atom}}{12}$

Que 2 – In every chemical reaction, total mass of all the reactants is equal to the total mass of all the products. This statement is according to:

(A) Law of constant proportions

(B) Law of multiple proportions

(C) Law of conservation of mass

(D) Postulates of Dalton's atomic theory

Answer – (C) Law of conservation of mass

Que 3 – In the species $^{199}_{80}\text{Hg}$, the number of protons, neutrons and electrons respectively are:

(A) 80, 119, 80

(B) 80, 199, 80

(C) 119, 80, 119

(D) 199, 80, 199

Answer – (A) 80, 119, 80

Que 4 – The ratio of the number of moles of one component to the total number of moles in the solution is known as:



(A) Molarity

(B) Molality

(C) Normality

(D) Mole fraction

Answer – (D) Mole fraction

Que 5 – Adiabatic processes proceeds with:

(A) a change in temperature

(B) no change in temperature

(C) a change in pressure

(D) an exchange of heat between the system and the surroundings

Answer – (A) a change in temperature

Que 6 – The standard enthalpy of atomisation of a substance is the change in enthalpy when:

(A) One mole of a substance is converted into its atoms in gaseous state at 25°C and 1 bar pressure.

(B) One molecule of a substance is converted into its atoms in gaseous state at 25°C and 1 bar pressure.

(C) One mole of a substance is converted into its atoms in gaseous state at a given temperature and 1 bar pressure.

(D) One molecule of a substance is converted into its atom in gaseous state at a given temperature and 1 bar pressure.

Answer – (A) One mole of a substance is converted into its atoms in gaseous state at 25°C and 1 bar pressure.

Que 7 – The extent of ionisation of weak acids or bases and the strength of weak acids or bases are:

(A) directly related to each other

(B) inversely related to each other

(C) exponentially related to each other

(D) not related to each other



Answer – (A) directly related to each other

Que 8 – Bronsted - Lowry concept of an acid and a base is based on:

- (A) donation of H^+ ion and OH^- ion respectively
- (B) formation of H_3O^+ ion and OH^- ion
- (C) donation of proton and acceptance of proton respectively
- (D) acceptance of proton and donation of proton respectively

Answer – (C) donation of proton and acceptance of proton respectively

Que 9 – The factors affecting conductivity of an electrolyte are:

- (A) nature of the electrolyte and temperature
- (B) nature of the electrolyte and concentration
- (C) temperature and concentration
- (D) nature of the electrolyte, temperature and concentration

Answer – (D) nature of the electrolyte, temperature and concentration

Que 10 – Which of the following is not a function of salt bridge?

- (A) It completes the inner circuit.
- (B) It completes the outer circuit.
- (C) It maintains electrical neutrality.
- (D) It prevents accumulation of charges in the two half cells.

Answer – (B) It completes the outer circuit.

Que 11 – Choose the most electronegative element from the following:

- (A) Nitrogen
- (B) Oxygen
- (C) Sulphur
- (D) Fluorine

Answer – (D) Fluorine

Que 12 – The 3d series of transition metals/elements is from:



- (A) Yttrium to Lanthanum (B) Scandium to Copper
(C) Scandium to Zinc (D) Actinium to Lawrencium

Answer – (C) Scandium to Zinc

Que 13 – Lanthanide contraction is due to increase in:

- (A) Shielding by 4f electrons (B) Atomic number
(C) Effective nuclear charge (D) Size of 4f orbital

Answer – (C) Effective nuclear charge

Que 14 – Geometrical isomerism is shown by isomers in which first coordination sphere is same but geometrical arrangement of ligands varies. This isomerism is only possible for coordination number:

- (A) greater than or equal to four (B) less than or equal to four
(C) greater than or equal to two (D) equal to two

Answer – (A) greater than or equal to four

Que 15 – Vulcanization of rubber produces:

- (A) an elastomer (B) a thermoplastic polymer
(C) a thermosetting polymer (D) a plasticizer

Answer – (A) an elastomer

Que 16 – Low density polythene:

- (A) has linear chain of molecules
(B) has branching in polymer chains
(C) is packed in a compact fashion
(D) is harder and stronger than polypropylene

Answer – (B) has branching in polymer chains



Note: Question No. 17 to 28 are objective type questions of 2 marks each

Que 17 – Complete the following by given options below:

CHO, CH₂O, CHO₂, 27.59%, 72.41%, 27.89%

(1) The empirical formula of fructose is _____ .

(2) The percentage of oxygen in Fe₃O₄ is _____ .

(Atomic mass of Fe is 56.0 amu)

Answer – (i) CH₂O, (ii) 27.59%

Que 18 – Read the passage and answer the following questions :

Louis de-Broglie proposed that if light can show particle as well as wave nature, why should particles of matter not possess wave like characteristics ? On this wave-particle duality of matter and radiation, Heisenberg stated that more accurately you measure a particle's position, the less accurately you are able to measure its momentum and vice-versa.

(1) Give the mathematical expression of de-Broglie equation.

Answer –

$$\lambda = \frac{h}{mv} \quad \text{or} \quad \lambda = \frac{h}{p}$$

(2) State Heisenberg's uncertainty principle.

Answer – It states that it is impossible to determine simultaneously and precisely both the position and the momentum of a microscopic particle like an electron.

Que 19 – Write True (T) for correct statement and False (F) for incorrect statement.

(1) Raoult's law is applicable only if the liquids are volatile and miscible.

(2) Boiling point of a liquid is the temperature at which the vapour pressure of the liquid becomes zero.



Answer – (1) true, (2) false

Que 20 – Complete the following by given options below :

+20 kJ, +80 kJ, $-1574 \text{ kJ mol}^{-1}$, $+1574 \text{ kJ mol}^{-1}$

(1) When a certain change is accompanied by absorption of 50 kJ of heat and expenditure of 30 kJ of work, then the change in internal energy is _____.

(2) If the bond enthalpy of C – H and C – Cl bonds are 415 kJ mol^{-1} and 339 kJ mol^{-1} respectively, then the energy released in the formation of one mole of CH_3Cl molecules is _____.

Answer – (1) +20 kJ, (2) $-1574 \text{ kJ mol}^{-1}$

Que 21 – Complete the following by given options below :

(open, isolated, closed, state, path)

(1) A system which can exchange energy but not matter with the surroundings is called _____ system.

(2) Enthalpy is a _____ function.

Answer – (1) Closed, (2) state

Que 22 – Read the passage given below and answer the following questions :

Oxidation number is the state of oxidation of an element in a compound which is calculated by a set of rules. It is based on the concept that electrons in a covalent bond belong to the more electronegative element.

(1) What is the oxidation number of atoms in their elemental form ?

Answer – The oxidation number of atoms in their elemental (natural) form (e.g., Na, O_2 , P_4) is always Zero (0).

(2) State the oxidation number of N and Cl in NCl_3 .

Answer – In NCl_3 , the oxidation number of Nitrogen is +3 and Chlorine is -1.



Que 23 – Read the passage given below and answer the following questions :

The similarity between first member of one group and the second member of the succeeding group is called diagonal relationship. Thus lithium shows properties similar to magnesium. The closeness of the diagonal elements arises due to their comparable polarizing power. So lithium and magnesium have some physical and chemical properties.

(1) State one physical property which is same for lithium and magnesium.

Answer – Physical property: Both Lithium (Li) and Magnesium (Mg) are significantly harder and have higher melting points compared to other metals in their respective groups.

(2) Name two elements which show a diagonal relationship other than lithium and magnesium.

Answer – Other elements: Beryllium (Be) and Aluminium (Al) also show a diagonal relationship.

Que 24 – Match the item in column - I with column - II.

Column - I

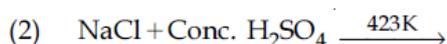
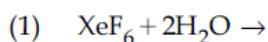
- (a) Tailing of mercury
- (b) Blue $\text{CuSO}_4 \rightarrow$ white CuSO_4
- (c) Decomposed in a strong beam of light
- (d) Yellow and transparent crystalline substance

Column - II

- (1) Conc. Sulphuric acid
- (2) Rhombic sulphur
- (3) Ozone
- (4) Sulphur dioxide

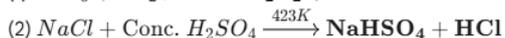
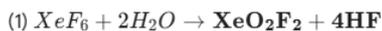
Answer – (a) – (3), (b) – (1), (c) – (4), (d) – (2)

Que 25 – Complete and balance the following chemical equations :



Answer –





Que 26 – Read the passage given below and answer the following questions :

The fission of a covalent bond involving unequal sharing of bonding electrons is known as heterolytic fission. It results in the formation of ions such as a carbocation or carbanion. These charged species can initiate chemical reactions and are classified as electrophiles or nucleophiles.

(1) Which compound forms ethyl carbocation ?

Answer – Compound forming ethyl carbocation: Ethyl chloride (CH_3CH_2Cl) or Ethanol in the presence of a strong acid.

(2) Give two examples of nucleophiles.

Answer – Two examples of nucleophiles: OH^- (Hydroxide ion) and NH_3 (Ammonia).

Que 27 – Write TRUE (T) for correct statement and FALSE (F) for incorrect statements.

(1) Benzoic acid can be prepared by oxidation of toluene by alkaline $KMnO_4$.

(2) In HVZ reaction, carboxylic acids undergo halogenation at β -Carbon atom.

Answer – (1) true, (2) false

Que 28 – Read the passage given below and answer the following questions :

Hormones are chemical messengers which are secreted by the endocrine glands.

Majority of the hormones in humans are steroids. One class is of sex hormones which control maturation, tissue growth and reproduction. The hormones which are polypeptide in nature are vasopressin and oxytocin.

(1) How are hormones transported to their place of action ?

Answer – Hormones are secreted directly into the bloodstream, which carries them to the specific target organ or place of action.



(2) State the function of oxytocin.

Answer – It stimulates the contraction of uterine muscles during childbirth and promotes the ejection of milk from mammary glands.

SECTION - B / खंड -ब



Note : Q.No. 29 to 43 are subjective type questions. An internal choice has been provided in some of these questions.

Que 29 – If 3d and 4p orbitals are to be filled in an atom by an electron then which orbital will be occupied first ? Explain it on the basis of Aufbau Principle.

Answer – According to the Aufbau Principle (specifically the $n+l$ rule):

For 3d orbital: $n = 3, l = 2$. Total $(n + l) = 5$.

For 4p orbital: $n = 4, l = 1$. Total $(n + l) = 5$.

Since both have the same $(n+l)$ value, the orbital with the lower value of n (principal quantum number) is filled first. Therefore, the 3d orbital will be occupied first.

OR / अथवा

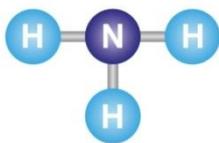
Which observation of Rutherford's α -ray scattering experiment led to the conclusion that all the positive charge of the atom was contained in the nucleus ?

Answer – The specific observation was that a very small fraction of α – particles (about 1 in 20,000) were deflected by very large angles, and some even bounced back (180° deflection). This indicated that they hit a very dense, small, and positively charged center, which Rutherford called the nucleus.

Que 30 – Why the shape of ammonia molecule is trigonal pyramidal ?

Answer – In Ammonia (NH_3), Nitrogen undergoes sp^3 hybridization. It has 3 bond pairs and 1 lone pair. According to VSEPR Theory, the repulsion between the lone pair and bond pairs (lp-bp) is stronger than the repulsion between bond pairs (bp-bp). This causes the H-N-H bond angles to decrease to 107° (from 109.5°), resulting in a Trigonal Pyramidal shape.



Ammonia | NH₃


Que 31 – A solution containing 12.5 g of a non-electrolyte substance in 175 g of water gave boiling point elevation of 0.70 K. Calculate the molar mass of the substance.

Answer – Formula: $M_2 = \frac{1000 \times K_b \times w_2}{\Delta T_b \times w_1}$

Given: $w_2 = 12.5$ g, $w_1 = 175$ g, $\Delta T_b = 0.70$ K, $K_b = 0.52$ kg mol⁻¹

$$M_2 = \frac{1000 \times 0.52 \times 12.5}{0.70 \times 175} = 53.06 \text{ g mol}^{-1}$$

OR / अथवा

What is the molar concentration of solute particles in human blood if the osmotic pressure is 7.2 atm at normal body temperature of 37°C ? (R = 0.0821 L atm K⁻¹mol⁻¹) (R=0.0821 L atm K⁻¹mol⁻¹)

Answer – Formula: $\Pi = CRT \Rightarrow C = \frac{\Pi}{RT}$

Given: $\Pi = 7.2$ atm, $T = 37 + 273 = 310$ K, $R = 0.0821$

$$C = \frac{7.2}{0.0821 \times 310} = 0.283 \text{ M}$$

Que 32 – How will you prove that a solution of acetic acid and sodium acetate is a buffer solution ?

Answer – This is an acidic buffer. When a small amount of acid (H⁺) is added, it reacts with acetate ions (CH₃COO⁻) to form weak acetic acid. When a small amount of base (OH⁻) is added, it reacts with acetic acid to form water and acetate ions. In both cases, the pH remains almost constant, proving it is a buffer.

OR / अथवा

What is the pH of a 0.001 M aqueous solution of HCl ?

Answer – HCl is a strong acid, so $H^+ = 0.001 \text{ M} = 10^{-3} \text{ M}$



$$\text{pH} = -\log [\text{H}^+] = -\log [10^{-3}] = 3$$

Que 33 – Classify the following oxides into acidic, basic or amphoteric oxides : FeO, SiO₂, SO₂, Al₂O₃.

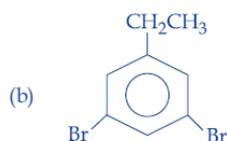
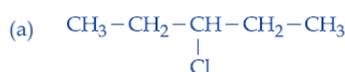
Answer – Acidic Oxides = SiO₂, SO₂, Basic Oxides = FeO, Amphoteric Oxides = Al₂O₃

Que 34 – Explain with the help of Valence Bond Theory (VBT) the shape and magnetic behaviour of [Ni(CN)₄]²⁻ ion.

Answer – Shape: Square Planar.

Magnetic Behaviour: All electrons are paired, so it is Diamagnetic.

Que 35 – Write the IUPAC name of the following compounds :



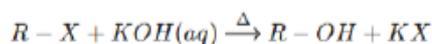
Answer – (a) Propan-2-ol (b) Ethoxyethane

OR / अथवा

(a) Distinguish between a haloalkane and a haloarene by a chemical test.

(b) Why is chloroform stored in dark coloured bottles ?

Answer – (a) Haloalkane and haloarenes can be distinguished by silver nitrate (AgNO₃). Haloalkanes react with AgNO₃ to give white precipitate of AgCl while haloarenes do not react.



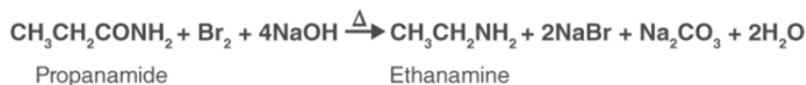
(b) Chloroform reacts with oxygen in sunlight to form a highly poisonous gas called Phosgene (COCl₂). Dark bottles prevent this reaction.



Que 36 – How can you obtain ethanamine using Hofmann Bromomide reaction ?

Write chemical equation involved.

Answer – Ethanamine ($\text{CH}_3\text{CH}_2\text{NH}_2$) is obtained by reacting Propanamide ($\text{CH}_3\text{CH}_2\text{CONH}_2$) with Bromine (Br_2) and aqueous/ethanolic NaOH.



Que 37 – What is the active component of soap ? What is the polar part in (i) a soap molecule and (ii) a synthetic detergent molecule ?

Answer – The active component is the Sodium or Potassium salt of long-chain fatty acids.

(i) Soap polar part: Carboxylate group ($-\text{COO}^-$).

(ii) Detergent polar part: Sulphonate group ($\text{SO}_3^- \text{Na}^+$).

Que 38 – Define bond enthalpy. Calculate the bond enthalpy of CH_4 molecule if average bond enthalpy of C–H bond is 414 kJ mol^{-1} .

Answer – The amount of energy required to break one mole of bonds of a particular type between two atoms in a gaseous state is called bond enthalpy.

CH_4 has 4 C-H bonds.

Total bond enthalpy = $4 \times 414 = 1656 \text{ kJ mol}^{-1}$.

OR / अथवा

Define Hybridisation. What is meant by 'sp' hybridisation, explain with the help of formation of BeCl_2 molecule ?

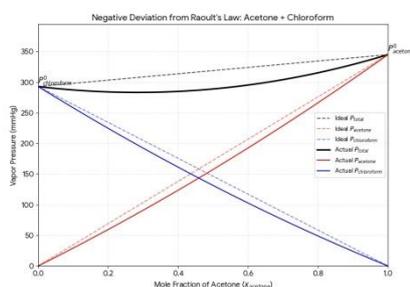
Answer – It is the process of mixing of atomic orbitals of slightly different energies to form a new set of equivalent orbitals called hybrid orbitals.

BeCl_2 : In Be ($1s^2, 2s^2$), one electron from 2s is promoted to 2p. One 2s and one 2p orbital mix to form two sp hybrid orbitals which are arranged at 180° , giving a Linear shape.



Que 39 – Which liquid pairs show negative deviation from Raoult's Law ? Explain and draw the graph for it by taking an example of chloroform and acetone.

Answer – Liquid pairs where the A-B interactions are stronger than A-A and B-B interactions show negative deviation. In Chloroform and Acetone, a Hydrogen bond is formed between the oxygen of acetone and the hydrogen of chloroform. This reduces the escaping tendency of molecules, leading to lower vapour pressure.



Que 40 – (a) State Faraday's first law of electrolysis.

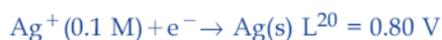
(b) What is the mass of silver deposited when 300 coulomb electricity is passed through a solution of AgNO_3 ? (Atomic mass of Ag = 108 u)

Answer – (a) The mass of a substance deposited at an electrode is directly proportional to the quantity of electricity (Q) passed through it ($m = zQ$).

$$(b) m = \frac{\text{Eq. weight} \times Q}{96500} = \frac{108 \times 300}{96500} = 0.335 \text{ g}$$

OR / अथवा

Calculate the reduction potential of the following half-cell at 298 K.



Answer – $\text{Ag}^+ (0.1\text{M}) + e^- \rightarrow \text{Ag} (s)$

Standard Reduction Potential (E°): 0.80V.

Concentration of Ag^+ ions (Ag^+): 0.1M.

Number of electrons (n): 1.



Temperature (T): 298 K

For a reduction reaction at 298 K, the Nernst equation is simplified to

$$E = E^\circ - \frac{0.0591}{n} \log \frac{1}{[\text{Ag}^+]}$$

$$\Rightarrow E = 0.80 - \frac{0.0591}{1} \log \frac{1}{[0.1]}$$

$$\Rightarrow E = 0.80 - 0.0591 \times 1 = 0.7409 \text{ V}$$

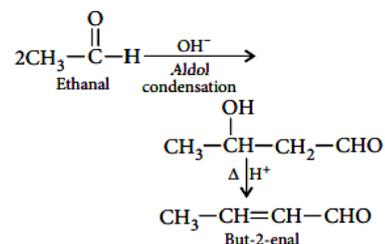
Que 41 – How will you carry out the following conversions ?

(i) Ethanol to But-2-enal

(ii) Propanone to 2-Methyl Butan-2-ol

(iii) Butanoic acid to 2-Bromobutanoic acid

Answer –



(ii) Perform acidic hydrolysis of the resulting adduct to yield 2-Methyl Butan-2-ol.

(iii) Treat butanoic acid ($\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$) with Bromine (Br_2) in the presence of red phosphorus (P)

Que 42 – (i) Give reasons for the following :

(a) Manganese shows the largest number of oxidation states among 3d elements.

(b) Sc^{3+} ion does not show magnetic behaviour.

(c) Copper sulphate solution is blue in colour.

(d) Transition metals of first series form alloys.



(e) Transition metals form interstitial compounds.

Answer – (a) Mn oxidation states: Has the highest number of unpaired electrons (5 in 3d and 2 in 4s).

(b) Sc^{3+} magnetism: Sc^3 has $3d^0$ configuration (no unpaired electrons).

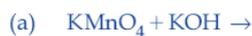
(c) Blue colour: Due to d-d transition in Cu^{2+} ($3d^9$) ions.

(d) Alloys: Transition metals have similar atomic sizes.

(e) Interstitial compounds: Small atoms like H, C, N fit into voids of metal lattices.

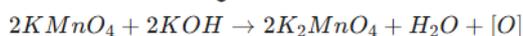
OR / अथवा

Complete and balance the following reactions :

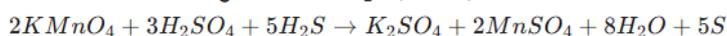


Answer –

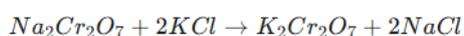
1. Potassium Permanganate with KOH:



2. Potassium Permanganate with H_2S (Acidic):



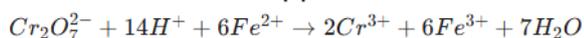
3. Sodium Dichromate with KCl:



4. Potassium Dichromate with Conc. H_2SO_4 :



5. Dichromate ion with Iron(II) in Acidic Medium:



Que 43 – Give reasons for the following :

(a) Phenols exhibit higher boiling points as compared to the hydrocarbons of similar molecular weight.



(b) Ethers have geometry similar to water and alcohols.

(II) Explain Lucas' test. What is its use, explain ?

Answer – (a) Due to intermolecular Hydrogen bonding.

(b) Ethers have sp^3 hybridization with two lone pairs, creating a bent shape like water.

(II) Lucas Test: Mixture of Conc. HCl and anhydrous $ZnCl_2$. It distinguishes alcohols: Tertiary (immediate turbidity), Secondary (5 mins), Primary (only on heating).

OR / अथवा

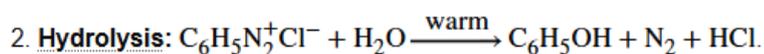
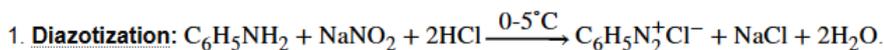
(a) How will you convert aniline to phenol ?

(b) Give chemical equations for the following :

I. Kolbe reaction

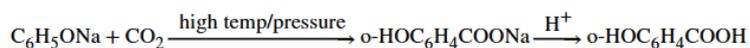
II. Coupling reaction

Answer – (a) This conversion is carried out in two main steps:

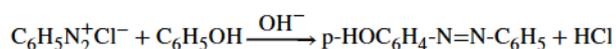


(b) Chemical equation:

(1) Kolbe reaction



(2) Coupling reaction : Benzenediazonium chloride reacts with phenol in a weak alkaline to produce hydroxyazobenzene (an orange dye).



SECTION - A / खंड - अ

A.
B.
C. 

SET - B

Que 1 – Which of the following is equal to 1 mole O₂

- (A) 6.022×10^{23} molecules of Oxygen
- (B) 6.022×10^{23} atoms of Oxygen
- (C) 60.22×10^{23} molecules of Oxygen
- (D) 60.22×10^{23} atoms of Oxygen

Answer – (A) 6.022×10^{23} molecules of Oxygen

Que 2 – The factors affecting conductivity of an electrolyte are :

- (A) nature of the electrolyte and temperature
- (B) nature of the electrolyte and concentration
- (C) temperature and concentration
- (D) nature of the electrolyte, temperature and concentration

Answer – (D) nature of the electrolyte, temperature and concentration

Que 3 – Bronsted - Lowry concept of an acid and a base is based on:

- (A) donation of H⁺ ion and OH⁻ ion respectively
- (B) formation of H₃O⁺ ion and OH⁻ ion
- (C) donation of proton and acceptance of proton respectively
- (D) acceptance of proton and donation of proton respectively

Answer – (C) donation of proton and acceptance of proton respectively

Que 4 – The extent of ionisation of weak acids or bases and the strength of weak acids or bases are:

- (A) directly related to each other
- (B) inversely related to each other
- (C) exponentially related to each other
- (D) not related to each other



Answer – (A) directly related to each other

Que 5 – Choose the most electronegative element from the following:

- (A) Nitrogen (B) Oxygen
(C) Sulphur (D) Fluorine

Answer – (D) Fluorine

Que 6 – The 3d series of transition metals/elements is from:

- (A) Yttrium to Lanthanum (B) Scandium to Copper
(C) Scandium to Zinc (D) Actinium to Lawrencium

Answer – (C) Scandium to Zinc

Que 7 – In every chemical reaction, total mass of all the reactants is equal to the total mass of all the products. This statement is according to:

- (A) Law of constant proportions
(B) Law of multiple proportions
(C) Law of conservation of mass
(D) Postulates of Dalton's atomic theory

Answer – (C) Law of conservation of mass

Que 8 – In the species $^{199}_{80}\text{Hg}$, the number of protons, neutrons and electrons respectively are:

- (A) 80, 119, 80 (B) 80, 199, 80
(C) 119, 80, 119 (D) 199, 80, 199

Answer – (A) 80, 119, 80

Que 9 – The standard enthalpy of atomisation of a substance is the change in enthalpy when:



- (A) One mole of a substance is converted into its atoms in gaseous state at 25°C and 1 bar pressure.
- (B) One molecule of a substance is converted into its atoms in gaseous state at 25°C and 1 bar pressure.
- (C) One mole of a substance is converted into its atoms in gaseous state at a given temperature and 1 bar pressure.
- (D) One molecule of a substance is converted into its atom in gaseous state at a given temperature and 1 bar pressure.

Answer – (A) One mole of a substance is converted into its atoms in gaseous state at 25°C and 1 bar pressure.

Que 10 – Adiabatic processes proceeds with:

- (A) a change in temperature
- (B) no change in temperature
- (C) a change in pressure
- (D) an exchange of heat between the system and the surroundings

Answer – (A) a change in temperature

Que 11 – The ratio of the number of moles of one component to the total number of moles in the solution is known as:

- (A) Molarity
- (B) Molality
- (C) Normality
- (D) Mole fraction

Answer – (D) Mole fraction

Que 12 – Which of the following is not a function of salt bridge?

- (A) It completes the inner circuit.
- (B) It completes the outer circuit.
- (C) It maintains electrical neutrality.
- (D) It prevents accumulation of charges in the two half cells.



Answer – (B) It completes the outer circuit.

Que 13 – The consequence of lanthanide contraction is :

- (A) radii of elements of second and third transition series becomes similar.
- (B) radii of elements of third transition series is smaller than elements of second transition series.
- (C) radii of elements of first transition series decreases.
- (D) radii of elements of second transition series increases.

Answer – (A) radii of elements of second and third transition series becomes similar.

Que 14 – Low density polythene:

- (A) has linear chain of molecules
- (B) has branching in polymer chains
- (C) is packed in a compact fashion
- (D) is harder and stronger than polypropylene

Answer – (B) has branching in polymer chains

Que 15 – Geometrical isomerism is shown by isomers in which first coordination sphere is same but geometrical arrangement of ligands varies. This isomerism is only possible for coordination number :

- (A) greater than or equal to four
- (B) less than or equal to four
- (C) greater than or equal to two
- (D) equal to two

Answer – (A) greater than or equal to four

Que 16 – Vulcanization of rubber produces :

- (A) an elastomer
- (B) a thermoplastic polymer
- (C) a thermosetting polymer
- (D) a plasticizer

Answer – (C) a thermosetting polymer



Note: Question No. 17 to 28 are objective type questions of 2 marks each.

Que 17 – Complete the following by given options below :

NH, NH₃, 72.41%, 24.1%

(1) The empirical formula of ammonia is _____.

(2) The percentage of iron in Fe₃O₄ is _____.

(Atomic mass of Fe=56.0 amu)

Answer – (1) NH₃, (2) 72.41 %

Que 18 – Read the passage given below and answer the following questions :

Oxidation number is the state of oxidation of an element in a compound which is calculated by a set of rules. It is based on the concept that electrons in a covalent bond belong to the more electronegative element.

(1) What is the oxidation number of atoms in their elemental form ?

Answer – The oxidation number of atoms in their elemental (natural) form (e.g., Na, O₂, P₄) is always Zero (0).

(2) State the oxidation number of N and Cl in NCl₃.

Answer – In NCl₃, the oxidation number of Nitrogen is +3 and Chlorine is -1.

Que 19 – Complete the following by given options below :

open, isolated, closed, state, path

(1) A system which can exchange energy but not matter with the surroundings is called _____ system.

(2) Enthalpy is a _____ function.

Answer – (1) Closed, (2) state

Que 20 – Read the passage and answer the following questions :



Louis de-Broglie proposed that if light can show particle as well as wave nature, why should particles of matter not possess wave like characteristics? On this wave-particle duality of matter and radiation, Heisenberg stated that more accurately you measure a particle's position, the less accurately you are able to measure its momentum and vice-versa.

(1) Give the mathematical expression of de-Broglie equation.

Answer –

$$\lambda = \frac{h}{mv} \quad \text{or} \quad \lambda = \frac{h}{p}$$

(2) State Heisenberg's uncertainty principle.

Answer – It states that it is impossible to determine simultaneously and precisely both the position and the momentum of a microscopic particle like an electron.

Que 21 – Write True (T) for correct statement and False (F) for incorrect statement.

(1) Raoult's law is applicable only if the liquids are volatile and miscible.

(2) Boiling point of a liquid is the temperature at which the vapour pressure of the liquid becomes zero.

Answer – (1) true, (2) false

Que 22 – Complete the following by given options below :

$$+20 \text{ kJ}, +80 \text{ kJ}, -1574 \text{ kJ mol}^{-1}, +1574 \text{ kJ mol}^{-1}$$

(1) When a certain change is accompanied by absorption of 50 kJ of heat and expenditure of 30 kJ of work, then the change in internal energy is _____.

(2) If the bond enthalpy of C – H and C – Cl bonds are 415 kJ mol⁻¹ and 339 kJ mol⁻¹ respectively, then the energy released in the formation of one mole of CH₃Cl molecules is _____.

Answer – (1) +20 kJ, (2) -1574 kJ mol⁻¹



23. Read the passage given below and answer the following questions :

The oxide of hydrogen is essential to all life. It occurs as water in lakes, rivers etc.

Water is made up of two hydrogen atoms and one oxygen atom. An ice cube floats on water.

(1) Which type of a compound water is?

Answer – Water (H_2O) is a polar covalent compound. It is also technically an inorganic oxide (specifically, hydrogen oxide).

(2) Why an ice cube floats on water ?

Answer – An ice cube floats because it is less dense than liquid water.

Que 24 – Read the passage given below and answer the following questions :

Hormones are chemical messengers which are secreted by the endocrine glands.

Majority of the hormones in humans are steroids. One class is of sex hormones which control maturation, tissue growth and reproduction. The hormones which are polypeptide in nature are vasopressin and oxytocin.

(1) How are hormones transported to their place of action ?

Answer – Hormones are secreted directly into the bloodstream, which carries them to the specific target organ or place of action.

(2) State the function of oxytocin.

Answer – It stimulates the contraction of uterine muscles during childbirth and promotes the ejection of milk from mammary glands.

Que 25 – Match the item in column - I with column - II.

Column - I

(a) Tailing of mercury

(b) Blue $CuSO_4 \rightarrow$ white $CuSO_4$

Column - II

(1) Conc. Sulphuric acid

(2) Rhombic sulphur



(c) Decomposed in a strong beam of light

(3) Ozone

(d) Yellow and transparent crystalline substance

(4) Sulphur dioxide

Answer – (a) – (3), (b) – (1), (c) – (4), (d) – (2)

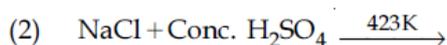
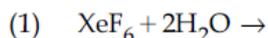
Que 26 – Write TRUE (T) for correct statement and FALSE (F) for incorrect statements.

(1) Benzoic acid can be prepared by oxidation of toluene by alkaline KMnO_4 .

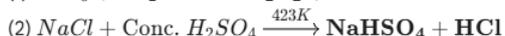
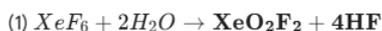
(2) In HVZ reaction, carboxylic acids undergo halogenation at β -Carbon atom.

Answer – (1) true, (2) false

Que 27 – Complete and balance the following chemical equations :



Answer –



Que 28 – Read the passage given below and answer the following questions :

The fission of a covalent bond involving unequal sharing of bonding electrons is known as heterolytic fission. It results in the formation of ions such as a carbocation or carbanion. These charged species can initiate chemical reactions and are classified as electrophiles or nucleophiles.

(1) Which compound forms ethyl carbocation ?

Answer – Compound forming ethyl carbocation: Ethyl chloride ($\text{CH}_3\text{CH}_2\text{Cl}$) or Ethanol in the presence of a strong acid.

(2) Give two examples of nucleophiles.

Answer – Two examples of nucleophiles: OH^- (Hydroxide ion) and NH_3 (Ammonia).



SECTION - B / खंड -ब



Note : Q.No. 29 to 43 are subjective type questions. An internal choice has been provided in some of these questions.

Que 29 – (i) If 3d and 4p orbitals are to be filled in an atom by an electron then which orbital will be occupied first ? Explain it on the basis of Aufbau Principle.

Answer – According to the Aufbau Principle (specifically the $n+l$ rule):

For 3d orbital: $n = 3, l = 2$. Total $(n + l) = 5$.

For 4p orbital: $n = 4, l = 1$. Total $(n + l) = 5$.

Since both have the same $(n+l)$ value, the orbital with the lower value of n (principal quantum number) is filled first. Therefore, the 3d orbital will be occupied first.

OR / अथवा

Which observation of Rutherford's α -ray scattering experiment led to the conclusion that all the positive charge of the atom was contained in the nucleus ?

Answer – The specific observation was that a very small fraction of α – particles (about 1 in 20,000) were deflected by very large angles, and some even bounced back (180° deflection). This indicated that they hit a very dense, small, and positively charged center, which Rutherford called the nucleus.

Que 30 – Predict the shape of methane molecule on the basis of VSEPR theory.

Answer – In methane, the central Carbon atom has 4 bond pairs and 0 lone pairs, which orient themselves to minimize repulsion. According to VSEPR theory, this results in a Tetrahedral shape with bond angles of 109.5° .

Que 31 – How will you prove that a solution of acetic acid and sodium acetate is a buffer solution ?

Answer – This is an acidic buffer. When a small amount of acid (H^+) is added, it reacts with acetate ions (CH_3COO^-) to form weak acetic acid. When a small amount of base (OH^-) is



added, it reacts with acetic acid to form water and acetate ions. In both cases, the pH remains almost constant, proving it is a buffer.

OR / अथवा

What is the pH of a 0.001 M aqueous solution of HCl ?

Answer – HCl is a strong acid, so $H^+ = 0.001 \text{ M} = 10^{-3} \text{ M}$

$$\text{pH} = -\log [H^+] = -\log [10^{-3}] = 3$$

Que 32 – A solution containing 12.5 g of a non-electrolyte substance in 175 g of water gave boiling point elevation of 0.70 K. Calculate the molar mass of the substance.

Answer – Formula: $M_2 = \frac{1000 \times K_b \times w_2}{\Delta T_b \times w_1}$

Given: $w_2 = 12.5 \text{ g}$, $w_1 = 175 \text{ g}$, $\Delta T_b = 0.70 \text{ K}$, $K_b = 0.52 \text{ kg mol}^{-1}$

$$M_2 = \frac{1000 \times 0.52 \times 12.5}{0.70 \times 175} = 53.06 \text{ g mol}^{-1}$$

OR / अथवा

What is the molar concentration of solute particles in human blood if the osmotic pressure is 7.2 atm at normal body temperature of 37°C ? ($R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$) ($R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$)

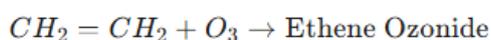
Answer – Formula: $\Pi = CRT \Rightarrow C = \frac{\Pi}{RT}$

Given: $\Pi = 7.2 \text{ atm}$, $T = 37 + 273 = 310 \text{ K}$, $R = 0.0821$

$$C = \frac{7.2}{0.0821 \times 310} = 0.283 \text{ M}$$

Que 33 – What are Ozonides ? Give chemical equation for their formation.

Answer – Ozonides are unstable, intermediate addition products formed when ozone (O_3) reacts with the carbon-carbon double bond of an alkene



Que 34 – What is the shape and magnetic behaviour of $Ni(CO)_4$?



Answer – Shape: The molecule has a Tetrahedral geometry.

Magnetic Behavior: It is Diamagnetic.

Que 35 – What is the active component of soap ? What is the polar part in (i) a soap molecule and (ii) a synthetic detergent molecule ?

Answer – The active component is the Sodium or Potassium salt of long-chain fatty acids.

(i) Soap polar part: Carboxylate group ($-\text{COO}^-$).

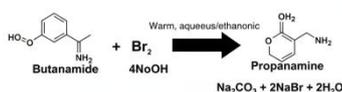
(ii) Detergent polar part: Sulphonate group ($\text{SO}_3^- \text{Na}^+$).

36. How can you obtain propanamine using Hofmann Bromamide reaction ?

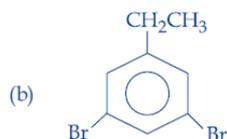
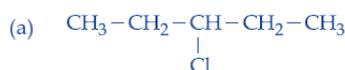
Answer – To obtain propanamine ($\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$) using the Hofmann Bromamide reaction, you need to react butanamide with bromine and sodium hydroxide.

In this reaction, an amide is treated with bromine (Br_2) and an aqueous or ethanolic solution of sodium hydroxide (NaOH), which produces a primary amine containing one less carbon atom than the starting amide.

Hofmann Bromamide reaction



Que 37 – Write the IUPAC name of the following compounds :



Answer – (a) Propan-2-ol (b) Ethoxyethane

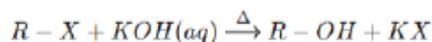
OR / अथवा

(a) Distinguish between a haloalkane and a haloarene by a chemical test.



(b) Why is chloroform stored in dark coloured bottles ?

Answer – (a) Haloalkane and haloarenes can be distinguished by silver nitrate (AgNO_3). Haloalkanes react with AgNO_3 to give white precipitate of AgCl while haloarenes do not react.



(b) Chloroform reacts with oxygen in sunlight to form a highly poisonous gas called Phosgene (COCl_2). Dark bottles prevent this reaction.

Que 38 – (a) State Faraday's first law of electrolysis.

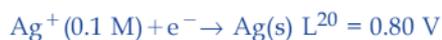
(b) What is the mass of silver deposited when 300 coulomb electricity is passed through a solution of AgNO_3 ? (Atomic mass of $\text{Ag} = 108 \text{ u}$)

Answer – (a) The mass of a substance deposited at an electrode is directly proportional to the quantity of electricity (Q) passed through it ($m = zQ$).

$$(b) m = \frac{\text{Eq. weight} \times Q}{96500} = \frac{108 \times 300}{96500} = 0.335 \text{ g}$$

OR / अथवा

Calculate the reduction potential of the following half-cell at 298 K.



Answer – $Ag^+(0.1M) + e^- \rightarrow Ag(s)$

Standard Reduction Potential (E°): 0.80V.

Concentration of Ag^+ ions (Ag^+): 0.1M.

Number of electrons (n): 1.

Temperature (T): 298 K

For a reduction reaction at 298 K, the Nernst equation is simplified to



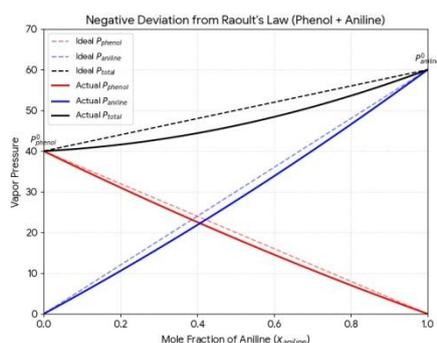
$$E = E^\circ - \frac{0.0591}{n} \log \frac{1}{[\text{Ag}^+]}$$

$$\Rightarrow E = 0.80 - \frac{0.0591}{1} \log \frac{1}{[0.1]}$$

$$\Rightarrow E = 0.80 - 0.0591 \times 1 = 0.7409 \text{ V}$$

Que 39 – Which liquid pairs show negative deviation from Raoult's law ? Explain taking example of phenol-aniline solution. Draw a graph for the same.

Answer – Liquid pairs where the A-B interactions are stronger than A-A and B-B interactions show negative deviation. In a mixture of Phenol and Aniline, a strong intermolecular hydrogen bond is formed between the phenolic proton (hydrogen) and the lone pair of electrons on the nitrogen atom of the aniline molecule.



Que 40 – Define bond enthalpy. Calculate the bond enthalpy of CH_4 molecule if average bond enthalpy of C–H bond is 414 kJ mol^{-1} .

Answer – The amount of energy required to break one mole of bonds of a particular type between two atoms in a gaseous state is called bond enthalpy.

CH_4 has 4 C–H bonds.

Total bond enthalpy = $4 \times 414 = 1656 \text{ kJ mol}^{-1}$.

OR / अथवा

Define Hybridisation. What is meant by 'sp' hybridisation, explain with the help of formation of BeCl_2 molecule ?



Answer – It is the process of mixing of atomic orbitals of slightly different energies to form a new set of equivalent orbitals called hybrid orbitals.

BeCl₂: In Be (1s², 2s²), one electron from 2s is promoted to 2p. One 2s and one 2p orbital mix to form two sp hybrid orbitals which are arranged at 180°, giving a Linear shape.

41. How will you carry out the following conversions ?

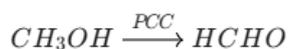
(a) Methanol to Propan-2-ol

(b) Methylbenzene to Benzoic acid

(c) Propanone to its Cyanohydrin

Answer – (a) Methanol to Propan-2-ol

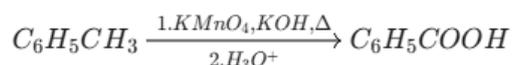
1. Oxidation: Methanol is first oxidized to Methanal (Formaldehyde) using PCC (Pyridinium chlorochromate).



Grignard Reaction: Methanal is then reacted with Ethyl magnesium bromide (CH₃CH₂MgBr), followed by acid hydrolysis, to produce Propan-2-ol.

(b) Methylbenzene to Benzoic acid

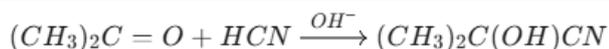
Oxidation: Methylbenzene (Toluene) is heated with alkaline Potassium Permanganate (KMnO₄) The intermediate potassium salt is then acidified with dilute HCl to yield Benzoic acid.



(c) Propanone to its Cyanohydrin

Addition: Propanone (Acetone) reacts with Hydrogen cyanide (HCN) in the presence of a base. The cyanide ion (CN⁻) attacks the carbonyl carbon to form Propanone Cyanohydrin (Acetone Cyanohydrin).





Que 42 – (i) Give reasons for the following:

- (a) Manganese shows the largest number of oxidation states among 3d elements.
- (b) Sc^{3+} ion does not show magnetic behaviour.
- (c) Copper sulphate solution is blue in colour.
- (d) Transition metals of first series form alloys.
- (e) Transition metals form interstitial compounds.

Answer – (a) Mn oxidation states: Has the highest number of unpaired electrons (5 in 3d and 2 in 4s).

(b) Sc^{3+} magnetism: Sc^3 has $3d^0$ configuration (no unpaired electrons).

(c) Blue colour: Due to d-d transition in Cu^{2+} ($3d^9$) ions.

(d) Alloys: Transition metals have similar atomic sizes.

(e) Interstitial compounds: Small atoms like H, C, N fit into voids of metal lattices.

OR / अथवा

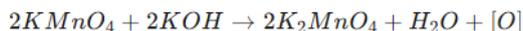
Complete and balance the following reactions :



Answer –



1. Potassium Permanganate with KOH:



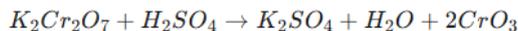
2. Potassium Permanganate with H_2S (Acidic):



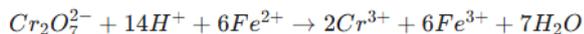
3. Sodium Dichromate with KCl:



4. Potassium Dichromate with Conc. H_2SO_4 :



5. Dichromate ion with Iron(II) in Acidic Medium:



Que 43 – (I) Give reasons for the following :

(a) Phenols exhibit higher boiling points as compared to the hydrocarbons of similar molecular weight.

(b) Ethers have geometry similar to water and alcohols.

(II) Explain Lucas' test. What is its use, explain ?

Answer – (I) (a) Due to intermolecular Hydrogen bonding.

(b) Ethers have sp^3 hybridization with two lone pairs, creating a bent shape like water.

(II) Lucas Test: Mixture of Conc. HCl and anhydrous $ZnCl_2$. It distinguishes alcohols: Tertiary (immediate turbidity), Secondary (5 mins), Primary (only on heating).

OR / अथवा

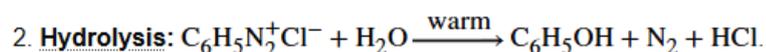
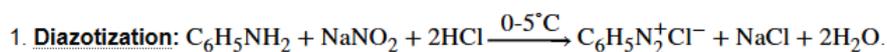
(a) How will you convert aniline to phenol ?

(b) Give chemical equations for the following :

I. Kolbe reaction

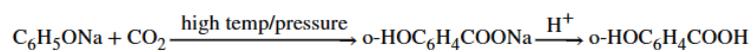
II. Coupling reaction

Answer – (a) This conversion is carried out in two main steps:



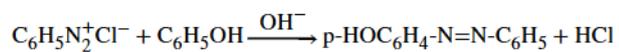
(b) Chemical equation:

(1) Kolbe reaction



(2) Coupling reaction

Benzenediazonium chloride reacts with phenol in a weak alkaline to produce hydroxyazobenzene (an orange dye).



SECTION - A / खंड - अ

A.
B.
C. 

SET - C

Que 1 – The ratio of the number of moles of one component to the total number of moles in the solution is known as:

- (A) Molarity (B) Molality
(C) Normality (D) Mole fraction

Answer – (D) Mole fraction

Que 2 – Adiabatic processes proceeds with:

- (A) a change in temperature
(B) no change in temperature
(C) a change in pressure
(D) an exchange of heat between the system and the surroundings

Answer – (A) a change in temperature

Que 3 – In the species $^{199}_{80}\text{Hg}$, the number of protons, neutrons and electrons respectively are:

- (A) 80, 119, 80 (B) 80, 199, 80
(C) 119, 80, 119 (D) 199, 80, 199

Answer – (A) 80, 119, 80

Que 4 – One atomic mass unit is equal to:

- (A) Mass of one mole of C-12 atoms
(B) $\frac{\text{Mass of one C 12 atom}}{12}$
(C) Mass of one C-12 atom $\times 12$



(D) $\frac{\text{Mass of one mole of C 12 atoms}}{12}$

Answer – (B) $\frac{\text{Mass of one C 12 atom}}{12}$

Que 5 – In every chemical reaction, total mass of all the reactants is equal to the total mass of all the products. This statement is according to:

- (A) Law of constant proportions
- (B) Law of multiple proportions
- (C) Law of conservation of mass
- (D) Postulates of Dalton's atomic theory

Answer – (C) Law of conservation of mass

Que 6 – Choose the most electronegative element from the following:

- (A) Nitrogen
- (B) Oxygen
- (C) Sulphur
- (D) Fluorine

Answer – (D) Fluorine

Que 7 – Which of the following is not a function of salt bridge?

- (A) It completes the inner circuit.
- (B) It completes the outer circuit.
- (C) It maintains electrical neutrality.
- (D) It prevents accumulation of charges in the two half cells.

Answer – (B) It completes the outer circuit.

Que 8 – The standard enthalpy of atomisation of a substance is the change in enthalpy when:

- (A) One mole of a substance is converted into its atoms in gaseous state at 25°C and 1 bar pressure.



- (B) One molecule of a substance is converted into its atoms in gaseous state at 25°C and 1 bar pressure.
- (C) One mole of a substance is converted into its atoms in gaseous state at a given temperature and 1 bar pressure.
- (D) One molecule of a substance is converted into its atom in gaseous state at a given temperature and 1 bar pressure.

Answer – (A) One mole of a substance is converted into its atoms in gaseous state at 25°C and 1 bar pressure.

Que 9 – The extent of ionisation of weak acids or bases and the strength of weak acids or bases are:

- (A) directly related to each other (B) inversely related to each other
- (C) exponentially related to each other (D) not related to each other

Answer – (A) directly related to each other

Que 10 – Bronsted - Lowry concept of an acid and a base is based on:

- (A) donation of H⁺ ion and OH⁻ ion respectively
- (B) formation of H₃O⁺ ion and OH⁻ ion
- (C) donation of proton and acceptance of proton respectively
- (D) acceptance of proton and donation of proton respectively

Answer – (C) donation of proton and acceptance of proton respectively

Que 11 – The factors affecting conductivity of an electrolyte are:

- (A) nature of the electrolyte and temperature
- (B) nature of the electrolyte and concentration
- (C) temperature and concentration
- (D) nature of the electrolyte, temperature and concentration

Answer – (D) nature of the electrolyte, temperature and concentration



(1) Raoult's law is applicable only if the liquids are volatile and miscible.

(2) Boiling point of a liquid is the temperature at which the vapour pressure of the liquid becomes zero.

Answer – (1) true, (2) false

18. Read the passage and answer the following questions :

The distribution of electrons in shells and sub-shells is called electronic configuration of an element which is governed by some basic rules and principles. These rules sometimes fails to predict the correct electronic configuration where the energies of neighbouring subshells are quite close e.g. 4s, 3d ; 5s, 4d ; 4f, 5d etc.

(1) The electronic configuration of copper is $3d^9 4s^2$ or $3d^{10} 4s^1$. Give reason for the correct answer.

Answer – The correct configuration is $3d^{10} 4s^1$ because completely filled d – subshells provide extra stability due to symmetry and higher exchange energy.

(2) What is meant by exchange energy ?

Answer – Exchange energy is the energy released when electrons with the same spin exchange their positions within degenerate orbitals, contributing to the stability of the atom.

Que 19 – Complete the following by given options below:

CHO, CH₂O, CHO₂, 27.59%, 72.41%, 27.89%

(1) The empirical formula of fructose is _____ .

(2) The percentage of oxygen in Fe₃O₄ is _____ .

(Atomic mass of Fe is 56.0 amu)

Answer – (i) CH₂O, (ii) 27.59%

Que 20 – Complete the following by given options below :



+20 kJ, +80 kJ, $-1574 \text{ kJ mol}^{-1}$, $+1574 \text{ kJ mol}^{-1}$

(1) When a certain change is accompanied by absorption of 50 kJ of heat and expenditure of 30 kJ of work, then the change in internal energy is _____.

(2) If the bond enthalpy of C – H and C – Cl bonds are 415 kJ mol^{-1} and 339 kJ mol^{-1} respectively, then the energy released in the formation of one mole of CH_3Cl molecules is _____.

Answer – (1) +20 kJ, (2) $-1574 \text{ kJ mol}^{-1}$

Que 21 – Complete the following by given options below :

open, isolated, closed, state, path

(1) A system which can exchange energy but not matter with the surroundings is called _____ system.

(2) Enthalpy is a _____ function.

Answer – (1) Closed, (2) state

22. Read the passage and answer the following questions :

An electrochemical cell is a device used for the interconversion of electrical and chemical energy. It contains two electrodes and an electrolyte. In electrolytic cell, a battery is used while in a galvanic cell an emf is developed as a result of redox reaction occurring at the electrodes.

(1) Which cell converts chemical energy into electrical energy ?

Answer – A Galvanic cell (also known as a voltaic cell) is the device that converts chemical energy into electrical energy as a result of a spontaneous redox reaction.

(2) At which electrode ions undergo reduction ?

Answer – Reduction always occurs at the Cathode.

Que 23 – Read the passage given below and answer the following questions :



Hormones are chemical messengers which are secreted by the endocrine glands.

Majority of the hormones in humans are steroids. One class is of sex hormones which control maturation, tissue growth and reproduction. The hormones which are polypeptide in nature are vasopressin and oxytocin.

(1) How are hormones transported to their place of action ?

Answer – Hormones are secreted directly into the bloodstream, which carries them to the specific target organ or place of action.

(2) State the function of oxytocin.

Answer – It stimulates the contraction of uterine muscles during childbirth and promotes the ejection of milk from mammary glands.

Que 24 – Read the passage given below and answer the following questions :

The fission of a covalent bond involving unequal sharing of bonding electrons is known as heterolytic fission. It results in the formation of ions such as a carbocation or carbanion. These charged species can initiate chemical reactions and are classified as electrophiles or nucleophiles.

(1) Which compound forms ethyl carbocation ?

Answer – Compound forming ethyl carbocation: Ethyl chloride ($\text{CH}_3\text{CH}_2\text{Cl}$) or Ethanol in the presence of a strong acid.

(2) Give two examples of nucleophiles.

Answer – Two examples of nucleophiles: OH^- (Hydroxide ion) and NH_3 (Ammonia).

Que 25 – Write TRUE (T) for correct statement and FALSE (F) for incorrect statements.

(1) Benzoic acid can be prepared by oxidation of toluene by alkaline KMnO_4 .

(2) In HVZ reaction, carboxylic acids undergo halogenation at β -Carbon atom.

Answer – (1) true, (2) false



Que 26 – Read the passage given below and answer the following questions :

The similarity between first member of one group and the second member of the succeeding group is called diagonal relationship. Thus lithium shows properties similar to magnesium. The closeness of the diagonal elements arises due to their comparable polarizing power. So lithium and magnesium have some physical and chemical properties.

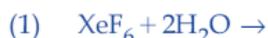
(1) State one physical property which is same for lithium and magnesium.

Answer – Physical property: Both Lithium (Li) and Magnesium (Mg) are significantly harder and have higher melting points compared to other metals in their respective groups.

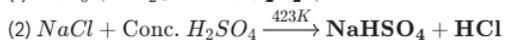
(2) Name two elements which show a diagonal relationship other than lithium and magnesium.

Answer – Other elements: Beryllium (Be) and Aluminium (Al) also show a diagonal relationship.

Que 27 – Complete and balance the following chemical equations :



Answer –



Que 28 – Match the item in column - I with column - II.

Column - I

(a) Tailing of mercury

(b) Blue $\text{CuSO}_4 \rightarrow$ white CuSO_4

(c) Decomposed in a strong beam of light

(d) Yellow and transparent crystalline substance

Column - II

(1) Conc. Sulphuric acid

(2) Rhombic sulphur

(3) Ozone

(4) Sulphur dioxide

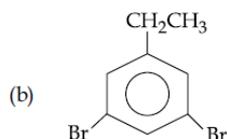
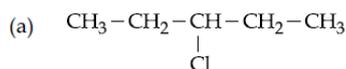


SECTION - B / खंड - ब



Note: Q.No. 29 to 43 are subjective type questions. An internal choice has been provided in some of these questions.

Que 29 – Write the IUPAC name of the following compounds :



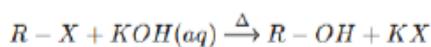
Answer – (a) Propan-2-ol (b) Ethoxyethane

OR / अथवा

(a) Distinguish between a haloalkane and a haloarene by a chemical test.

(b) Why is chloroform stored in dark coloured bottles ?

Answer – (a) Haloalkane and haloarenes can be distinguished by silver nitrate (AgNO_3). Haloalkanes react with AgNO_3 to give white precipitate of AgCl while haloarenes do not react.



(b) Chloroform reacts with oxygen in sunlight to form a highly poisonous gas called Phosgene (COCl_2). Dark bottles prevent this reaction.

Que 30 – Predict the shape of BF_3 molecule on the basis of VSEPR theory.

Answer – According to VSEPR theory, the shape of the BF_3 (Boron Trifluoride) molecule is determined as follows:



Central Atom and Bonding: The central Boron atom has 3 valence electrons, all of which form 3 bond pairs with Fluorine atoms, leaving 0 lone pairs.

Shape and Angle: To minimize repulsion, these pairs orient themselves in a Trigonal Planar geometry with a bond angle of 120° .

Que 31 – If 3d and 4p orbitals are to be filled in an atom by an electron then which orbital will be occupied first ? Explain it on the basis of Aufbau Principle.

Answer – According to the Aufbau Principle (specifically the $n+l$ rule):

For 3d orbital: $n = 3, l = 2$. Total $(n + l) = 5$.

For 4p orbital: $n = 4, l = 1$. Total $(n + l) = 5$.

Since both have the same $(n+l)$ value, the orbital with the lower value of n (principal quantum number) is filled first. Therefore, the 3d orbital will be occupied first.

OR / अथवा

Which observation of Rutherford's α -ray scattering experiment led to the conclusion that all the positive charge of the atom was contained in the nucleus ?

Answer – The specific observation was that a very small fraction of α – particles (about 1 in 20,000) were deflected by very large angles, and some even bounced back (180° deflection). This indicated that they hit a very dense, small, and positively charged center, which Rutherford called the nucleus.

Que 32 – What is the active component of soap ? What is the polar part in (i) a soap molecule and (ii) a synthetic detergent molecule ?

Answer – The active component is the Sodium or Potassium salt of long-chain fatty acids.

(i) Soap polar part: Carboxylate group ($-\text{COO}^-$).

(ii) Detergent polar part: Sulphonate group ($\text{SO}_3^- \text{Na}^+$).

Que 33 – Why oxy acetylene flame is used during welding or cutting of metals ? Give chemical equation involved.



Oxy-acetylene flame is used for welding and cutting metals because the combustion of acetylene in the presence of pure oxygen produces an extremely high temperature, reaching approximately 3300°C. This intense heat is sufficient to melt most metals, allowing them to be joined or cut effectively.



Que 34 – what is the shape and magnetic behaviour of $[Ni(CN)_4]^{2-}$ ion. Explain

Answer – Shape: Square Planar.

Magnetic Behaviour: All electrons are paired, so it is Diamagnetic.

Que 35 – A solution containing 12.5 g of a non-electrolyte substance in 175 g of water gave boiling point elevation of 0.70 K. Calculate the molar mass of the substance.

Answer – Formula: $M_2 = \frac{1000 \times K_b \times w_2}{\Delta T_b \times w_1}$

Given: $w_2 = 12.5$ g, $w_1 = 175$ g, $\Delta T_b = 0.70$ K, $K_b = 0.52$ kg mol⁻¹

$$M_2 = \frac{1000 \times 0.52 \times 12.5}{0.70 \times 175} = 53.06 \text{ g mol}^{-1}$$

OR / अथवा

What is the molar concentration of solute particles in human blood if the osmotic pressure is 7.2 atm at normal body temperature of 37°C ? ($R = 0.0821$ L atm K⁻¹mol⁻¹) ($R=0.0821$ L atm K⁻¹mol⁻¹)

Answer – Formula: $\Pi = CRT \Rightarrow C = \frac{\Pi}{RT}$

Given: $\Pi = 7.2$ atm, $T = 37 + 273 = 310$ K, $R = 0.0821$

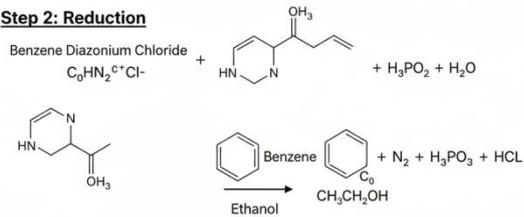
$$C = \frac{7.2}{0.0821 \times 310} = 0.283 \text{ M}$$

36. How aniline is converted into benzene ?

Answer –



Step 1: Diazotization

Step 2: Reduction


Que 37 – How will you prove that a solution of acetic acid and sodium acetate is a buffer solution ?

Answer – This is an acidic buffer. When a small amount of acid (H^+) is added, it reacts with acetate ions (CH_3COO^-) to form weak acetic acid. When a small amount of base (OH^-) is added, it reacts with acetic acid to form water and acetate ions. In both cases, the pH remains almost constant, proving it is a buffer.

OR / अथवा

What is the pH of a 0.001 M aqueous solution of HCl ?

Answer – HCl is a strong acid, so $\text{H}^+ = 0.001 \text{ M} = 10^{-3} \text{ M}$

$$\text{pH} = -\log [\text{H}^+] = -\log [10^{-3}] = 3$$

Que 38 – (a) State Faraday's first law of electrolysis.

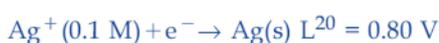
(b) What is the mass of silver deposited when 300 coulomb electricity is passed through a solution of AgNO_3 ? (Atomic mass of Ag = 108 u)

Answer – (a) The mass of a substance deposited at an electrode is directly proportional to the quantity of electricity (Q) passed through it ($m = zQ$).

$$(b) m = \frac{\text{Eq. weight} \times Q}{96500} = \frac{108 \times 300}{96500} = 0.335 \text{ g}$$

OR / अथवा

Calculate the reduction potential of the following half-cell at 298 K.





Standard Reduction Potential (E°): 0.80V.

Concentration of Ag^+ ions (Ag^+): 0.1M.

Number of electrons (n): 1.

Temperature (T): 298 K

For a reduction reaction at 298 K, the Nernst equation is simplified to

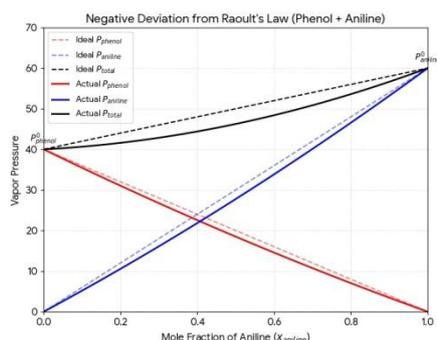
$$E = E^\circ - \frac{0.0591}{n} \log \frac{1}{[\text{Ag}^+]}$$

$$\Rightarrow E = 0.80 - \frac{0.0591}{1} \log \frac{1}{[0.1]}$$

$$\Rightarrow E = 0.80 - 0.0591 \times 1 = 0.7409 \text{ V}$$

Que 39 – Which liquid pairs show negative deviation from Raoult's law ? Explain taking example of phenol-aniline solution. Draw a graph for the same.

Answer – Liquid pairs where the A-B interactions are stronger than A-A and B-B interactions show negative deviation. In a mixture of Phenol and Aniline, a strong intermolecular hydrogen bond is formed between the phenolic proton (hydrogen) and the lone pair of electrons on the nitrogen atom of the aniline molecule.



Que 40 – Define bond enthalpy. Calculate the bond enthalpy of CH_4 molecule if average bond enthalpy of C–H bond is 414 kJ mol^{-1} .



Answer – The amount of energy required to break one mole of bonds of a particular type between two atoms in a gaseous state is called bond enthalpy.

CH₄ has 4 C-H bonds.

Total bond enthalpy = $4 \times 414 = 1656 \text{ kJ mol}^{-1}$.

OR / अथवा

Define Hybridisation. What is meant by 'sp' hybridisation, explain with the help of formation of BeCl₂ molecule ?

Answer – It is the process of mixing of atomic orbitals of slightly different energies to form a new set of equivalent orbitals called hybrid orbitals.

BeCl₂: In Be (1s², 2s²), one electron from 2s is promoted to 2p. One 2s and one 2p orbital mix to form two sp hybrid orbitals which are arranged at 180°, giving a Linear shape.

41. Convert :

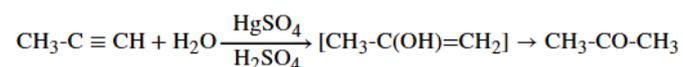
(a) Propyne to propanone

(b) Propanone to 2-methylbutan-2-ol

(c) Ethanol to Ethanoic acid

Answer – (a) Propyne to Propanone

Reaction: Propyne is treated with dilute sulfuric acid (H₂SO₄) in the presence of mercuric sulfate (HgSO₄) as a catalyst. The intermediate enol quickly tautomerizes to form Propanone (Acetone).

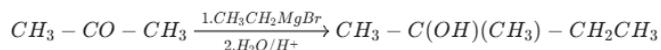


(b) Propanone to 2-methylbutan-2-ol

This conversion requires increasing the carbon chain using a Grignard Reagent.



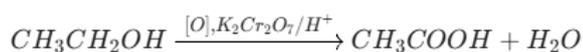
Reaction: Propanone reacts with Ethyl magnesium bromide ($\text{CH}_3\text{CH}_2\text{MgBr}$). The intermediate complex is then hydrolyzed with dilute acid to yield the tertiary alcohol, 2-methylbutan-2-ol.



(c) Ethanol to Ethanoic acid

This is a direct oxidation reaction.

Reaction: Ethanol is treated with a strong oxidizing agent like acidified Potassium Dichromate ($\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$) or alkaline Potassium Permanganate (KMnO_4). The primary alcohol is oxidized completely to the carboxylic acid.



Que 42 – (I) Give reasons for the following :

(a) Phenols exhibit higher boiling points as compared to the hydrocarbons of similar molecular weight.

(b) Ethers have geometry similar to water and alcohols.

(II) Explain Lucas' test. What is its use, explain ?

Answer – (I) (a) Due to intermolecular Hydrogen bonding.

(b) Ethers have sp^3 hybridization with two lone pairs, creating a bent shape like water.

(II) Lucas Test: Mixture of Conc. HCl and anhydrous ZnCl_2 . It distinguishes alcohols: Tertiary (immediate turbidity), Secondary (5 mins), Primary (only on heating).

OR / अथवा

(a) How will you convert aniline to phenol ?

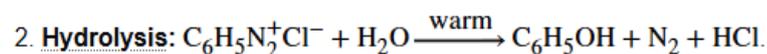
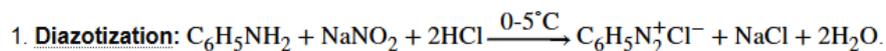
(b) Give chemical equations for the following :

I. Kolbe reaction



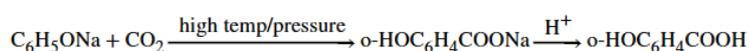
II. Coupling reaction

Answer – (a) This conversion is carried out in two main steps:



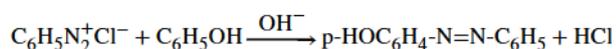
(b) Chemical equation:

(1) Kolbe reaction



(2) Coupling reaction

Benzenediazonium chloride reacts with phenol in a weak alkaline to produce hydroxyazobenzene (an orange dye).



Que 43 – (i) Give reasons for the following :

(a) Manganese shows the largest number of oxidation states among 3d elements.

(b) Sc^{3+} ion does not show magnetic behaviour.

(c) Copper sulphate solution is blue in colour.

(d) Transition metals of first series form alloys.

(e) Transition metals form interstitial compounds.

Answer – (a) Mn oxidation states: Has the highest number of unpaired electrons (5 in 3d and 2 in 4s).

(b) Sc^{3+} magnetism: Sc^3 has $3d^0$ configuration (no unpaired electrons).

(c) Blue colour: Due to d-d transition in Cu^{2+} ($3d^9$) ions.

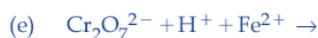
(d) Alloys: Transition metals have similar atomic sizes.



(e) Interstitial compounds: Small atoms like H, C, N fit into voids of metal lattices.

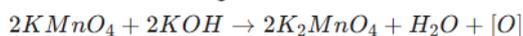
OR / अथवा

Complete and balance the following reactions :

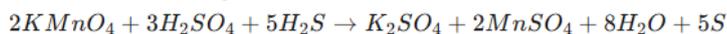


Answer –

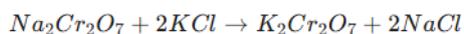
1. Potassium Permanganate with KOH:



2. Potassium Permanganate with H_2S (Acidic):



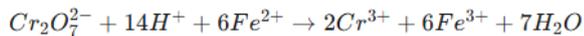
3. Sodium Dichromate with KCl:



4. Potassium Dichromate with Conc. H_2SO_4 :



5. Dichromate ion with Iron(II) in Acidic Medium:





Thank you!

★ We hope you found this material helpful. We wish you the very best for your examination. ✎

Strive for Excellence – Your Path to Success