CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. The **incorrect** statement about the imperfections in solids is:

   (A) Schottky defect decreases the density of the substance.

   (B) Interstitial defect increases the density of the substance.

   (C) Frenkel defect does not alter the density of the substance.

   (D) Vacancy defect increases the density of the substance.

Answer (D)

Sol. Vacancy defect causes decrease in density

2. The Zeta potential is related to which property of colloids?

   (A) Colour

   (B) Tyndall effect

   (C) Charge on the surface of colloidal particles

   (D) Brownian movement

Answer (C)

Sol. The potential difference between the fixed layer and the diffused layer of opposite charges is called zeta potential.

It is related with the charge on the surface of colloidal particles.

3. Element "E" belongs to the period 4 and group 16 of the periodic table. The valence shell electron configuration of the element, which is just above "E" in the group is

   (A) $3s^2, 3p^4$ (B) $3d^{10}, 4s^2, 4p^4$

   (C) $4d^{10}, 5s^2, 5p^4$ (D) $2s^2, 2p^4$

Answer (A)

Sol. Element E is Selenium

The element which is just above 'E' in periodic table is sulphur, its electronic configuration is $1s^2, 2s^2, 2p^6, 3s^2, 3p^4$

4. Given are two statements one is labelled as **Assertion A** and other is labelled as **Reason R**.

   Assertion A : Magnesium can reduce Al_2O_3 at a temperature below 1350°C, while above 1350°C aluminium can reduce MgO.

   Reason R : The melting and boiling points of magnesium are lower than those of aluminium.

   In light of the above statements, choose most appropriate answer from the options given below :

   (A) Both **A** and **R** are correct, and **R** is correct explanation of **A**.

   (B) Both **A** and **R** are correct, but **R** is NOT the correct explanation of **A**.

   (C) **A** is correct **R** is not correct.

   (D) **A** is not correct, **R** is correct.

Answer (B)

Sol. Magnesium can reduce Al_2O_3 at a temperature below 1350°C while above 1350°C aluminium can reduce MgO because below 1350°C ΔG of MgO (formation) is more negative and above 1350°C ΔG of Al_2O_3 (formation) is more negative.

The melting and boiling point of magnesium are lower than those of aluminium but it is not the correct reason.

5. Dihydrogen reacts with CuO to give

   (A) CuH_2 (B) Cu

   (C) Cu_2O (D) $Cu(OH)_2$

Answer (B)

Sol. $CuO + H_2 \rightarrow Cu + H_2O$

6. Nitrogen gas is obtained by thermal decomposition of

   (A) $Ba(NO_3)_2$

   (B) $Ba(N_3)_2$

   (C) $NaNO_2$

   (D) $NaNO_3$

Answer (B)

Sol. $Ba(N_3)_2 \xrightarrow{\Delta} Ba + 3N_2$

7. Given below are two statements :

Statement I : The pentavalent oxide of group-15 element, E_2O_5, is less acidic than trivalent oxide, E_2O_3, of the same element.

Statement II : The acidic character of trivalent oxide of group 15 elements, E_2O_3, decreases down the group.

In light of the above statements, choose **most appropriate** answer from the options given below:

(A) Both Statement I and Statement II are true

(B) Both Statement I and Statement II are false

(C) Statement I true, but Statement II is false

(D) Statement I false, but Statement II is true

Answer (D)

Sol. Statement I is false, as E_2O_5 is more acidic than E_2O_3

Statement II is correct.

8. Which one of the lanthanoids given below is the most stable in divalent form?

(A) Ce (Atomic Number 58)

(B) Sm (Atomic Number 62)

(C) Eu (Atomic Number 63)

(D) Yb (Atomic Number 70)

Answer (C)

Sol. Eu^{+2} is $4f^7$

Yb^{+2} is $4f^{14}$

but Eu^{+2} is more stable than Yb^{+2} because

$E^{\circ}_{Eu|Eu^{+2}} > E^{\circ}_{Yb|Yb^{+2}}$

9. Given below are two statements:

Statement I: $[Ni(CN)_4]^{2-}$ is square planar and diamagnetic complex, with dsp^2 hybridization for Ni but $[Ni(CO)_4]$ is tetrahedral, paramagnetic and with sp^3-hybridization for Ni.

Statement II: $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ both have same *d*-electron configuration, have same geometry and are paramagnetic.

In light of the above statements, choose the **correct** answer from the options given below :

(A) Both Statement I and Statement II are true

(B) Both Statement I and Statement II are false

(C) Statement I is correct but Statement II is false

(D) Statement I is incorrect but Statement II is true

Answer (B)

Sol. $[Ni(CN)_4]^{2-}$ is square planar and diamagnetic with $\mu = 0$

its hybridisation is dsp^2

$Ni(CO)_4$ is tetrahedral but diamagnetic.

10. Which amongst the following is **not** a pesticide?

(A) DDT (B) Organophosphates

(C) Dieldrin (D) Sodium arsenite

Answer (D)

Sol. Sodium arsenite is a herbicide.

11. Which one of the following techniques is not used to spot components of a mixture separated on thin layer chromatographic plate?

(A) I_2 (Solid)

(B) U.V. Light

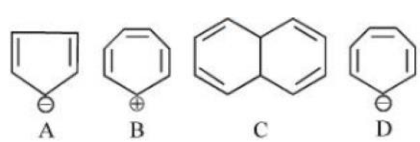
(C) Visualisation agent as a component of mobile phase

(D) Spraying of an appropriate reagent

Answer (C)

Sol. The function of mobile phase is to carry the components present on TLC.

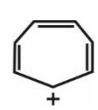
12. Which of the following structures are aromatic in nature?



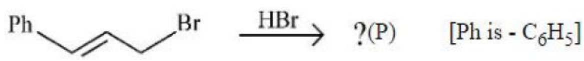
(A) A, B, C and D (B) Only A and B

(C) Only A and C (D) Only B, C and D

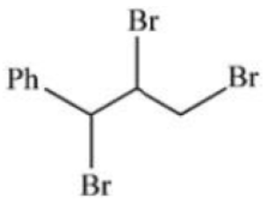
Answer (B)

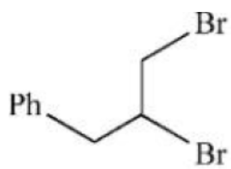
Sol.  and  are aromatic as they are cyclic, planar and has $4n + 2\ \pi\ e^-$ (n = 1)

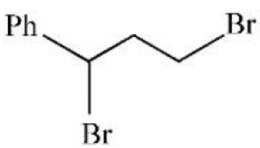
13. The major product (P) in the reaction

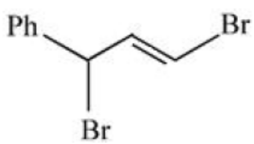


is

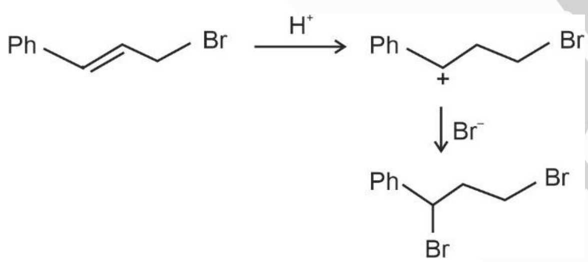
(A) 

(B) 

(C) 

(D) 

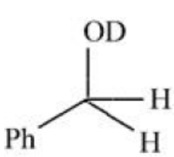
Answer (C)

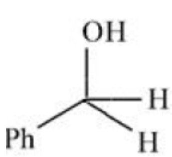
Sol. 

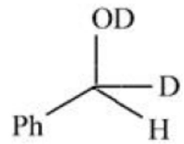
14. The correct structure of product 'A' formed in the following reaction,

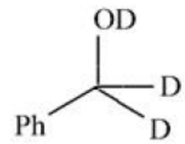
$$PhCHO + Ph \cdot CHO \xrightarrow[\text{in } D_2O]{NaOD} A + Ph-\overset{O}{\overset{\|}{C}}-O^-$$

(Ph is - C_6H_5) is

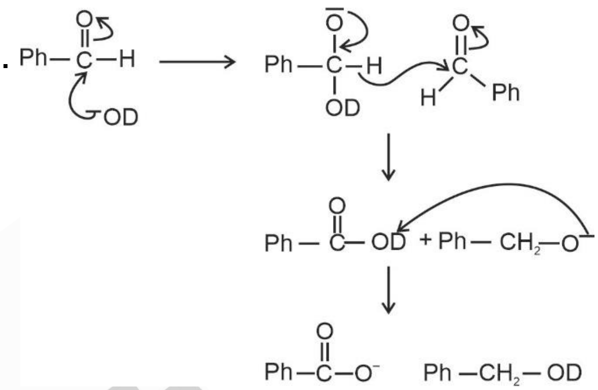
(A) 

(B) 

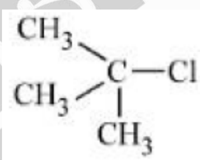
(C) 

(D) 

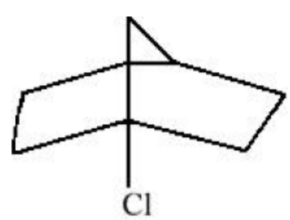
Answer (A)

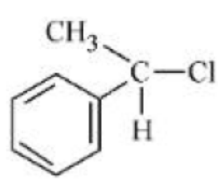
Sol. 

15. Which one of the following compounds is inactive towards S_N1 reaction?

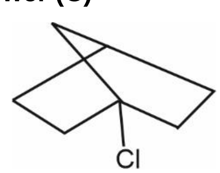
(A) 

(B) 

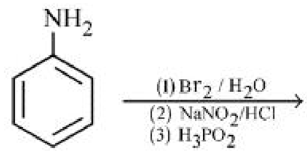
(C) 

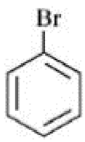
(D) 

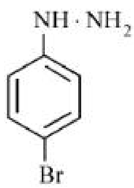
Answer (C)

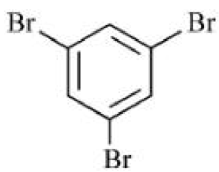
Sol.  is inactive towards S_N1 as halogen is attached to bridge head carbon atom, where formation of carbocation is not possible.

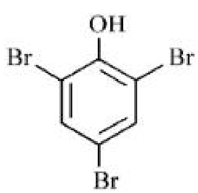
16. Identify the major product formed in the following sequence of reactions:



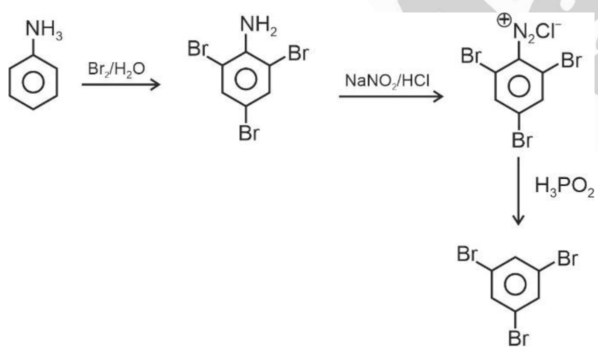
(A) 

(B) 

(C) 

(D) 

Answer (C)

Sol. 

17. A primary aliphatic amine on reaction with nitrous acid in cold (273 K) and there after raising temperature of reaction mixture to room temperature (298 K), gives

(A) nitrile (B) alcohol

(C) diazonium salt (D) secondary amine

Answer (B)

Sol. $R-NH_2 \xrightarrow[0^\circ C]{HNO_2} [R-\overset{\oplus}{N_2}] \longrightarrow R-OH$

18. Which one of the following is **NOT** a copolymer?

(A) Buna-S

(B) Neoprene

(C) PHBV

(D) Butadiene-styrene

Answer (B)

Sol. Monomer of neoprene is 2-chloro-1,3-butadiene, and it is not a copolymer.

19. Stability of α-Helix structure of proteins depends upon

(A) dipolar interaction

(B) H-bonding interaction

(C) van der Walls forces

(D) π-stacking interaction

Answer (B)

Sol. Mostly H-bonding is responsible for the stability of α-helix form.

20. The formula of the purple colour formed in Laissaigne's test for sulphur using sodium nitroprusside is

(A) $NaFe[Fe(CN)_6]$

(B) $Na[Cr(NH_3)_2(NCS)_4]$

(C) $Na_2[Fe(CN)_5(NO)]$

(D) $Na_4[Fe(CN)_5(NOS)]$

Answer (D)

Sol. $S^{2-} + [Fe(CN)_5NO)]^{2-} \rightarrow [Fe(CN)_5(NOS)]^{4-}$

Purple

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

1. A 2.0 g sample containing MnO_2 is treated with HCl liberating Cl_2. The Cl_2 gas is passed into a solution of KI and 60.0 mL of 0.1 M $Na_2S_2O_3$ is required to titrate the liberated iodine. The percentage of MnO_2 in the sample is ______. (Nearest integer)

[Atomic masses (in u) Mn = 55; Cl = 35.5; O = 16, I = 127, Na = 23, K = 39, S = 32]

Answer (13)

Sol. $MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2$

$$Cl_2 + KI \longrightarrow Cl^- + I_2$$

$$\Big\downarrow 2Na_2S_2O_3$$

$$Na_2S_4O_6 + 2NaI$$

Equivalent of MnO_2 = HCl = Cl_2 = I_2 = $Na_2S_2O_3$

2 × number of moles of MnO_2 = 1 × number of moles of $Na_2S_2O_3$

Moles of MnO_2 = $\dfrac{60 \times 0.1 \times 10^{-3}}{2}$

$= 3 \times 10^{-3}$ mole

Mass of MnO_2 = 0.261 g

% of MnO_2 = $\dfrac{0.261}{2} \times 100 \simeq 13\%$

2. If the work function of a metal is 6.63×10^{-19} J, the maximum wavelength of the photon required to remove a photoelectron from the metal is ______ nm. (Nearest integer)

[Given : h = 6.63×10^{-34} J s, and c = 3×10^8 m s^{-1}]

Answer (300)

Sol. $\because \quad E = \dfrac{hc}{\lambda}$

$$6.63 \times 10^{-19} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{\lambda}$$

$\lambda = 3 \times 10^{-7}$ m

$= 300 \times 10^{-9}$ m

$= 300$ nm

3. The hybridization of P exhibited in PF_5 is sp_xd_y. The value of y is _______

Answer (1)

Sol. PF_5 is sp^3d hybridised

y = 1

4. 4.0 L of an ideal gas is allowed to expand isothermally into vacuum until the total volume is 20 L. The amount of heat absorbed in this expansion is ____ L atm.

Answer (0)

Sol. Work done = $-P_{ext}\,\Delta v$

$\because \; P_{ext} = 0$ (vacuum)

$\therefore$ w = 0, $\Delta U = 0$ (as the process is isothermal)

So, q = 0

5. The vapour pressures of two volatile liquids A and B at 25°C are 50 Torr and 100 Torr, respectively. If the liquid mixture, contains 0.3 mole fraction of A, then the mole fraction of liquid B in the vapour phase is $\dfrac{x}{17}$. The value of x is _______.

Answer (14)

Sol. $P_T = P_A^0.x_A + P_B^0.x_B$

$= 50 \times 0.3 + 100 \times 0.7$

= 85 mm Hg

$$y_B = \frac{70}{85} = \frac{x}{17}$$

$$\frac{x}{17} = 14$$

6. The solubility product of a sparingly soluble salt A_2X_3 is 1.1×10^{-23}. If specific conductance of the solution is 3×10^{-5} S m^{-1}, the limiting molar conductivity of the solution is $x \times 10^{-3}$ S m^2 mol^{-1}. The value of x is _______.

Answer (3)

Sol. $A_2X_3 \rightleftharpoons 2A + 3X$

$\quad\quad\quad\quad\quad 2S \quad 3S$

$K_{sp} = (2s)^2(3s)^3 = 1.1 \times 10^{-23}$

$S \approx 10^{-5}$

For sparingly soluble salts

$$\wedge_m = \wedge_m^o$$

$$\wedge_m = \frac{k}{S \times 10^3}$$

$$= \frac{3 \times 10^{-5}}{10^{-5}} \times 10^{-3}$$

$$= 3 \times 10^{-3} \text{ Sm}^2 \text{ mol}^{-1}$$

7. The quantity of electricity of Faraday needed to reduce 1 mol of $Cr_2O_7^{2-}$ to Cr^{3+} is

Answer (6)

Sol. $\overset{+6}{Cr_2}O_7^{2-} \longrightarrow 2Cr^{3+}$

$\because$ Each Cr is converting from +6 to +3

$\therefore$ 6 faradays of charge is required

8. For a first order reaction $A \rightarrow B$, the rate constant, $k = 5.5 \times 10^{-14}$ s^{-1}. The time required for 67% completion of reaction is $x \times 10^{-1}$ times the half life of reaction. The value of x is _____ (Nearest integer)

Answer (16)

Sol. $\because$ $kt = \ln\frac{A_0}{A}$

$$\frac{\ln 2}{t_{\frac{1}{2}}} t_{67\%} = \ln\frac{A_0}{0.33A_0}$$

$$\frac{\log 2}{t_{\frac{1}{2}}} t_{67\%} = \log\frac{1}{0.33}$$

$t_{67\%} = 1.566\ t_{1/2}$

x = 15.66

Nearest integer = 16

9. Number of complexes which will exhibit synergic bonding amongst, $[Cr(CO)_6]$, $[Mn(CO)_5]$ and $[Mn_2(CO)_{10}]$ is ________.

Answer (3)

Sol. CO ligand shows synergic bonding, so all complexes can show synergic bonding.

10. In the estimation of bromine, 0.5 g of an organic compound gave 0.40 g of silver bromide. The percentage of bromine in the given compound is _____% (nearest integer)

(Relative atomic masses of Ag and Br are 108 u and 80 u, respectively).

Answer (34)

Sol. 188 g AgBr has 80 g of Br

$$\therefore \quad 0.4 \text{ g AgBr} = \frac{80}{188} \times 0.4$$

% of Br in given organic compound

$$= \frac{80 \times 0.4}{188 \times 0.5} \times 100$$

$\approx 34\%$