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. Electronic configuration of Nd^{2+} is

(1) $4f^2$

(2) $4f^3$

(3) $4f^4$

(4) $4f^5$

Answer (3)

Sol. Nd^{2+} = [Xe] $4f^4$

2. Following values of K (Rate constants) are given at different temperatures. Find out (E_a) Activation energy.

T = 200 K $\rightarrow$ K_1 = 0.03

T = 300 K $\rightarrow$ K_2 = 0.05

(1) 2.548 kJ

(2) 11.488 kJ

(3) 1.106 kJ

(4) 51.437 kJ

Answer (1)

Sol. $$\log\left(\frac{0.05}{0.03}\right) = \frac{E_a}{2.303\times 8.314}\left(\frac{1}{200}-\frac{1}{300}\right)$$

$$= \frac{E_a}{2.303\times 8.314}\left(\frac{1}{600}\right)$$

E_a = 2.548 kJ

3. Basic strength of oxides of V

V_2O_3 V_2O_5 V_2O_4

(1) $V_2O_3 < V_2O_5 < V_2O_4$

(2) $V_2O_3 < V_2O_4 < V_2O_5$

(3) $V_2O_3 > V_2O_4 > V_2O_5$

(4) $V_2O_3 = V_2O_4 = V_2O_5$

Answer (3)

Sol. As oxidation state of V increases than other acidic nature increases

Correct basic order is $\overset{+3}{V_2}O_3 > \overset{+4}{V_2}O_4 > \overset{+5}{V_2}O_5$

4. XeF_4, SF_4 and $BrCl_3$ show hybridizations respectively

(1) sp^3, sp^3, sp^3

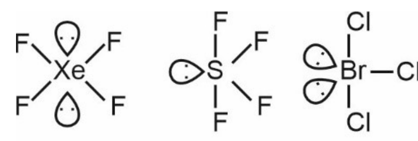
(2) dsp^2, sp^3, sp^3

(3) sp^3d^2, sp^3d, sp^3d

(4) d^2sp^2, sp^3d, sp^3d

Answer (3)

Sol.



sp^3d^2 sp^3d sp^3d

5. $Cu^{2+} + I^- \rightarrow A \xrightarrow[\Delta]{} B + C$

B and C are

(1) I_2, Cu_2I_2

(2) $[CuI_4]$

(3) CuI_3^-

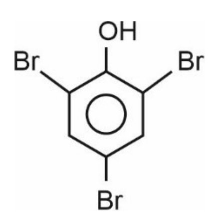
(4) I^-, CuI_2

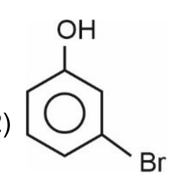
Answer (1)

Sol. $Cu^{2+} + 2I^- \rightarrow \underset{(A)}{[CuI_2]} \xrightarrow{\Delta} \frac{1}{2}\underset{(B)}{Cu_2I_2} + \frac{1}{2}\underset{(C)}{I_2}$

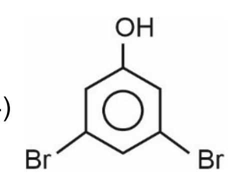
$\therefore$ Products (B) and (C) are Cu_2I_2 and I_2 respectively.

6. When phenol reacts with Br_2 in low polarity solvent, it produces as a major product _____________?

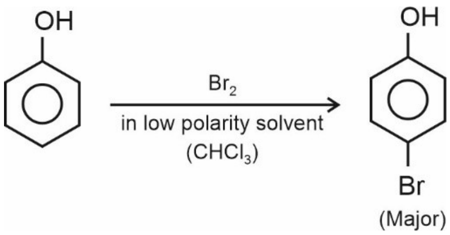
(1) 

(2) 

(3) 

(4) 

Answer (3)

Sol. 

7. Choose the correct information regarding products obtained on electrolysis of Brine solution

(1) Cl_2 at cathode (2) O_2 at cathode

(3) H_2 at cathode (4) OH^- at anode

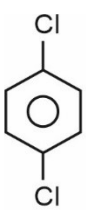
Answer (3)

Sol. Anode : $2Cl^- \longrightarrow Cl_2 + 2e^-$

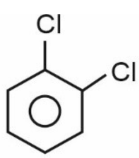
Cathode : $2e^- + 2H_2O \longrightarrow H_2 + 2OH^-$

Net reaction $2Cl^- + 2H_2O \longrightarrow \underbrace{Cl_2}_{\text{anode}} + \underbrace{H_2 + 2OH^-}_{\text{cathode}}$

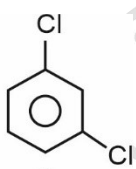
8. Melting point order of



A



B



C

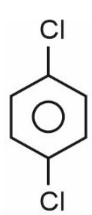
(1) A > B > C

(2) C > A > B

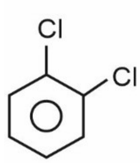
(3) B > A > C

(4) A > C > B

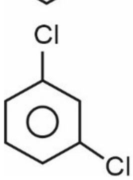
Answer (1)

Sol. 

m.p. = 323 K



m.p. = 256 K



m.p. = 249 K

9. Consider the following reaction :

$$SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$$

If $K_p = 2\times10^{12}$ and $K_c = x \times 10^{13}$, the value of x in terms of RT will be

(1) $\frac{\sqrt{RT}}{4}$

(2) $\frac{\sqrt{RT}}{5}$

(3) $\frac{\sqrt{RT}}{10}$

(4) $10\sqrt{RT}$

Answer (2)

Sol. $K_p = K_c(RT)^{-1/2}$

$2\times10^{12} = x\times10^{13}(RT)^{-1/2}$

$x = \frac{2\times10^{12}}{10^{13}\times(RT)^{-1/2}} = \frac{2\sqrt{RT}}{10} = \frac{\sqrt{RT}}{5}$

10. Arrange the following ions in the increasing order of their ionic radii.

S^{2-}, Cl^-, K^+ and Ca^{2+}

(1) $S^{2-} < Cl^- < K^+ < Ca^{2+}$

(2) $Cl^- < S^{2-} < K^+ < Ca^{2+}$

(3) $K^+ < Ca^{2+} < Cl^- < S^{2-}$

(4) $Ca^{2+} < K^+ < Cl^- < S^{2-}$

Answer (4)

Sol. The given ionic species are isoelectronic species. The radii of isoelectronic ionic species increases as the atomic of the ion decreases. Therefore, the correct increasing order of radii of ionic species is

$Ca^{2+} < K^+ < Cl^- < S^{2-}$

11. Which of the following option contains the compound which has highest sweetening value?

(1) Aspartame

(2) Saccharin

(3) Sucralose

(4) Alitame

Answer (4)

Sol. Alitame has the highest sweetening value.

12. Which of the following method is not a concentration of ore?

(1) Electrolysis (2) Leaching

(3) Froth floatation (4) Hydraulic washing

Answer (1)

Sol. The following methods are commonly used for concentration of ore

1. Hydraulic washing

2. Leaching

3. Froth floatation

But electrolysis is used for refining of the crude metal.

13. In which of the following reactions, H_2O_2 acts as a reducing agent

(1) $H_2O_2 + Mn^{2+} \rightarrow MnO_2 + H_2O$

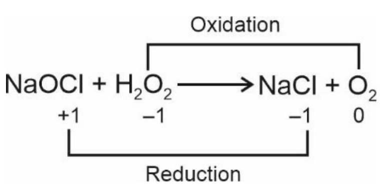
(2) $NaOCl + H_2O_2 \rightarrow NaCl + O_2$

(3) $Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + H_2O$

(4) $PbS + H_2O_2 \rightarrow PbSO_4 + H_2O$

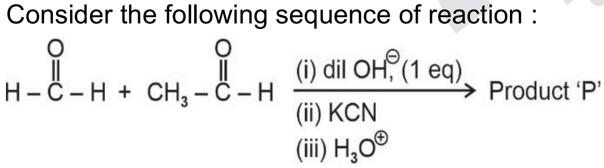
Answer (2)

Sol.



In Option (2), oxidation of H_2O_2 is taking place and hence H_2O_2 acts as a reducing agent.

14. Consider the following sequence of reaction :



The product 'P' is?

(1) $CH_3 - CH_2 - COOH$

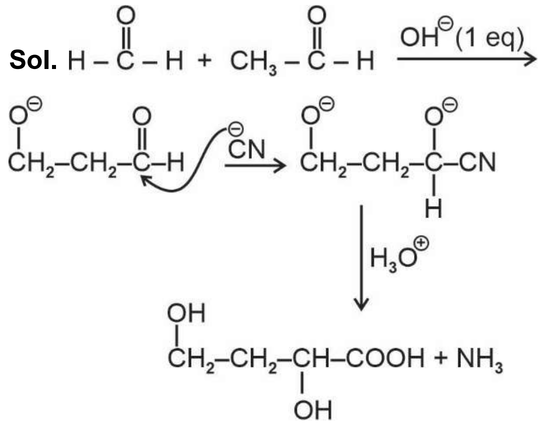
(2) $\overset{OH}{\overset{|}{C}H_2} - CH_2 - \overset{OH}{\overset{|}{C}H} - COOH$

(3) $\overset{OH}{\overset{|}{C}H_2} - CH_2 - \overset{O}{\overset{\|}{C}} - COOH$

(4) $\overset{O}{\overset{\|}{C}H} - CH_2 - \overset{O}{\overset{\|}{C}} - COOH$

Answer (2)

Sol.



15. Which of the following transition emits the same wavelength as that for ($n = 4 \rightarrow n = 2$) for He^+ Ion

(1) H($n = 3 \rightarrow n = 1$)

(2) H($n = 2 \rightarrow n = 1$)

(3) Li^{2+}($n = 4 \rightarrow n = 3$)

(4) He^+($n = 6 \rightarrow 3$)

Answer (2)

Sol. $\dfrac{\Delta E_{(H-atom)}}{n = 2 \rightarrow n = 1} = \dfrac{(\Delta E)_{He^+ Ion}}{n = 4 \rightarrow n = 2} = \dfrac{(\Delta E)_{Li^{++} Ion}}{n = 6 \rightarrow n = 3}$

16. A complex compound of Co (X) is pink colour in water. On reaction with conc. HCl forms (Y) of deep blue colour and has geometry (Z). Identify (X), (Y) and (Z).

(1) $[Co(H_2O)_6]^{2+}$, $[CoCl_6]^{3-}$, Octahedral

(2) $[Co(H_2O)_6]^{3+}$, $[CoCl_4]^{2-}$, Tetrahedral

(3) $[Co(H_2O)_6]^{2+}$, $[CoCl_4]^{2-}$, Tetrahedral

(4) $[Co(H_2O)_6]^{3+}$, $[CoCl_6]^{3-}$, Octahedral

Answer (3)

Sol. Co^{2+} ions in aqueous medium are pink in colour. On addition of conc. HCl to it, the solution becomes blue due to formation of $[CoCl_4]^{2-}$ which is tetrahedral.

$$Co^{2+} + 6H_2O \longrightarrow \underset{(Pink)}{\underset{(X)}{[Co(H_2O)_6]^{2+}}}$$

$$[Co(H_2O)_6]^{2+} + \underset{(Conc.)}{4HCl} \longrightarrow \underset{(Blue)}{\underset{(Y)}{[CoCl_4]^{2-}}} + 4H^+ + 6H_2O$$

Geometry of (Y) is tetrahedral (Z).

17. Which of the following option contains the correct match?

List-I	List-II
(A) XeF_4	(P) T-shape
(B) SF_4	(Q) See-saw
(C) $NH_4^{\oplus}$	(R) Square planar
(D) BrF_3	(S) Tetrahedral

(1) $A \to P$, $B \to Q$, $C \to R$, $D \to S$

(2) $A \to R$, $B \to Q$, $C \to S$, $D \to P$

(3) $A \to Q$, $B \to P$, $C \to S$, $D \to R$

(4) $A \to S$, $B \to R$, $C \to P$, $D \to Q$

Answer (2)

Sol. $XeF_4 \to$ Square planar

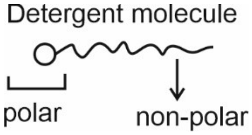
$SF_4 \to$ See-saw

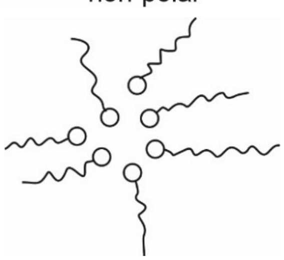
$NH_4^{\oplus} \to$ Tetrahedral

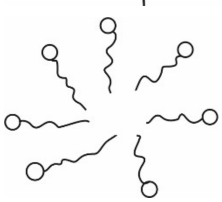
$BrF_3 \to$ T-shaped

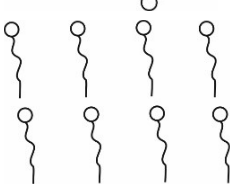
18. A detergent is dissolved in non-polar solvent. The structure of micelle in non-polar solvent

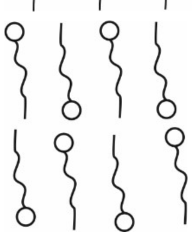
Detergent molecule



(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. In non-polar-solvent, non-polar part will be outside.

19. Consider the following reaction :

$$ClO(g) + NO_2(g) \longrightarrow A \xrightarrow{H_2O(g)} B + C$$

A, B and C are respectively

(1) $ClONO_2(g)$; $HOCl(g)$; $HNO_3(g)$

(2) $ClONO_2(g)$; $HOCl(g)$; $NO_2(g)$

(3) $ClNO_2(g)$; HCl; Cl_2

(4) $ClNO_2(g)$; $HCl(g)$; $HNO_3(g)$

Answer (1)

Sol. $ClO(g) + NO_2(g) \longrightarrow \underset{(A)}{ClONO_2(g)}$

$$ClONO_2(g) + H_2O(g) \longrightarrow \underset{(B)}{HOCl(g)} + \underset{(C)}{HNO_3(g)}$$

20.

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.

21. 2.56 g of a non-electrolyte solute is dissolved in one litre of a solution, it has osmotic pressure (π) equal to 4 bar at 300 K temperature. Then find the molar mass of the compound.

[Given : R = 0.083 bar] (Round off to the nearest integer)

Answer (16)

Sol. p = CRT

$$4 = \frac{2.56}{M} \times 0.083 \times 300$$

$$\approx 16 \text{ g}$$

22. Weight of an organic compounds is 0.492 g, when the hydrocarbon undergoes combustion it produces 0.792 g CO_2. Find the % of carbon in the given hydrocarbon (Round off to the nearest integer)

Answer (44)

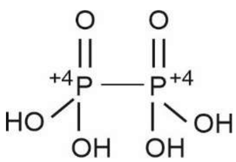
Sol. $\%C = \frac{12}{44} \times \frac{0.792}{0.492} \times 100$

= 43.90%

23. The oxidation state of phosphorus atom in the hypophosphoric acid is _______?

Answer (4)

Sol. The hypophosphoric acid is :



24. What is the volume of Hydrogen Gas produced (in litre) when 11.2 gm of Zn metal reacts with excess of dil. HCl (Closest Integer)

Given: Molar volume of H_2 = 22.7 L/mole

Molar mass of Zn is 65 gm/mole

Answer (4)

Sol. $\underset{11.2\text{ gm}}{Zn} + 2HCl \rightarrow ZnCl_2 + H_2$

$\left(\frac{11.2}{65}\right)$ $\qquad \frac{11.2}{65} \times 22.7$ litre

= 3.911 litre

$\approx$ 4 litre

25. The value of logarithm of the equilibrium constant of the following reaction is $\frac{X}{3}$. Then 'X' is

$$Pd^{2+} + 4Cl^- \rightleftharpoons PdCl_4^{2-}$$

Given : $[Pd^{2+} + 2e^- \longrightarrow Pd$; $E^\circ = 0.83$ V

$PdCl_4^{2-} + 2e^- \longrightarrow Pd + 4Cl^-$; $E^\circ = 0.63$ V

and $\frac{2.303\text{ RT}}{F} = 0.06]$

Answer (20)

Sol. $\Delta G_3^\circ = \Delta G_1^\circ - \Delta G_2^\circ$

$-2.303 \times \text{RTlogk} = -0.83 \times 2 \times F + 0.63 \times 2 \times F$

$\log k = \frac{0.2 \times 2 \times F}{2.303 \times RT}$

$= \frac{0.2 \times 2}{0.06} = \frac{20}{3}$

26. Find the value of $|\Delta H|$ in kJ for

$\frac{1}{2}Cl_2(g) \rightarrow Cl^-(aq)$

Given:

ΔH_{diss} $Cl_2(g) \rightarrow 2Cl(g)$ $\quad 240$ kJ mol^{-1}

ΔH_{eg} $Cl(g) + e \rightarrow Cl^-(g)$ $\quad -320$ kJ mol^{-1}

$\Delta H_{hydration}$ $Cl^-(g) + aq \rightarrow Cl^-(aq)$ $\quad -340$ kJ mol^{-1}

Answer (540)

Sol.

$\frac{1}{2}Cl_2(g) \rightarrow Cl(g)$ $\qquad \Delta H_1 = \frac{240}{2} = 120$ kJ

$Cl(g) + e \rightarrow Cl^-(g)$ $\qquad \Delta H_2 = -320$ kJ

$Cl^-(g) + aq \rightarrow Cl^-(aq)$ $\qquad \Delta H_3 = -340$ kJ

$\frac{1}{2}Cl_2(g) + e^- + aq \rightarrow Cl^-(aq)$ ΔH

$\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3$

= 120 – 320 – 340

= –540 kJ

$|\Delta H|$ = 540 kJ

27.

28.

29.

30.