VIDYAPEETH ACADEMY
SINCE 2013
IIT JEE | NEET | FOUNDATION

Head Office: 2nd Floor, Grand Plaza, Fraser Road, Dak Bunglow, Patna - 01

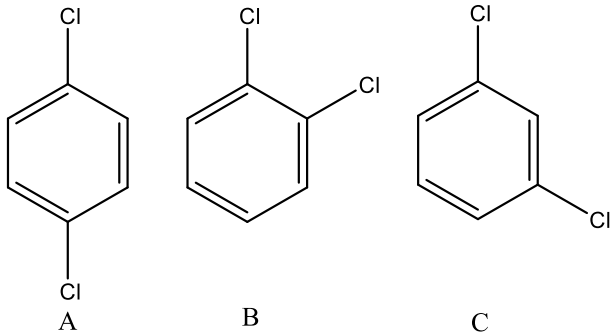
JEE Main 2023 (Memory based)

31 January 2023 - Shift 1

Answer & Solutions

CHEMISTRY

1. Melting point order of

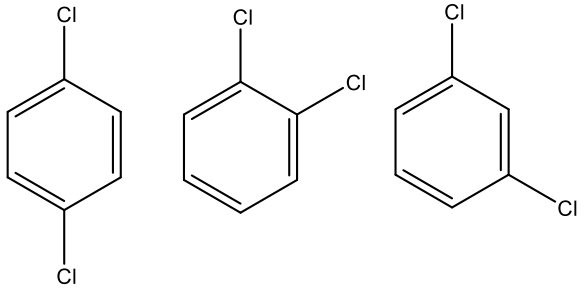


A B C

A. A > B > C
B. C > A > B
C. B > A > C
D. A > C > B

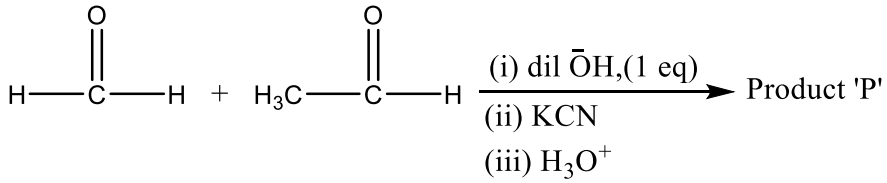
Answer (A)

Solution:



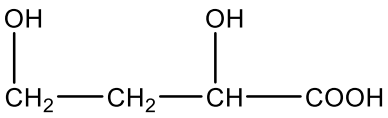
M.P = 323 K M.P = 256 K M.P = 244 K

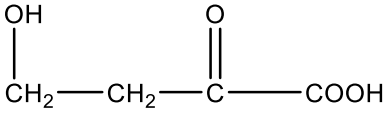
2. Consider the following sequence of reaction:

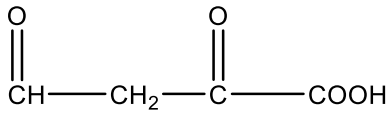


The Product 'P' is ?

A. $CH_3—CH_2—COOH$

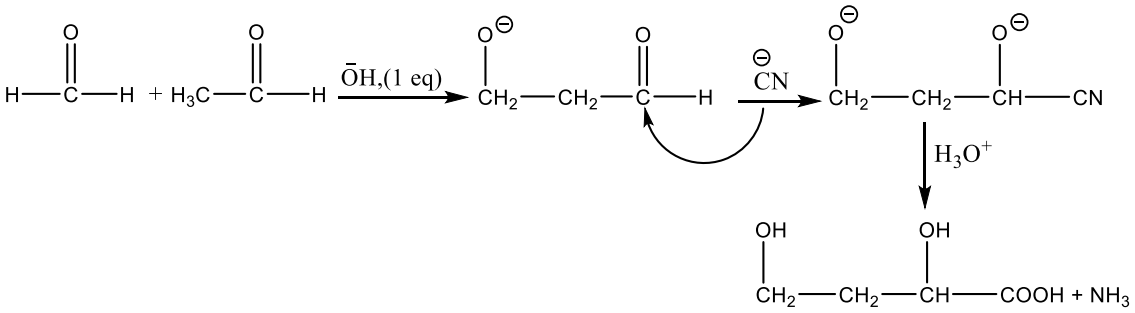
B. 

C. 

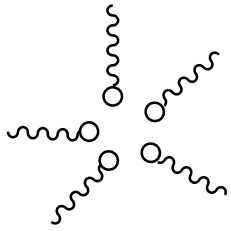
D. 

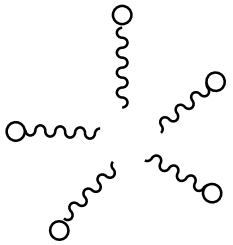
Answer (B)

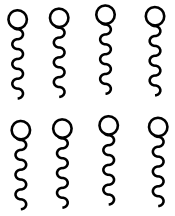
Solution:

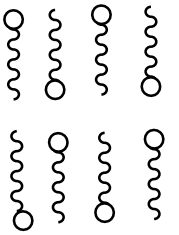


3. A detergent is dissolved in non-polar solvent. The structure of micelle in non-polar solvent is

A. 

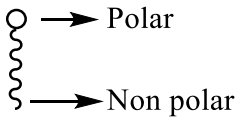
B. 

C. 

D. 

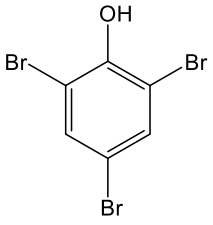
Answer (A)

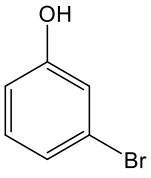
Solution:

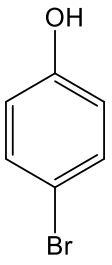


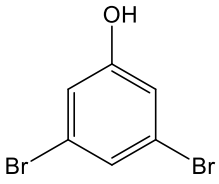
In non-polar solvent, the non-polar part will be outside.

4. When phenol reacts with Br_2 in low polarity solvent, it produces a major product _____?

A. 

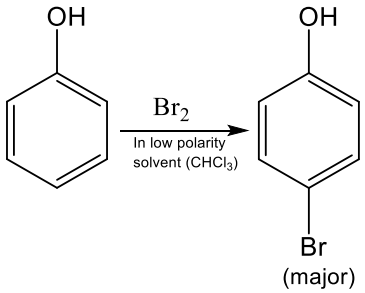
B. 

C. 

D. 

Answer (C)

Solution:

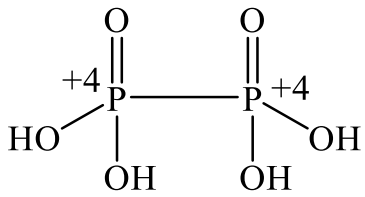


5. The oxidation state of Phosphorus atom in hypophosporic acid is _____?

Answer (4)

Solution:

The hypophosphoric acid is:



6. Electronic configuration of Nd^{2+} is

A. $4f^2$
B. $4f^3$

C. $4f^4$

D. $4f^5$

Answer (C)

Solution:

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

7. Following values of K (Rate constants) are given at different temperatures. Find out the activation energy (E_a).
Given:
T = 200K → K_1 = 0.03
T = 300K → K_2 = 0.05

A. 2.548 KJ

B. 11.488 KJ

C. 1.106 KJ

D. 51.437 KJ

Answer (A)

Solution:

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

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

$$E_a = 2.548\,KJ$$

8. Basic strength of oxides of V:
V_2O_3 V_2O_5 V_2O_4

A. $V_2O_3 < V_2O_5 < V_2O_4$

B. $V_2O_3 < V_2O_4 < V_2O_5$

C. $V_2O_3 > V_2O_4 > V_2O_5$

D. $V_2O_3 = V_2O_5 = V_2O_4$

Answer (C)

Solution:

As oxidation state of V increases then its acidic nature increases. So, the correct basic order is
$V_2O_3 > V_2O_4 > V_2O_5$

9. Choose the correct information regarding the products obtained on electrolysis of brine solution.

A. Cl_2 at cathode

B. O_2 at cathode

C. H_2 at cathode

D. OH^- at cathode

Answer (C)

Solution:

At anode

$2Cl^- \rightarrow Cl_2 + 2e^-$

At cathode

$2e^- + 2H_2O \rightarrow H_2 + 2OH^-$

Net reaction

$2Cl^- + 2H_2O \rightarrow Cl_2 + H_2 + 2OH^-$

10. Consider the following reaction

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

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

A. $\frac{\sqrt{RT}}{4}$

B. $\frac{\sqrt{RT}}{5}$

C. $\frac{\sqrt{RT}}{10}$

D. $10\sqrt{RT}$

Answer (B)

Solution:

$K_P = K_C \times (RT)^{\frac{-1}{2}}$

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

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

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

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

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

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

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

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

Answer (D)

Solution:

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

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

12. Which of the following options contains the compound which has highest sweetening value?

A. Aspartame

B. Saccharin

C. Sucralose

D. Alitame

Answer (D)

Solution:

Sweetener	Sweetening Value
Aspartame	100
Saccharin	550
Sucralose	600
Alitame	2000

Alitame has the highest sweetening value.

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

A. Electrolysis
B. Leaching
C. Froth flotation
D. Hydraulic washing

Answer (A)

Solution:

The following methods are commonly used for concentration of ore

1. Hydraulic washing
2. Leaching
3. Froth floatation
4. Magnetic separation

But Electrolysis is used for refining of the crude metal.

14. 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).

A. $[Co(H_2O)_6]^{2+}$, $[CoCl_6]^{3-}$, Octahedral
B. $[Co(H_2O)_6]^{3+}$, $[CoCl_4]^{2-}$, Tetrahedral
C. $[Co(H_2O)_6]^{2+}$, $[CoCl_4]^{2-}$, Tetrahedral
D. $[Co(H_2O)_6]^{3+}$, $[CoCl_6]^{3-}$, Octahedral

Answer (C)

Solution:

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

$Co^{2+} + 6H_2O \rightarrow [Co(H_2O)_6]^{2+}$

Here, X is $[Co(H_2O)_6]^{2+}$ which is pink in colour.

$[Co(H_2O)_6]^{2+} + 4HCl \rightarrow [CoCl_4]^{2-} + 4H^+ + 6H_2O$

Here, Y is $[CoCl_4]^{2-}$ which is blue in colour and tetrahedral in structure.

15. Consider the following reaction.

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

A, B and C are respectively.

A. $ClONO_2(g);\ HOCl(g)\ ;\ HNO_3(g)$
B. $ClONO_2(g);\ HOCl(g);\ NO_2(g)$
C. $ClNO_2(g);\ HCl;\ Cl_2$
D. $ClNO_2(g);\ HCl;\ HNO_3(g)$

Answer (A)

Solution:

$ClO(g) + NO_2(g) \rightarrow ClONO_2\ (g)$

$ClONO_2(g) + H_2O(g) \rightarrow HOCl(g) + HNO_3(g)$

Hence, the correct answer is option (A).

16. $Cu^{2+} + I^- \rightarrow A \rightarrow B + C$
Find B and C

A. I_2, Cu_2I_2
B. Cu_2I_4
C. CuI_3^-
D. I^-, CuI_2

Answer (A)

Solution:

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

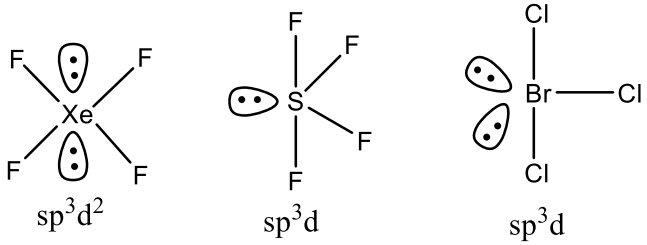
Products (B) and (C) are Cu_2I_2 and I_2 respectively

17. XeF_4, SF_4 and $BrCl_3$ show hybridisations respectively

A. sp^3, sp^3, sp^3
B. dsp^2, sp^3, sp^3
C. sp^3d^2, sp^3d, sp^3d
D. d^2sp^2, sp^3d, sp^3d

Answer (C)

Solution:

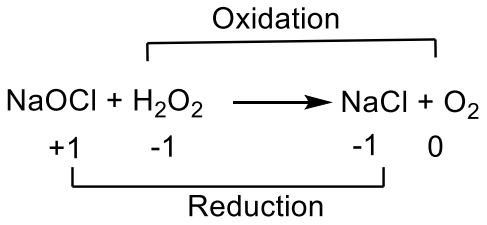


18. In which of the following reaction, H_2O_2 acts as a reducing agent.

A. $H_2O_2 + Mn^{2+} \rightarrow MnO_2 + H_2O$
B. $NaOCl + H_2O_2 \rightarrow NaCl + O_2$
C. $Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + H_2O$
D. $PbS + H_2O_2 \rightarrow PbSO_4 + H_2O$

Answer (B)

Solution:



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

19. Which of the following transition emits the same wavelength as that for (n = 4 → n = 2) for He^+ ion

A. H (n = 3 → n = 1)
B. H (n = 2 → n = 1)
C. H^{2+} (n = 4 → n = 3)
D. He^+ (n = 6 → n = 3)

Answer (B)

Solution:

$$\frac{1}{\lambda} = \frac{RZ^2}{hc}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

For He^+ ion, (n = 4 → n = 2)

$$\frac{1}{\lambda_{He^+}} = \frac{R2^2}{hc}\left(\frac{1}{2^2} - \frac{1}{4^2}\right) = \frac{R\ X\ 4}{hc}\left(\frac{1}{4} - \frac{1}{16}\right) = \frac{3R}{4hc}$$

For H ion, (n = 2 → n = 1)

$$\frac{1}{\lambda_H} = \frac{R1^2}{hc}\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = \frac{R}{hc}\left(\frac{1}{1} - \frac{1}{4}\right) = \frac{3R}{4hc}$$

20. 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^+	(R) Square planar
D. BrF_3	(S) Tetrahedral

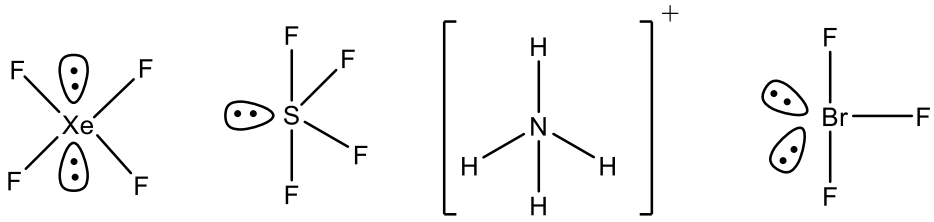
A. A → P, B →Q, C→R, D→S
B. A → R, B →Q, C→S, D→P
C. A → Q, B →P, C→S, D→R
D. A → S, B →R, C→P, D→Q

Answer (B)

Solution:

Molecule	Number of lone pairs	Number of sigma bonds	Shape
XeF_4	2	4	Square Planar

SF_4	1	4	See - saw
NH_4^+	0	4	Tetrahedral
BrF_3	2	3	T- shape



21. 2.56 g of a non-electrolyte solute is dissolved in one litre of a solution, it has osmotic pressure 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)

Solution:

$\prod$ = CRT

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

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

= 16 g

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

Answer (44)

Solution:

%Carbon= $\frac{MW_C}{MW_{CO_2}} X \frac{W_{CO_2}}{W} X\ 100$

MW_C – Molecular weight of Carbon

MW_{CO_2} – Molecular weight of CO_2

W_{CO_2} – Weight of CO_2 produced

W – Weight of the organic compound

= $\frac{12}{44}\ X \frac{0.792}{0.492}\ X\ 100$

= 43.90%

23. What is the volume of hydrogen gas produced (lit) when 11.2 g of Zn metal reacts with excess of dil. HCl. (Closest integer)

Given, Molar volume of H_2 = 22.7 L/mol, Molar mass of Zn = 65 g/mol

Answer (4)

Solution:

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

Weight of the Zn = 11.2 g

From the equation, one mole of Zn i.e 65 g produces one mole of H_2 i.e 22.7 L

Therefore, volume of H_2 produced by 11.2 g of Zn

$= \frac{11.2}{65} \; X \; 22.7 \; L$

= 3.911 L ≈ 4L

24. The value of logarithms of the equilibrium constant of the following reaction is $\frac{X}{3}$. Then X is ?

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

Given : [$Pd^{2+} + 2e^- \rightarrow Pd \quad E^o = 0.83 \; V$

$PdCl_4^{2-} + 2e^- \rightarrow Pd + 4Cl^- \quad E^o = 0.63 \; V \; and \; 2.303 \frac{RT}{F} = 0.06 J$

Answer (20)

Solution:

From Nernst Equation,

$$\boldsymbol{E_{cell} = E^o_{cell} - 2.303 \frac{RT}{nF} \; log \; Q}$$

Q – Reaction quotient

At equilibrium,

$$\boldsymbol{E_{cell} = 0 \; and \; Q = K_{eq}}$$

$$\Rightarrow, \boldsymbol{E^o_{cell} = 2.303 \frac{RT}{nF} log \; K_{eq}} ------(1)$$

Given, $Pd^{2+} + 2e^- \rightarrow Pd \quad E^o = 0.83 \; V$

$PdCl_4^{2-} + 2e^- \rightarrow Pd + 4Cl^- \quad E^o = 0.63 \; V$

Net reaction is,

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

From the above reactions,

$$\boldsymbol{E^o_{cell} = E^o_{Pd^{2+}/Pd} + E^o_{Pd/PdCl_4^{2-}}}$$

= 0.83 – 0.63 = 0.20 V

Putting values in eqn (1)

$0.20 = \frac{0.06}{2} \frac{x}{3}$

$x = \frac{0.20 \; X \; 6}{0.06}$ = 20

25. Find the value $|\Delta H|$ in KJ for

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

Given : [$\Delta H_{diss} \; Cl_2(g) \rightarrow 2Cl(g) \quad 240 \; kJ/mol^{-1}$

$\Delta H_{eg} \; Cl(g) + e^- \rightarrow Cl^-(g) \quad -320 \; kJ/mol^{-1}$

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

Answer (540)

Solution:

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

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

$Cl^-(g) + aq \rightarrow Cl^-(aq) \quad \Delta H_3 = -340 \; KJ$

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

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

$$= 120 - 320 - 340$$

$$= -540 \text{ kJ}$$

$$|\Delta H| = 540\ kJ$$