

IIT-JEE 2012

PAPER - 2

PART - II : CHEMISTRY

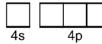
SECTION - I : Single Correct Answer Type

This section contains 8 multiple choice questions, Each question has four choices, (A), (B), (C) and (D) out of which ONLY ONE is correct.

- 21. NiCl₂ {P (C_2H_5)₂ (C_6H_5)}₂ exhibits temperature dependent magnetic behaviour (paramagnetic/ diamagnetic). the coordination geometries of Ni²⁺ in the paramagnetic and diamagnetic states are respectively
 - (A) tetrahedral and tetrahedral
 - (B) square planar and square planar
 - (C) tetrahedral and square planar
 - (D) square planar and tetrahedral
- Ans. (C)
- **Sol.** [NiCl₂ {PEt₂Ph}] contains Ni²⁺ with electronic configuration

$$Ni^{2+} = [Ar] 3d^84s^0$$





In high spin state, it is paramagnetic, sp³ hybridised, tetrahedral.

In low spin state, it is diamagnetic, dsp², square planar.

- 22. The reaction of white phosphorous with aqueous NaOH gives phosphine along with another phosphorus containing compound. The reaction type; the oxidation states of phosphorous in phosphine and the other product are respectively
 - (A) redox reaction; -3 and -5
 - (B) redox reaction; 3 and + 5
 - (C) disproportionation reaction; -3 and +5
 - (D) disproportionation reaction; -3 and +3
- Ans. (C)
- Sol. $P_4(s) + NaOH \longrightarrow PH_3 + NaH_2PO_2(aq)$ $(-3) \qquad (+1)$ $\downarrow \Delta$ $Na_3PO_4 + PH_3$

Oxidation states of P in Na₃PO₄ & PH₃ are +5 & -3 respectively. It is a disproportionation reaction.

- 23. In the cyanide extraction process of silver from argentite ore, the oxidizing and reducing agents used are
 - (A) O₂ and CO respectively

- (B) O₂ and Zn dust respectively
- (C) HNO₃ and Zn dust respectively.
- (D) HNO₃ and CO respectively

Ans. (B)

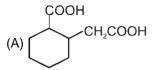
Sol. In extraction of silver, Ag, S is leached with KCN in presence of air :

$$Ag_2S + NaCN + O_2 \longrightarrow Na [Ag(CN)_2] + Na_2S_2O_3$$

Thus, O₂ is oxidant.

$$2Ag(CN)_2^- + Zn \longrightarrow [Zn(CN)_4]^{2-} + 2Ag \downarrow$$

24. The compound that undergoes decarboxlylation most readily under mild condition is



Ans. (B)

Sol. In decarboxylation, β -carbon acquires δ - charge. Whenever δ - charge is stabilized, decarboxylation becomes simple. In (B), it is stabilized by -m & -I of C = O, which is best amongst the options offered,

25. Using the data provided, calculate the multiple bond energy (kJ mol⁻¹) of a C≡C bond C₂H₂. That energy is (take the bond energy of a C-H bond as 350 kJ mol⁻¹)

$$2C(s) + H_2(g) \longrightarrow C_2H_2(g)$$
 $\Delta H = 225 \text{ kJ mol}^{-1}$

$$\Delta H = 225 \text{ kJ mol}^{-1}$$

$$2C(s) \longrightarrow 2C(g)$$

$$\Delta H = 1410 \text{ kJ mol}^{-1}$$

$$H_{2}(g) \longrightarrow 2H(g)$$

$$\Delta H = 330 \text{ kJ mol}^{-1}$$

Ans. (D)

Sol.

$$\triangle H = +1410 + 330 - (350 \times 2) - \varepsilon_{C=C} = +225$$

∴
$$\epsilon_{\text{C=C}} = 1740 - 700 - 225 = +815 \text{ KJ/mol.}$$

- 26. The shape of XeO₂F₂ molecule is
 - (A) trigonal bipyramidal

(B) square plannar

(C) tetrahedral

(D) see-saw

Ans. (D)

 $\rm XeO_2F_2$ has trigonal bipyramidal geometry. Due to presence of lone pair on equitorial position, the shape is Sol. see-saw.

27. The major product H in the given reaction sequence is

$$CH_3$$
- CH_2 - CO - CH_3 $\xrightarrow{\Theta CN}$ G $\xrightarrow{95\% H_2SO_4}$ $Heat$

(C)
$$CH_3-CH_2-C-COOH$$

(B) Ans.

Sol.
$$\begin{array}{c}
CN^{-} \\
OH
\end{array}$$

$$\begin{array}{c}
CN \\
OH
\end{array}$$

$$\begin{array}{c}
OH
\end{array}$$

$$\begin{array}{c}
OH
\end{array}$$

$$\begin{array}{c}
OH
\end{array}$$

$$\begin{array}{c}
OH
\end{array}$$

- 28. For a dilute solution containing 2.5 g of a non-volatile non-electrolyte solute in 100 g of water, the elevation in boiling point at 1 atm pressure is 2°C. Assuming concentration of solute is much lower than the concentration of solvent, the vapour pressure (mm of Hg) of the solution is (take $K_h = 0.76 \text{ K kg mol}^{-1}$)
 - (A)724
- (B) 740
- (C) 736
- (D)718

Ans. (A)

Sol.
$$\Delta T_b = 2^{o}C$$
; $m_a = 2.5 \text{ g}$ $m_{\text{solvent}} = 100 \text{ g}$ $K_b = 0.76 \text{ K. kg. mol}^{-1}$ $P_{\text{solution}} = ?$

$$\Delta T_b = K_b \times m$$

$$2 = 0.76 \times m$$

$$\therefore m = \frac{2}{0.76}$$

$$\frac{P^0 - P}{P} = m \times MM \times 10^{-3}$$

$$\frac{P^0 - P}{P} = m \times MM \times 10^{-3}$$
 $\therefore \frac{760 - P}{P} = \frac{2}{0.76} \times 18 \times 10^{-3}$

$$760 - P = \frac{36}{760}P$$
 $\therefore 760 = \frac{796}{760}P$

$$\therefore 760 = \frac{796}{760} P$$

∴ P = 760
$$\left(\frac{796}{760}\right)$$
 torr = 725.6 torr ≈ 724 torr

SECTION - II: Paragraph Type

This section contains 6 multiple choice questions relating to three paragraphs with two questions on each paragraph. Each question has four choices (A), (B) (C) and (D) out of which ONLY ONE is correct.

Paragraph for Questions Nos. 29 to 30

The electrochemical cell shown below is a concentration cell.

M|M²⁺ (saturated solution of a sparingly soluble salt,MX₂)|| M²⁺ (0.001 mol dm⁻³) |M

The emf of the cell depends on the difference in concetration of M2+ ions at the two electrodes. The emf of the cell at 298 is 0.059 V

29. The solubility product (K_{sp} ; mol³ dm⁻⁹) of MX_2 at 298 based on the information available the given concentration cell is (take 2.303× R × 298/F = 0.059 V)

(A)
$$1 \times 10^{-15}$$

(B)
$$4 \times 10^{-15}$$

(C)
$$1 \times 10^{-12}$$

(D)
$$4 \times 10^{-12}$$

(B) Ans.

Anode:

$$M \longrightarrow M^{2+}(aq) + 2e^{-}$$

Cathode:

$$M^{2+}$$
 (aq) + $2e^- \longrightarrow M$

$$M^{2+}$$
 (aq)_c \Longrightarrow M^{2+} (aq)_a

$$\mathsf{E}_{\text{cell}} = 0 - \frac{0.059}{2} \log \left\{ \frac{\mathsf{M}^{2+}(\mathsf{aq})_a}{10^{-3}} \right\}$$

$$0.059 = -\frac{0.059}{2} log \left\{ \frac{M^{2+}(aq)_a}{10^{-3}} \right\}$$

$$-2 = \log \left\{ \frac{M^{2+}(aq)_a}{10^{-3}} \right\}$$

$$10^{-2} \times 10^{-3} = M^{2+} (aq)_a = solubility = s$$

 $K_{sp} = 4s^3 = 4 \times (10^{-5})^3 = 4 \times 10^{-15}$

- 30. The value of ΔG (kJ mol⁻¹) for the given cell is (take 1F = 96500 C mol⁻¹)
 - (A) 5.7
- (B) 5.7
- (C) 11.4
- (D) 11.4

Ans. (D)

Sol.
$$\Delta G = - \text{ nFE}_{cell} = -2 \times 96500 \times 0.059 \times 10^{-3} \text{ kJ/mole}$$

= -11.4 kJ/mole

Paragraph for Questions Nos. 31 to 32

Bleaching powder and bleach solution are produced on a large scale and used in several house hold products. The effectiveness of bleach solution is often measured by iodometry.

- 31. 25 mL of household bleach solution was mixed with 30 mL of 0.50 M KI and 10 mL of 4N acetic acid. In the titration of the liberated iodine, 48 mL of 0.25 N Na₂S₂O₃ was used to reach the end point. The molarity of the household bleach solution is
 - (A) 0.48 M
- (B) 0.96 M
- (C) 0.24 M
- (D) 0.024 M

Ans. (C)

A115. (C)

Sol. milli mole of Hypo = 0.25×48

= 2 × milli mole of Cl₂

milli mole of $Cl_2 = \frac{0.25 \times 48}{2} = 6$ milli mole

= milli mole of Cl₂ = milli mole of CaOCl₂

So, molarity = $\frac{6}{25}$ M = 0.24 M

- 32. Bleaching powder contains a salt of an oxoacid as one of its components. The anhydride of that oxoacid is
 - (A) Cl₂O
- (B) Cl₂O₇
- (C) CIO₂
- (D) Cl₂O₆

Ans. (A)

Sol. CaOCl₂ = Ca(OCl)Cl

OCI-- Hypochlorite ion

which is anion of HOCI

Anhydride of HOCI = CI₂O

Paragraph for Questions Nos. 33 to 34

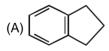
In the following reactions sequence, the compound J is an intermediate.

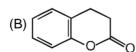
$$I \xrightarrow{\text{(CH}_3\text{CO})_2\text{O}} J \xrightarrow{\text{(i) H}_2,\text{Pd/C}} K$$

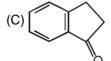
$$I \xrightarrow{\text{(ii) SOCl}_2} \text{(ii) anhyd. AlCl}_3$$

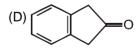
 $\rm J~(C_{_9}H_8O_{_2})$ gives effervescence on treatment with $\rm ~NaHCO_{_3}$ and positive Baeyer's test

33. The compound K is









Ans. (C)

34. The compound I is

Ans. (A)

Sol. (33 to 34)

$$\begin{array}{c} \text{CHO} \\ \hline \\ \text{CH}_3\text{COONa} \end{array} \\ \begin{array}{c} \text{CH} = \text{CH} - \text{COOH} \\ \hline \\ \text{CH}_2\text{-Pd/C} \end{array} \\ \end{array}$$

SECTION - III: Multiple Correct Answer(s) Type

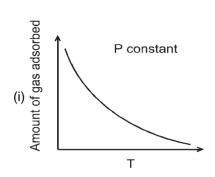
This section contains 6 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE are correct.

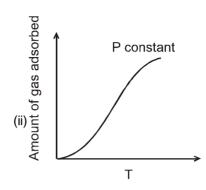
- 35. With respect to graphite and diamond, which of the statement(s) given below is (are) correct?
 - (A) Graphite is harder than diamond.
 - (B) Graphite has higher electrical conductivity than diamond
 - (C) Graphite has higher thermal conductivity than diamond
 - (D) Graphite has higher C-C bond order than diamond

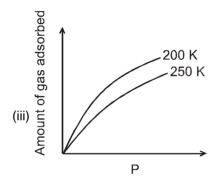
Ans. (BD)

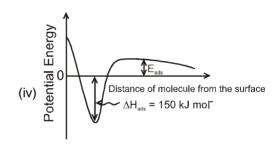
- **Sol.** (A) Diamond is harder than graphite.
 - (B) Graphite is better conductor of electricity than diamond.
 - (C) Diamond is better conductor of heat than graphite.
 - (D) Bond order of graphite (≈ 1.5) > Bond order of diamond (=1)

36. The given graph / data I, II, III and IV represent general trends observed for different physisorption and chemisorption processes under mild conditions of temperature and pressure. Which of the following choice (s) about I, II, III and IV is (are) correct









- (A) I is physisorption and II is chemisorption
- (B) I is physisorption and III is chemisorption
- (C) IV is chemisorption and II is chemisorption
- (D) IV is chemisorption and III is chemisorption

Ans. (AC)

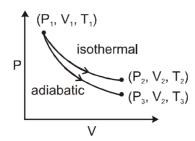
Sol. In physisorption on increasing temperature at constant pressure, adsorption decreases while in chemical adsorption on increasing temperature due to requirement of activation energy adsorption will increase at same pressure. So, I is physisorption while II is chemisorption.

III is physical adsorption as on increasing temperature, extent of adsorption is decreasing.

IV is representing enthalpy change (which is high) during chemical adsorption (due to bond formation) So, is valid for chemical adsorption.

So, answer is (A) and (C)

37. The reversible expansion of an ideal gas under adiabatic and isothermal conditions is shown in the figure. Which of the following statement(s) is (are) correct?



- (A) $T_1 = T_2$
- (C) W_{isothermal} > W_{adiabatic}

- (B) $T_3 > T_1$
- (D) $\Delta U_{isothermal} > \Delta U_{adiabatic}$

- Ans. (AD)
 - (P_1, V_1, T_1) isothermal (P_2, V_2, T_2) (P_3, V_2, T_3)

Sol.

- (A) $T_1 = T_2$ (due to isothermal)
- (B) $T_3 > T_1$ (incorrect) cooling will take place in adiabatic expansion)
- (C) $W_{isothermal} > W_{adiabatic}$ { with sign, this is incorrect}
- (D) $\Delta U_{\text{isothermal}} = 0 > \Delta U_{\text{adiabatic}} = \text{ ve}$
- So, answer is (A) and (D)
- **38.** For the given aqueous reaction which of the statement(s) is (are) true?

excess KI +
$$K_3$$
[Fe(CN)₆] \longrightarrow brownish-yellow solution $ZnSO_4$ (white precipitate + brownish- yellow filtrate) \longrightarrow $Na_2S_2O_3$ colourless solution

- (A) The first reaction is a redox reaction
- (B) White precipitate is Zn₃[Fe(CN)₆]₂
- (C) Addition of filtrate to starch solution gives blue colour.
- (D) White precipitate is soluble in NaOH solution

Ans. (ACD)

(D) with NaOH
$$\text{K}_2\text{Zn} \left[\text{Fe(CN)}_6\right] + \text{NaOH} \\ \longrightarrow \left[\text{Zn(OH)}_4\right]^{2-} (\text{aq}) + \left[\text{Fe(CN)}_6\right]^{4-} (\text{aq})$$

39. With reference to the scheme given, which of the given statments(s) about T, U, V and W is (are) correct?

$$CH_3$$
 CrO_3/H^{\oplus}
 CrO_3/H

(A) T is soluble in hot aqueous NaOH

(B) U is optically active

(C) Molecular formula of W is $C_{10} H_{18} O_4$

(D) V gives effervescence on treatment with aqueous NaHCO₃

Ans. (ACD)

Sol.
$$COOH$$
 CrO_3/H^{\oplus}
 CH_3
 $COOH$
 CrO_3/H^{\oplus}
 CH_3
 CH

40. Which of the given statement(s) about N, O, P and Q with respect to M is (are) correct?

- (A) M and N are non-mirror image stereoisomers
- (B) M and O are identical
- (C) M and P are enantiomers
- (D) M and Q are identical

Ans. (ABC)

Sol. HO HO HO HO CH₃ CI CH₃ CI CH₃ CI CH₃ N O

