AIEEE 2009 Chemistry Solutions

CHEMISTRY

PART – B

31. Knowing that the Chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state, which of the following statements in incorrect ?
(1) Because of the large size of the Ln (III) ions the bonding in its compounds is predominantly ionic in character.
(2) The ionic sizes of Ln (III) decrease in general with increasing atomic number.
(3) Ln (III) compounds are generally colourless.
(4) Ln (III) hydroxides are mainly basic in character.

Sol: **(3)**
Ln^{+3} compounds are mostly coloured.

32. A liquid was mixed with ethanol and a drop of concentrated H_2SO_4 was added. A compound with a fruity smell was formed. The liquid was :
(1) CH_3OH (2) $HCHO$
(3) CH_3COCH_3 (4) CH_3COOH

Sol: **(4)**
Esterification reaction is involved

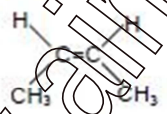
$$CH_3COOH_{(\ell)} + C_2H_5OH_{(\ell)} \xrightarrow{H^+} CH_3COOC_2H_{5(\ell)} + H_2O_{(\ell)}$$

*33. Arrange the carbanions, $(CH_3)_3\bar{C}$, $\bar{C}Cl_3$, $(CH_3)_2\bar{C}H$, $C_6H_5\bar{C}H_2$, in order of their decreasing stability :
(1) $C_6H_5\bar{C}H_2 > \bar{C}Cl_3 > (CH_3)_3\bar{C} > (CH_3)_2\bar{C}H$ (2) $(CH_3)_2\bar{C}H > \bar{C}Cl_3 > C_6H_5\bar{C}H_2 > (CH_3)_3\bar{C}$
(3) $\bar{C}Cl_3 > C_6H_5\bar{C}H_2 > (CH_3)_2\bar{C}H > (CH_3)_3\bar{C}$ (4) $(CH_3)_3\bar{C} > (CH_3)_2\bar{C}H > C_6H_5\bar{C}H_2 > \bar{C}Cl_3$

Sol: **(3)**
2° carbanion is more stable than 3° and Cl is –I effect group.

*34. The alkene that exhibits geometrical isomerism is :
(1) propene (2) 2-methyl propene
(3) 2-butene (4) 2- methyl -2- butene

Sol: **(3)**



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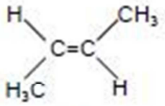


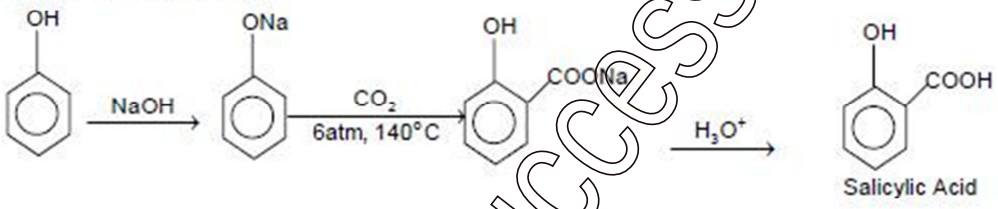
Trans

*35. In which of the following arrangements, the sequence is not strictly according to the property written against it ?
(1) $CO_2 < SiO_2 < SnO_2 < PbO_2$: increasing oxidising power
(2) HF< HCl < HBr < HI : increasing acid strength
(3) $NH_3 < PH_3 < AsH_3 < SbH_3$: increasing basic strength
(4) B < C < O < N : increasing first ionization enthalpy.

Sol: **(3)**
Correct basic strength is $NH_3 > PH_3 > AsH_3 > BiH_3$

36. The major product obtained on interaction of phenol with sodium hydroxide and carbon dioxide is :
(1) benzoic acid (2) salicylaldehyde
(3) salicylic acid (4) phthalic acid

Sol: **(3)**
Kolbe – Schmidt reaction is



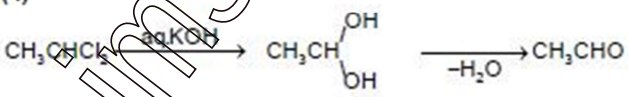
Salicylic Acid

37. Which of the following statements is incorrect regarding physisorptions ?
(1) It occurs because of vander Waal's forces
(2) More easily liquefiable gases are adsorbed readily.
(3) Under high pressure it results into multi molecular layer on adsorbent surface.
(4) Enthalpy of adsorption $(\Delta H_{adsorption})$ is low and positive.

Sol: **(4)**
Enthalpy of adsorption regarding physisorption is not positive and it is negative.

38. Which of the following on heating with aqueous KOH, produces acetaldehyde ?
(1) CH_3COCl (2) CH_3CH_2Cl
(3) $CH_2Cl\ CH_2Cl$ (4) CH_3CHCl_2

Sol: **(4)**



*39. In an atom, an electron is moving with a speed of 600m/s with an accuracy of 0.005%. Certainty with which the position of the electron can be located is ($h = 6.6\times10^{-34}$ kg m^{2}s^{-1}, mass of electron, $e_m = 9.1\times10^{-31}$kg)

(1) 1.52×10^{-4}m (2) 5.10×10^{-3}m
(3) 1.92×10^{-3}m (4) 3.84×10^{-3}m

Sol: **(3)**

$$\Delta x.m\ \Delta v = \frac{h}{4\pi}$$

$$\Delta x = \frac{h}{4\pi\, m\Delta v}$$

$$\Delta v = 600\times\frac{0.005}{100} = 0.03$$

$$\Rightarrow \Delta x = \frac{6.625\times10^{-34}}{4\times3.14\times9.1\times10^{-31}\times0.03} = 1.92\times10^{-3}\text{m}$$

40. In a fuel cell methanol is used as fuel and oxygen gas is used as an oxidizer. The reaction is $CH_3OH(\ell)+\frac{3}{2}O_2(g)\rightarrow CO_2(g)+2H_2O(\ell)$ At 298K standard Gibb's energies of formation for $CH_3OH(\ell)$, $H_2O(\ell)$ and $CO_2(g)$ are -166.2, -237.2 and -394.4 kJ mol^{-1} respectively. If standard enthalpy of combustion of methanol is -726kJ mol^{-1}, efficiency of the fuel cell will be

(1) 80 % (2) 87%
(3) 90% (4) 97%

Sol: **(4)**

$$CH_3OH(\ell)+\frac{3}{2}O_2(g)\rightarrow CO_2(g)+2H_2O(\ell)\quad \Delta H = -726\text{kJ mol}^{-1}$$

Also $\Delta G_f^\circ CH_3OH(\ell)$ = -166.2 kJ mol^{-1}

$\Delta G_f^\circ H_2O(\ell)$ = -237.2 kJ mol^{-1}

$\Delta G_f^\circ CO_2(\ell)$ = -394.4 kJ mol^{-1}

$\because\ \Delta G = \Sigma\Delta G_f^\circ$ products $-\Sigma\Delta G_f^\circ$ reactants.

= -394.4 -2 (237.2) + 166.2

= –702.6 kJ mol^{-1}

now Efficiency of fuel cell = $\frac{\Delta G}{\Delta H}\times100$

$= \frac{702.6}{726}\times100$

= 97%

41. Two liquids X and Y form an ideal solution. At 300K, vapour pressure of the solution containing 1 mol of X and 3 mol of Y is 550 mm Hg. At the same temperature, if 1 mol of Y is further added to this solution, vapour pressure of the solution increases by 10 mm Hg. Vapour pressure (in mm Hg) of X and Y in their pure states will be, respectively :
(1) 200 and 300 (2) 300 and 400
(3) 400 and 600 (4) 500 and 600

Sol: (3)

$P_T = P_X^\circ x_X + P_Y^\circ x_Y$

x_X = mol fraction of X

x_Y = mol fraction of Y

$\therefore\ 550 = P_x^\circ\left(\frac{1}{1+3}\right) + P_Y^\circ\left(\frac{3}{1+3}\right)$

$= \frac{P_X^\circ}{4} + \frac{3P_Y^\circ}{4}$

$\therefore\ 550\ (4) = P_X^\circ + 3P_Y^\circ$ ..... (1)

Further 1 mol of Y is added and total pressure increases by 10 mm Hg.

$\therefore\ 550 + 10 = P_X^\circ\left(\frac{1}{1+4}\right) + P_Y^\circ\left(\frac{4}{1+4}\right)$

$\therefore\ 560\ (5) = P_X^\circ + 4P_Y^\circ$ .....(2)

By solving (1) and (2)

We get, $P_X^\circ = 400$ mm Hg

$P_Y^\circ = 600$ mm Hg

42. The half life period of a first order chemical reaction is 6.93 minutes. The time required for the completion of 99% of the chemical reaction will be (log 2=0.301) :
(1) 230.3 minutes (2) 23.03 minutes
(3) 46.06 minutes (4) 460.6 minutes

Sol: (3)

$\because \lambda = \frac{0.6932}{t_{1/2}} = \frac{0.6932}{6.93} min^{-1}$

Also $t = \frac{2.303}{\lambda} \log \frac{[A_o]}{[A]}$

$[A_o]$ = initial concentration (amount)

$[A]$ = final concentration (amount)

$\therefore t = \frac{2.303 \times 6.93}{0.6932} \log \frac{100}{1}$

= 46.06 minutes

43. Given : $E^\circ_{Fe^{3+}/Fe} = -0.036V$, $E^\circ_{Fe^{2+}/Fe} = -0.439V$. The value of standard electrode potential for the change, $Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}(aq)$ will be :
(1) -0.072 V (2) 0.385 V
(3) 0.770 V (4) -0.270

Sol: (3)

$\because Fe^{3+} + 3e^- \rightarrow Fe; E^\circ = -0.036V$

$\therefore \Delta G_1^\circ = -nFE^\circ = -3F(-0.036)$

$= +0.108\ F$

Also $Fe^{2+} + 2e^- \rightarrow Fe;\ E^\circ = -0.439\ V$

$\therefore \Delta G_2^\circ = -nF E^\circ$

$= -2\ F(-0.439)$

$= 0.878\ F$

To find E° for $Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}(aq)$

$\Delta G^\circ = -nFE^\circ$

$= -1FE^\circ$

$\because G^\circ = G_1^\circ - G_2^\circ$

$\therefore G^\circ = 0.108F - 0.878F$

$\therefore -FE^\circ = +0.108F - 0.878F$

$\therefore E^\circ = 0.878 - 0.108$

= 0.77v

*44. On the basis of the following thermochemical data : ($\Delta fG^\circ H^+_{(aq)} = 0$)

$H_2O(\ell) \rightarrow H^+(aq) + OH^-(aq);\ \Delta H = 57.32kJ$

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\ell)\ ;\ \Delta H = -286.20kJ$

The value of enthalpy of formation of OH^- ion at 25°C is :

(1) -22.88 kJ (2) -228.88 kJ
(3) +228.88 kJ (4) -343.52 kJ

Sol: **(2)**

By adding the two given equations, we have

$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H^+_{(aq)} + OH^-_{(aq)}\ ;\ \Delta H = -228.88\ Kj$

Here ΔH_f° of $H^+_{(aq)} = 0$

$\therefore\ \Delta H_f^\circ$ of $OH^- = -228.88$ kJ

45. Copper crystallizes in fcc with a unit cell length of 361 pm. What is the radius of copper atom ?

(1) 108 pm (2) 127 pm
(3) 157 pm (4) 181 pm

Sol: **(2)**

For FCC,

$\sqrt{2}a = 4r$ (the atoms touches each other along the face diagonal)

$r = \frac{\sqrt{2}a}{4} = \frac{\sqrt{2} \times 361}{4}$

= 127 pm

46. Which of the following has an optical isomer ?

(1) $[CO(NH_3)_3Cl]^+$ (2) $[CO(en)(NH_3)_2]^{2+}$
(3) $[CO(H_2O)_4(en)]^{3+}$ (4) $[CO(en)_2(NH_3)_2]^{3+}$

Sol: **(4)**

It is an octahedral complex of the type $[M(AA)_2X_2]$

Where AA is bidentate ligand.

*47. Solid Ba $(NO_3)_2$ is gradually dissolved in a 1.0×10^{-4} M Na_2CO_3 solution. At what concentration of Ba^{2+} will a precipitate begin to form ?(K_{sp} for Ba $CO_3 = 5.1 \times 10^{-9}$).

(1) 4.1×10^{-5} M (2) 5.1×10^{-5} M
(3) 8.1×10^{-9} M (4) 8.1×10^{-7} M

Sol: **(2)**

$Ba(NO_3)_2 + CaCO_3 \rightarrow BaCO_3 + 2NaNO_3$

Here $[CO_3^{-2}] = [Na_2CO_3] = 10^{-4}$ M

$K_{sp} = [Ba^{+2}][CO_3^{-2}] \Rightarrow 5.1 \times 10^{-9} = [Ba^{2+}](10^{-4}) \Rightarrow [Ba^{+2}] = 5.1 \times 10^{-5}$

At this value, just precipitation starts.

48. Which one of the following reactions of Xenon compounds is not feasible ?
(1) $XeO_3 + 6HF \rightarrow Xe\ F_6 + 3H_2O$
(2) $3Xe\ F_4 + 6H_2O \rightarrow 2\,Xe + XeO_3 + 12\ HF + 1.5\ O_2$
(3) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$
(4) $XeF_6 + RbF \rightarrow Rb(XeF_7]$

Sol: **(1)**
Remaining are feasible

*49. Using MO theory predict which of the following species has the shortest bond length ?
(1) O_2^{2+} (2) O_2^{+}
(3) O_2^{-} (4) O_2^{2-}

Sol: **(1)**

Bond length $\alpha \frac{1}{\text{bond order}}$

Bond order $= \frac{\text{no..of bonding } \bar{e} - \text{no.of antibonding } \bar{e}}{2}$

Bond orders of O_2^{+}, O_2^{-}, O_2^{-2} and O_2^{+2} are respectively 2.5, 1.5, 1 and 3.

50. In context with the transition elements, which of the following statements is incorrect ?
(1) In addition to the normal oxidation states, the zero oxidation state is also shown by these elements

in complexes.
(2) In the highest oxidation states, the transition metal show basic character and form cationic complexes.
(3) In the highest oxidation states of the first five transition elements (Sc to Mn), all the 4s and 3d electrons are used for bonding.
(4) Once the d^5 configuration is exceeded, the tendency to involve all the 3d electrons in bonding decreases.

Sol: **(2)**
In higher Oxidation states transition elements show acidic nature

*51. Calculate the wavelength (in nanometer) associated with a proton moving at $1.0 \times 10^3\ ms^{-1}$ (Mass of proton = 1.67×10^{-27} kg and $h = 6.63 \times 10^{-34}$ Js) :
(1) 0.032 nm (2) 0.40 nm
(3) 2.5 nm (4) 14.0 nm

Sol: **(2)**

$$\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{1.67 \times 10^{-27} \times 10^3} \equiv 0.40\ nm$$

52. A binary liquid solution is prepared by mixing n-heptane and ethanol. Which one of the following statements is correct regarding the behaviour of the solution ?
(1) The solution formed is an ideal solution
(2) The solution is non-ideal, showing +ve deviation from Raoult's law.
(3) The solution is non-ideal, showing –ve deviation from Raoult's law.
(4) n-heptane shows +ve deviation while ethanol shows –ve deviation from Raoult's law.

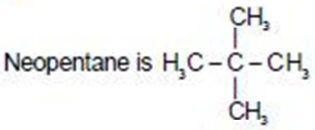
Sol: **(2)**
The interactions between n –heptane and ethanol are weaker than that in pure components.

*53. The number of stereoisomers possible for a compound of the molecular formula $CH_3 - CH = CH - CH(OH) - Me$ is :
(1) 3 (2) 2
(3) 4 (4) 6

Sol: **(3)**
About the double bond, two geometrical isomers are possible and the compound is having one chiral carbon.

*54. The IUPAC name of neopentane is
(1) 2-methylbutane (2) 2, 2-dimethylpropane
(3) 2-methylpropane (4) 2,2-dimethylbutane

Sol: **(2)**

Neopentane is 

*55. The set representing the correct order of ionic radius is :
(1) $Li^+ > Be^{2+} > Na^+ > Mg^{2+}$ (2) $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$
(3) $Li^+ > Na^+ > Mg^{2+} > Be^{2+}$ (4) $Mg^{2+} > Be^{2+} > Li^+ > Na^+$

Sol: **(2)**
Follow the periodic trends

56. The two functional groups present in a typical carbohydrate are :
(1) -OH and -COOH (2) -CHO and -COOH
(3) > C = O and - OH (4) - OH and -CHO

Sol: **(3)**
Carbohydrates are polyhydroxy carbonyl compounds.

*57. The bond dissociation energy of B – F in BF_3 is 646 kJ mol^{-1} whereas that of C-F in CF_4 is 515kJ mol^{-1}. The correct reason for higher B-F bond dissociation energy as compared to that of C- F is :
(1) smaller size of B-atom as compared to that of C- atom
(2) stronger σ bond between B and F in BF_3 as compared to that between C and F in CF_4
(3) significant $p\pi$- $p\pi$ interaction between B and F in BF_3 whereas there is no possibility of such interaction between C and F in CF_4
(4) lower degree of $p\pi$ - $p\pi$ interaction between B and F in BF_3 than that between C and F in CF_4.

Sol: **(3)**
option itself is the reason

58. In Cannizzaro reaction given below

$$2\ Ph\ CHO \xrightarrow{(-)\ :OH} Ph\ CH_2OH + PhCO_2^{(-)}$$

the slowest step is :

(1) the attack of $^{(-)}OH$ at the carboxyl group
(2) the transfer of hydride to the carbonyl group
(3) the abstraction of proton from the carboxylic group
(4) the deprotonation of $Ph\ CH_2OH$

Sol: **(2)**
Hydride transfer is the slowest step.

59. Which of the following pairs represents linkage isomers ?

(1) $[Cu(NH_3)_4][Pt\ Cl_4]$ and $[Pt(NH_3)_4][CuCl_4]$

(2) $[Pd(P\ Ph_3)_2(NCS)_2]$ and $[Pd\ (P\ Ph_3)_2\ (SCN)_2]$

(3) $[CO\ (NH_3)_5\ NO_3]SO_4$ and $[CO(NH_3)_5\ SO_4]NO_3$

(4) $[Pt\ Cl_2\ (NH_3)_4]Br_2$ and $[Pt\ Br_2\ (NH_3)_4]Cl_2$

Sol: **(2)**

NCS^- is ambidentate ligand and it can be linked through N (or) S

60. Buna-N synthetic rubber is a copolymer of :

(1) $H_2C = CH - \underset{\displaystyle Cl}{\underset{|}{C}} = CH_2$ and $H_2C = CH - CH = CH_2$

(2) $H_2C = CH - CH = CH_2$ and $H_5C_6 - CH = CH_2$

(3) $H_2C = CH - CN$ and $H_2C = CH - CH = CH_2$

(4) $H_2C = CH - CN$ and $H_2C = CH - \underset{\displaystyle CH_3}{\underset{|}{C}} = CH_2$

Sol: **(3)**