PART B – CHEMISTRY

DIRECTIONS : There are 45 multiple choice questions numbered 46 to 90. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE is correct.

46. A hydrocarbon A on chlorination gives B which on heating with alcoholic potassium hydroxide changes into another hydrocarbon C. The latter decolourises Baeyer's reagent and on ozonolysis forms formaldehyde only. A is

(1) Ethane (2) Butane
(3) Methane (4) Ethene

47. The IUPAC name of the compound having the molecular formula $Cl_3C–CH_2CHO$ is

(1) 3, 3, 3- Trichloropropanal
(2) 1, 1, 1- Trichloropropanal
(3) 2, 2, 2- Trichloropropanal
(4) Chloral

48. Which one of the following complexes is not expected to exhibit isomerism?

(1) $[Ni(en)_3]^{2+}$

(2) $\left[Ni(NH_3)_4(H_2O)_2\right]^{2+}$

(3) $\left[Pt(NH_3)_2Cl_2\right]$

(4) $\left[Ni(NH_3)_2Cl_2\right]$

49. The increasing order of the rate of HCN addition to compound A – D is

(A) HCHO (B) CH_3COCH_3
(C) $PhCOCH_3$ (D) PhCOPh
(1) D < C < B < A (2) C < D < B < A
(3) A < B < C < D (4) D < B < C < A

50. Phosphorus pentachloride dissociates as follows, in a closed reaction vessel

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

If total pressure at equilibrium of the reaction mixture is P and degree of dissociation of PCl_5 is x, the partial pressure of PCl_3 will be

(1) $\left(\frac{x}{x-1}\right)P$ (2) $\left(\frac{x}{1-x}\right)P$
(3) $\left(\frac{x}{x+1}\right)P$ (4) $\left(\frac{2x}{1-x}\right)P$

51. Which of the following will not show cis-trans isomerism?

(1) $CH_3 — CH = CH — CH_3$

(2) $CH_3 — CH_2 — CH = CH — CH_2 — CH_3$

(3) $CH_3 — \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} = CH — CH_2 — CH_3$

(4) $CH_3 — \underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH}} — CH = CH — CH_2 — CH_3$

52. Point out the false statement

(1) Brownian movement and Tyndall effect are shown by colloidal systems.
(2) Gold number is a measure of the protective power of a lyophillic colloid.
(3) The colloidal solution of a liquid in liquid is called gel.
(4) Hardy - Schulze rule is related with coagulation.

53. P_A and P_B are the vapour pressure of pure liquid components, A and B, respectively of an ideal binary solution. If X_A represents the mole fraction of component A, the total pressure of the solution will be.

(1) $P_A + X_A(P_B - P_A)$ (2) $P_A + X_A(P_A - P_B)$
(3) $P_B + X_A(P_B - P_A)$ (4) $P_B + X_A(P_A - P_B)$

54. In which one of the following species the central atom has the type of hybridization which is not the same as that present in the other three?

(1) SF_4 (2) I_3^- (3) $SbCl_5^{2-}$ (4) PCl_5

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55. A strong base can abstract an α -hydrogen from :
(1) alkene (2) amine
(3) ketone (4) alkane

56. What products are expected from the disproportionation reaction of hypochlorous acid?
(1) HCl and Cl_2O (2) HCl and $HClO_3$
(3) $HClO_3$ and Cl_2O (4) $HClO_2$ and $HClO_4$

57. Which one of the following pairs of substances on reaction will not evolve H_2 gas?
(1) Iron and $H_2SO_4(aq)$
(2) Iron and steam
(3) Copper and HCl(g)
(4) Sodium and ethyl alchohol

58. An antibiotic contains nitro group attached to aromatic nucleus. It is
(1) penicillin (2) streptomycin
(3) tetracycline (4) chloramphenicol

59. An ionic compound has a unit cell consisting of A ions at the corners of a cube and B ions on the centres of the faces of the cube. The empirical formula for this compound would be
(1) A_3B (2) AB_3
(3) A_2B (4) ABl

60. In a reaction, when the concentration of reactant is increased two times, the increase in rate of reaction was four times. Order of reaction is :
(1) zero (2) 1
(3) 2 (4) 3

61. The cell reaction $Cu + 2Ag^+ \rightarrow Cu^{2+} + Ag$ is best represented by
(1) $Cu(s) \mid Cu^{2+}(aq) \mid\mid Ag^+(aq) \mid Ag(s)$
(2) $Pt \mid Cu^{2+} \mid\mid Ag^+(aq) \mid Ag(s)$
(3) $Cu^{2+} \mid Cu \mid\mid Pt \mid Ag$
(4) None of the above representations

62. Chlorine is liberated when we heat
(1) $KMnO_4 + NaCl$ (2) $K_2Cr_2O_7 + MnO_2$
(3) $Pb(NO_3)_2 + MnO_2$ (4) $K_2Cr_2O_7 + HCl$

63. According to kinetic theory of gases, for a diatomic molecule
(1) the pressure exerted by the gas is proportional to mean velocity of the molecule
(2) the pressure exerted by the gas is proportional to the root mean velocity of the molecule
(3) the root mean square velocity of the molecule is inversely proportional to the temperature
(4) the mean translational kinetic energy of the molecule is proportional to the absolute temperature.

64. Larger number of oxidation states are exhibited by the actinoids than those by the lanthanoids, the main reason being
(1) 4*f* orbitals more diffused than the 5*f* orbitals
(2) lesser energy difference between 5*f* and 6*d* than between 4*f* and 5*d* orbitals
(3) more energy difference between 5*f* and 6*d* than between 4*f* and 5*d* orbitals
(4) more reactive nature of the actinoids than the lanthanoids

65. Which one of the following arrangements does not give the correct picture of the trends indicated against it ?
(1) $F_2 > Cl_2 > Br_2 > I_2$: Oxidizing power
(2) $F_2 > Cl_2 > Br_2 > I_2$: Electron gain enthalpy
(3) $F_2 > Cl_2 > Br_2 > I_2$: Bond dissociation energy
(4) $F_2 > Cl_2 > Br_2 > I_2$: Electronegativity.

66. The process of converting hydrated alumina into anhydrous alumina is called
(1) roasting (2) smelting
(3) dressing (4) calcination

67. The rate constant of a reaction becomes equal to the pre-exponential factor when
(1) the absolute temperature is zero
(2) the activation energy is infinity
(3) the absolute temperature is infinity
(4) the temperature in Celsius is zero.

68. Which one of the following cyano complexes would exhibit the lowest value of paramagnetic behaviour ?
(1) $[Co(CN)_6]^{3-}$ (2) $[Fe(CN)_6]^{3-}$
(3) $[Mn(CN)_6]^{3-}$ (4) $[Cr(CN)_6]^{3-}$

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(At. No : Cr = 24, Mn = 25, Fe = 26, Co = 27)

69. On the basis of the following thermochemical data :

$(\Delta_f G°H^+(aq) = 0)$

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

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

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

(1) –228.88 kJ (2) +228.88 kJ

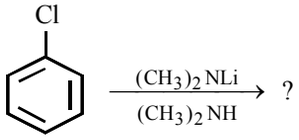
(3) –343.52 kJ (4) –22.88 kJ

70. In which of the following pair both the species have sp^3 hybridization?

(1) H_2S, BF_3 (2) SiF_4, BeH_2

(3) NF_3, H_2O (4) NF_3, BF_3

71. What is the product of the following reaction ?



(1) N, N-dimethylaniline

(2) phenyllithium (C_6H_5Li)

(3) *para*-chloro-N, N-dimethylaniline

(4) *meta*-chloro-N, N-dimethylaniline

72. From amongst the following alcohols the one that would react fastest with conc. HCl and anhydrous $ZnCl_2$, is

(1) 2-Butanol (2) 2- Methylpropan-2-ol

(3) 2-Methylpropanol (4) 1- Butanol

73. Number of moles of MnO_4^- required to oxidize one mole of ferrous oxalate completely in acidic medium will be :

(1) 0.6 moles (2) 0.4 moles

(3) 7.5 moles (4) 0.2 moles

74. Which of the following practices will not come under green chemistry?

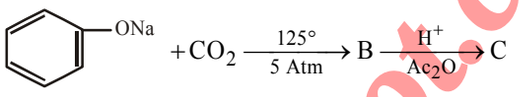
(1) If possible, making use of soap made of vegetable oils instead of using synthetic detergents.

(2) Using H_2O_2 for bleaching purpose instead of using chlorine based bleaching agents.

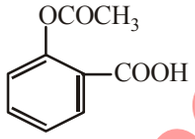
(3) Using bicycle for travelling small distances instead of using petrol/ diesel based vehicles.

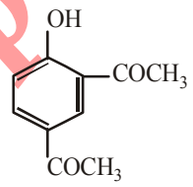
(4) Using plastic cans for neatly storing substances.

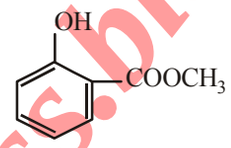
75. Sodium phenoxide when heated with CO_2 under pressure at 125°C yields a product which on acetylation produces C

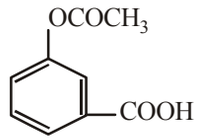


The major product C would be

(1) 

(2) 

(3) 

(4) 

76. The strength in volumes of a solution containing 30.36 g/L of H_2O_2 is

(1) 10 V (2) 5 V

(3) 20 V (4) None of these

77. The position of some metals in the electrochemical series in decreasing electropositive character is given as Mg > Al > Zn > Cu > Ag. What will happen, if a copper spoon is used to stir a solution of aluminium nitrate ?

(1) The spoon will get coated with Al

(2) An alloy of Cu and Al is formed

(3) The solution becomes blue

(4) There is no reaction

78. Which of the following graph correspond to one node

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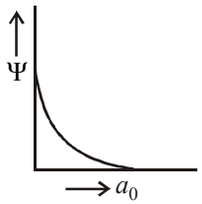
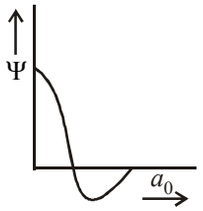
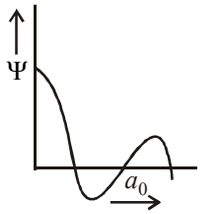
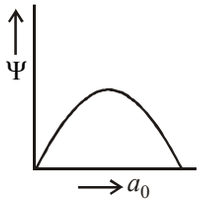
(1) 

(2) 

(3) 

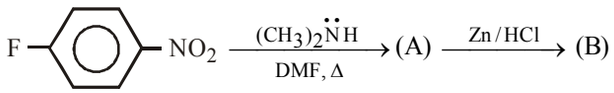
(4) 

79. Which of the following substances has the greatest ionic character ?

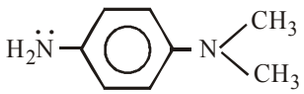
(1) Cl_2O (2) NCl_3 (3) $PbCl_2$ (4) $BaCl_2$

80. The reaction of benzyl chloride with sodium cyanide followed by reduction with hydrogen in the presence of nickel gives

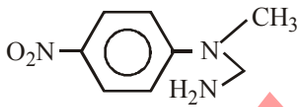
(1) β-Phenylethylamine (2) N-Isobutylaniline
(3) Benzylamine (4) Aniline.

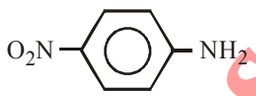
81. 

(B) is –

(1) 

(2) 

(3) 

(4) 

82. Which one of the following statements is correct?

(1) All amino acids except lysine are optically active
(2) All amino acids are optically active
(3) All amino acids except glycine are optically active
(4) All amino acids except glutamic acids are optically active

83. Which of the following structure is similar to graphite?

(1) B (2) B_4C
(3) B_2H_6 (4) BN

84. Four species are listed below:

i. HCO_3^- ii. H_3O^+
iii. HSO_4^- iv. HSO_3F

Which one of the following is the correct sequence of their acid strength?

(1) iv < ii < iii < i (2) ii < iii < i < iv
(3) i < iii < ii < iv (4) iii < i < iv < ii

85. Arrange the following in increasing order of stability

(A) $(CH_3)_2\overset{\oplus}{C}-CH_2CH_3$ (B) $(CH_3)_3\overset{\oplus}{C}$

(C) $(CH_3)_2\overset{\oplus}{C}H$ (D) $CH_3\overset{\oplus}{C}H_2$

(E) $\overset{\oplus}{C}H_3$

(1) E < D < C < B < A (2) E < D < C < A < B
(3) D < E < C < A < B (4) A < E < D < C < B

86. An organic compound A upon reacting with NH_3 gives B. On heating B gives C. C in presence of KOH reacts with Br_2 to given $CH_3CH_2NH_2$. A is :

(1) CH_3COOH (2) $CH_3CH_2CH_2COOH$

(3) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOH$ (4) CH_3CH_2COOH

87. The ratio of ionization energy of H and Be^{3+} is

(1) 1 : 1 (2) 1 : 3
(3) 1 : 9 (4) 1 : 16

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88. Which is the correct order of electronegativity ?

(1) F > N < O > C (2) F > N > O > C

(3) F > N > O < C (4) F < N < O = C

89. **Statement-1 :** Teflon has high thermal stability and chemical inertness.

Statement-2 : Teflon is a thermoplastic.

(1) Statement-1 is true, Statement-2 is true, Statement-2 is a correct explanation for Statement -1

(2) Statement-1 is true, Statement-2 is true ; Statement-2 is NOT a correct explanation for Statement-1

(3) Statement-1 is true, Statement-2 is false

(4) Statement-1 is false, Statement-2 is true

90. The rate of diffusion of SO_2, CO_2, PCl_3 and SO_3 are in the following order

(1) $PCl_3 > SO_3 > SO_2 > CO_2$

(2) $CO_2 > SO_2 > PCl_3 > SO_3$

(3) $SO_2 > SO_3 > PCl_3 > CO_2$

(4) $CO_2 > SO_2 > SO_3 > PCl_3$

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Hints and Solutions

PART B – CHEMISTRY

46. (1) Given

$$A \xrightarrow{Cl_2} B \xrightarrow[\text{Hydrocarbon}]{\text{alc./KOH}} C \xrightarrow{O_3/H_2O} CH_2O$$

Since hydrocarbon C give only CH_2O, on ozonolysis, C should be $CH_2 = CH_2$ hence on going backward, A should be ethane. Thus the reactions are

$$\underset{(A)}{CH_3CH_3} \xrightarrow{Cl_2/h\nu} \underset{(B)}{CH_3CH_2Cl} \xrightarrow{\text{alc. KOH}}$$

$$\underset{(C)}{CH_2{=}CH_2} \xrightarrow[\Delta]{O_3/H_2O} HCHO$$

47. (1)

48. (4) In $\left[Ni(NH_3)_2Cl_2\right]$, Ni^{2+} is in sp^3 hybridisation, thus tetrahedral in shape. Hence the four ligands are not different to exhibit optical isomerism.

49. (1) Addition of HCN to carbonyl compounds is nucleophilic addition reaction. The order of reactivity of carbonyl compounds is :

$HCHO > CH_3COCH_3 > PhCOCH_3 > PhCOPh$

The lower reactivity of Ketones is due to the presence of two alkyl group which shows +I effect. The reactivity of Ketones decreases as the size of alkyl group increases.

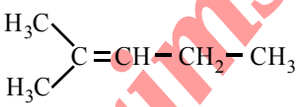
50. (3) $\underset{1-x}{PCl_5(g)} \rightleftharpoons \underset{x}{PCl_3(g)} + \underset{x}{Cl_2(g)}$

Total moles after dissociation

$1 - x + x + x = 1 + x$

p_{PCl_3} = mole fraction of $PCl_3 \times$ Total pressure $= \left(\frac{x}{1+x}\right)P$

51. (3)



Due to the presence of two similar methyl group at same carbon atom, above compound doesn't show geometrical isomerism.

52. (3) Liquid - liquid system is known as emulsion.

53. (4) $P = P_A X_A + P_B X_B$

$= P_A X_A + P_B (1 - X_A)$

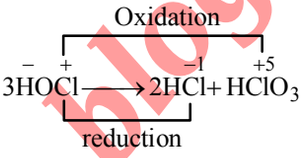
$\Rightarrow \quad P_A X_A + P_B - P_B X_A$

$\Rightarrow \quad P_B + X_A (P_A - P_B)$

54. (3) For $SbCl_5^{2-}$, $H = \frac{5+5+2}{2} = 6$ means sp^3d^2 hybridization I_3^-, SF_4, and PCl_5; all have sp^3d hybridization.

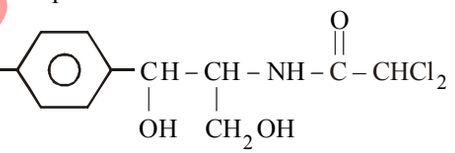
55. (3) A strong base can abstract an α-hydrogen from a ketone.

56. (2) During disproportionation same compound undergo simultaneous oxidation and reduction.



57. (3) $Cu + HCl \rightarrow$ No reaction as copper is less reactive than hydrogen while others will give H_2.

58. (4) Chloramphenicol is



59. (2) Number of A ions in the unit cell. $= \frac{1}{8} \times 8 = 1$

Number of B ions in the unit cell $= \frac{1}{2} \times 6 = 3$

Hence empirical formula of the compound $= AB_3$

60. (3) Since rate of reaction becomes four times on doubling concentration of reactant, it is second order reaction.

61. (1)

62. (4) $K_2Cr_2O_7 + \text{conc.}HCl \rightarrow Cl_2\uparrow$

63. (4) Pressure exerted by the gas, $P = \frac{1}{3}\frac{mnu^2}{V}$ ...(1)

Here, u = root mean square velocity

m = mass of a molecule, n = No. of molecules of the gas

Hence (1) & (2) are clearly wrong.

Again $u^2 = \frac{3RT}{M}$ [explained from (1)]

Here, M = Molecular wt. of the gas;

Hence (3) is wrong

Further, Average K.E. $= \frac{3}{2}$ KT; Hence (4) is true.

64. (2) The main reason for exhibiting larger number of oxidation states by actinoids as compared to lanthanoids is lesser energy difference between 5*f* and 6*d* orbitals as compared to that between 4*f* and 5*d* orbitals.

In case of actinoids we can remove electrons from 5*f* as well as from 6*d* and due to this actinoids exhibit larger number of oxidation state than lanthanoids.

65. (2 and 3) From the various given option we find option (1) correct. The oxidising power of halogen follow the order $F_2 > Cl_2 > Br_2 > I_2$. Option (2) incorrect because it in not the correct order of electron gain enthalpy of halogens.

The correct order is $Cl_2 > F_2 > Br_2 > I_2$. The low value of F_2 than Cl_2 is due to its small size.

Option (3) incorrect. The correct order of bond dissociation energies of halogens is

$Cl_2 > Br_2 > F_2 > I_2$.

Option (4) correct. It is the correct order of electronegativity values of halogens. Thus option (2) and (3) are incorrect.

66. (4) $Al_2O_3.2H_2O \rightarrow Al_2O_3 + 2H_2O$ is calcination.

67. (3) According to Arrhenius equation, the rate constant of reaction is given by,

$$k = Ae^{-Ea/RT}$$

where A is pre-exponential factor, E_a is activation energy and T is absolute temperature.

when $T \rightarrow \infty$, $\frac{E_a}{RT} \rightarrow 0$

then $k = Ae^0$

or $k = A$

68. (1) Co^{3+} : $\boxed{\uparrow\downarrow}\ \boxed{1}\ \boxed{1}\ \boxed{1}\ \boxed{1}$ 3*d*-orbital

$[Co(CN)_6]^{3-}$: $\boxed{\uparrow\downarrow}\ \boxed{\uparrow\downarrow}\ \boxed{\uparrow\downarrow}\ \boxed{\ }\ \boxed{\ }$ 3*d*-orbital

CN^- is a strong field ligand and it causes pairing of electrons, as a result number of unpaired electrons in Co^{3+} becomes zero and hence it has lowest value of paramagnetic behaviour.

69. (1) Given, for reaction

(i) $H_2O(l) \longrightarrow H^+(aq.) + OH^-(aq.)$; $\Delta H_r = 57.32$ kJ

(ii) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l)$; $\Delta H_r = -286.20$ kJ

For reaction (i)

$$\Delta H_r = \Delta H°_f(H^+aq) + \Delta H°_f(OH^-aq) - \Delta H°_f(H_2O,l)$$

$$57.32 = 0 + \Delta H°_f(OH^-,aq) - \Delta H°_f(H_2O,l) \quad ...(iii)$$

For reaction (ii)

$$\Delta H_r = \Delta H°_f(H_2O, l) - \Delta H°_f(H_2, g) - \frac{1}{2}\Delta H°_f(O_2, g)$$

$$-286.20 = \Delta H°_f(H_2O, l)$$

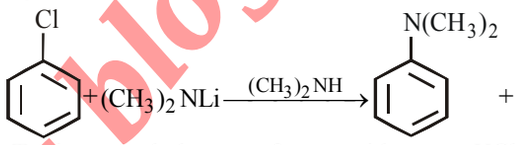
On replacing this value in equ. (iii) we have

$$57.32 = \Delta H°_f(OH^-, aq) - (-286.20)$$

$$\Delta H°_f = -286.20 + 57.32$$

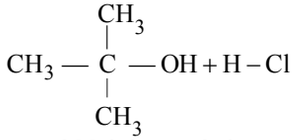
$$= -228.88 \text{ kJ}$$

70. (3) Applying VSEPR theory, both NF_3 and H_2O are sp^3 hybridized.

71. (1) 

72. (2) Tertiary alcohols react fastest with conc. HCl and anhydrous $ZnCl_2$ (lucas reagent) as its mechanism proceeds through the formation of stable tertiary carbocation.

Mechanism

Step 1 : 

2-Methylpropan-2-ol

$$\rightleftharpoons (CH_3)_3C-\overset{+}{O}H_2 + Cl^-$$

Step 2 : $(CH_3)_3C-\overset{+}{O}H_2 \rightleftharpoons (CH_3)_3C^+ + H_2O$

3° Carbocation

Step 3 : $(CH_3)_3C^+ + Cl^- \rightleftharpoons (CH_3)_3C-Cl$

t–Butyl chloride

73. (1)

$$2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5(O)] \times 3$$

$$2\ \begin{matrix}COO\\|\\COO\end{matrix}\!\!>Fe + 3(O) \longrightarrow Fe_2O_3 + 2CO_2 \quad] \times 5$$

$$6KMnO_4 + 9H_2SO_4 + 10\ \begin{matrix}COO\\|\\COO\end{matrix}\!\!>Fe \longrightarrow 3K_2SO_4 + 6MnSO_4 + 9H_2O + 5Fe_2O_3 + 10CO_2$$

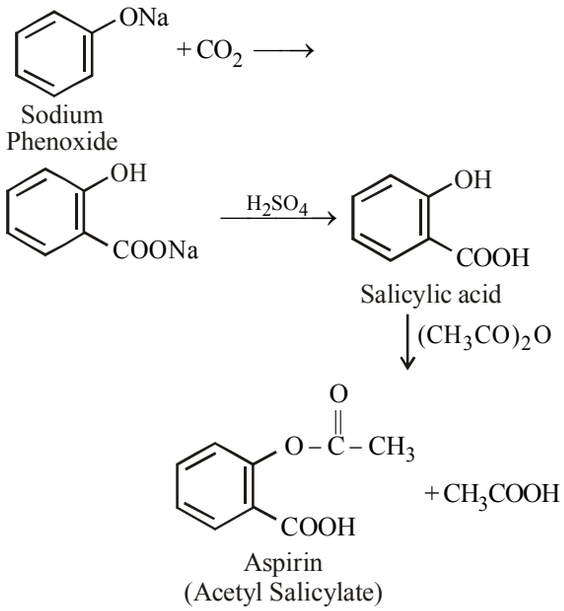
(6 moles) (10 moles)

From above equation 6 moles MnO_4^- required to oxidise 10 moles of oxalate.

Thus number of moles of MnO_4^- required to oxidise one mole of oxalate $= \frac{6}{10} = 0.6$ moles

74. (4)

75. (1)



76. (1) Eq. wt. of $H_2O_2 = 17$

$$N = \frac{30.36}{17} = 1.78 \text{ N}$$

Volume strength = 5.6 × normality

= 5.6 × 1.78 = 10 V

77. (4) The metal placed below in electrochemical series does not react with that metal salt solution whose metal is placed above in electrochemical series.

78. (2)

79. (4) According to Fajan's rule :

$$\text{Covalent character} \propto \frac{1}{\text{size of cation}}$$

$\propto$ size of anion

Among the given species order of size of cations

$N^{3+} < O^{2+} < Pb^{2+} < Ba^{2+}$

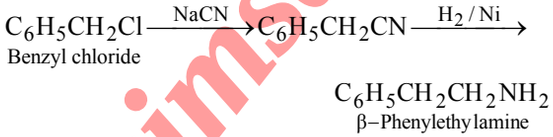
Order of size of anions $O^{2-} > Cl^-$.

Hence the order of covalent character is

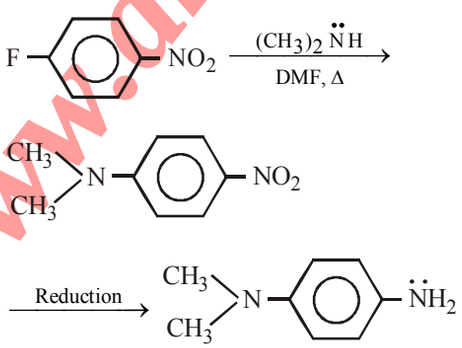
$NCl_3 > Cl_2O > PbCl_2 > BaCl_2$

$BaCl_2$ is most ionic in nature.

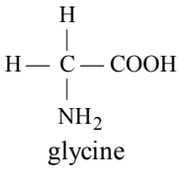
80. (1)



81. (1)

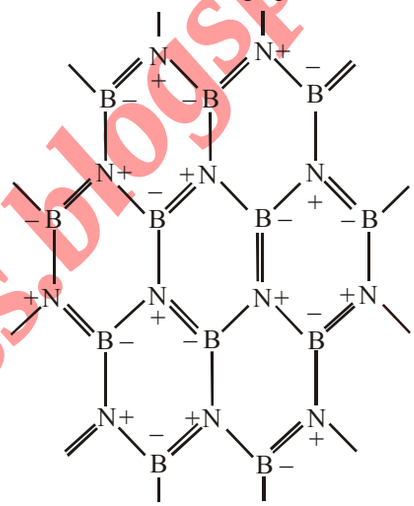


82. (3) With the exception of glycine all the 19 other common amino acids have a uniquely different functional group on the central tetrahedral alpha carbon.



glycine

83. (4) Boron nitride (BN) is known as inorganic graphite. The most stable form is hexagonal one. It has layered structure similar to graphite.



84. (3) The correct order of acidic strength of the given species in

$$\underset{\text{(iv)}}{HSO_3F} > \underset{\text{(ii)}}{H_3O^+} > \underset{\text{(iii)}}{HSO_4^-} > \underset{\text{(i)}}{HCO_3^-}$$

(i) < (iii) < (ii) < (iv)

It corresponds to choice (c) which is correct answer.

85. (2) Stability depends on number of hyperconjugative structures.

86. (4)

$$A \xrightarrow[(I)]{NH_3} B \xrightarrow[II]{\Delta} C \xrightarrow[KOH,(III)]{Br_2} CH_3CH_2NH_2$$

Reaction (III) is a Hofmann bromamide reaction. Now formation of $CH_3CH_2NH_2$ is possible only from a compound $CH_3CH_2CONH_2$(C) which can be obtained from the compound $CH_3CH_2COO^-NH_4^+$(B).

Thus (A) should be CH_3CH_2COOH

$$\underset{\text{(A)}}{CH_3CH_2-\overset{\overset{O}{\|}}{C}-OH} \xrightarrow{NH_3} \underset{\text{(B)}}{CH_3CH_2COO^-NH_4^+} \xrightarrow{\Delta} \underset{\text{(C)}}{CH_3CH_2CONH_2} \xrightarrow[KOH]{Br_2} CH_3CH_2NH_2$$

87. **(4)** Ionisation energy = $E_\infty - E_1$

For H = 0 – (–13.6). For $Be^{3+} = 0 - (-13.6 \times 4^2)$.

Therefore Ratio is 1 : 16.

88. **(1)**

89. **(2)** Due to the presence of strong C–F bonds, teflon has high thermal stability and chemical inertness.

90. **(4)** Rate $\propto \sqrt{\frac{1}{M}}$. The smaller the value of M the more is the rate of diffusion