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# JEE (Main)

## PAPER-1 (B.E./B. TECH.)

# 2023

# COMPUTER BASED TEST (CBT)

# Questions & Solutions

**Date: 10 April, 2023 (SHIFT-1) | TIME : (9.00 a.m. to 12.00 p.m)**

**Duration: 3 Hours | Max. Marks: 300**

## SUBJECT: CHEMISTRY


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# PART : CHEMISTRY

**61.** Given below are two statements:

Statement I : Aqueous solution of $K_2Cr_2O_7$ is preferred as a primary standard in volumetric analysis over $Na_2Cr_2O_7$ aqueous solution.

Statement II : $K_2Cr_2O_7$ has a higher solubility in water than $Na_2Cr_2O_7$.

In the light of the above statements, choose the correct answer from the options given below :

(1) Both Statement I and Statement II are true

(2) Statement I is false but Statement II is true

(3) Both statement I and statement II are false

(4) Statement I is true but statement II is false

**Ans.** **NTA : (4)**

**Reso : (4)**

**Sol.** (i) Potassium dichromate is used as a primary standard in volumetric analysis.

(ii) $K_2Cr_2O_7$ is less soluble in water than $Na_2Cr_2O_7$.

Sodium salt has a greater solubility in water and is extensively used as an oxidising agent in organic chemistry.

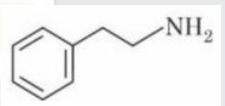
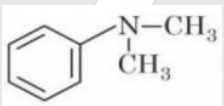
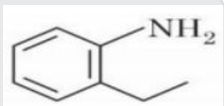
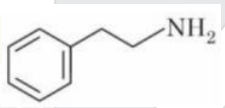
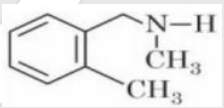
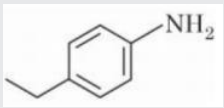
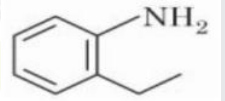
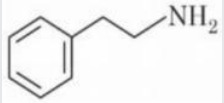
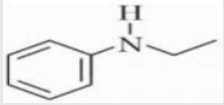
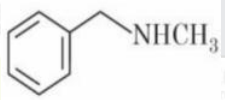
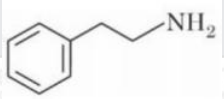
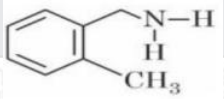
**62.** Isomeric amines with molecular formula $C_8H_{11}N$ give the following tests

Isomer (P) $\Rightarrow$ Can be prepared by Gabriel phthalimide synthesis

Isomer (Q) $\Rightarrow$ Reacts with Hinesburg's reagent to give solid insoluble in NaOH

Isomer (R) $\Rightarrow$ Reacts with HONO followed by $\beta$–naphthol in NaOH to give red dye.

Isomers (P), (Q) and (R) respectively are

| | P | Q | R |
|---|---|---|---|
| (1) |  |  |  |
| (2) |  |  |  |
| (3) |  |  |  |
| (4) |  |  |  |

**Ans.** **NTA : (2)**

**Reso : (2)**

**Sol.** (P) Gabriel synthesis is used for the preparation of aliphatic primary amines. Aromatic primary amines cannot be prepared by this method.

(Q) 2º amine react with Hinsberg's reagent to give solid insoluble in NaOH.

(R) Aromatic amines react with nitrous acid at low temperatures (273-278 K) to form diazonium salts, which form red/orange dye with $\beta$-Napthol.

**63.** The number of molecules and moles in 2.8375 litres of $O_2$ at STP are respectively

(1) $7.527 \times 10^{22}$ and 0.125 mol

(2) $7.527 \times 10^{22}$ and 0.250 mol

(3) $7.527 \times 10^{23}$ and 0.125 mol

(4) $1.505 \times 10^{22}$ and 0.250 mol

**Ans.** **NTA : (1)**

**Reso : (1)**

**Sol.** $\frac{2.8375}{22.7} = 0.125$ mol

$0.125 \times 6.02 \times 10^{23} = 7.527 \times 10^{22}$ molecules

**64.** Match List I with List II

| | **List-I Industry** | | **List-II Waste Generatedd** |
|---|---|---|---|
| (A) | Steel plants | (i) | Gypsum |
| (B) | Thermal power plants | (ii) | Fly ash |
| (C) | Fertilizer industries | (iii) | Slag |
| (D) | Paper mills | (iv) | Bio-degradable wastes |

Choose the correct answer from the options given below :

(1) (A) – (ii) ; (B) – (iii) ; (C) – (iv) ; (D) – (i)

(2) (A) – (iii) ; (B) – (ii) ; (C) – (i) ; (D) – (iv)

(3) (A) – (iii) ; (B) – (iv) ; (C) – (i) ; (D) – (ii)

(4) (A) – (iv) ; (B) – (i) ; (C) – (ii) ; (D) – (iii)

**Ans.** **NTA : (2)**

**Reso : (2)**

**Sol.** Biodegradable wastes are generated by cotton mills, food processing units, paper mills, and textile factories.
Non-biodegradable wastes are generated by thermal power plants which produce fly ash; integrated iron and steel plants which produce blast furnace slag and steel melting slag.
Fertilizer industries produce gypsum.

**65.** The enthalpy change for the adsorption process and micelle formation respectively are

(1) $\Delta H_{ads} < 0$ and $\Delta H_{mic} < 0$

(2) $\Delta H_{ads} < 0$ and $\Delta H_{mic} > 0$

(3) $\Delta H_{ads} > 0$ and $\Delta H_{mic} < 0$

(4) $\Delta H_{ads} > 0$ and $\Delta H_{mic} > 0$

**Ans.** **NTA : (2)**

**Reso : (2)**

**Sol.** Enthalpy of Adsorption is negative because attraction force increases in Adsorption. Enthalpy of formation of micelle is in general positive.

**66.** Suitable reaction condition for preparation of Methyl phenyl ether is

(1) Ph –Br,$MeO^{\ominus}Na^{\oplus}$

(2) $PhO^{\ominus}Na^{\oplus}$, MeOH

(3) $PhO^{\ominus}Na^{\oplus}$, MeBr

(4) Benzene, MeBr

**Ans.** **NTA : (3)**

**Reso : (3)**

**Sol.** $\underset{\text{Sodium phenoxide}}{C_6H_5ONa} \xrightarrow[\text{Methyl bromide}]{CH_3Br} \underset{\text{Ansole}}{C_6H_5OCH_3}$

This reaction is Williamson's reaction and it is used for the preparation of simple as well as mixed ethers.

**67.** Given

(A) $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$ $\quad \Delta H_1^\theta = -x \text{ kJ mol}^{-1}$

(B) $C(\text{graphite}) + O_2(g) \rightarrow CO_2(g)$ $\quad \Delta H_2^\theta = -y \text{ kJ mol}^{-1}$

The $\Delta H^\theta$ for the reaction

$C(\text{graphite}) + \frac{1}{2}O_2(g) \rightarrow CO(g)$ is

(1) $\frac{x-2y}{2}$ (2) $2y - x$

(3) $\frac{2x-y}{2}$ (4) $\frac{x+2y}{2}$

**Ans.** **NTA : (1)**

**Reso : (1)**

**Sol.** From equation (ii) $- \frac{(i)}{2}$ = target equation

$C(\text{graphite}) + O_2(g) \longrightarrow CO_2(g)$ ; $\quad \Delta H = -y \text{ KJ/mol}$

$[2CO_2(g) \longrightarrow 2CO(g) + O_2(g)] \times \frac{1}{2}$ ; $\quad \Delta H = -x \text{ KJ/mol} \times \frac{1}{2}$

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$C(\text{graphite}) + \frac{1}{2}O_2(g) \longrightarrow CO(g)$ $\quad$ so $\Delta H =$

So $\Delta H$ for target equation $= -y - \left(\frac{-x}{2}\right) = -y + \frac{x}{2}$

$= \frac{x-2y}{2} \text{ KJ/mol}$

**68.** Prolonged heating is avoided during the preparation of ferrous ammonium sulphate to

(1) prevent hydrolysis

(2) prevent breaking

(3) prevent oxidation

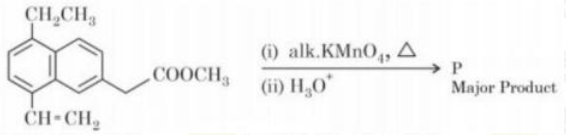
(4) prevent reduction

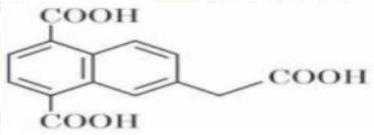
**Ans.** **NTA : (3)**

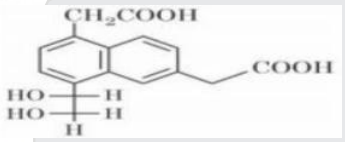
**Reso : (3)**

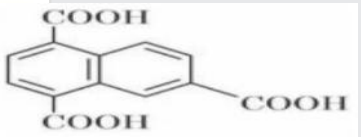
**Sol.** On Prolong heating some ferrous ions ($Fe^{+2}$) oxidised to ferric ions ($Fe^{+3}$). So in solution ferrous ammonium sulphate present with some ferric ion ($Fe^{+3}$)

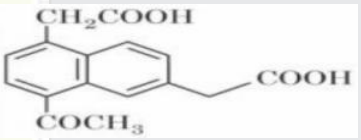
**69.** The major product 'P' formed in the given reaction is




(1) 

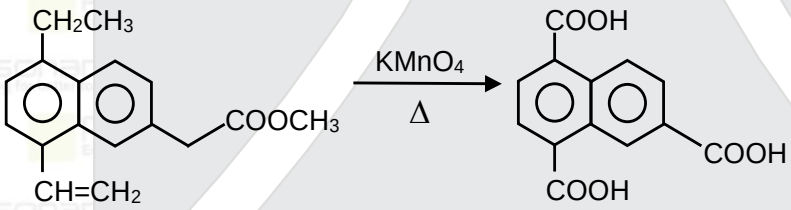
(2) 

(3) 

(4) 

**Ans.** **NTA : (3)**
**Reso : (3)**

**Sol.** Benzylic carbon gets oxidised into carboxylic acid in presence of $KMnO_4$ and heat.




**70.** The octahedral diamagnetic low spin complex among the following is

(1) $[NiCl_4]^{2-}$

(2) $[Co(NH_3)_6]^{3+}$

(3) $[CoF_6]^{3-}$

(4) $[CoCl_6]^{3-}$

**Ans.** **NTA : (2)**
**Reso : (2)**

**Sol.** In $[Co(NH_3)_6]^{3+}$, $NH_3$ is strong field ligand. $Co^{+3} \Rightarrow d^6 \Rightarrow t_{2g}^{2,2,2}\ e_g^{0,0}$

**71.** Given below are two reactions, involved in the commercial production of dihydrogen ($H_2$).
The two reactions are carried out at temperature "$T_1$" and "$T_2$", respectively

$C(s) + H_2O(g) \xrightarrow{T_1} CO(g) + H_2(g)$

$CO(g) + H_2O(g) \xrightarrow[\text{Catalyst}]{T_2} CO_2(g) + H_2(g)$

The temperatures $T_1$ and $T_2$ are correctly related as

(1) $T_1 = T_2$

(2) $T_1 < T_2$

(3) $T_1 > T_2$

(4) $T_1 = 100K$ , $T_2 = 1270K$

**NTA Ans.** **(3)**

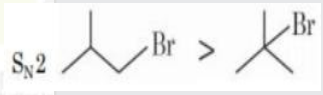
**Reso Ans.** **(3)**

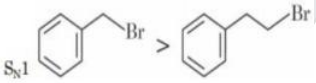
**Sol.** $C(s) + H_2O(g) \xrightarrow[T_1]{1270K} \underset{\text{Water gas}}{CO(g)+H_2(g)}$

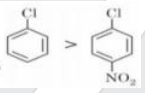
$CO(g) + H_2O(g) \xrightarrow[\text{Catalyst}]{673K} CO_2(g) + H_2(g)$

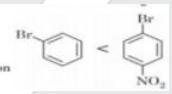
so ($T_1 > T_2$)

**72.** Identify the correct order of reactivity for the following pairs towards the respective mechanism

(A) $S_N2$ 

(B) $S_N1$ 

(C) Electrophilic substitution 

(D) Nucleophilic substitution 

Choose the correct answer from the options given below:

(1) (A), (B), (C) and (D) (2) (A), (B) and (D) only

(3) (B), (C) and (D) only (4) (A), (C) and (D) only

**Ans.** **NTA : (1)**

**Reso : (1)**

**Sol.** Reactivity of $SN^2 \propto \frac{1}{\text{Steric Crowding}}$ ($1^o > 2^o > 3^o$) halide.

Reactivity of $SN^1 \propto$ Stability of carbocation.

Reactivity of electrophilic substitution reaction $\propto$ Electron density.

Reactivity of Nucleophilic substitution reaction $\propto \frac{1}{\text{Electron density}}$.

**73.** Using column cyhromatography, mixture of two compounds 'A' and 'B' was separated. 'A' eluted first, this indicates 'B'

(1) low $R_f$, stronger adsorption (2) high $R_f$, stronger adsorption

(3) low $R_f$, weaker adsorption (4) high $R_f$, weaker adsorption

**Ans.** **NTA : (1)**

**Reso : (1)**

**Sol.** Theory Based

**74.** The compound which does not exist is

(1) $NaO_2$ (2) $(NH_4)_2BeF_4$ (3) $BeH_2$ (4) $PbEt_4$

**Ans.** **NTA : (1)**

**Reso : (1)**

**Sol.** Alkali metals generally form oxides and peroxides.

$M+O_2 \longrightarrow M_2O$ (Oxide) $\xrightarrow{O_2} M_2O_2$ (Peroxide)

The alkali metals tarnish in dry air due to the formation of their oxides on their surface.

$4M + O_2 \longrightarrow 2M_2O$

They react vigorously in oxygen forming following oxides.

$4\ Li + O_2 \longrightarrow 2\ Li_2O$ (Monoxide)

$2\ Na + O_2 \longrightarrow Na_2O_2$ (Peroxide)

$M + O_2 \longrightarrow MO_2$ ( Superoxide) where M = K, Rb, Cs

| Principal Combustion Product (Minor Product) | | | |
|---|---|---|---|
| **Metal** | **Oxide** | **Peroxide** | **Superoxide** |
| Li | $Li_2O$ | $(Li_2O_2)$ | |
| Na | $(Na_2O)$ | $Na_2O_2$ | |
| K | | | $KO_2$(Orange/Yellow Crystalline) |
| Rb | | | $RbO_2$ (Orange/Yellow Crystalline) |
| Cs | | | $CsO_2$ (Orange/Yellow Crystalline) |

**75.** Lime reacts exothermally with water to give 'A' which has low solubility in water. Aqueous solution of 'A' is often used for the test of $CO_2$, a test in which insoluble B is formed. If B is further reacted with $CO_2$ then soluble compound is formed. 'A' is

(1) White lime (2) Quick lime (3) Lime water (4) Slaked lime

**Ans.** **NTA : (4)**

**Reso : (4)**

**Sol.** $CaO \xrightarrow{H_2O} Ca(OH)_2(A)$

$Ca(OH)_2aq + CO_2 \longrightarrow CaCO_3\downarrow(B) + H_2O$

$CaCO_3\downarrow + H_2O + CO_2 \longrightarrow Ca(HCO_3)_2aq$

**76.** Which of the following statements are correct?

(A) The $M^{3+}/M^{2+}$ reduction potential for iron is greater than manganese.

(B) The higher oxidation states of first row d-block elements get stabilized by oxide ion.

(C) Aqueous solution of $Cr^{2+}$ can liberate hydrogen from dilute acid.

(D) Magnetic moment of $V^{2+}$ is observed between 4,4 – 5.2 BM.

Choose the correct answer from the options given below :

(1) (A), (B) only (2) (A), (B), (D) only

(3) (B), (C) only (4) (C), (D) only

**Ans.** **NTA : (3)**

**Reso : (3)**

**Sol.** **(A)** $Mn^{+2}$ is having stable $d^5$ configration

(B) $CrO_4^{-2}$ , $MnO_4^-$

(C) $Cr^{+2}(aq) + H^+(aq) \longrightarrow Cr^{+3}(aq) + H_2\uparrow$

(D) three unpaired $e^-$, therefore it is 3.87 BM

**77.** Match List I with List II

| **List I (Polymer)** | **List II (Type/class)** |
|---|---|
| (A) Nylon-2-Nylon-6 | (i) Thermosetting polymer |
| (B) Buna-N | (ii) Biodegradable polymer |
| (C) Urea-formaldehyde resin | (iii) Synthetic rubber |
| (D) Dacron | (iv) Polyester |

Choose the correct answer from the options given below :

(1) (A) – (iv), (B) – (i), (C) – (iii), (D) – (ii)

(2) (A) – (ii), (B) – (i), (C) – (iv), (D) – (iii)

(3) (A) – (ii), (B) – (iii), (C) – (i), (D) – (iv)

(4) (A) – (iv), (B) – (iii), (C) – (i), (D) – (ii)

**Ans.** **NTA : (3)**

**Reso : (3)**

**Sol.** Nylon-2-Nylon-6 is biodegradable polymer

Buna-N is synthetic rubber

Urea-formaldehyde resin is thermosetting polymer

Dacron is polyester

**78.** Which of the following is used as a stabilizer during the concentration of sulphide ores?

(1) Pine oils (2) Xanthates (3) Fatty acids (4) Cresols

**Ans.** **NTA : (4)**

**Reso : (4)**

**Sol.** In Froth floatation process, a suspension of the powdered ore is made with water. To it, collectors and froth stabilisers are added. Collectors (e. g. xanthates, etc.) enhance non-wettability of the mineral particles and froth stabilisers (e. g., cresols, aniline) stabilise the froth.

**79.** The one that does not stabilize 2° and 3° structures of proteins is

(1) – O – O – linkage (2) H-bonding

(3) vander waals forces (4) – S –S – linkage

**Ans.** **NTA : (1)**

**Reso : (1)**

**Sol.** The main forces which stabilise the 2° and 3° structures of proteins are hydrogen bonds, disulphide linkages, van der Waals and electrostatic forces of attraction.

**80.** The pair from the following pairs having both compounds with net non-zero dipole moment is

(1) cis-butene, trans-butene

(2) 1,4-Dichlorobenzene, 1,3-Dichlorobenzene

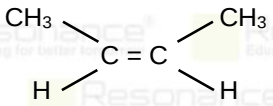
(3) $CH_2Cl_2$, $CHCl_3$

(4) Benzene, anisidine

**Ans.** **NTA : (3)**

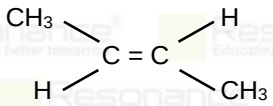
**Reso : (3)**

**Sol.**



Cis butene

$\mu \neq 0$



trans butene

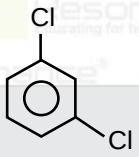
$\mu = 0$

1,4-Dichlorobenzene

$\mu = 0$

$CH_2Cl$

$\mu \neq 0$



1,3-Dichlorobenzene

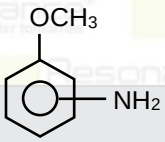
$\mu \neq 0$

$CHCl_3$

$\mu \neq 0$

Benzene

$\mu = 0$



Anisidine

$\mu \neq 0$

**81.** In potassium ferrocyanide, there are _____ pairs of electrons in the $t_{2g}$ set of orbitals.

**Ans.** **NTA : 3**

**Reso : 3**

**Sol.** $K_4[Fe(CN)_6]$

$Fe^{+2} \Rightarrow d^6 \Rightarrow t_{2g}^{2,2,2}\ e_g^{0,0}$

Number of electron pair in $t_{2g}$ orbitals = 3

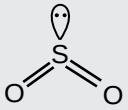
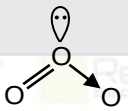
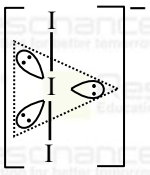
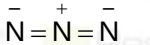
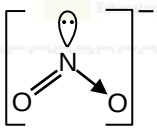
**82.** The number of bent-shaped molecule/s from the following is _____

$N_3^-, NO_2^-, I_3^-, O_3, SO_2$

**Ans.** **NTA : 3**

**Reso : 3**

**Sol.**

| Molecule/Species | Structure | Shape |
|---|---|---|
| $SO_2$ |  | Bent |
| $O_3$ |  | Bent |
| $I_3^-$ |  | Linear |
| $N_3^-$ |  | Linear |
| $NO_2^-$ |  | Bent |

**83.** A molecule undergoes two independent first order reactions whose respective half lives are 12 min and 3 min. If both the reactions are occurring then the time taken for the 50% consumption of the reactant is _____ min. (Nearest integer)

**Ans.** **NTA : 2**
**Reso : 2**

**Sol.** $\frac{1}{t_{1/2}} = \frac{1}{3} + \frac{1}{12}$ or $t_{1/2} = 2.4$ min

**84.** The number of incorrect statement/s about the black body from the following is _____
(A) Emit or absorb energy in the form of electromagnetic radiation.
(B) Frequency distribution of the emitted radiation depends on temperature.
(C) At a given temperature, intensity vs frequency curve passes through a maximum value.
(D) The maximum of the intensity vs frequency curve is at a higher frequency at higher temperature compared to that at lower temperature.

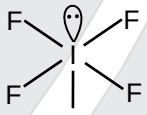
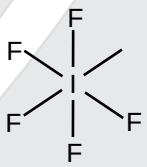
**Ans.** **NTA : 0**
**Reso : 0**

**Sol.** All Statements are correct

**85.** The sum of lone pairs present on the central atom of the interhalogen $IF_5$ and $IF_7$ is _____

**Ans.** **NTA : (1)**
**Reso : (1)**

**Sol.**

| **Molecule** | **Structure** | Number of Lone pair of electron on central atom |
|---|---|---|
| $IF_5$ |  | (1) |
| $IF_7$ |  | (0) |

**86.** $FeO_4^{2-} \xrightarrow{+2.2V} Fe^{3+} \xrightarrow{+0.70\,V} Fe^{2+} \xrightarrow{-0.45\,V} Fe^0$

$E^{\theta}_{FeO_4^{2-}/Fe^{2+}}$ is $x \times 10^{-3}$ V. The value of x is _____

**Ans.** **NTA : (725)**
**Reso : (725)**

**Sol.** $FeO_4^{2-} + 8H^+ + 3e^- \longrightarrow Fe^{3+} + 4H_2O$ $\quad E_1^0 = 2.20$ V $\quad \Delta G_1^0 = -3F(2.20)$

$Fe^{3+} + e^- \longrightarrow Fe^{2+}$ $\quad E_2^0 = 0.7$ V $\quad \Delta G_2^0 = -1 \times F(0.7)$

---

Target eq.

$FeO_4^{2-} + 8H^+ + 4e^- \longrightarrow Fe^{2+} + 4H_2O$ $\quad E_3^0 = ? \quad \Delta G_3^0 = -4 \times F(E_3^0)$

Target eq. = $eq_1 + eq_2$

$-4F\ E_3^0 = -3F \times 2.20 - 1 \times F\,(0.7)$

$E_3^0 = \left[\frac{3 \times 2.20 + 0.7}{4}\right] = 1.825 = 1825 \times 10^{-3}$ V

**87.** In the following reactions, the total number of oxygen atoms in X and Y is _____

$Na_2O + H_2O \rightarrow 2X$

$Cl_2O_7 + H_2O \rightarrow 2Y$

**Ans.** **NTA : (5)**

**Reso : (5)**

**Sol.** $Na_2O + H_2O \longrightarrow 2NaOH$

$Cl_2O_7 + H_2O \longrightarrow 2HClO_4$

NaOH = 1 Oxygen – atom

$HClO_4$ = 4 Oxygen – atom

Total Oxygen atoms in X and Y = 1 + 4 = 5

**88.** At constant temperature, a gas is at a pressure of 940.3 mm Hg. The pressure at which its volume decreases by 40% is _____ mm Hg. (Nearest integer)

**Ans.** **NTA : (1567)**

**Reso : (1567)**

**Sol.** For ideal gas at constant temperature

$P_1V_1 = P_2V_2$

$940.3 \times V = P_2 [0.6V]$

$P_2 = \left(\frac{940.3}{0.6}\right)$

= 1567.16 mm Hg

**89.** If the degree of dissociation of aqueous solution of weak monobasic acid is determined to be 0.3, then the observed freezing point will be _____ % higher than the expected/theoretical freezing point. (Nearest integer)

**Ans.** **NTA : (65)**

**Reso : (65)**

**Sol.** For calculated value $\Delta T_f$

$(\Delta T_f) = K_f \times m$

For observed value of $\Delta T_f$

$\Delta T_f = i[K_f \times m]$

$i = 1 + (n - 1)\alpha$

$i = 1 + (2 - 1)\ 0.3$

$i = 1.3$

$(\Delta T_f)_{observed} = 1.3[K_f \times m]$

% greater observed $\Delta T_f = \frac{(\Delta T_f)_{observed} - (\Delta T_f)_{Calculated}}{(\Delta T_f)_{Calculated}} \times 100 = 0.3 \times 100 = 30\ \%$

**90.** The number of correct statement/s involving equilibria in physical processes from the following is ____

(A) Equilibrium is possible only in a closed system at a given temperature.

(B) Both the opposing processes occur at the same rate.

(C) When equilibrium is attained at a given temperature, the value of all its parameters became equal.

(D) For dissolution of solids in liquids, the solubility is constant at a given temperature.

**Ans.** **NTA : 3**

**Reso : 3**

**Sol.** A, B and D

(C) $\longrightarrow$ values of parameters becomes constant.