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

JEE (Main) 2020

COMPUTER BASED TEST (CBT)

Questions & Solutions

Date: 04 September, 2020 (SHIFT-2) | TIME : (03.00 p.m. to 06.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT : CHEMISTRY

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Ph. No.: +91-744-2777777, 2777700 | **FAX No. :** +91-022-39167222

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PART : CHEMISTRY

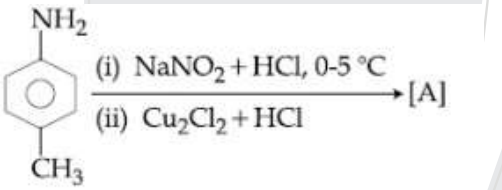
SECTION – 1 : (Maximum Marks : 80)

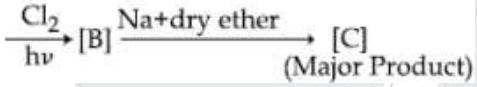
Straight Objective Type (सीधे वस्तुनिष्ठ प्रकार)

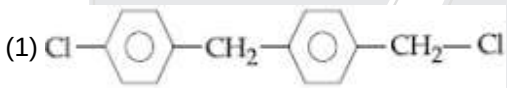
This section contains **20 multiple choice questions.** Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which **Only One** is correct.

इस खण्ड में **20 बहु–विकल्पी प्रश्न** हैं। प्रत्येक प्रश्न के 4 विकल्प (1), (2), (3) तथा (4) हैं, जिनमें से **सिर्फ एक सही** है।

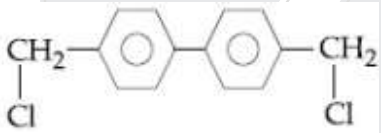
1. In the following reaction sequence, [C] is :

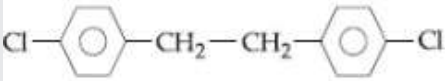




(1) 

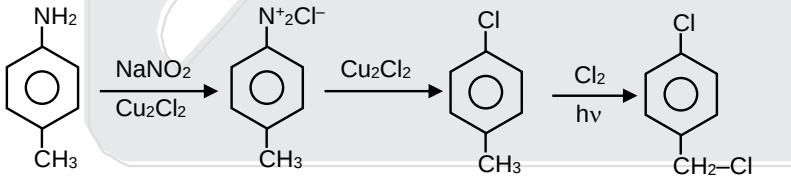
(2) 

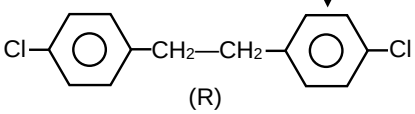
(3) 

(4) 

Ans. (4)

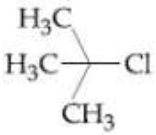
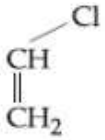
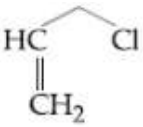
Sol.





(R)
Final product.

2. Among the following compounds, which one has the shortest C–Cl bond ?

(1)  (2)  (3)  (4) $H_3C–Cl$

Ans. (2)

Sol. Due to conjugation of lone pair of chlorine with π bond of C–C, partial double bond character decrease bond length that's why $CH_2=CH–Cl$ have shortest C–Cl bond length.

3. If the equilibrium constant for $A \rightleftharpoons B + C$ is $K_{eq}^{(1)}$ and that of $B + C \rightleftharpoons P$ is $K_{eq}^{(2)}$, the equilibrium constant for $A \rightleftharpoons P$ is :

(1) $K_{eq}^{(1)} / K_{eq}^{(2)}$ (2) $K_{eq}^{(1)} + K_{eq}^{(2)}$ (3) $K_{eq}^{(2)} - K_{eq}^{(1)}$ (4) $K_{eq}^{(1)} K_{eq}^{(2)}$

Ans. (4)

Sol. On adding Reaction 1st and Reaction 2nd we get.

$A \rightleftharpoons P$ $\quad K_{eq} = K_{eq}(1) \cdot K_{eq}(2)$

4. The molecule in which hybrid MOs involve only one d-robital of the central atom is :

(1) $[Ni(CN)_4]^{2-}$ (2) XeF_4 (3) $[CrF_6]^{3-}$ (4) BrF_5

Ans. (1)

Sol.

Complex	Hybridisation
(1) $[Ni(CN)_4]^{2-}$	dsp^2
(2) XeF_4	$sp^3 d^2$
(3) $[CrF_6]^{3-}$	$sp^3 d^2$
(4) BrF_5	sp^3d^2

5. The one that can exhibit highest paramagnetic behaviour among the following is :

gly = glycinato ; bpy = 2, 2'-bipyridine

(1) $[Fe(en)(bpy)(NH_3)_2]^{2+}$ (2) $[Pd(gly)_2]$

(3) $[Ti(NH_3)_6]^{3+}$ (4) $[Co(OX)_2(OH)_2]^{-}$ (Δ_0 > P)

Ans. (4)

Sol.

Complex	EC	Unpaired electrons
(1) $[Fe(en)(bpy)(NH_3)_2]^{2+}$	$Fe^{2+} = 3d^6 = t_{2g}^{2,2,2}, e_g^{0,0}$	0
(2) $[Pd(gly)_2]$	$Pd^{2+} = 4d^8$	0
(3) $[Ti(NH_3)_6]^{3+}$	$Ti^{3+} = 3d^1$	1
(4) $[Co(OX)_2(OH)_2]^{-}$ (Δ_0 > P)	$Co^{5+} \Rightarrow 3d^4 \Rightarrow t_{2g}^{2,1,1}, e_g^{0,0}$	2

6. The incorrect statement(s) among (a) - (c) is (are) :

(a) W(VI) is more stable than Cr(VI).

(b) in the presence of HCl, permanganate titrations provide satisfactory results.

(c) some lanthanoid oxides can be used as phosphors.

(1) (a) only (2) (b) and (c) only (3) (b) only (4) (a) and (b) only

Ans. (3)

Sol. (a) In transition metals on moving down the group higher oxidation states are more stable due to smaller size of atoms, due to lanthanide and actinide contractions.

(b) $KMnO_4$ can oxidise chloride into chlorine, so it will give incorrect results

(c) its a fact

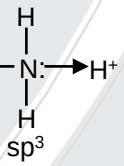
7. The reaction in which the hybridisation of the underlined atom is affected is :

(1) $H_2\underline{S}O_4 + NaCl \xrightarrow{420\ K}$ (2) $\underline{N}H_3 \xrightarrow{H^+}$

(3) $H_3\underline{P}O_2 \xrightarrow{\text{Disproportionation}}$ (4) $XeF_4 + SbF_5 \longrightarrow$

Ans. (4)

Sol. (1) $\underset{sp^3}{H_2SO_4} + 2NaCl \longrightarrow \underset{sp^3}{Na_2SO_4} + 2HCl$

(2) $\underset{sp^3}{NH_3} + H^+ \longrightarrow$ 

(3) $\underset{sp^3}{H_3PO_2} \longrightarrow \underset{sp^3}{H_3PO_4} + PH_3$

(4) $\underset{sp^3d^2}{XeF_4} + SbF_5 \longrightarrow \underset{sp^3d}{[XeF_3]^+}[SbF_6]^-$

8. An alkaline earth metal 'M' readily forms water soluble sulphate and water insoluble hydroxide. Its oxide MO is very stable to heat and does not have rock-salt structure. M is :

(1) Sr (2) Mg (3) Ca (4) Be

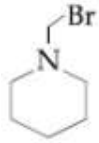
Ans. (4)

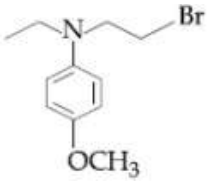
Sol. $BeSO_4$ Soluble in water

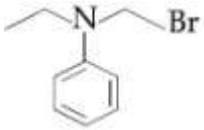
$Be(OH)_2$ Insoluble in water

Structure of BeO is Hexagonal Wurtzite.

9. Which of the following compounds will form the precipitate with aq. $AgNO_3$ solution most readily ?

(1) 

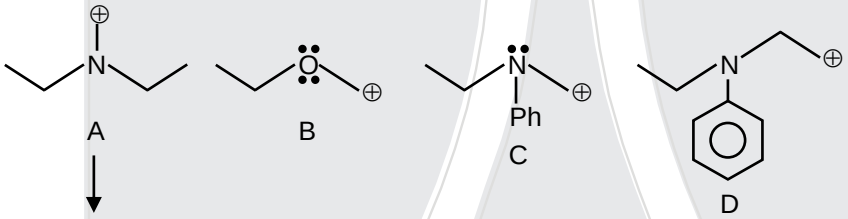
(2) 

(3) 

(4) 

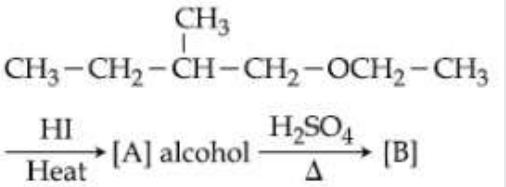
Ans. (1)

Sol. Given reaction is an examples of S_N1 reaction. Which depend upon stability of carbocation.

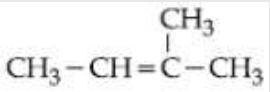


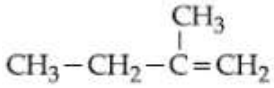
Most stable by +M effect of –N (amine)

10. The major product [B] in the following reaction is :



(1) $CH_2=CH_2$

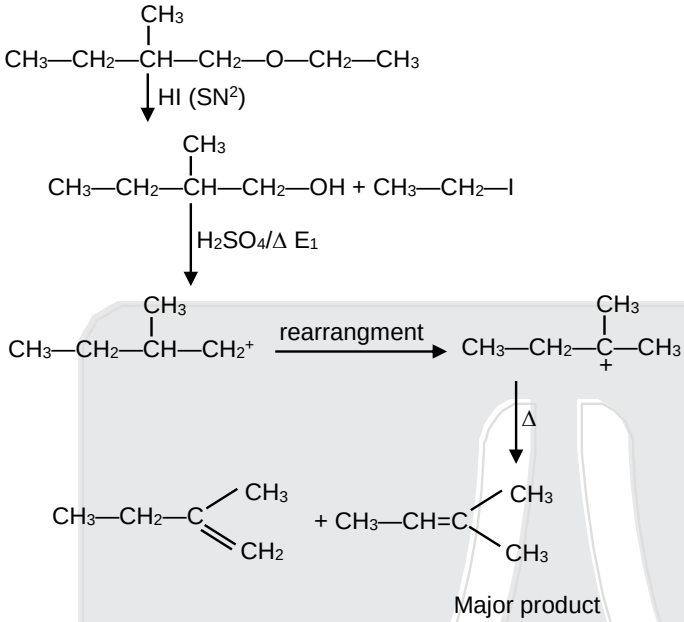
(2) 

(3) 

(4) $CH_3–CH_2CH=CH–CH_3$

Ans. (2)

Sol.



Major product

11. The process that is NOT endothermic in nature is :

(1) $H_{(g)} + e^- \rightarrow H^-_{(g)}$ (2) $Ar_{(g)} + e^- \rightarrow Ar^-_{(g)}$ (3) $O^-_{(g)} + e^- \rightarrow O^{2-}_{(g)}$ (4) $Na_{(g)} \rightarrow Na^+_{(g)} + e^-$

Ans. (1)

Sol.

$H_{(g)} + e^- \xrightarrow{\text{exothermic}} H^-_{(g)}$ $\Delta H_{eg} = -72$ KJ/mol

$O^-_{(g)} + e^- \xrightarrow{\text{endothermic}} O^{2-}_{(g)}$ $\Delta H_{eg} = +744$ KJ/mol

$Ar_{(g)} + e^- \xrightarrow{\text{endothermic}} Ar^-_{(g)}$ $\Delta H_{eg} = +96$ KJ/mol

$Na_{(g)} \xrightarrow{\text{endothermic}} Na^+_{(g)} + e^-$ IE = 495.8 KJ/mol

12. The mechanism of action of "Terfenadine" (Seldane) is :

(1) Helps in the secretion of histamine (2) Inhibits the secretion of histamine

(3) Activates the histamine receptor (4) Inhibits the action of histamine receptor

Ans. (4)

Sol. Seldane act as antihistamines and interfere with the natural action of histamine by competing with histamine for binding sites of receptor.

13. 250 mL of a waste solution obtained from the workshop of a goldsmith contains 0.1 M $AgNO_3$ and 0.1 M AuCl. The solution was electrolyzed at 2 V by passing a current of 1 A for 15 minutes. The metal/metals electrodeposited will be : $\left(E^o_{Ag^+/Ag} = 0.80V, E^o_{Au^+/Au} = 1.69V\right)$

(1) silver and gold in proportion to their atomic weights

(2) silver and gold in equal mass proportion

(3) only silver

(4) only gold

Ans. **(4){NTA answer given is (1)}**

Sol. Charge(q) = $\frac{it}{96500}F = \frac{1\times15\times60}{96500} = \frac{900}{96500} = \frac{9}{965}F = 0.0093\ F$

No. of moles of $Au^+ = 0.025$ & No. of moles of $Ag^+ = 0.025$

Species with higher value of SRP will get deposited first at cathode.

(i) $Au^+(aqs) + e^- \longrightarrow Au(s)$

0.025 0.0093 mole

so only Au will get deposited.

14. The processes of calcination and roasting in metallurgical industries, respectively, can lead to :

(1) Photochemical smog and ozone layer depletion

(2) Photochemical smog and global warming

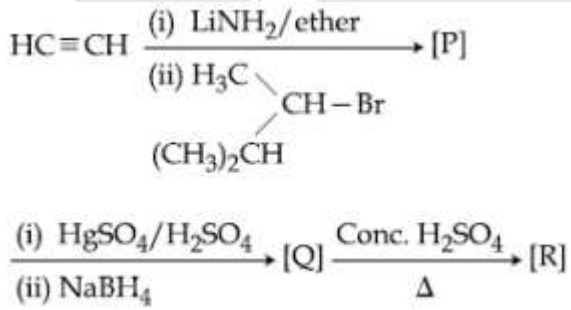
(3) Global warming and acid rain

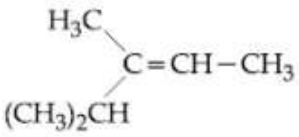
(4) Global warming and photochemical smog

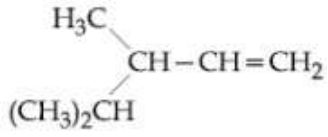
Ans. (3)

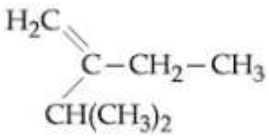
Sol. In Calcination and roasting CO_2 and SO_2 are released which are responsible for Global warning and acid rain.

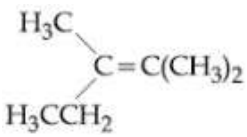
15. The major product [R] in the following sequence of reaction is :



(1) 

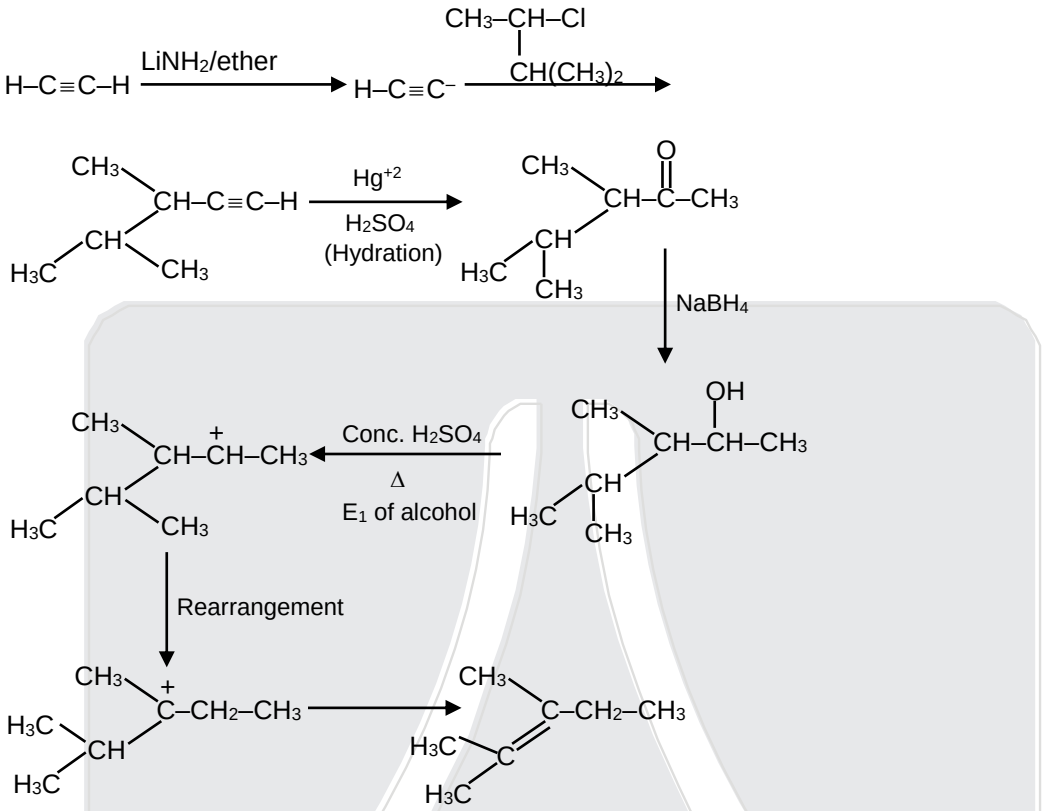
(2) 

(3) 

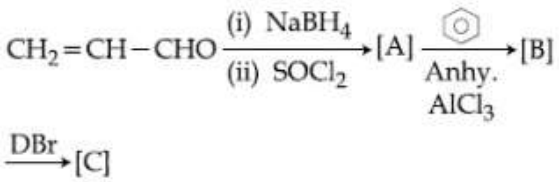
(4) 

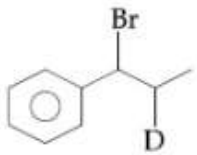
Ans. (4)

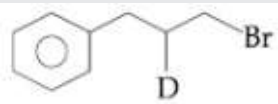
Sol.

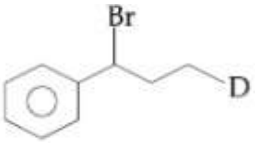


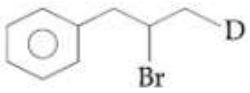
16. The major product [C] of the following reaction sequence will be :



(1) 

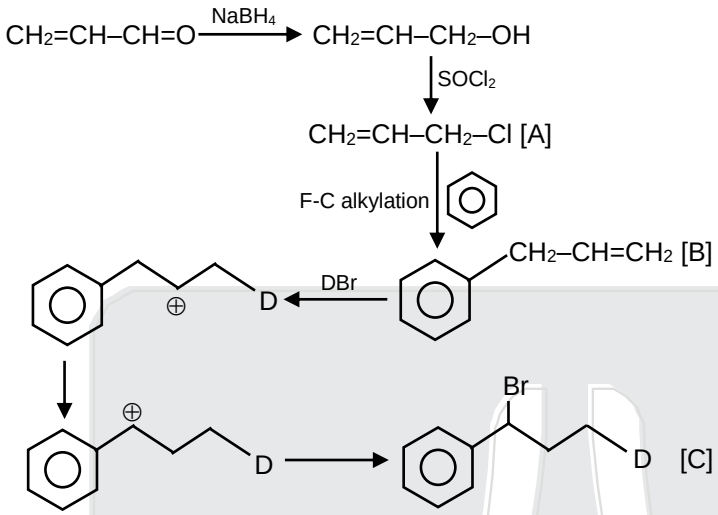
(2) 

(3) 

(4) 

Ans. (3)

Sol.



17. Five moles of an ideal gas at 1 bar and 298 K is expanded into vacuum to double the volume. The work done is :

(1) $-RT(V_2 - V_1)$ (2) Zero (3) $-RT$ in V_2 / V_1 (4) $C_2(T_2 - T_1)$

Ans. (2)

Sol. $W = -P_{ext}\,\Delta V$

In expansion against vacuum $P_{ext} = 0$

So work done is zero.

18. A sample of red ink (a colloidal suspension) is prepared by mixing eosine dye, egg white, HCHO and water. The component which ensures stability of the ink sample is :

(1) HCHO (2) Water (3) Eosine dye (4) Egg white

Ans. (4)

Sol. Blue ink is a colloidal sol, so it can be stabilised by material like natural gum or Egg white/albumen.

19. The shortest wavelength of H atom in the Lyman series is λ_1. The longest wavelength in the Balmer series of He^+ is :

(1) $\frac{9\lambda_1}{5}$ (2) $\frac{36\lambda_1}{5}$ (3) $\frac{5\lambda_1}{9}$ (4) $\frac{27\lambda_1}{5}$

Ans. (1)

Sol. For hydrogen atom :

For Lyman series $n_1 = 1$ & $n_2 = \infty$

$\frac{1}{\lambda_H} = R_H\left[\frac{1}{1} - \frac{1}{\infty}\right]$ So, $\lambda = \frac{1}{R_H}$

For He^+ ion

Balmer series $n_1 = 2$ & $n_2 = 3$

$$\frac{1}{\lambda_{He^+}} = R_H \times Z^2\left[\frac{1}{4}-\frac{1}{9}\right]$$

$$\frac{1}{\lambda_{He^+}} = R_H \times 4 \times \frac{5}{36}$$

$$\frac{1}{\lambda_{He^+}} = \frac{5}{9}R_H = \left(\frac{5}{9}\right)\frac{1}{\lambda}$$

$$\left(\lambda_{He^+}\right) = \frac{9}{5}\lambda$$

20. The Crystal Field Stabilization Energy (CFSE) of $[CoF_3(H_2O)_3]$ ($\Delta_0 < P$) is :

(1) $-0.4\,\Delta_0$ (2) $-0.8\,\Delta_0$ (3) $-0.4\,\Delta_0 + P$ (4) $-0.8\,\Delta_0 + 2P$

Ans. (1)

Sol. $[Co(H_2O)_3F_3]$ $Co^{3+} = 3d^6 4s^0 \Rightarrow t_{2g}^{2,1,1}, e_g^{1,1}$

$$CFSE = [-0.4nt_{2g} + 0.6n_{eg}]\Delta_0 + n(P)$$
$$= [-0.4 \times 4 + 0.6 \times 2]\Delta_0 + 0$$
$$= -0.4\Delta_0$$

SECTION – 2 : (Maximum Marks : 20)

- This section contains **FIVE (05)** questions. The answer to each question is **NUMERICAL VALUE** with two digit integer and decimal upto one digit.
- If the numerical value has more than two decimal places **truncate/round-off** the value upto **TWO** decimal places.
  - Full Marks : **+4** If ONLY the correct option is chosen.
  - Zero Marks : **0** In all other cases

खंड 2 (अधिकतम अंकः 20)

- इस खंड में **पाँच (05)** प्रश्न है। प्रत्येक प्रश्न का उत्तर संख्यात्मक मान **(NUMERICAL VALUE)** हैं, जो द्वि–अंकीय पूर्णांक तथा दशमलव एकल–अंकन में है।
- यदि संख्यात्मक मान में दो से अधिक दशमलव स्थान है , तो संख्यात्मक मान को दशमलव के दो स्थानों तक **ट्रंकेट/राउंड ऑफ (truncate/round-off)** करें।
- अंकन योजना :
  - पूर्ण अंक : **+4** यदि सिर्फ सही विकल्प ही चुना गया है।
  - शून्य अंक : **0** अन्य सभी परिस्थितियों में।

21. The number of molecules with energy greater than the threshold energy for a reaction increases five fold by a rise of temperature from 27° C to 42° C. Its energy of activation in J/mol is ……..

(Take in 5 = 1.6094; R = 8.314 J mol^{-1})

Ans. (84297)

Sol. $k = Ae^{-\frac{Ea}{RT}}$

$$\ln\left(\frac{K_2}{K_1}\right) = \frac{Ea}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\ln(5) = \frac{Ea}{8.314}\left[\frac{1}{300} - \frac{1}{315}\right]$$

$$1.6094 = \frac{Ea}{8.314}\left[\frac{15}{300\times 315}\right]$$

Ea = 84297J

22. The osmotic pressure of a solution of NaCl is 0.10 atm and that of a glucose solution is 0.20 atm. The osmotic pressure of a solution formed by mixing 1 L of the sodium chloride solution with 2 L of the glucose solution is x × 10^{-3} atm. x is …….. (nearest integer)

Ans. (167)

Sol. $\Pi = i\,CRT = i\left[\frac{n}{V}\right]RT$

$$\Pi_{final} = \frac{(\pi_1 V_1) + (\pi_2 V_2)}{V_1 + V_2}$$

$$\Pi_{final} = \frac{(0.1\times 1) + (0.2\times 2)}{3}$$

$$= \frac{(0.1+0.4)}{3} = \frac{0.5}{3} = \frac{500}{3} \times 10^{-3}\,atm$$

so X = 167

23. A 100 mL solution was made by adding 1.43 g of $Na_2CO_3.xH_2O$. The normality of the solution is 0.1 N. The value of x is ……..

(The atomic mass of Na is 23 g/mol)

Ans. (10)

Sol. Equivalent of solute = 0.1 × 0.1

Mole of solute ($Na_2CO_3.xH_2O$) = $[0.1 \times 0.1]\frac{1}{2}$

Mass of $Na_2CO_3.xH_2O = [0.1 \times 0.1]\frac{1}{2} \times [106 + 18x] = 1.43$

$\Rightarrow$ $[106 + 18x = 286$

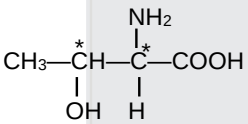
$18x = 180$

$x = 10$

24. The number of chiral centres present in threonine is ……

Ans. (2)

Sol.



Threonine have two chiral carbon atom.

25. Consider the following equations :

$2Fe^{2+} + H_2O_2 \rightarrow xA + yB$ (in basic medium)

$2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow x'C + y'D + z'E$

(in acidic medium)

The sum of the stoichiometric coefficients x, y, x', y' and z'

for products A, B, C, D and E, respectively, is ……..

Ans. (19)

Sol. (i) $2Fe^{2+} + H_2O_2 \longrightarrow 2Fe^{3+} + 2OH^-$

(ii) $2MnO_4^- + 5H_2O_2 + 6H^+ \longrightarrow 2Mn^{2+} + 5O_2 + 8H_2O$

So sum of $(x + y + x^1 + y^1 + z^1) = 2 + 2 + 2 + 5 + 8 = 19$

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