Solution

CHEMISTRY

JEE main - Chemistry

CHEMISTRY (Section-A)

1.

(c) Tritium $^{3}_{1}H$

Explanation:

Among the isotopes of hydrogen, only tritium is radioactive and emits low energy β^- particles.

2.

(c) Te

Explanation:

Metalloids have intermediate properties between metals and non-metals

Sc, Pb, Bi are metals Te is a metalloid.

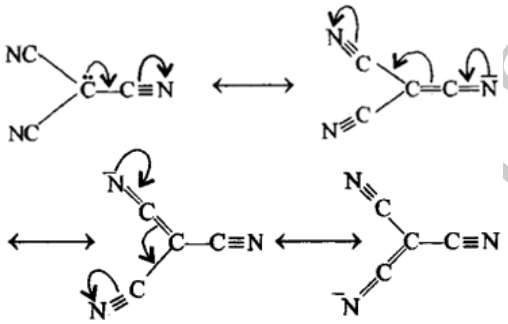
3.

(b) $CH(CN)_3$

Explanation:

Due to the resonance stabilisation of the conjugate base, $CH(CN)_3$ is the strongest acid amongst the given compounds.

$CH(CN)_3 \rightleftharpoons H^+ + \overline{C}(CN)_3$



The conjugate bases of $CHBr_3$ and CHI_3 are stabilised by inductive effect of halogens. This is why, they are less stable. Also, the conjugate base of $CHCl_3$ involves back-bonding between 2p and 3p orbitals.

4.

(b) A-B has the stiffest bond

Explanation:

A-B bond has the highest intermolecular potential energy among the given molecules. Hence, it is the strongest bond and has maximum bond enthalpy.

5. **(a)** 9.0 L

Explanation:

pH = 1 $\therefore$ $[H^+] = 10^{-1} = 0.1$ M

pH = 2 $\therefore$ $[H^+] = 10^{-2} = 0.01$ M

For dilution of HCl, $M_1V_1 = M_2V_2$

$0.1 \times 1 = 0.01 \times V_2$

$V_2 = 10$ L

Volume of water to be added = 10 -1 = 9 L

6.

(c) 2

Explanation:

MnO_4^- + $5e^-$ $\longrightarrow$ Mn^{2+}

i. $FeC_2O_4 \longrightarrow Fe^{3+} + 2CO_2 + 3e^-$

1 mole of FeC_2O_4 reacts with $\frac{3}{5}$ mole of acidified $KMnO_4$

ii. $Fe_2(C_2O_4)_3 \longrightarrow Fe^{3+} + CO_2 + 6e^-$

1 mole of $Fe_2(C_2O_4)_3$ reacts with $\frac{6}{5}$ moles of $KMnO_4$

(iii) $FeSO_4 \longrightarrow Fe^{3+} + e^-$

1 mole of $FeSO_4$ react with $\frac{1}{5}$ moles of $KMnO_4$

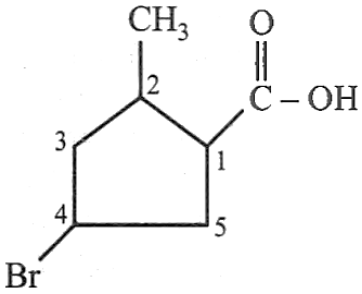
(iv) $Fe_2(SO_4)_3$ does not oxidise

$\therefore$ Total moles required = $\frac{3}{6} + \frac{6}{5} + \frac{1}{5} = 2$

7.

(c) 4-Bromo-2-methylcyclopentane carboxylic acid

Explanation:



4-Bromo-2-methylcyclopentane carboxylic acid

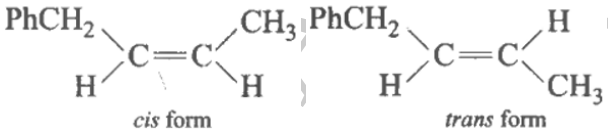
8. **(a)** I^-

Explanation:

If an electronegative element is in its lowest possible oxidation state in a compound or in a free state. It can function as a powerful reducing agent, e.g. I^-

9. **(a)** 1-phenyl-2-butene

Explanation:



10.

(b) 38.0 torr and 0.589

Explanation:

Total V.P. of solution = $P_A^\circ X_A + P_B^\circ X_B$

Given, P_A° = 74.7 torr, P_B° = 22.3 torr

$n_{benzene}$ = 1.5 mol, $n_{toluene}$ = 3.5 mol

$n_{solution}$ = 1.5 + 3.5 = 5 mol

$x_A = \frac{n_{benzene}}{n_{solution}} = \frac{1.5}{5}$ = 0.3

$x_B = \frac{n_{toluene}}{n_{solution}} = \frac{3.5}{3}$ = 0.7

Total V.P. of solution = (0.3 $\times$ 74.7 + 0.5 $\times$ 22.3) torr

= (22.4 + 15.6) torr = 38 torr

Mole fraction of benzene in vapour form = $\frac{22.4}{38}$ = 0.589

11.

(c) 1.51

Explanation:

The molality of 20% (mass/mass) aqueous solution of KI can be calculated by following formula.

$m = \frac{w_2 \times 1000}{Mw_2 \times w_1}$

20% aqueous solution of KI means that 20 gm of KI is present in 80 gm solvent.

$m = \frac{20}{166} \times \frac{1000}{80} = 1.506 \approx$ 1.51 mol/kg

12.

(d) $C_2 = \sqrt{2}C_1$

Explanation:

For the concentration cell, E^o_{cell} = 0

Anode : $Cu(s) \longrightarrow Cu^{2+}(aq)_A$

Cathode : $Cu^{2+}(aq)_e \longrightarrow Cu(s)$

Overall : $Cu^{2+}(aq)_C \underset{(C_2M)}{} \longrightarrow \underset{(C_1M)}{Cu^{2+}(aq)_A}$

As ΔG = -nFE

If ΔG = - ve, then E_{cell} is +ve.

$E_{cell} = 0 - \frac{RT}{2F} \ln \frac{C_1}{C_2}$

$E_{cell} = \frac{RT}{2F} \ln \frac{C_2}{C_1}$

So, $C_2 > C_1$

Thus, $C_2 = \sqrt{2}C_1$ relation is correct.

13.

(c) 1

Explanation:

Time of 75% reaction is twice the time taken for 50% reaction if it is first-order reaction w.r.t P. From the graph, [Q] decreases linearly with time, thus it is zeroth-order reaction w.r.t. Q

$\frac{dx}{dt} = bk[P]^a [Q]^b$

Order w.r.t P = a = 1

Order w.r.t Q = b = 0

Thus, overall order of the reaction = 1 + 0 = 1

14. **(a)** -2.69 V; the reaction will not occur

Explanation:

$Mn^{2+} + 2e^- \rightarrow Mn$; E^o = -1.18 V; ...(i)

$Mn^{3+} + e^- \rightarrow Mn^{2+}$; E^o = +1.51 V; ...(ii)

Now multiplying equation (ii) by two and subtracting from equation (i):

$3Mn^{2+} \rightarrow Mn^+ + 2Mn^{3+}$;

E^o = -1.18 - (+ 1.51) = -2.69 V

-ve value of EMF (i.e., ΔG = +ve) shows that the reaction is non-spontaneous.

15.

(c) Superoxide and $-\frac{1}{2}$

Explanation:

In KO_2, the nature of oxygen species and the oxidation state of oxygen atom are superoxide (superoxide ion is O_2^-)and -1/2 respectively.

Let x be oxidation state of oxygen. The oxidation state of K is +1. Hence + 1 + 2(x) = 0 $\Rightarrow x = -\frac{1}{2}$

16.

(b) $[Co(H_2O)_5Cl]\ Cl_2 \cdot H_2O$

Explanation:

Molarity (M) = $\frac{\text{Number of moles of solute}}{\text{Volume of solution (in L)}}$

∴ Number of moles of complex

= $\frac{\text{Molarity} \times \text{volume (in mL)}}{1000}$

= $\frac{0.1 \times 100}{1000} = 0.01\text{mole}$

Number of moles of ions precipitate

= $\frac{1.2 \times 10^{22}}{6.02 \times 10^{23}} = 0.02$ moles

∴ Number of Cl^- present in ionisation sphere

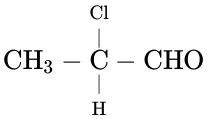
= $\frac{\text{Number of moles of ions precipitated}}{\text{Number of moles of complex}} = \frac{0.02}{0.01} = 2$

∴ 2 Cl^- are present outside the square brackets, i.e. in ionisation sphere. Thus, the formula of complex is $[Co(H_2O)_5Cl]\ Cl_2 \cdot H_2O$

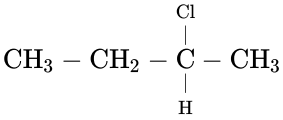
17. **(a)** 2-chloro-2-methylbutane

Explanation:

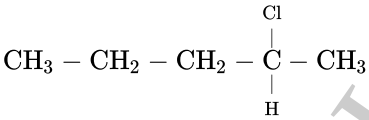
The optically inactive compound must contains achiral carbon atom(s). Option (d) contains achiral carbon atom



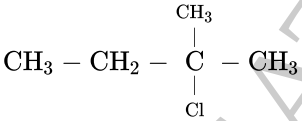
2-Chloropropanol (chiral)



2-Chlorobutane (chiral)



2-Chloropentane (chiral)



2-Chloro-2-methylbutane (achiral)

18.

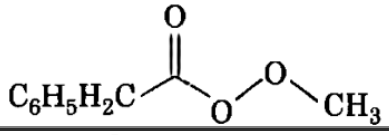
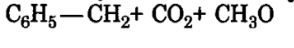
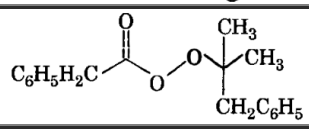
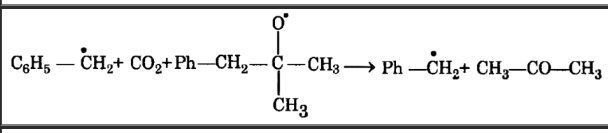
(d) (P) - (1), (Q) - (3), (R) - (4), (S) - (2)

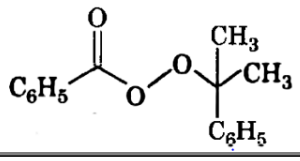
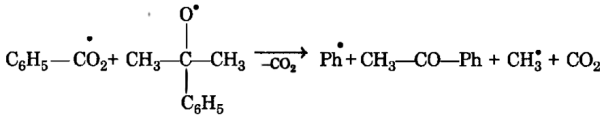
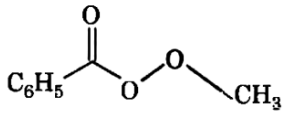
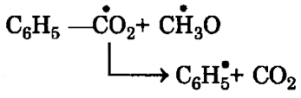
Explanation:

Allylic radical are more stable than alkyl radical, so when there is a possibility of formation of allyl radical, it will undergo fragmentation

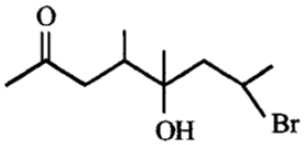
through formation of allyl radical, i.e. fragmentation produces stable radical.

On the basis of stability of radical, fragmentation can be done as

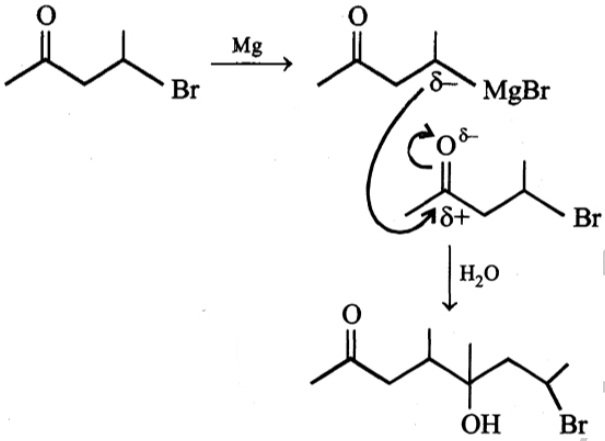
Column I	Column II	Explaination
P.	1. 	
Q.	3. 	
R.		

	4. 	
S.	2. 	

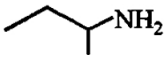
19.

(b) 

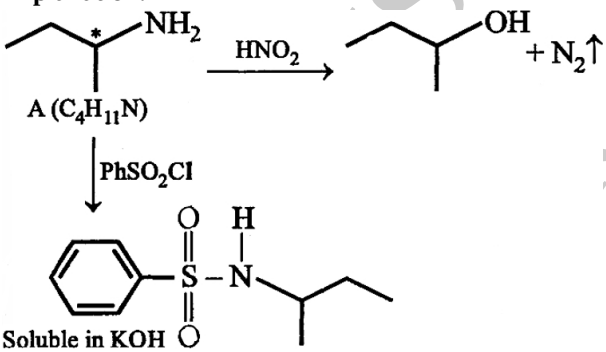
Explanation:



20.

(c) 

Explanation:



Soluble in KOH

CHEMISTRY (Section-B)

21. 270

Explanation:

$r \propto \frac{n^2}{Z}$ $\therefore r_{He^+} = r_H \times \frac{n^2}{Z}$

$r_{He^+} = 0.6 \times \frac{(3)^2}{2} = 2.7\overset{o}{A} = 270pm$

22. 1350.0

Explanation:

$\frac{t_1}{t_2} = \frac{\frac{1}{K}\ln\frac{a_0}{0.4a_0}}{\frac{1}{K}\ln\frac{a_0}{0.1a_0}}$

$\frac{540}{t_2} = \frac{\ln\frac{10}{4}}{\ln 10} \Rightarrow \frac{540}{t_2} = \frac{\log 10 - \log 4}{\log 10}$

$\frac{540}{t_2} = \frac{1-0.6}{1} \Rightarrow \frac{540}{t_2} = 0.4 \Rightarrow t_2 = \frac{540}{0.4} = 1350$ sec.

23. 2.0

Explanation:

$\left[\overset{+1}{\mathrm{Ag}}(\mathrm{NH_3})_2\right]^{+}\left[\overset{+1}{\mathrm{Ag}}(\mathrm{CN})_2\right]^{-}$

24. 4

Explanation:

$R = N_A \times k$

$= 6.023 \times 10^{23} \times 1.380 \times 10^{-23}$

= 8.312 which has 4 significant figures

25. 6.0

Explanation:

$\Delta G^{\circ} = -RT\ell nK$

$-nFE^{\circ}_{cell} = -RT \times 2.303 (\log_{10}K)$

$\frac{E^{\circ}_{cell}}{0.06} \times n = \log K$ ...(i)

$Pd^{+2}(aq.) + 2e^{-} \rightleftharpoons Pd(s)$, $E^{\circ}_{cat,\ redn} = 0.83$

$Pd(s) + 4Cl^{-}(aq.) \rightleftharpoons PdCl_4^{2-},(aq) + 2e^{-}$, $E^{\circ}_{anode,\ oxidn} = 0.65$

Net Reaction $\rightarrow Pd^{2+}(aq.)\ 4Cl^{-}(aq.) \rightleftharpoons PdCl_4^{2-}(aq.)$

$E^{\circ}_{cell} = E^{\circ}_{cat,\ redn} - E^{\circ}_{anode,\ oxidn}$

$E^{o}_{cell} = 0.83 - 0.65 \Rightarrow E^{o}_{cell} = 0.18$ ...(ii)

Also n = 2 using equation (i), (ii) & (iii), (iii)

$\Rightarrow \log K = 6$