JEE MAIN-2020

Chemistry
Section A

26. Sol. (3)

Ion-ion interactions are stronger because they have stronger electrostatic forces of attraction whereas dipoles have partial charges and hence the electrostatic forces in their case would be relatively weak.

27. Sol. (3)

Alkali metals always possess a $+1$ oxidation state, whereas oxygen present in K_2O (oxide) is -2, and in K_2O_2 (peroxide) is -1 and in KO_2 (superoxide) is $-\frac{1}{2}$.

28. Sol. (4)

Total pressure $P_T = p_A^0 x_A + p_B^0 x_B$

The maximum value x_A can hold is one, and hence the maximum value of P_T should come out to be $512\,\text{mm Hg}$, which is less than the value of P_T observed ($600\,\text{mm Hg}$). Therefore, positive deviation from Raoult's law that is observed. This implies that $A-A$ interactions and $B-B$ interactions are stronger than $A-B$ interactions. As we know, for a system not obeying Raoult's law and showing positive deviation, $\Delta V_{mix} > 0, \Delta H_{mix} > 0$.

29. Sol. (3)

Because of Lanthanide contraction, an increase in Z_{eff} is observed and so, the size of Au instead of being greater, as is expected, turns out be similar to that of Ag.

30. Sol. (3)

All the three compounds possess a tetrahedral geometry. In both CH_4 and CCl_4, $\mu_{net}=0$ as all atoms attached to carbon are same elements whereas in $CHCl_3, \mu_{net}>0$

31. Sol. (4)

Zeolite process removes only the cations responsible for permanent hardness whereas synthetic resins method both cations, as well as the anions responsible for permanent hardness are removed. Hence, resin method is more efficient in removing of hardness of water.

$$2RNa(s)+\underset{M=Ca,Mg}{M^{2+}}(aq)\rightarrow R_2M(s)+2Na^+(aq)$$

$$RNH_3^+OH^-(s)+X^-(aq)\rightarrow RNH_3^+X^-(s)+OH^-(aq)$$

32. Sol. (2)

When gases combine or react in a chemical reaction, they do so in a simple ratio by volume provided all gases are maintained at the same temperature and pressure- Gay-Lussac’s law.

33. Sol. (4)

Weaker is the conjugate acid the stronger the base is.

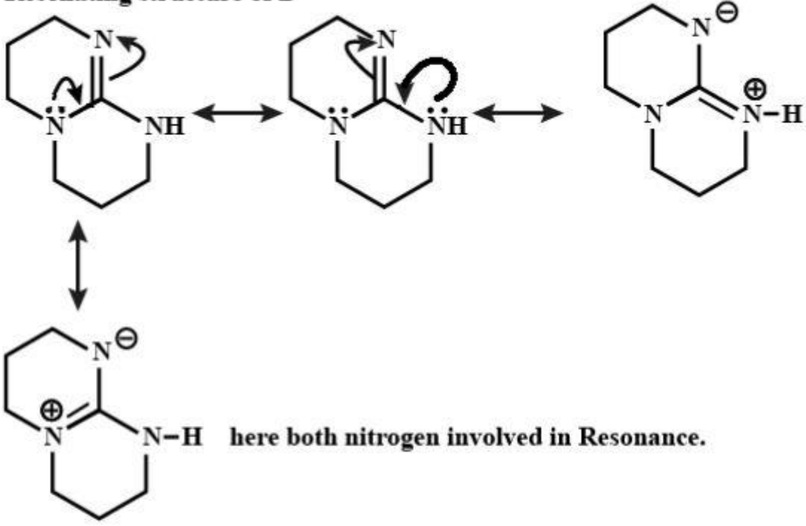
(ii) is the most basic as it has a guanidine like structure. It has a high tendency of accepting a proton, giving rise to a very stable conjugate acid and hence, is a very strong base.

In compound (i), the Nitrogen is sp^2 hybridised and its electronegativity is higher as compared to the compound (iii) which is a 2^0 amine (sp^3 hybridised). So, compound (ii) is more basic compared to compound (iii).

So the order of basicity is $(iii) < (i) < (ii)$ and thus the order of pK_b value will be $(ii) < (i) < (iii)$.

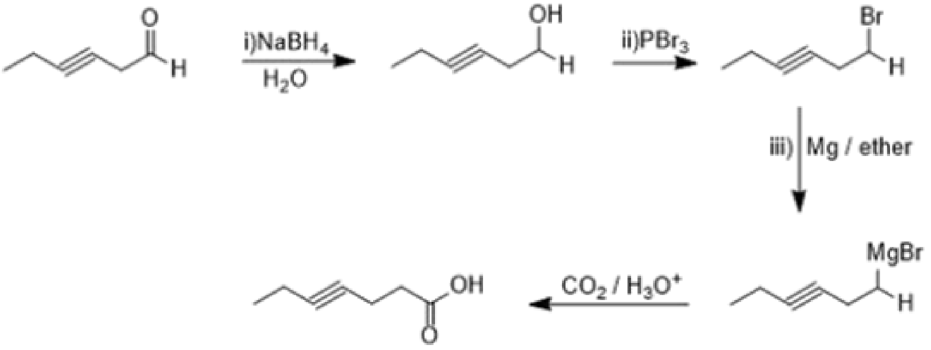
Only one nitrogen involve in Resonance.

Resonating structure of B



here both nitrogen involved in Resonance.

34. Sol. (2)



35. Sol. (3)

$n = 5, l = (n-1) = 4;$ hence the possible sub-shells for $n = 5$ are: $5s, 5p, 5d, 5f, 5g$

The number of orbitals in each would be $1, 3, 5, 7 \& 9$, respectively and summing them up gives the answer as 25. As each orbital would have one electron with $m_s = +\frac{1}{2}$.

36. Sol. (2)

Purest form of iron is wrought iron with carbon composition between 0.12 to 0.25%. Wrought iron is prepared from cast iron by oxidising impurities in a reverberatory furnace lined with haematite.

Cast iron $\rightarrow < 2\%$ of C.

Pig iron $\rightarrow 3.4$ **to** 4.5% C.

37. Sol. (3)

The bonding present in $[Ni(CO)_4]$ is synergic bond i.e. transference of electrons form ligands to metal and the transference of electrons from filled metal orbitals to anti-bonding orbitals of ligands.

$\pi -$back bonding is present between metal and the carbonyl.

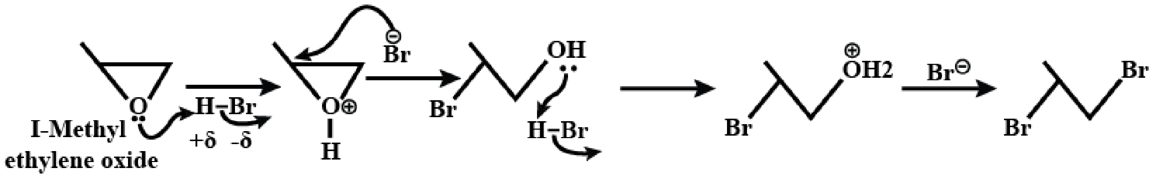
Werner's theory fails to explain directional properties of the bonds but MOT explains the bonding and molecular structure of the complex.

38. Sol. (1)

The IUPAC name of the complex $[Pt(NH_3)_2Cl(NH_2CH_3]Cl$ is

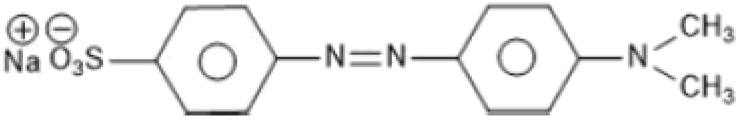
Diamminechlorido(methanamine)platinum(II) chloride

39. Sol. (3)



40. Sol. (4)

X formed is methyl orange. Methyl orange is an acid-base indicator.



41. Sol. (2)

	Chemical compound	Vitamin	Deficiency diseases
(i)	Riboflavin	Vitamin B_2	Cheliosis
(ii)	Thiamine	Vitamin B_1	Beri beri
(iii)	Ascorbic acid	Vitamin C	Scurvy
(iv)	Pyridoxine	Vitamin B_6	Convulsions

42. Sol. (1)

$$Cu^{2+} + 2e^- \rightarrow Cu; \qquad E^0 = 0.340\,\text{V}$$

$$\text{Cu} \rightarrow \text{Cu}^+ + e^-; \qquad E^0 = -0.522\,\text{V}$$

$$Cu^{2+} + e^- \rightarrow Cu^+ \qquad E^0 = ?$$

Applying $\Delta G = -nFE^0$

We get,

$$\left(-1 \times F \times E^0\right) = -2 \times F \times 0.340 + \left(-1 \times F \times -0.522\right)$$

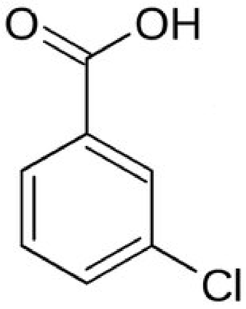
Solving, we get, $E^0 = +0.158\,\text{V}$

43. Sol. (1)

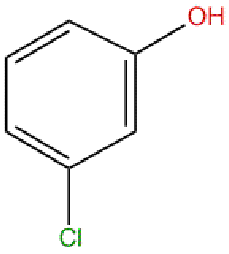
$m-$chlorobenzoic acid being the most acidic can be separated by a weak base like $NaHCO_3$ and hence will be labelled fraction A.

$m-$chlorophenol is not as acidic as $m-$chlorobenzoic acid, and can be separated by a stronger base like $NaOH$, and hence can be labelled as fraction B.

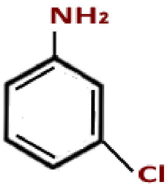
$m-$chloroaniline being a base, does not react with either of the bases and hence would be labelled as fraction C.



(A)



(B)



(C)

44. Sol. (2)

Electron gain enthalpy is defined as the amount of energy released when an electron is added to an isolated gaseous atom.

As one move down the group, atomic size increases and added electron will be farther from the nucleus resulting due to which electron gain enthalpy becomes less negative down the group.

But chlorine has more negative electron gain enthalpy than fluorine which is due to small size of fluorine incoming electron experience less attraction due to stronger inter-electronic repulsion.

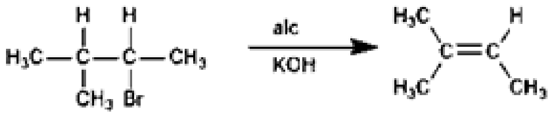
Therefore, order will be $Cl > F > Br > I$.

45. Sol. (4)

Saytzeff or Zaitsev Rule states that the more substituted alkene will be the major product.

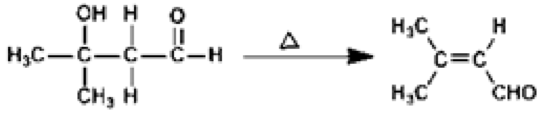
(a)

(b)



(c)

(d)



Section B

46. Sol. 10.6

Molarity of $NaOH$ $(4\,g \text{ in } 100\,\text{L}) = \;=10^{-3}\,\text{M}$

Molarity of H_2SO_4 $(9.8\,g \text{ in } 100\,\text{L}) = 10^{-3}\,\text{M}$

Equivalents of $NaOH = M \times V \times n_f = 10^{-3} \times 40 \times 1 = 0.04$

Equivalents of $H_2SO_4 = M \times V \times n_f = 10^{-3} \times 10 \times 2 = 0.02$

$$M \times V_{total} = \left(M_{NaOH} \times V_{NaOH} \times (n_f)_{NaOH}\right) - \left(M_{H_2SO_4} \times V_{H_2SO_4} \times (n_f)_{H_2SO_4}\right)$$

$$M \times 50 = (10^{-3} \times 40 \times 1) - (10^{-3} \times 10 \times 2)$$

$$\Rightarrow M = 4 \times 10^{-4}$$

$$\begin{aligned} pOH &= -\log M \\ &= -\log 4 \times 10^{-4} \\ &= 4 - 2\log 2 \\ &= 3.4 \end{aligned}$$

$$pH = 14 - pOH = 14 - 3.4 = 10.6$$

47. Sol. 23.03

All nuclear processes follow first order kinetics, and hence

$$t_{\frac{1}{2}} = \frac{0.693}{\lambda}$$

$$\lambda = 0.1\,yrs^{-1}$$

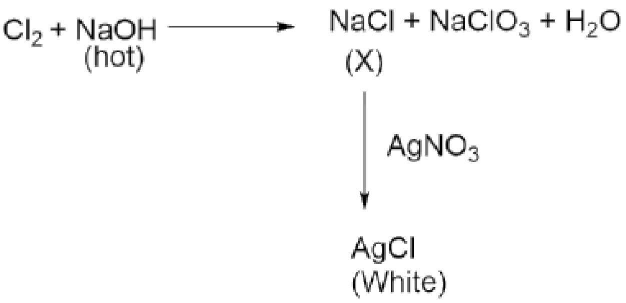
$$t=\frac{2.303}{\lambda}\left(\log\frac{a_0}{a_t}\right)=\frac{2.303}{0.1}\left(\log\frac{a_0}{0.1a_0}\right)$$

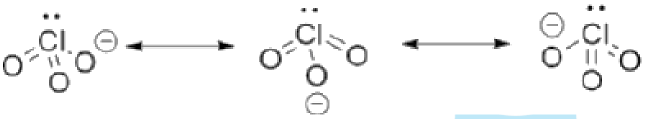
On solving, $t = 23.03\,yrs$

48. Sol. 1.67

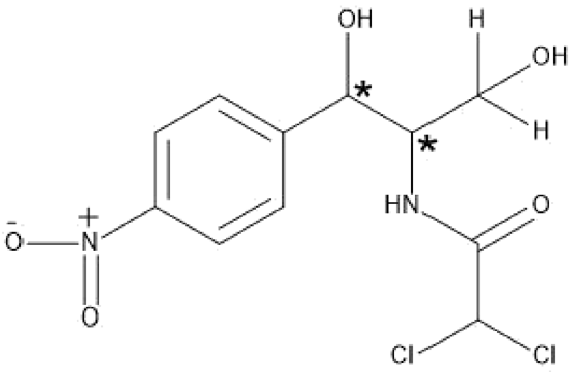
Compound Y is $NaClO_3$.

Bond order $=\dfrac{Total\ no.of\ bonds}{Total\ resonating\ structures}=\dfrac{5}{3}=1.67$





49. Sol. 2



50. Sol. 2.7

$$\Delta H = \Delta U + \Delta n_g RT$$

$$\Delta H = 2100 + (2 \times 2 \times 300) = 3300\,\text{cal} \quad (R = 2\,\text{cal K}^{-1}\,\text{mol}^{-1})$$

$$\begin{aligned}\Delta G &= \Delta H - T\Delta S \\ &= 3300 - (300 \times 20) \\ &= -2700\,\text{cal} \\ &= -2.7\,\text{kcal}\end{aligned}$$

$$|\Delta G| = |-2.7| = 2.7\,\text{kcal}$$