IIT-JEE-2004

Chemistry

1. Correct Answer:

a) Let the order w.r.t A & B are x any y respectively

$$r = K[A]^x[B]^y$$
$$0.05 = K[0.1]^x[0.1]^y$$
$$0.1 = K[0.2]^x[0.1]^y$$
$$\text{or } 2 = [2]^x$$
$$x = 1$$
$$0.05 = K[0.1]^x[0.1]^y$$
$$0.05 = K[0.1]^x[0.2]^y$$
$$1 = [2]^y$$
$$y = 0$$

b) rate equation $= r = K[A][B]^0$

$$0.1 = K[0.2]$$

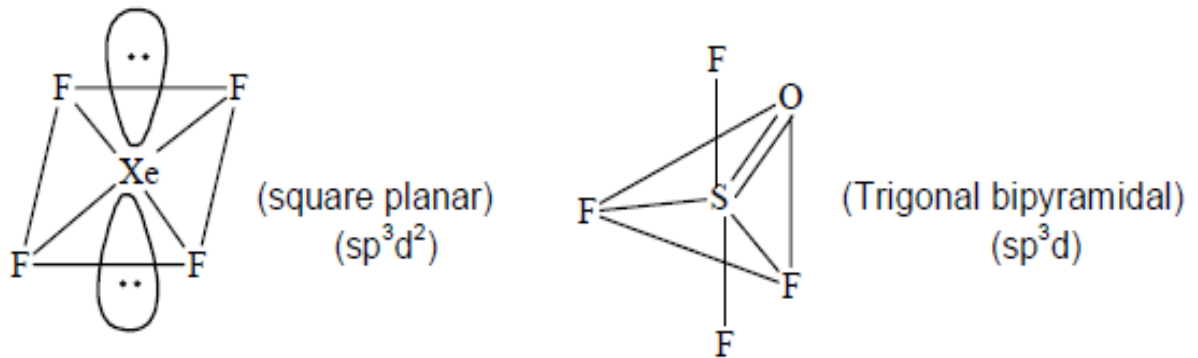$$K = 0.5\,\text{Sec}^{-1}$$

2. Correct Answer:

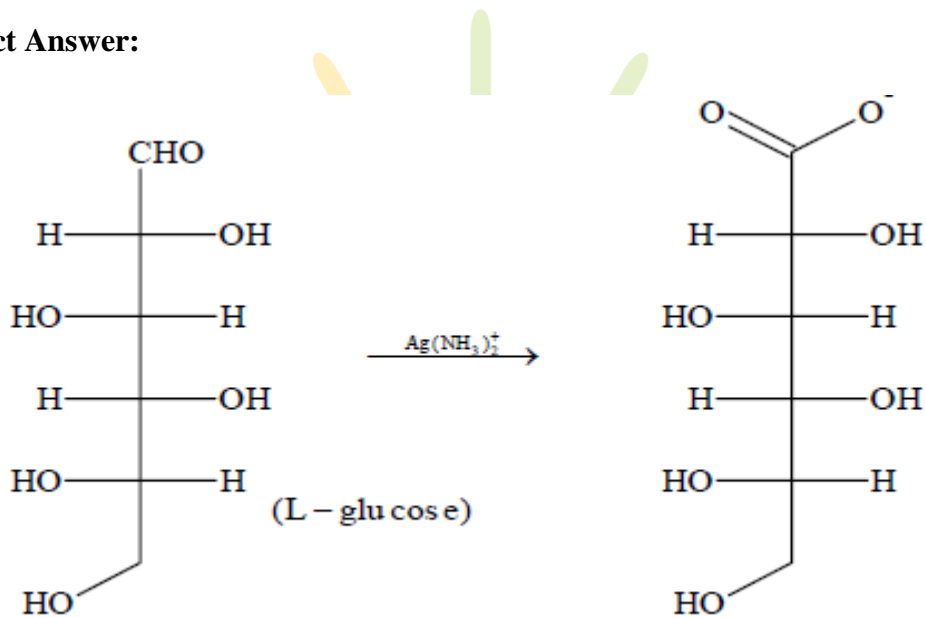$$\Delta H = 0, \Delta q_p = \Delta U - W$$
$$W = PdV$$
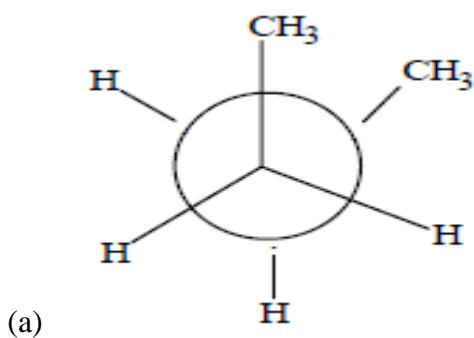$$= 100 \times 1\,\text{atmmL}$$
$$= 10^{-2}\,KJ = \Delta U$$

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3. Correct Answer:

(square planar)
(sp^3d^2)

(Trigonal bipyramidal)
(sp^3d)

4. Correct Answer:

CHO

H————OH

HO————H

H————OH

HO————H

HO

$\xrightarrow{Ag(NH_3)_2^+}$

(L – glucose)

H————OH

HO————H

H————OH

HO————H

HO

5. Correct Answer:

(a)

b) Less stability is due to Vander Waal's strain

6. Correct Answer:

$$Cl_2O_7 < SO_3 < CO_2 < B_2O_3 < BaO$$

7. Correct Answer:

$$3KF + AlF_3 \rightarrow K_3AlF_6$$
$$K_3AlF_6 + 3BF_3 \rightarrow AlF_3 + 3KBF_4$$
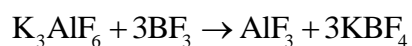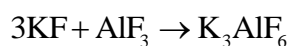
8. Correct Answer:

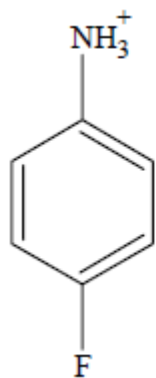a) Density $= \dfrac{4 \times 6.023 \times y}{6.023 \times 10^{23} \times 8 \times y \times 10^{-27}} \left[\text{since } a = 2y^{1/3} \right]$

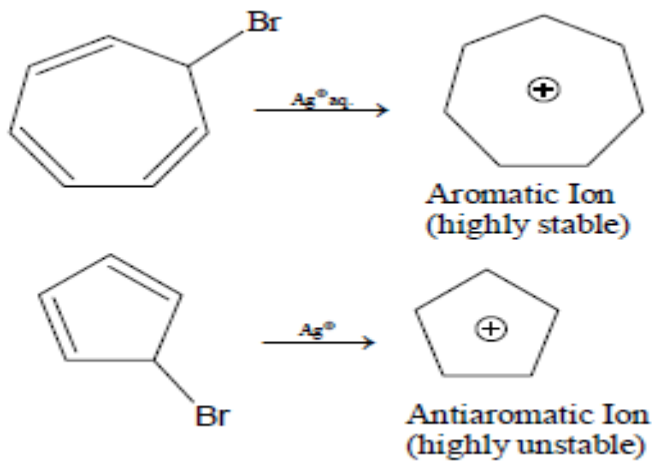$= 5 \times 10^3 \, g/m^3$
$= 5 \, Kg/m^3$

b) Since the (density) calculated < density observed, it means the defect is metal excess defect.

9. Correct Answer:

 is more acidic due to – inductive effect of fluorine

10. Correct Answer:

11. Correct Answer:

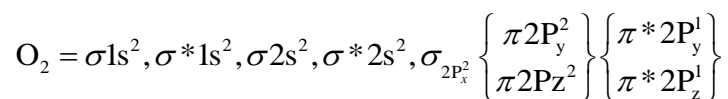(a) $\Psi_{2s}^2 = $ probability of finding electrons at any place

$\therefore \Psi^2 = $ at node

$$\Psi^2 = 0 = \frac{1}{4}\frac{1}{\sqrt{2\pi}}\left(\frac{1}{a^0}\right)\left(2-\frac{r}{a^0}\right)^2 \times e^{-r/a_0}$$

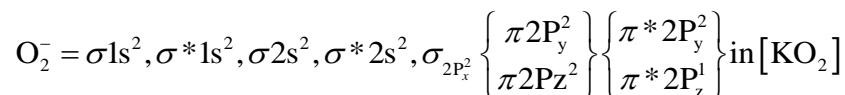$$\left(2-\frac{r}{a^0}\right) = 0 \Rightarrow 2 = \frac{r}{a^0} \Rightarrow 2a_0 = r$$

b) $\lambda = \dfrac{h}{mv} = \dfrac{6626\times10^{-34}}{100\times10^{-3}\times100}$

$\lambda = 6.626\times10^{-35}\,m = 6.626\times10^{-25}\,A°$

c) Y is $_{84}Po^{206}$

12. Correct Answer:

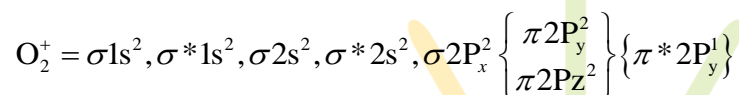$$O_2 = \sigma 1s^2, \sigma*1s^2, \sigma 2s^2, \sigma*2s^2, \sigma_{2P_x^2} \left.\begin{cases} \pi 2P_y^2 \\ \pi 2Pz^2 \end{cases}\right\} \left.\begin{cases} \pi*2P_y^1 \\ \pi*2P_z^1 \end{cases}\right\}$$

bond order $= \dfrac{10-6}{2} = 2$

$$O_2^- = \sigma 1s^2, \sigma*1s^2, \sigma 2s^2, \sigma*2s^2, \sigma_{2P_x^2} \left.\begin{cases} \pi 2P_y^2 \\ \pi 2Pz^2 \end{cases}\right\} \left.\begin{cases} \pi*2P_y^2 \\ \pi*2P_z^1 \end{cases}\right\} \text{in} [KO_2]$$

bond order $= \dfrac{10-7}{2} = \dfrac{3}{2}$

$$O_2^+ = \sigma 1s^2, \sigma*1s^2, \sigma 2s^2, \sigma*2s^2, \sigma 2P_x^2 \left.\begin{cases} \pi 2P_y^2 \\ \pi 2Pz^2 \end{cases}\right\} \left\{ \pi*2P_y^1 \right\}$$

in $\left[O_2 (AsF_6) \right]$

bond order $= \dfrac{10-5}{2} = \dfrac{5}{2}$

Bond length order is $O_2^+ < O_2 < O_2^-$

13. Correct Answer:

a) i) $N_2O_4(g) \rightleftharpoons 2NO_2(g)$
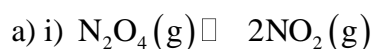
Reaction quotient $= \dfrac{P_{NO_2}^2}{P_{N_2O_4}} = \dfrac{100}{10} = 10\,atm$

$$\Delta G^\circ \text{ reaction} = \Delta G_f^\circ\left(NO_2\right) - \Delta G_f^\circ\left(N_2O_4\right)$$

$$0 = 100 - 100$$

$$\Delta G = \Delta G^\circ + RT \ln k$$

$$\therefore \Delta G = RT \ln Q$$

$$= 2.303 \times .082 \times 298 \times \log 9.9 = 56.0304 \, \text{Lit atm.} = \text{Positive}$$

$$\Delta G_f^0\left(N_2O_4\right) = 100 \, KJ$$

$$\Delta G_f^0\left(NO_2\right) = 50 \, KJ$$

$$\Delta G$$

ii) Therefore reaction will shift towards backward direction.

b)

$$\therefore \left(P + \frac{a}{v_m^2}\right)\left(v_m - b\right) = RT$$

$$\left(P + \frac{aP^2}{\left(PV\right)^2}\right)\left(\frac{PV}{P} - b\right) = RT$$

$$\left[\left(PV\right)^2 P + a\,P^2\right]\left[\left(PV\right) - b\right] = P\left(PV\right)^2 RT$$

$$\Rightarrow P\left[\left(PV\right)^2 + aP\right]\left(PV - bP\right) = P\left(PV\right)^2 RT$$

Put $P = 0$

$$\Rightarrow \left(PV\right)^3 = \left(PV\right)^2 RT$$

Intercept $= RT$

14. Correct Answer:

a) In first case

$$\Delta T_b = K_b \times m$$

$$0.17 = 1.7 \times \frac{1.22}{M \times 100 \times 10^{-3}} \Rightarrow M = 122$$

ii) In second case

$$\Delta T_b = K_b \times m$$

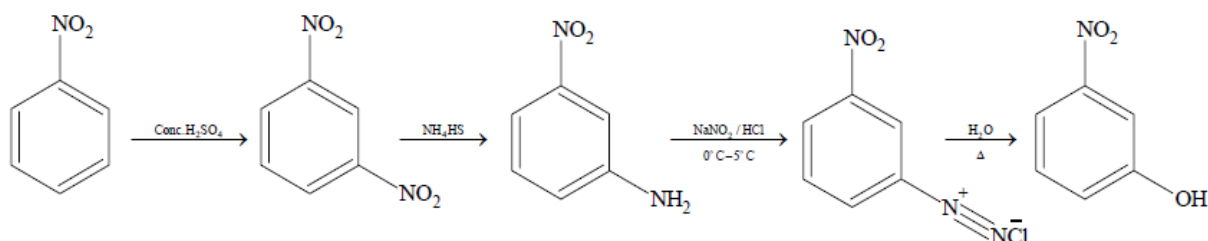$$0.13 = 2.6 \times \frac{1.22}{M' \times 100 \times 10^{-3}}$$

$$M' = 122$$

Benzoic acid dimerises in benzene
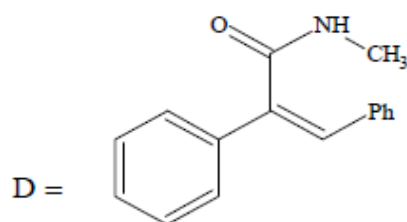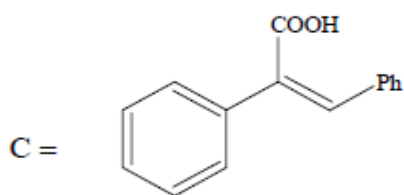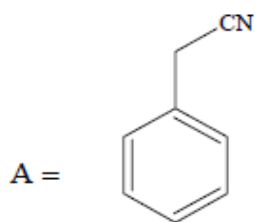
b) Since at end point molarity of salt $= \frac{0.1}{2} M$

$\therefore$ pH of salt of weak acid and strong base

$$pH = \frac{(pK_w + pK_a + \log_c)}{2} = \frac{1}{2}\left[14 + 5.3010 + \left[-1.3010\right]\right] \Rightarrow pH = 9.$$

15 .Correct Answer:

16. Correct Answer:

A =

B =

C =

D =

17. Correct Answer:

$$A_1 = Cu(OH)_2 \, CuCO_3$$

$$A_1 = Cu_2S$$

$$\underset{(A1)}{Cu(OH)_2 \, CuCO_3} \xrightarrow{\text{Calcination}} \underset{\text{(Black Solid)}}{2CuO} + CO_2 + H_2O$$

$$Cu(OH)_2 \, CuCO_3 \xrightarrow{\text{dilHCl}} CuCl_2 + CO_2 + 3H_2O$$

$$2CuCl_2 + 4KI \rightarrow Cu_2Cl_2 + I_2 + 4KCl$$

$$\underset{(A_2)}{2Cu_2S} + 3O_2 \rightarrow 2Cu_2O + 2SO_2$$

$$Cu_2S + 2Cu_2O \rightarrow 6Cu + SO_2$$
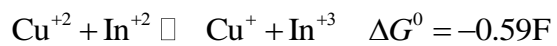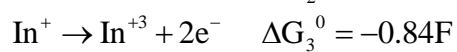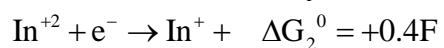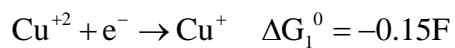
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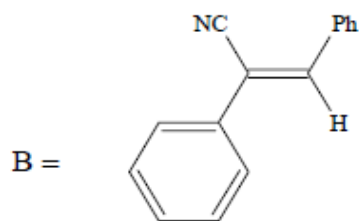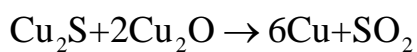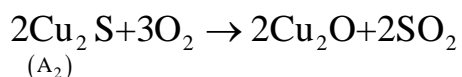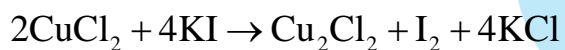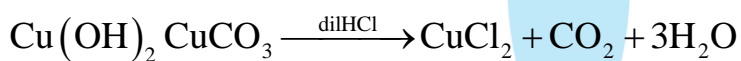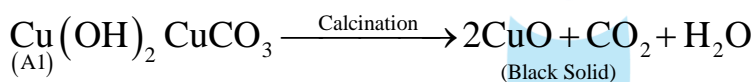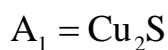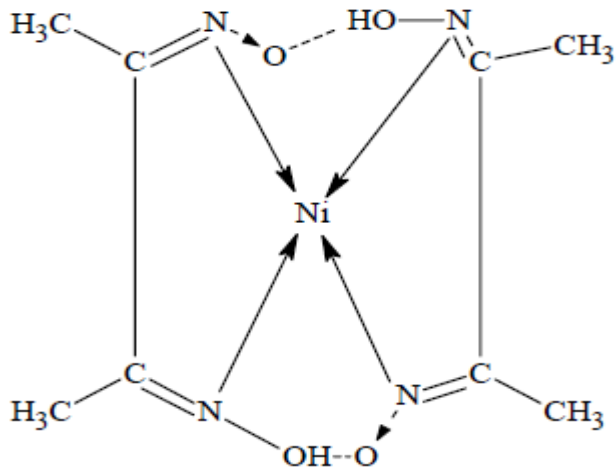
18. Correct Answer:

Oxidation state of nickel is $+2$ and hybridization is dsp^2

$$\mu s = \sqrt{n(n+2)}B.M$$
$$n = 0$$
$$\therefore \mu s = 0$$

19. Correct Answer:

$$Cu^{+2} + e^- \rightarrow Cu^+ \quad \Delta G_1^0 = -0.15F$$
$$In^{+2} + e^- \rightarrow In^+ + \quad \Delta G_2^0 = +0.4F$$
$$In^+ \rightarrow In^{+3} + 2e^- \quad \Delta G_3^0 = -0.84F$$

$$Cu^{+2} + In^{+2} \; \square \;\; Cu^+ + In^{+3} \quad \Delta G^0 = -0.59F$$

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$$-nFE° = -0.59F$$

$$-E^0_{cell} = 0.59F$$

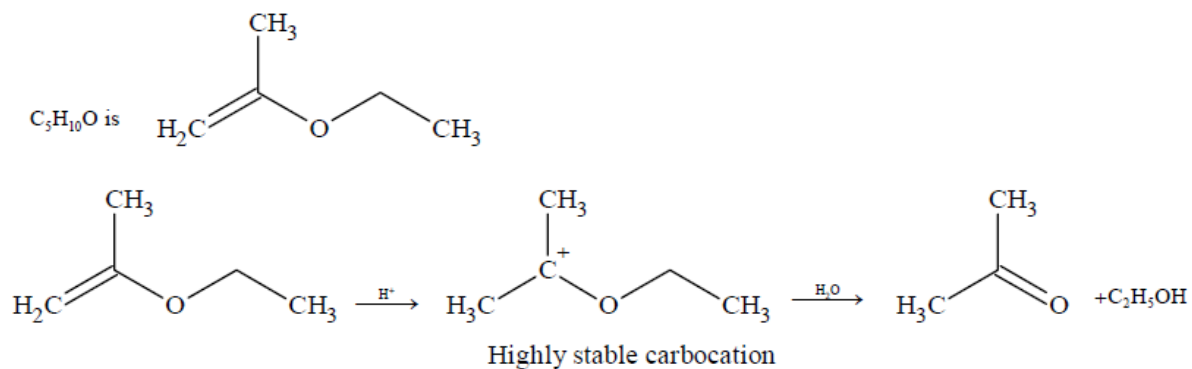$$E^0_{cell} = 0.59$$

$$E_{cell} = E° - \frac{0.0591}{n}\log K_c$$

$$0.59 = \frac{0.0591}{1}\log K_c$$

$$K_c = 10^{10}$$

20. Correct Answer:

P is stabilized by resonance