CHEMISTRY – JEE ADVANCED PAPER – 1

SECTION – 1

1. Which of the following set represent correct formula for Malachite, Magnetite, Calamine & Cryolite?

   (a) $CuCO_3, Fe_2O_3, ZnO, Al_2O_3$ (b) $CuCO_3, Cu(OH)_2, Fe_3O_4, ZnCO_3, Na_3AlF_6$

   (c) $CuCO_3, Fe_3O_4, ZnCO_3, Al_2O_3$ (d) $CuCO_3.Cu(OH)_2, Fe_2O_3, ZnCO_3, Na_3AlF_6$

Solution:

(B)

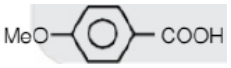
Malachite → $CuCO_3.Cu(OH)_2$

Magnetite → Fe_3O_4

Calamine → $ZnCO_3$

Cryollite → Na_3AlF_6

2. Find the correct acidic strength order:

   (i) HC = C – COOH (ii) H_2C = CH – COOH (iii) 

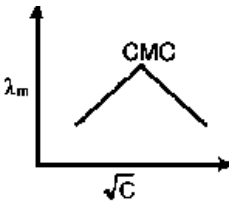
(iv) $CH_3 – CH_2 – COOH$

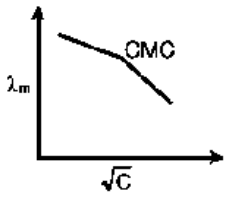
   (a) i > ii > iv > iii (b) i > ii > iii > iv (c) iii > ii > i > iv (d) iii > i > iv > ii

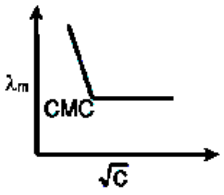
Solution:

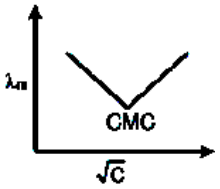
(B)

3. Sodium stearate is a strong electrolyte. Which of the following plot is correct regarding its conductance:

(a) 

(b) 

(c) 

(d) 

Solution:

(B)

By definition, $\lambda m \alpha \frac{1}{\sqrt{C}}$

4. Which green coloured compound of chromium is formed in borax bead test?

(a) $Cr\left(BO_2\right)_3$ (b) Cr_2O_3 (c) CrB (d) $CrBO_3$

Solution:

(A)

$$Na_2B_4O_7.10H_2O \xrightarrow{\Delta} Na_2B_4O_7$$

$$\downarrow \Delta$$

$$NaBO_2 + B_2O_3$$

$$Cr_2O_3 + B_2O_3 \longrightarrow \underset{green}{Cr\left(BO_2\right)_3}$$

SECTION – 2

5. Choose the reaction, for which the standard enthalpy of reaction is equal to the standard enthalpy of formation:

(a) $2C_{(g)} + 3H_{2(g)} \rightarrow C_2H_{6(g)}$ (b) $\frac{3}{2}O_{2(g)} \rightarrow O_{3(g)}$

(c) $\frac{1}{8}S_{8(s)} + O_{2(g)} \rightarrow SO_{2(g)}$ (d) $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O(\ell)$

Solution:

(B, C)

By definition,

Enthalpy of formation is defined as the Enthalpy change occurring when, a compound is formed from its constituent elements in standard state.

6. A Tin – chloride 'P' gives following reaction (unbalanced reaction)

$P + Cl^- \longrightarrow X$ [Monoanion pyramidal geometry]

$P + Me_3N \longrightarrow Y$

$P + CuCl_2 \longrightarrow Z + CuCl$

Then which of the following is/are correct.

(a) Y contains co-ordinate bond (b) X is sp^3 hybridised.

(c) Oxidation state of Sn is X is +1. (d) X contain lone pair on central atom.

Solution:

(A, B, D)

$$\underset{(P)}{SnCl_2} + Cl^- \longrightarrow \underset{(X)}{SnCl_3^-}$$

$$\underset{(P)}{SnCl_2} + Me_3N \longrightarrow \underset{(Y)}{SnCl_2\left[N\,Me_3\right]}$$

$$\underset{(P)}{SnCl_2} + CuCl_2 \longrightarrow \underset{(Z)}{SnCl_2} + CuCl$$

7. $^{238}_{92}U \xrightarrow{x_1} ^{234}_{90}Th \xrightarrow{x_2} ^{234}_{91}Pa \xrightarrow{x_3} ^{234}Z \xrightarrow{x_4} ^{230}_{90}Th$

$x_1, x_2, x_3, x_4,$ are either particles or radiation. Then

(a) x_1 is deflected toward negatively charged plate.

(b) x_2 is β-particle.

(c) x_3 is γ-radiation.

(d) z is isotope of ^{238}U

Solution:

(A, B, D)

$X_1 \rightarrow \alpha$ – decay

$X_2 \rightarrow \beta$ – decay

$X_3 \rightarrow \beta$ – decay

$X_4 \rightarrow \alpha$ – decay

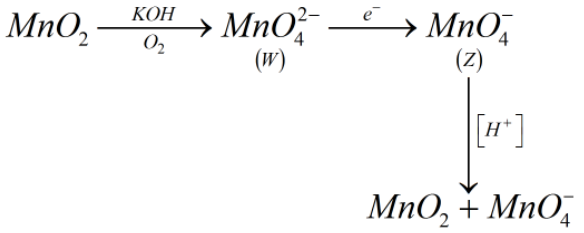
8. Fusion of MnO_2 along with KOH and O_2 forms X. Electrolytic oxidation of X yields Y. X undergoes disproportionation reaction in acidic medium to MnO_2 and Y. The Manganese in X and Y is in the form W & Z respectively, then

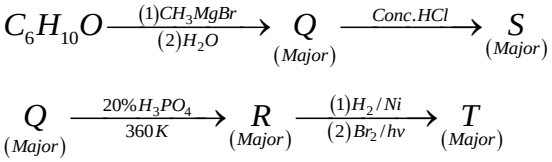
(a) W & Z are coloured (b) W is diamagnetic and Z is paramagnetic

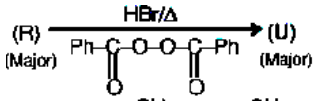
(c) Both W & Z are tetrahedral in shape (d) Both W & Z involve pπ-dπ bonding for π bond

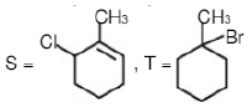
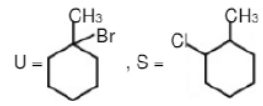
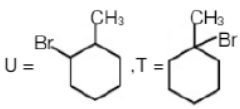
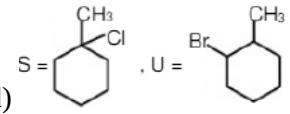
Solution:

(A, C, D)



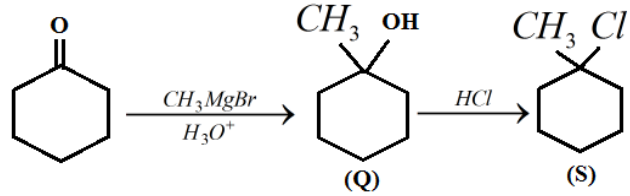
9. 

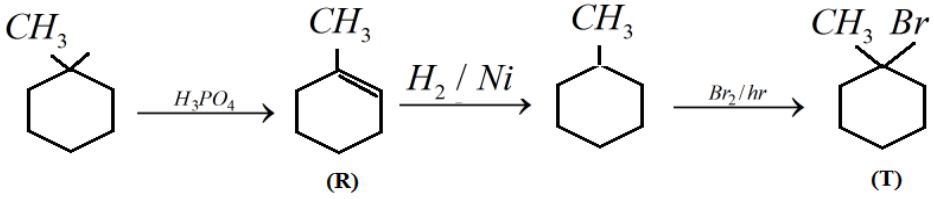


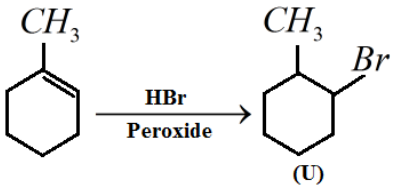
(a)  (b)  (c)  (d) 

Solution:

(C, D)







10. Which of the following are true.

(a) Monosachharides can not be hydrolysed to give polyhydroxy aldehydes and ketones.

(b) Hydrolysis of sucrose gives dextrorotatory glucose and laevorotatory fructose

(c) Oxidation of glucose with bromine water gives glutamic acid.

(d) The two six membered hemiacetal form of D(+) glucose are anomers.

Solution:

(A, B, D)

11. Identify the option where all four molecules possess permanent dipole moment at room temperature.

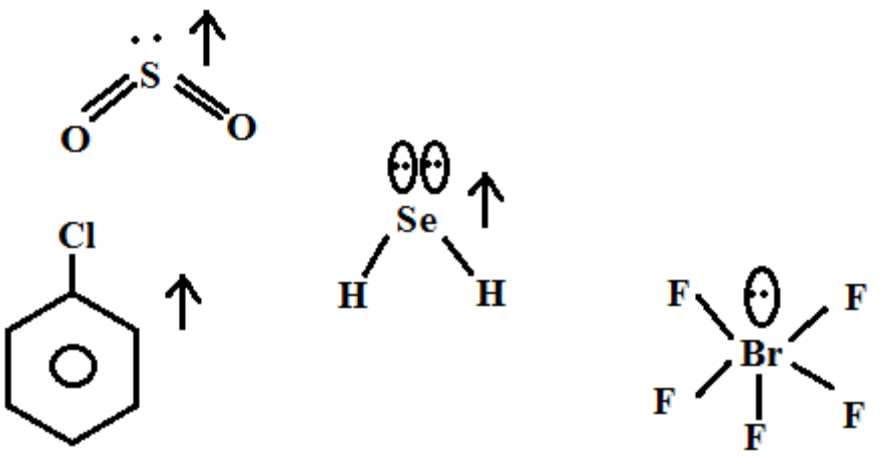
(a) BF, O_3, SF_6, XeF_6 (b) $BeCl_2, CO_2, BCl_3, CHCl_3$

(c) $SO_2, C_6H_5Cl, H_2Se, BrF_5$ (d) $NO_2, NH_3, POCl_3, CH_3Cl$

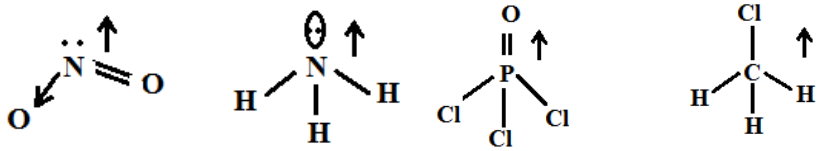
Solution:

(C, D)

(C) →



(D) →



12. Which of the following is/are correct regarding root mean square speed (U_{rms}) & average translation K.E. (E_{av}) of molecule in a gas at equilibrium.

(a) E_{av} is doubled when its temperature is increased 4 times

(b) U_{rms} is inversely proportional to the square root of its molecular mass

(c) E_{av} at a given temperature doesn't depend on its molecular mass

(d) U_{rms} is doubled when its temperature is increased 4 times

Solution:

(B, C, D)

$$E_{av} = \frac{3}{2}RT \quad \text{(independent of Mass)}$$

$$u_{rms} = \sqrt{\frac{3RT}{M}}$$

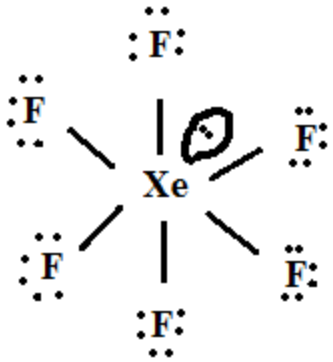
SECTION – 3

13. $XeF_4 + O_2F_2 \longrightarrow$ product. The total number of lone pairs on the xenon containing product is: (l)

Solution:

(19)

$$XeF_4 + O_2F_2 \longrightarrow XeF_6 + O_2$$



Distorted octahedral shape

14. For the following reaction, equilibrium constant K_c at 298 K is 1.6×10^{17}

$$Fe^{2+}_{(aq)} + S^{2-}_{(aq)} \rightleftharpoons FeS(s)$$

When equal volume of 0.06 M Fe^{+2} and 0.2 M S^{-2} solution are mixed, then equilibrium concentration of Fe^{+2} is found to be Y × 10^{-17} M. Y is:

Solution:

8.93 or 8.92

$$Fe^{2+} + S^{2-} \longrightarrow FeS$$

ini	0.06	0.2	0
After mix	0.03	0.1	
At 0 q/m	x	0.07	

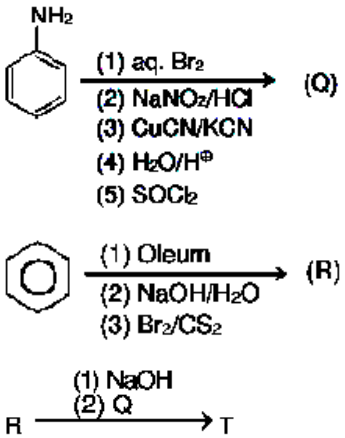
$$K_C = \frac{1}{(x)[0.07]} = 1.6\times10^{17}$$

$$\therefore \left[Fe^{2+}\right] = 8.928\times10^{-17}$$

$$= y\times10^{-17}$$

$$\therefore y = 8.93 \; or \; 8.92$$

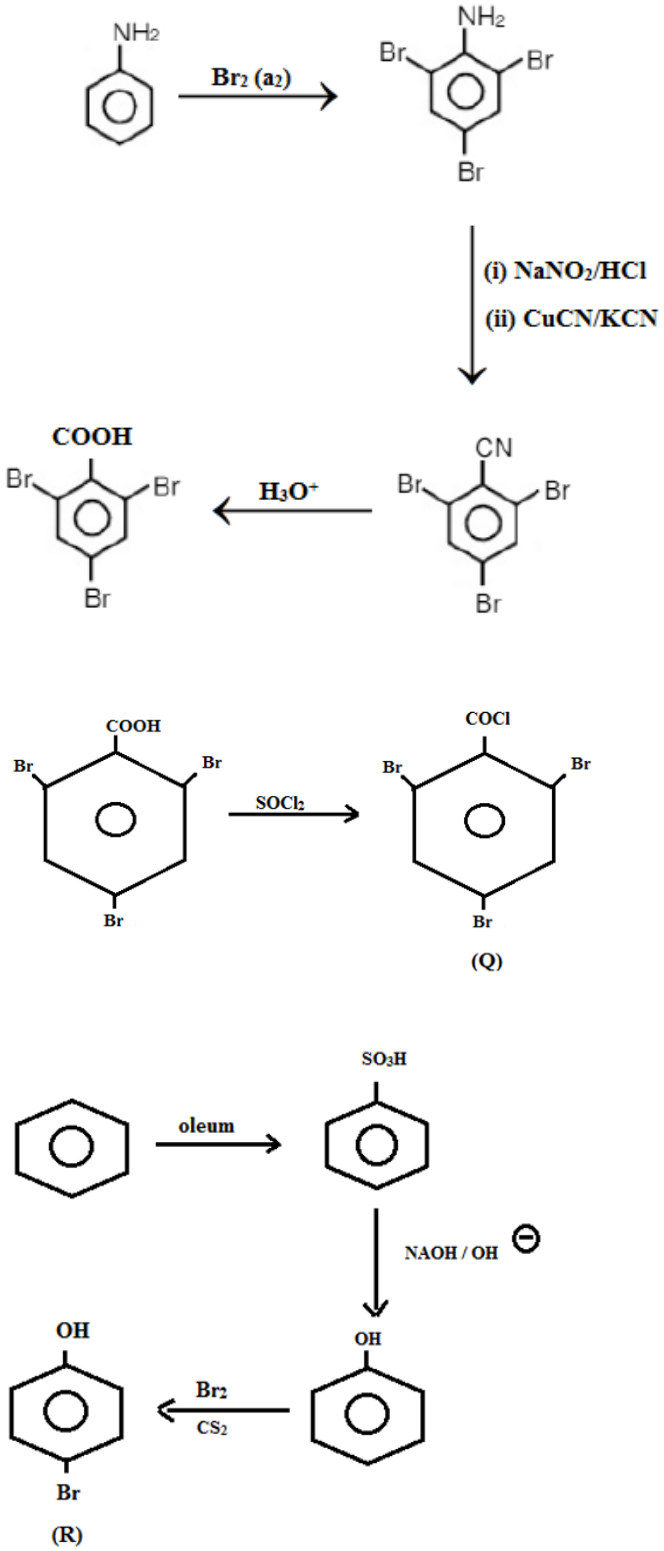
15.

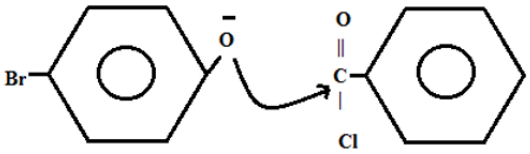


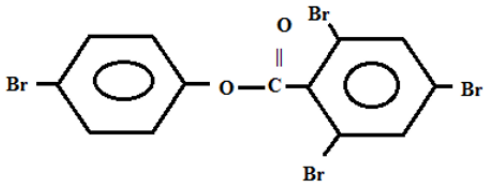
Number of atoms of Br in compound 'T'

Solution:

(4)


NH2
Br2 (a2)
NH2
Br
Br
Br
(i) NaNO2/HCl
(ii) CuCN/KCN
CN
Br
Br
Br
H3O+
COOH
Br
Br
Br
COOH
Br
Br
Br
SOCl2
COCl
Br
Br
Br
(Q)
SO3H
oleum
NAOH / OH
OH
OH
Br2
CS2
Br
(R)





(T)

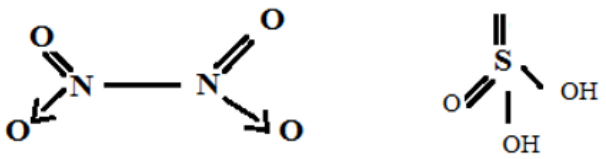
Total Br atoms = 4

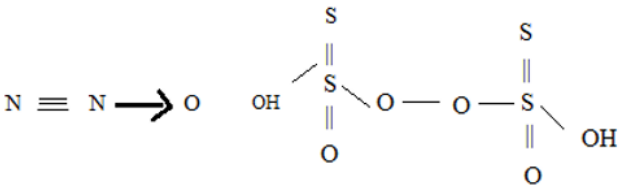
16. Which of the following compounds contain bond between same type of atoms.

$N_2O_4, B_3N_3H_6, H_2S_2O_3, N_2O, H_2S_2O_8, B_2H_6$

Solution:

$N_2O_4, H_2S_2O_3, N_2O, H_2S_2O_8$





17. A + B + C → Product

Ex. No	[A]	[B]	[C]	Rate of reaction
1.	0.2	0.1	0.1	6×10^{-5}
2.	0.2	0.2	0.1	6×10^{-5}
3.	0.2	0.1	0.2	1.2×10^{-4}

4.	0.3	0.1	0.1	9×10^{-5}

When [A] = 0.15

[B] = 0.25

[C] = 0.15

Rate of reaction is Y × 10^{-5} M/s Find Y.

Solution:

(6.75)

Let $r = K[A]^x [B]^y [C]^z$

From (1), (2) → y = 0

(1), (3) → z = 1

(1), (4) → x = 1

∴ rate law becomes

$$r = K[A]^1 [B]^0 [C]^1$$

From (2)

$$K = 3 \times 10^{-3}$$

When $[A] = 0.15, [B] = 0.25, [C] = 0.15$

$$r = 3 \times 10^{-3} [0.15]^1 [0.15]^1$$

$$= 6.75 \times 10^{-5} mol\, l^{-1} s^{-1}$$

$$\Rightarrow y \times 10^{-6}$$

$$\therefore y = 6.75$$

18. On dissolving 0.5 g of non-volatile, non-ionic solute to 39 g of benzene, its vapour pressure decreases from 650 mm of Hg to 640 mm of Hg. The depression of freezing point of benzene (in K) upon addition of the solute is _____.

[Given data: Molar mass & molar freezing point depression of benzene is 78 g mol^{-1} & 5.12 K Kg mol^{-1}]

Solution:

(1.02)

$$\frac{P^\circ - P_S}{P_S} = \frac{n_{solute}}{n_{solvent}}$$

$$\frac{650-640}{640} = \frac{1\times 0.5\times 78}{M\times 39}$$

$$\therefore M = 64g$$

$$\Delta T_f = K_f m = 5.12\times\frac{0.5\times 1000}{64\times 39}$$

$$\therefore \Delta T_f = 1.02$$