

PAPER-2 CHEMISTRY

MCQ

1. $X + Y^{2+} \longrightarrow X^{2+} + Y$; reaction is spontaneous

when X and Y are respectively:

$$\text{Ni}^{2+}/\text{Ni} = -0.24 \text{ V}$$

$$\text{Pb}^{2+}/\text{Pb} = -0.13 \text{ V}$$

$$\text{Fe}^{2+}/\text{Fe} = -0.44 \text{ V}$$

$$\text{Cd}^{2+}/\text{Cd} = -0.40 \text{ V}$$

$$\text{Given: } [X^{2+}] = 10^{-3} \text{ M,}$$

$$[Y^{2+}] = 10^{-1} \text{ M}$$

(A) Ni & Pb

(B) Cd & Fe

(C) Ni & Fe

(D) Pb & Cd

Ans. (AB)

Sol.
$$E = E^{\circ} - \frac{0.06}{2} \log_{10} \frac{10^{-3}}{10^{-1}}$$

$$\therefore E = E^{\circ} + 0.06$$

$$(A) E^{\circ} = (-0.13) - (-0.24) = 0.11 \quad \Rightarrow \quad E > 0$$

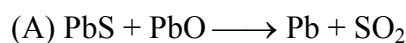
$$(B) E^{\circ} = (-0.44) - (-0.40) = 0.04 \quad \Rightarrow \quad E > 0$$

$$(C) E^{\circ} = (-0.44) - (-0.24) = -0.20 \quad \Rightarrow \quad E < 0$$

$$(D) E^{\circ} = (-0.40) - (-0.13) = -0.27 \quad \Rightarrow \quad E < 0$$

MCQ

2. Which of the following is/are correct?

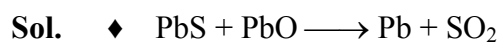


(B) SiO_2 is added in copper metallurgy to make copper silicate.

(C) In cyanide process, Zn dust is used to precipitate Au from $\text{Na}[\text{Au}(\text{CN})_2]$

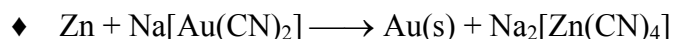
(D) In metallurgy of copper, partial roasting followed by self reduction gives blister copper.

Ans. (ACD)



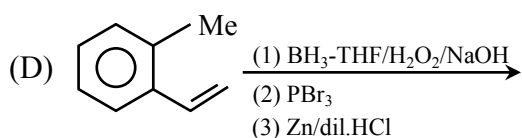
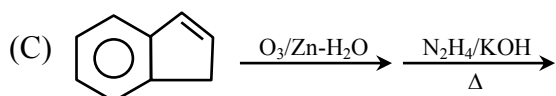
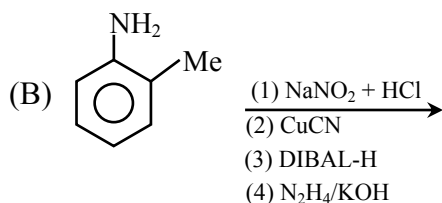
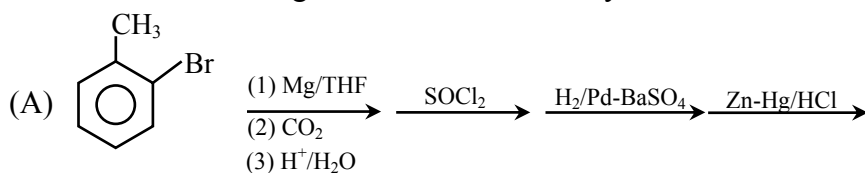
(Self reduction of Pb)

♦ In Cu metallurgy, SiO_2 is added to make FeSiO_3



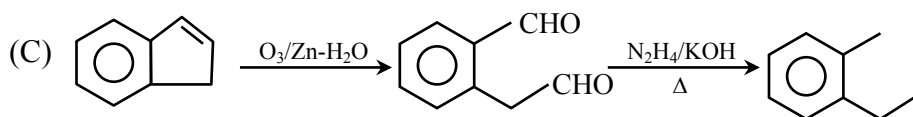
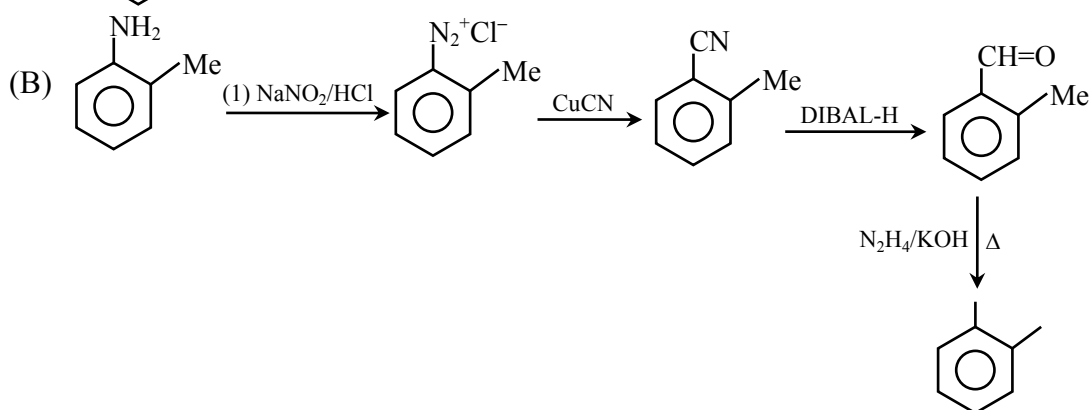
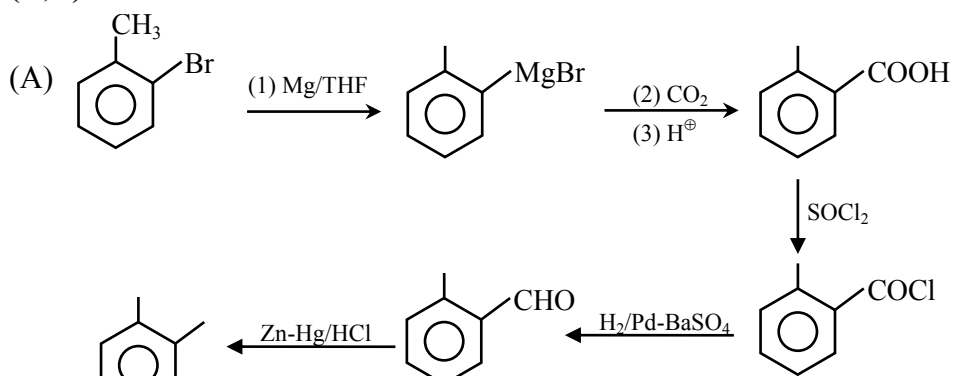
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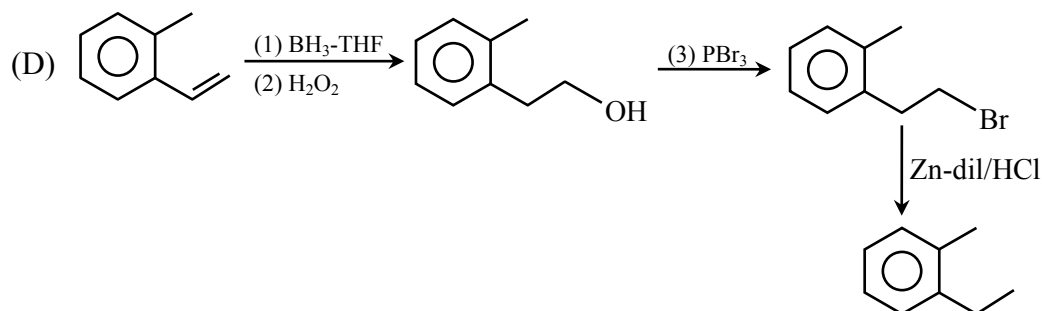
3. Which of the following reactions form ortho-xylene?



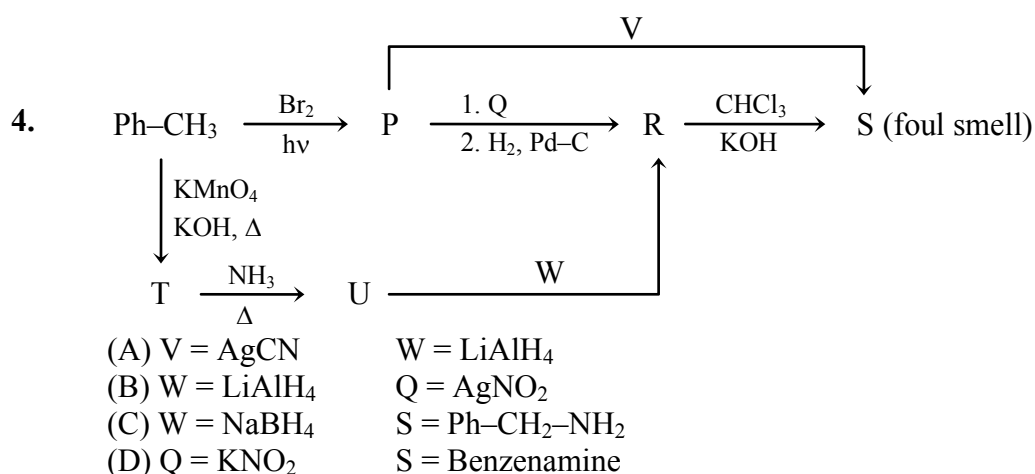
Ans. (A,B)

Sol.





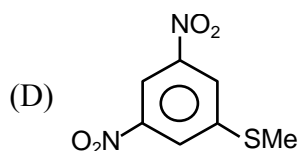
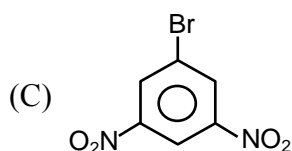
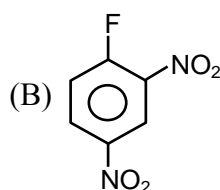
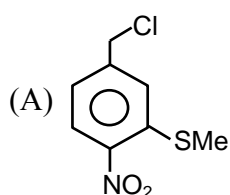
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Ans. (AB)

MCQ

5. Which of the following compounds react with $\text{Ph-S}^-\text{Na}^+$, followed by reaction with Na_2O_2 and BaCl_2 , gives positive carius test?



Ans. (AB)

Sol. Organic compound heated in a carius tube with sodium peroxide/fuming HNO_3 . Sulphur present in the compound is oxidised to sulphuric acid. When reacted with excess with $\text{BaCl}_2 \longrightarrow \text{BaSO}_4$ (precipitate is formed)

MCQ

6. In which of the following option/s both the complexes are tetrahedral?

- (A) $[\text{Cu}(\text{CN})_4]^{3-}$ $[\text{Cu}(\text{py})_4]^+$
 (B) $[\text{Ni}(\text{CO})_4]$ $[\text{Ni}(\text{CN})_4]^{2-}$
 (C) $[\text{Co}(\text{CO})_4]^-$ $[\text{CoCl}_4]^{2-}$
 (D) $[\text{Fe}(\text{CO})_4]^{2-}$ $[\text{FeCl}_4]^-$

Ans. (ABD)

Sol. $[\text{Cu}(\text{CN})_4]^{3-}$: sp^3
 $[\text{Cu}(\text{py})_4]^+$: sp^3
 $[\text{Ni}(\text{CO})_4]$: sp^3
 $[\text{Ni}(\text{CN})_4]^{2-}$: dsp^2
 $[\text{Co}(\text{CO})_4]^-$: sp^3
 $[\text{CoCl}_4]^{2-}$: sp^3
 $[\text{Fe}(\text{CO})_4]^{2-}$: sp^3
 $[\text{FeCl}_4]^-$: sp^3

MCQ

7. For a reaction $2x + y \longrightarrow \text{P}$ $\frac{d\text{P}}{dt} = k[x]$

Starting with 2 moles of x and 1 mole of y. At $t = 50$ sec y is found to be 0.5 mole.

Select correct options

(A) $\left(-\frac{dx}{dt}\right)_{t=50\text{sec}} = 13.86 \times 10^{-3}$

(B) $\left(-\frac{dy}{dt}\right)_{t=10\text{sec}} = 3.46 \times 10^{-3}$

(C) $K = 13.87 \times 10^{-4}$

(D) Half life = 50 sec

Ans. (ABD)

Sol.

	$2x$	+	y	\longrightarrow	P
$t = 0$	2mol		1mole		
$t = 50 \text{ sec}$	1mol		0.5 mole		

(A) $\frac{1}{2} \left(-\frac{dx}{dt}\right) = -\frac{dy}{dt} = \frac{d\text{P}}{dt} = k[x]$

$$\frac{-dx}{dt} = 2k[x]$$

$$= 2 \times \frac{\ln 2}{100} \times 1$$

$$= \frac{\ln 2}{50} = 13.86 \times 10^{-3}$$

$$(B) \left(-\frac{dy}{dt} \right) = k[x]$$

$$= \frac{\ln^2}{100} \times \frac{1}{2}$$

$$= \frac{0.693}{100} \times \frac{1}{2}$$

$$= 3.46 \times 10^{-3}$$

$$(D) \left(t_{\frac{1}{2}} \right)_x = \left(t_{\frac{1}{2}} \right)_y = 50 \text{ sec}$$

$$\frac{\ln 2}{2k} = 50$$

$$k = \frac{\ln 2}{100}$$

$$= \frac{0.693}{100}$$

$$= 6.93 \times 10^{-3}$$

MCQ

8. Which of the following options are correct -

(A) H_3PO_3 is a monobasic acid

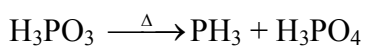
(B) P-H bond in H_3PO_3 is non ionisable in water

(C) $\text{H}_3\text{PO}_3 \xrightarrow{\Delta} \text{PH}_3 + \text{H}_3\text{PO}_4$

(D) H_3PO_3 can act as reducing agent while H_3PO_4 can not.

Ans. (C,D)

Sol. $\text{H}_3\text{PO}_3 \longrightarrow \text{H} \begin{array}{c} \text{O} \\ \parallel \\ \text{P} \\ | \\ \text{OH} \end{array} \text{OH}$, Basicity = 2



H_3PO_3 has phosphorous in (+)5 oxidation state so, cannot act as reducing agent.

Comprehension

5.6 g of an impure iron sample reacts completely with HCl and the solution is made upto 250 ml.

25 ml of this solution requires 12.5 ml of 0.03M KMnO_4

9. Determine number of moles of Fe^{2+} in $x \times 10^{-2}$ in original solution, then find out value of x.

Ans. 1.875

10. % purity of iron sample

Ans. 18.75 %

Sol. (1) $\text{Fe}^{2+} + \text{MnO}_4^- \longrightarrow \text{Mn}^{2+} + \text{Fe}^{3+}$

$$(\text{v.f.})_{\text{KMnO}_4} = 5$$

$$(\text{v.f.})_{\text{Fe}^{2+}} = 1$$

For 25 ml

$$\begin{aligned} \text{Meq of Fe}^{2+} &= \text{Meq of KMnO}_4 \\ &= 0.03 \times 5 \times 12.5 \end{aligned}$$

For 250 ml

$$\text{Meq of Fe}^{2+} = \frac{0.03 \times 5 \times 12.5}{25} \times 250$$

$$(\text{mole})_{\text{Fe}^{2+}} \times 1 \times 1000 = \frac{0.03 \times 5 \times 12.5 \times 250}{25}$$

$$(\text{mole})_{\text{Fe}^{2+}} = \frac{18.75}{1000} = 1.875 \times 10^{-2}$$

Ans. 1.875

(2) Weight of $\text{Fe}^{2+} = \frac{18.75}{1000} \times 56 = 1.05 \text{ gram}$

$$\begin{aligned} \% \text{ purity of Fe}^{2+} &= \frac{W_{\text{Fe}^{2+}}}{W_{\text{sample}}} \times 100 = \frac{1.05}{5.6} \times 100 \\ &= 18.75 \% \end{aligned}$$

Ans. 18.75 %

Comprehension

Limiting molar conductivity of weak monobasic acid (HA) is $4 \times 10^2 \text{ Scm}^2\text{mol}^{-1}$. Degree of dissociation of aq. solution of HA is α and its molar conductivity is $y \times 10^2 \text{ Scm}^2\text{mol}^{-1}$. On dilution to 20 times by adding water, molar conductivity changes to $3y \times 10^2 \text{ Scm}^2\text{mol}^{-1}$.

11. Calculate the value of α .

12. Calculate the value of y .

Sol. Original solution

$$\alpha_1 = \frac{\Lambda_m}{\Lambda_m^0} = \frac{y}{4} \quad \dots(1)$$

$$\frac{C_1 \alpha_1^2}{1 - \alpha_1} = K_a$$

$$\Rightarrow \frac{\alpha_1^2}{1 - \alpha_1} = \frac{K_a}{C_1} \quad \dots(2)$$

After dilution

$$\alpha_2 = \frac{3y}{4} \quad \dots(3)$$

$$\frac{C_2\alpha_2^2}{1-\alpha_2} = K_a$$

$$\Rightarrow \frac{\alpha_2^2}{1-\alpha_2} = \frac{K_a}{C_2} \quad \dots(4)$$

From (1) & (3)

$$\alpha_2 = 3\alpha_1$$

and $\frac{C_1}{C_2} = \frac{1}{20}$

Now (4) / (2)

$$\frac{\frac{\alpha_2^2}{1-\alpha_2}}{\frac{\alpha_1^2}{1-\alpha_1}} = \frac{K_a/C_2}{K_a/C_1} = \frac{C_1}{C_2}$$

$$\frac{\alpha_2^2}{1-\alpha_2} = 20 \frac{\alpha_1^2}{1-\alpha_1}$$

$$\frac{9\alpha_1^2}{1-3\alpha_1} = \frac{20\alpha_1^2}{1-\alpha_1}$$

$$9 - 9\alpha_1 = 20 - 60\alpha_1$$

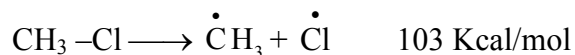
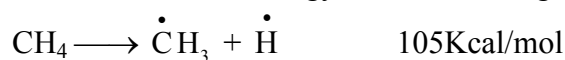
$$11 = 51\alpha_1$$

$$\Rightarrow \alpha_1 = \frac{11}{51} = 0.22$$

from (1) $y = 4\alpha = 0.86$

Comprehension

Bond dissociation energy of the following reactions are given.



Bond dissociation energy depends on stability of free radical & s-character.

13. Match the column



Ans. (P) \rightarrow (2) ; (Q) \rightarrow (1) ; (R) \rightarrow (4) ; (S) \rightarrow (3)

14. Which of the following is correct for chlorination of methane?

(A) Net reaction $\Delta H_{\text{reaction}} = 25$ and reaction is exothermic

(B) $\dot{\text{C}}\text{l} + \text{CH}_4 \longrightarrow \dot{\text{C}}\text{H}_3 + \text{HCl}; \Delta H = -2$

(C) $\dot{\text{C}}\text{H}_3 + \text{Cl}_2 \longrightarrow \text{CH}_3\dot{\text{C}}\text{l} + \dot{\text{C}}\text{l} \quad \Delta H = 47$

(D) None of above

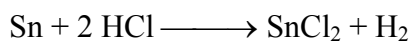
Ans. (A)

Integer

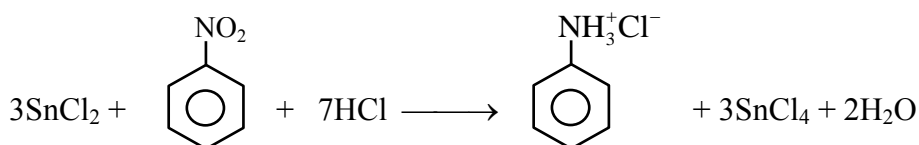
15. (X) gm of Sn dissolved in HCl and salt form is completely reacted with (Y) gm of Ph-NO₂ in HCl and organic salt form weigh 1.29 gm. Find (X) and (Y) :

Ans. X = 3.57, Y = 1.23

Sol. Moles of organic salt = $\frac{1.29}{129} = 0.01$



0.03 mole 0.03 mole



0.03 mole 0.01 mole 0.01 mole

$$W_{\text{Nitrobenzene}} = 0.01 \times 123 = 1.23 \text{ g}$$

$$W_{\text{Sn}} = 0.03 \times 119 = 3.57 \text{ g}$$

Integer

16. $\text{ClO}_2 \xrightarrow{\text{O}_3} \text{Product}$

Average oxidation state of Cl in product is -

Ans. +6

Sol. $\text{ClO}_2 + \text{O}_2 \longrightarrow \text{Cl}_2\text{O}_6 + \text{O}_2$

Integer

17. He atom is struck by photon of wavelength 330 nm. Determine change in velocity in cm/s?

$$N_A = 6 \times 10^{23}; \quad h = 6.6 \times 10^{-34}$$

Ans. 30

Sol. $m\Delta V = \frac{h}{\lambda}$

$$\frac{4}{6 \times 10^{23} \times 10^3} \Delta V = \frac{6.6 \times 10^{-34}}{330 \times 10^{-9}}$$

$$\Delta V = \frac{10^{-25}}{50} \times \frac{3 \times 10^{27}}{5 \times 4} = \frac{300}{250 \times 4} = 0.3 \text{ m/s}$$

$$= 30 \text{ cm/s}$$