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# JEE Advanced EXAMINATION - 2019

## PAPER-1

## PART-2 : CHEMISTRY

### SECTION-1 : (Maximum Marks : 12)

- This section contains **FOUR (04)** questions.
- Each question has **FOUR** options. **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme :

*Full Marks* : +3 If ONLY the correct option is chosen.
*Zero Marks* : 0 If none of the options is chosen (i.e. the question is unanswered)
*Negative Marks* : –1 In all other cases

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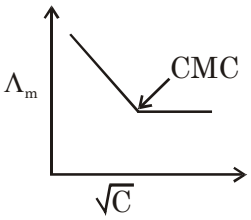
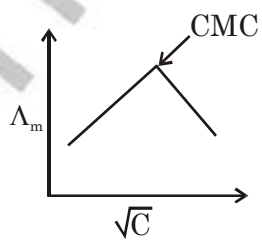
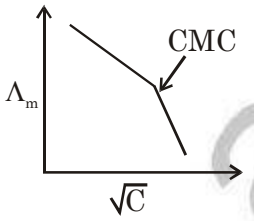
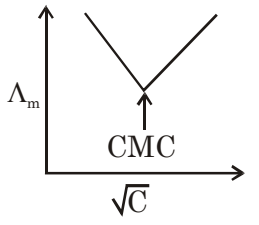
**1.** Molar conductivity ($\Lambda_m$) of aqueous solution of sodium stearate, which behaves as a strong electrolyte, is recorded at varying concentration(c) of sodium stearate. Which one of the following plots provides the correct representation of micelle formation in the solution ?

(Critical micelle concentration (CMC) is marked with an arrow in the figures.)

(1) 

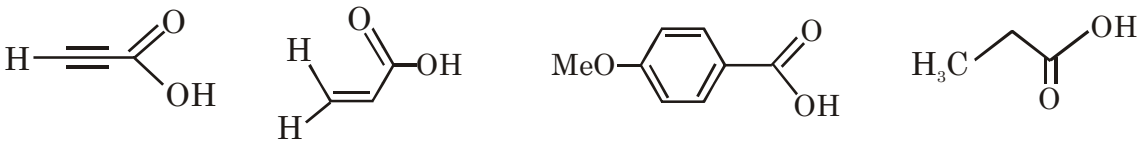

(2) 


(3) 


(4) 


**Ans. (3)**

**2.** The correct order of acid strength of the following carboxylic acids is -



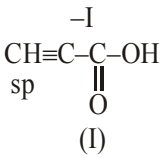

I II III IV

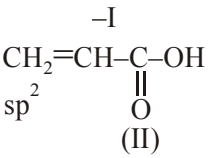
(1) I > III > II > IV (2) III > II > I > IV

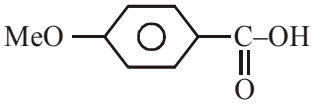
(3) II > I > IV > III (4) I > II > III > IV

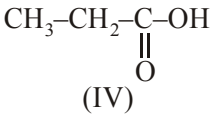
**Ans. (4)**

**Sol.** I > II > III > IV


(I)
(pKa value 1.86)


(II)
(pKa value 4.3)


(III)
(pKa value 4.5)


(IV)
(pKa value 4.88)

**3.** Calamine, malachite, magnetite and cryolite, respectively are

(1) $ZnSO_4$, $CuCO_3$, $Fe_2O_3$ , $AlF_3$ (2) $ZnCO_3$, $CuCO_3.Cu(OH)_2$, $Fe_3O_4$, $Na_3AlF_6$

(3) $ZnSO_4$, $Cu(OH)_2$, $Fe_3O_4$, $Na_3AlF_6$ (4) $ZnCO_3$, $CuCO_3$, $Fe_2O_3$, $Na_3AlF_6$

**Ans. (2)**

**Sol.**

| Ore | Formula |
|---|---|
| Calamine | $ZnCO_3$ |
| Malachite | $CuCO_3.Cu(OH)_2$ |
| Magnetite | $Fe_3O_4$ |
| Cryolite | $Na_3AlF_6$ |

So correct answer is option(2)

**4.** The green colour produced in the borax bead test of a chromium(III) salt is due to -

(1) $Cr(BO_2)_3$ (2) CrB (3) $Cr_2(B_4O_7)_3$ (4) $Cr_2O_3$

**Ans. (1)**

**Sol.** Chromium (III) salt $\xrightarrow{\Delta}$ $Cr_2O_3$

Borax $\xrightarrow{\Delta}$ $B_2O_3 + NaBO_2$

$2Cr_2O_3 + 6B_2O_3 \longrightarrow 4\ Cr(BO_2)_3$

So correct answer is option(1)

**SECTION-2 : (Maximum Marks: 32)**

- This section contains **EIGHT (08)** questions.
- Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all ) the correct answer(s)
- Answer to each question will be evaluated according to the following marking scheme:

*Full Marks* : +4 If only (all) the correct option(s) is (are) chosen.
*Partial Marks* : +3 If all the four options are correct but ONLY three options are chosen.
*Partial Marks* : +2 If three or more options are correct but ONLY two options are chosen and both of which are correct.
*Partial Marks* : +1 If two or more options are correct but ONLY one option is chosen and it is a correct option.
*Zero Marks* : 0 If none of the options is chosen (i.e. the question is unanswered).
*Negative Marks* : –1 In all other cases.

- For example, in a question, if (A), (B) and (D) are the ONLY three options corresponding to correct answers, then
  choosing ONLY (A), (B) and (D) will get +4 marks;
  choosing ONLY (A) and (B) will get +2 marks;
  choosing ONLY (A) and (D) will get +2 marks;
  choosing ONLY (B) and (D) will get +2 marks;
  choosing ONLY (A) will get +1 marks;
  choosing ONLY (B) will get +1 marks;
  choosing ONLY (D) will get +1 marks;
  choosing no option (i.e. the question is unanswered) will get 0 marks, and
  choosing any other combination of options will get –1 mark.

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**1.** Fusion of $MnO_2$ with KOH in presence of $O_2$ produces a salt **W**. Alkaline solution of **W** upon eletrolytic oxidation yields another salt **X**. The manganese containing ions present in **W** and **X**, respectively, are **Y** and **Z**. Correct statement(s) is (are)

(1) **Y** is diamagnetic in nature while **Z** is paramagnetic

(2) Both **Y** and **Z** are coloured and have tetrahedral shape

(3) In both **Y** and **Z** , π-bonding occurs between p-orbitals of oxygen and d-orbitals of manganese.

(4) In aqueous acidic solution, **Y** undergoes disproportionation reaction to give **Z** and $MnO_2$.

**Ans. (2,3,4)**

**Sol.** $MnO_2 + 2KOH + \frac{1}{2}O_2 \xrightarrow{\Delta} \underset{(W)}{K_2MnO_4} + H_2O$

$$\left[(W) = K_2MnO_{4(aq)} \rightleftharpoons 2K^{\oplus}_{(aq)} + \underset{(Y)}{MnO^{2-}_{4(aq)}}\right]$$

$$K_2MnO_4 + H_2O \xrightarrow[\text{Redox}]{\text{Electolytic}} H_2 + KOH + \underset{(X)}{KMnO_4}$$

[anion of X = $\underset{(Z)}{MnO_4^-}$]

$$\left[\because \underset{(Y)}{MnO_4^{2-}} \xrightarrow[\text{Oxidation}]{\text{Electrolytic}} \underset{(Z)}{MnO_4^-} + e^-\right]$$

$\because$ In acidic solution; Y undergoes disproportionation reaction

$$\left[3\underset{(Z)}{MnO^{2-}_{4(aq)}} + 4H^{\oplus} \longrightarrow 2MnO_4^- + MnO_2 + 2H_2O\right]$$

**2.** Which of the following statement(s) is (are) correct regarding the root mean square speed ($U_{rms}$) and average translational kinetic energy ($\varepsilon_{av}$) of a molecule in a gas at equilibrium ?

(1) $U_{rms}$ is doubled when its temperature is increased four times

(2) $\varepsilon_{av}$ at a given temperature does not depend on its molecular mass

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

(4) $\varepsilon_{av}$ is doubled when its temperature is increased four times

**Ans. (1,2,3)**

**Sol.** $U_{rms} = \sqrt{\frac{3RT}{M}}$

$E_{avg} = \frac{3}{2}kT$

**3.** In the decay sequence :

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

$x_1$, $x_2$, $x_3$ and $x_4$ are particles/ radiation emitted by the respective isotopes. The correct option(s) is/are-

(1) Z is an isotope of uranium

(2) $x_2$ is $\beta^-$

(3) $x_1$ will deflect towards negatively charged plate

(4) $x_3$ is $\gamma$-ray

**Ans. (1,2,3)**

**Sol.** $_{92}U^{238} \longrightarrow {}_{90}Th^{234} + {}_2He^4(\text{or } \alpha) \text{ or } x_1$

$\downarrow$

$_{91}Pa^{234} + \beta^-(\text{or } {}_{-1}e^\circ) \text{ or } x_2$

$\downarrow$

$_{92}Z^{234} + \beta^-(\text{or } {}_{-1}e^\circ) \text{ or } x_3$

$\downarrow$

$_{90}Th^{230} + {}_2He^4(\text{or } \alpha) \text{ or } x_4$

U and Z are isotopes

**4.** Which of the following statement(s) is(are) true ?

(1) Oxidation of glucose with bromine water gives glutamic acid

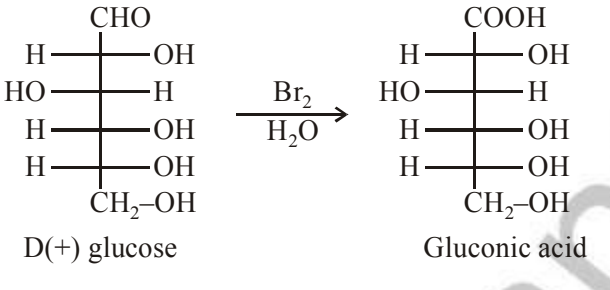
(2) The two six-membered cyclic hemiacetal forms of D-(+)-glucose ard called anomers

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

(4) Monosaccharides **cannot** be hydrolysed to give polyhydroxy aldehydes and ketones

**Ans. (2,3,4)**

**Sol.** (1) **FALSE :**




D(+) glucose Gluconic acid

(2) **TRUE :** Six member hemiacetal on anomeric carbon gives α-D glucose & β-D glucose.

(3) **TRUE :** $C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{Glucose (+)}}{C_6H_{12}O_6} + \underset{\text{Fructose (–)}}{C_6H_{12}O_6}$

(4) **TRUE :** Monosaccharide cannot be hydrolysed to give polyhydroxy aldehydes and ketones

**5.** A tin chloride **Q** undergoes the following reactions (not balanced)

**Q** + $Cl^- \rightarrow$ **X**

**Q** + $Me_3N \rightarrow$ **Y**

**Q** + $CuCl_2 \rightarrow$ **Z** + CuCl

X is a monoanion having pyramidal geometry. Both **Y** and **Z** are neutral compounds. Choose the correct option(s).

(1) The central atoms in **X** is $sp^3$ hybridized

(2) The oxidation state of the central atom in **Z** is +2

(3) The central atom in **Z** has one lone pair of electrons

(4) There is a coordinate bond in **Y**

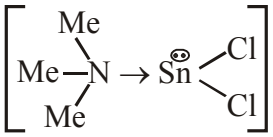
**Ans. (1,4)**

**Sol.** $SnCl_2 + Cl^- \longrightarrow SnCl_3^-$

**(Q)** **(X)**

$SnCl_2 + Me_3N \longrightarrow SnCl_2.NMe_3$

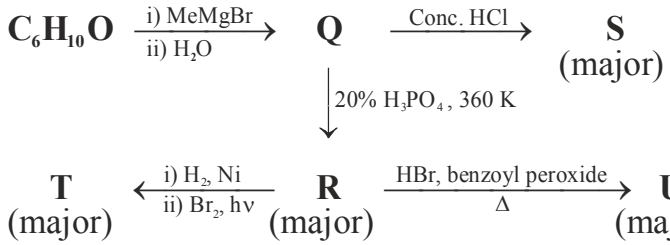
**(Q)** **(Y)**

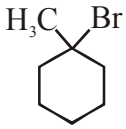
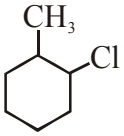


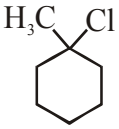
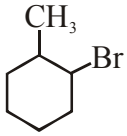

$SnCl_2 + 2CuCl_2 \longrightarrow SnCl_4 + 2CuCl$

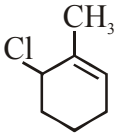
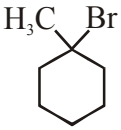
**(Q)** **(Z)**

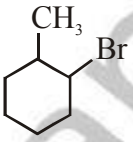
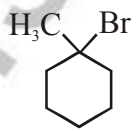
**6.** Choose the correct option(s) for the following set of reactions



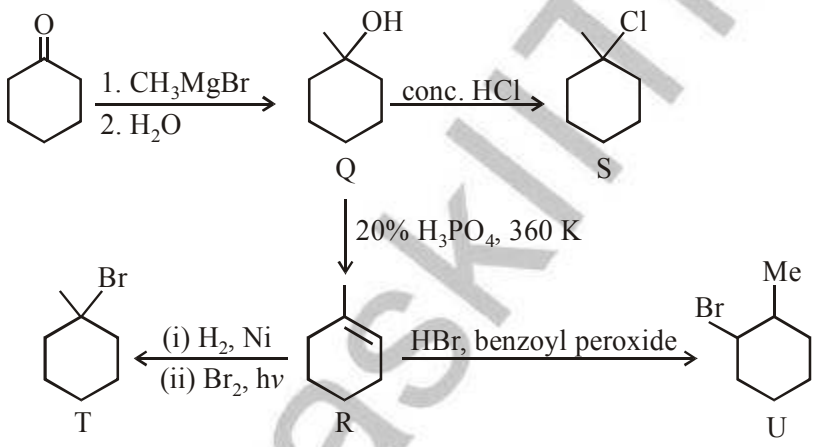

(1)  **U**  **S**

(2)  **S**  **U**

(3)  **S**  **T**

(4)  **U**  **T**

**Ans. (2,4)**

**Sol.** 


**7.** Each of the following options contains a set of four molecules. Identify the option(s) where all four molecules possess permanent dipole moment at room temperature.

(1) $BeCl_2$, $CO_2$, $BCl_3$, $CHCl_3$

(2) $SO_2$, $C_6H_5Cl$, $H_2Se$, $BrF_5$

(3) $BF_3$, $O_3$, $SF_6$, $XeF_6$

(4) $NO_2$, $NH_3$, $POCl_3$, $CH_3Cl$

**Ans. (2,4)**

**Sol.** Polar molecule

$CHCl_3$, $SO_2$, $C_6H_5Cl$,

$H_2Se$, $BrF_5$, $O_3$, $XeF_6$,

$NO_2$, $NH_3$, $POCl_3$, $CH_3Cl$

So correct answer is option (2) and (4)

Non-polar molecule

$BeCl_2$, $CO_2$, $BCl_3$, $SF_6$

**8.** Choose the reaction(s) from the following options, for which the standard enthalpy of reaction is equal to the standard enthalpy of formation.

(1) $\frac{3}{2}O_2(g) \rightarrow O_3(g)$ (2) $\frac{1}{8}S_8(s) + O_2(g) \rightarrow SO_2(g)$

(3) $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ (4) $2C(g) + 3H_2(g) \rightarrow C_2H_6(g)$

**Ans. (1,2)**

**Sol.** Enthalpy of formation is defined as enthalpy change for formation of 1 mole of substance from its elements, present in their natural most stable form.

**SECTION-3 : (Maximum Marks: 18)**

- This section contains **SIX (06)** questions. The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **Two** decimal places.
- Answer to each question will be evaluated according to the following marking scheme:

*Full Marks* : +3 If ONLY the correct numerical value is entered.

*Zero Marks* : 0 In all other cases.

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**1.** For the following reaction, the equilibrium constant $K_c$ at 298 K is $1.6 \times 10^{17}$.

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

When equal volumes of 0.06 M $Fe^{2+}(aq)$ and 0.2 M $S^{2-}(aq)$ solutions are mixed, the equilibrium concentration of $Fe^{2+}(aq)$ is found to be $\mathbf{Y \times 10^{-17}}$ **M**. The value of Y is ————

**Ans. (8.92 or 8.93)**

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

0.03 M 0.1 M

(0.03–x) (0.1–x)

$\simeq y$ $\simeq 0.07$

$K_c >> 10^3 \Rightarrow 0.03–x \simeq 0 \simeq y$

$\Rightarrow x = 0.03$

$$K_c = 1.6 \times 10^{17} = \frac{1}{y \times 0.07}$$

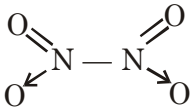
$$y = \frac{10^{-17}}{1.6 \times 0.07} = 8.928 \times 10^{-17} = Y \times 10^{-17}$$

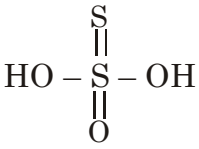
$\boxed{y \simeq 8.93}$

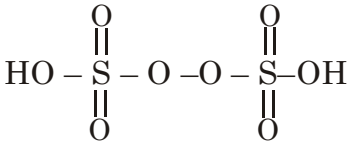
**2.** Among $B_2H_6$, $B_3N_3H_6$, $N_2O$, $N_2O_4$, $H_2S_2O_3$ and $H_2S_2O_8$, the total number of molecules containing covalent bond between two atoms of the same kind is ————

**Ans. (4.00)**

**Sol.** $N \equiv N \rightarrow O$







So correct answer is 4

**3.** Consider the kinetic data given in the following table for the reaction A + B + C → Product.

| Experiment No. | [A] (mol $dm^{-3}$) | [B] (mol $dm^{-3}$) | [C] (mol $dm^{-3}$) | Rate of reaction (mol $dm^{-3}$ $s^{-1}$) |
|---|---|---|---|---|
| 1 | 0.2 | 0.1 | 0.1 | $6.0 \times 10^{-5}$ |
| 2 | 0.2 | 0.2 | 0.1 | $6.0 \times 10^{-5}$ |
| 3 | 0.2 | 0.1 | 0.2 | $1.2 \times 10^{-4}$ |
| 4 | 0.3 | 0.1 | 0.1 | $9.0 \times 10^{-5}$ |

The rate of the reaction for [A] = 0.15 mol $dm^{-3}$, [B] = 0.25 mol $dm^{-3}$ and [C] = 0.15 mol $dm^{-3}$ is found to be **Y** $\times 10^{-5}$ mol $dm^{-3}$ $s^{-1}$. The value of **Y** is ————

**Ans. (6.75)**

**Sol.** $r = K[A]^{n_1}[B]^{n_2}[C]^{n_3}$

From table

$n_1 = 1$

$n_2 = 0$

$n_3 = 1$

$r = K[A][C]$

From Exp-1

$6 \times 10^{-5} = K \times 0.2 \times 0.1$

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

$r = (3 \times 10^{-3}) \times 0.15 \times 0.15$

$= 6.75 \times 10^{-5}$

$= Y \times 10^{-5}$

$Y = 6.75$

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

(Given data : Molar mass and the molal freezing point depression constant of benzene are 78 g $mol^{-1}$ and 5.12 K kg $mol^{-1}$, respectively)

**Ans. (1.02 or 1.03)**

**Sol.** $$\frac{P^o - P_s}{P^o} = \frac{n_{solute}}{n_{solute} + n_{solvent}}$$

$$\frac{650 - 640}{650} = \frac{n_{solute}}{n_{solute} + 0.5}$$

$$n_{solute} = \left(\frac{5}{640}\right)$$

$$\text{Molality} = \frac{5 \times 1000}{640 \times 39}$$

$$\Delta T_f = m \times K_b$$

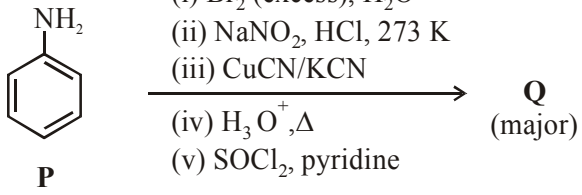
$$= \frac{5.12 \times 5 \times 1000}{640 \times 39}$$

$$= 1.0256$$

$$\boxed{\Delta T_f \approx 1.03}$$

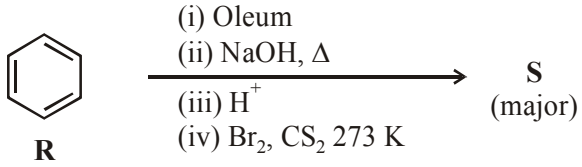
**5.** Scheme 1 and 2 describe the conversion of **P** to **Q** and **R** to **S**, respectively. Scheme 3 describes the synthesis of **T** from **Q** and **S**. The total number of Br atoms in a molecule of **T** is _____

**Scheme 1 :**

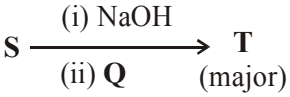



**P**

**Scheme 2 :**

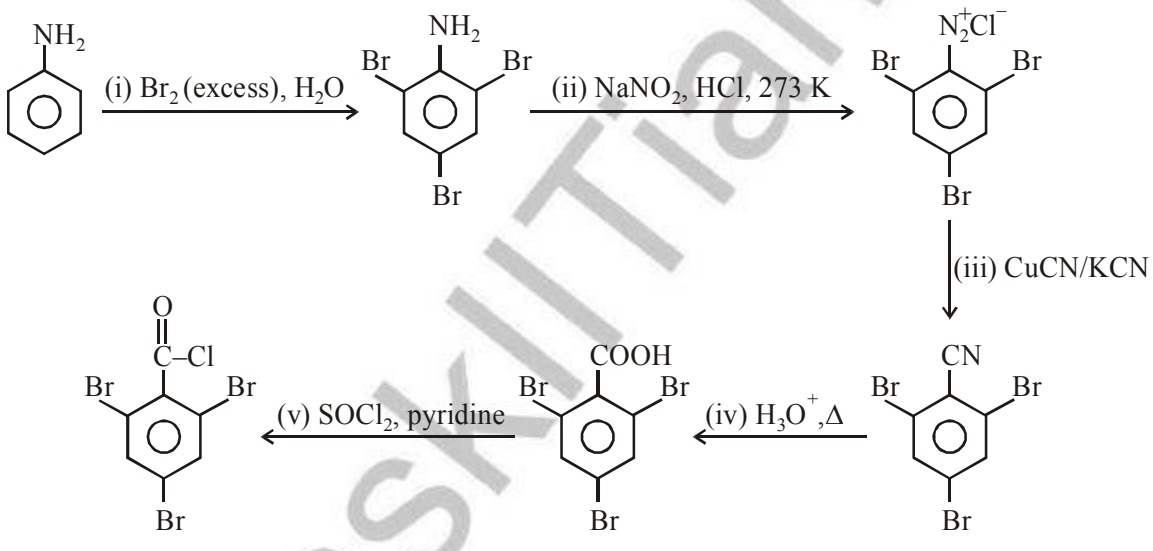



**Scheme 3 :**

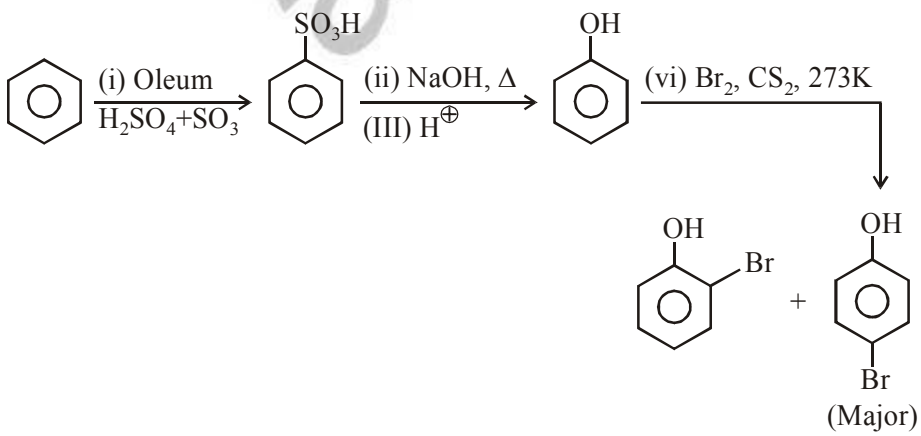



**Ans. (4.00)**

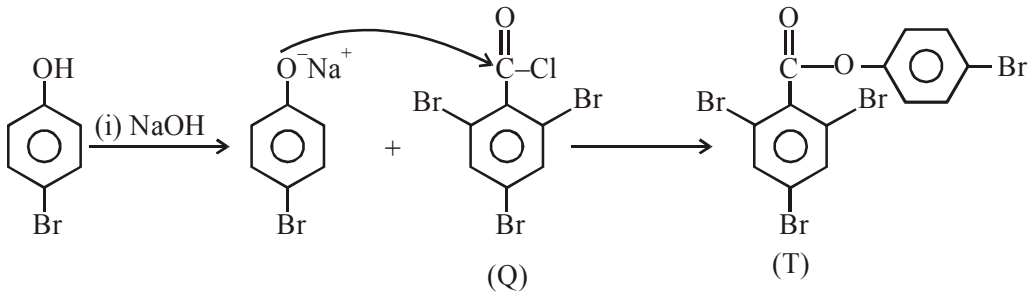
**Sol. Scheme 1 :**




**Scheme 2 :**



**Scheme 3 :**




**6.** At 143 K. the reaction of $XeF_4$ with $O_2F_2$ produces a xenon compound **Y**. The total number of lone pair(s) of electrons present on the whole molecule of **Y** is _____

**Ans. (19.00)**

**Sol.** $XeF_4 + O_2F_2 \rightarrow \underset{Y}{XeF_6} + O_2$

Y has 3 lone pair of electron in each fluorine and one lone pair of electron in xenon.

Hence total lone pair of electrons is 19.

Ans.(19)