FINAL JEE(Advanced) EXAMINATION - 2019

(Held On Monday 27th MAY, 2019)

PAPER-1 | **TEST PAPER WITH ANSWER & SOLUTION**

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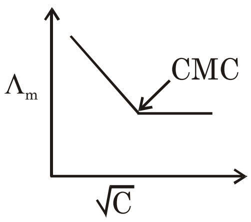
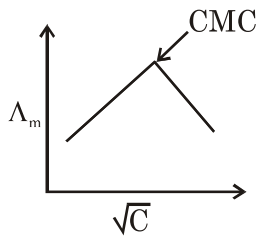
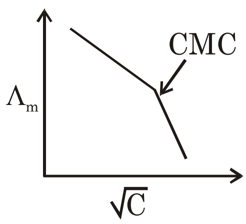
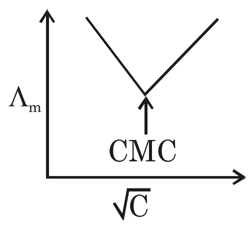
1. Molar conductivity (Λ_m) of aqueous solution of sodium stearate, which behaves as a strong electrolyte, is recorded at varying concentration(c) of sodium stearate. Which one of the following plots provides the correct representation of micelle formation in the solution ?

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

(1)


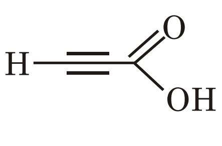
(2)


(3)


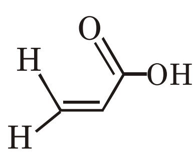
(4)


Ans. (3)

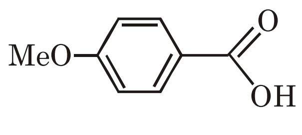
2. The correct order of acid strength of the following carboxylic acids is -



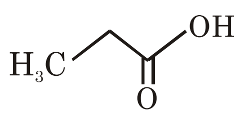
I



II



III

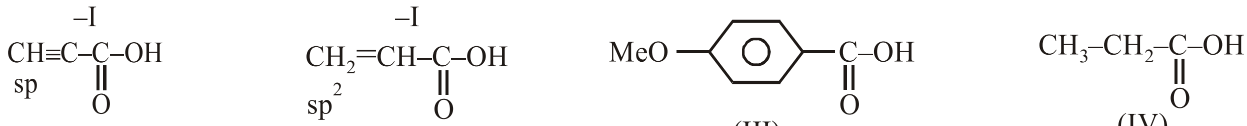


IV

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

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

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

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

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

∵ In acidic solution; Y undergoes disproportionation reaction

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

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

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

(2) ε_{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) ε_{av} is doubled when its temperature is increased four times

Ans. (1,2,3)

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

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

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 β^-

(3) x_1 will deflect towards negatively charged plate

(4) x_3 is γ-ray

Ans. (1,2,3)

Sol. ${}_{92}U^{238} \longrightarrow {}_{90}Th^{234} + {}_{2}He^{4}(\text{or } \alpha) \text{ or } x_1$

$\downarrow$

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

$\downarrow$

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

$\downarrow$

${}_{90}Th^{230} + {}_{2}He^{4}(\text{or } \alpha) \text{ or } x_4$

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

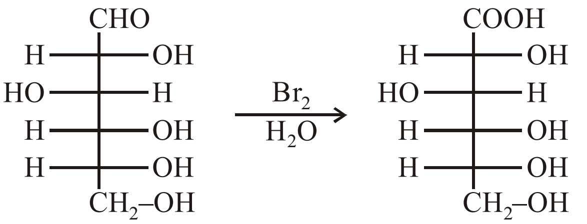
(2) The two six-membered cyclic hemiacetal forms of D-(+)-glucose ard called anomers

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

(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^- → **X**

Q + Me_3N → **Y**

Q + $CuCl_2$ → **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

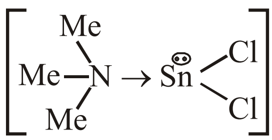
(3) The central atom in **Z** has one lone pair of electrons

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

Ans. **(1,4)**

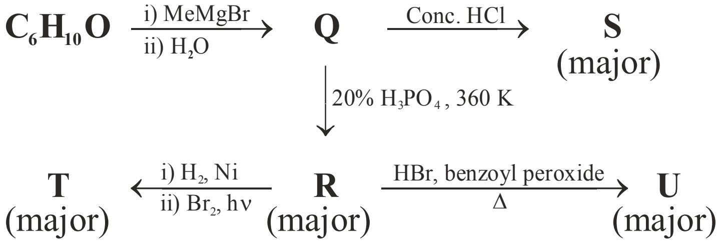
Sol. $\underset{\textbf{(Q)}}{SnCl_2} + Cl^- \longrightarrow \underset{\textbf{(X)}}{SnCl_3^-}$

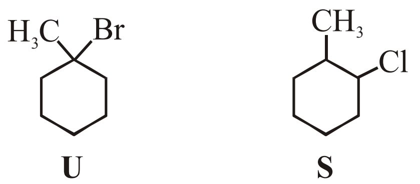
$\underset{\textbf{(Q)}}{SnCl_2} + Me_3N \longrightarrow \underset{\textbf{(Y)}}{SnCl_2.NMe_3}$

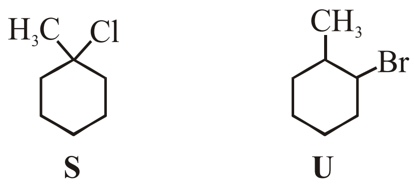


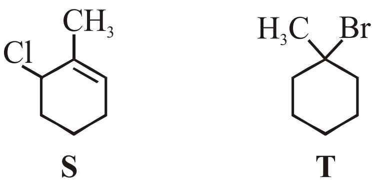
$\underset{\textbf{(Q)}}{SnCl_2} + 2CuCl_2 \longrightarrow \underset{\textbf{(Z)}}{SnCl_4} + 2CuCl$

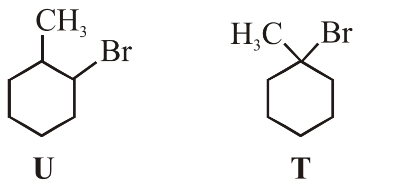
6. Choose the correct option(s) for the following set of reactions



(1) 

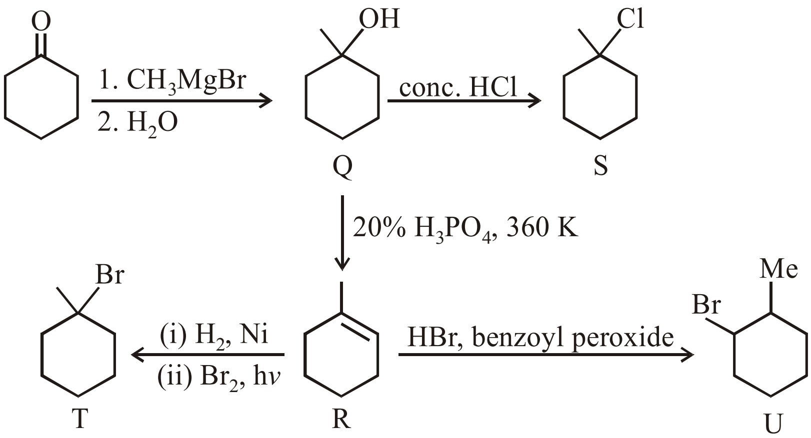
(2) 

(3) 

(4) 

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

Non-polar molecule

$BeCl_2$, CO_2, BCl_3, SF_6

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

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 1.6×10^{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. $Fe^{+2}_{(aq.)} \quad + \quad S^{-2}_{(aq.)} \quad \rightleftharpoons \quad FeS(s)$

0.03 M   0.1 M

(0.03–x)   (0.1–x)

$\simeq y$ $\simeq 0.07$

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

$\Rightarrow x = 0.03$

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

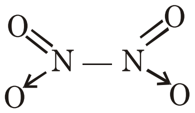
$$y = \frac{10^{-17}}{1.6 \times 0.07} = 8.928 \times 10^{-17} = Y \times 10^{-17}$$

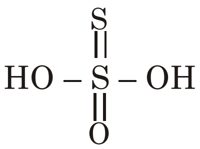
$\boxed{y \simeq 8.93}$

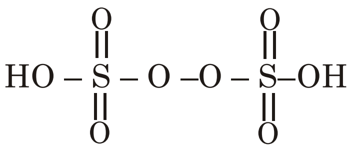
2. Among B_2H_6, $B_3N_3H_6$, N_2O, N_2O_4, $H_2S_2O_3$ and $H_2S_2O_8$, the total number of molecules containing covalent bond between two atoms of the same kind is ————

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	6.0×10^{-5}
2	0.2	0.2	0.1	6.0×10^{-5}
3	0.2	0.1	0.2	1.2×10^{-4}
4	0.3	0.1	0.1	9.0×10^{-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** × 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. $$\frac{P^o - P_s}{P^o} = \frac{n_{solute}}{n_{solute} + n_{solvent}}$$

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

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

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

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

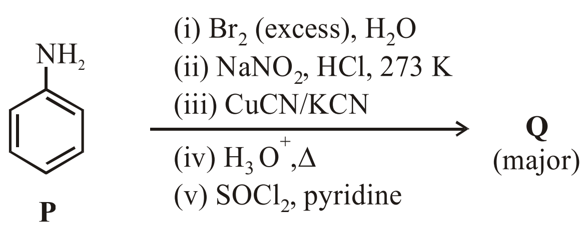
$$= \frac{5.12 \times 5 \times 1000}{640 \times 39}$$

$$= 1.0256$$

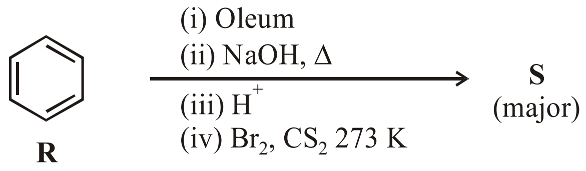
$$\boxed{\Delta T_f \approx 1.03}$$

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 ________

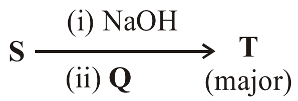
Scheme 1 :



Scheme 2 :

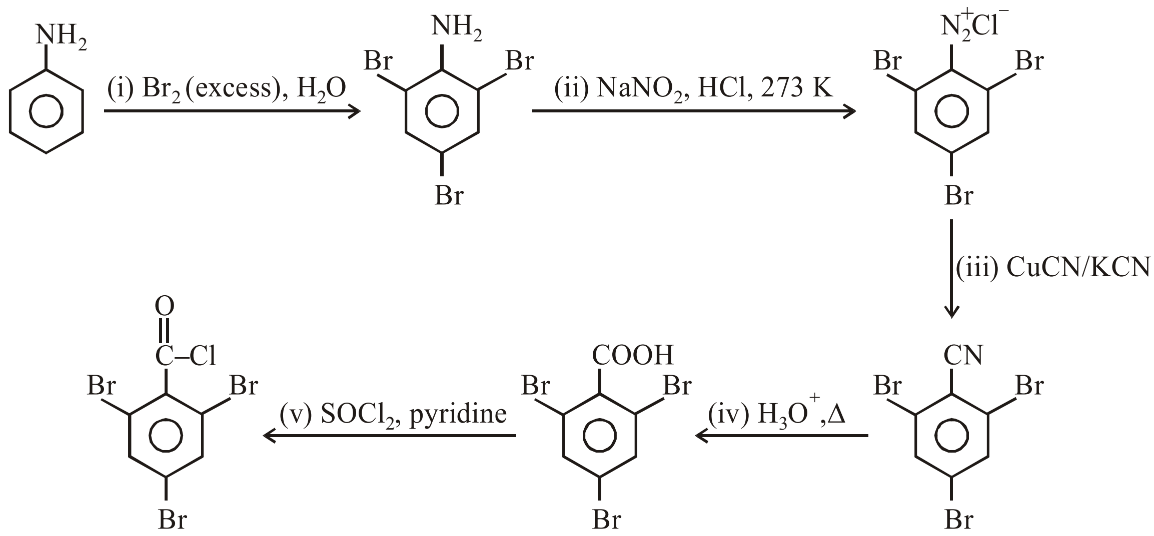


Scheme 3 :

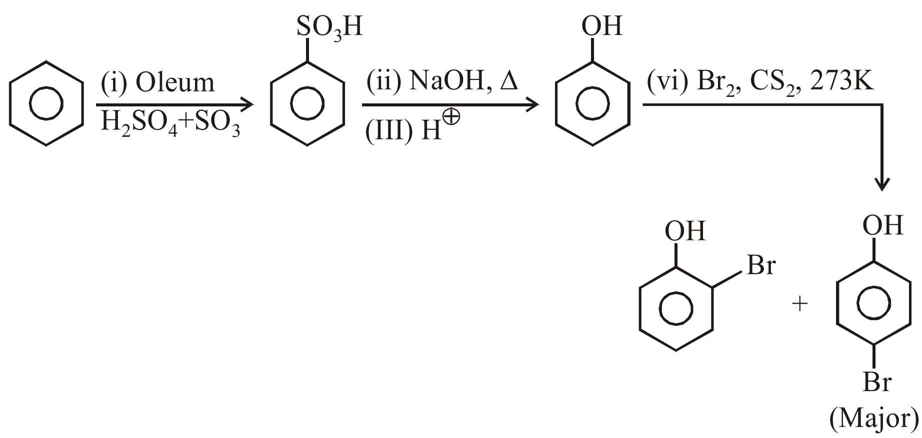


Ans. **(4.00)**

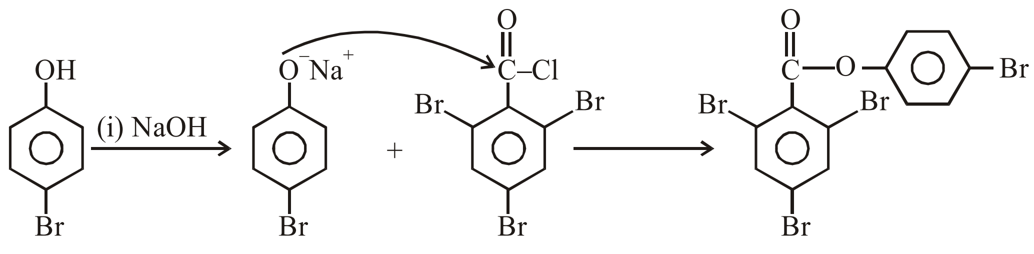
Sol. **Scheme 1 :**



Scheme 2 :



Scheme 3 :



(Q) (T)

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)