CAREER POINT

JEE Advanced Exam 2019
(Paper & Solution)

Date : 27 / 05 / 2019

PAPER-1

PART-I (CHEMISTRY)

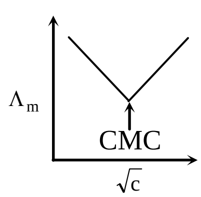
SECTION – 1 (Maximum Marks : 12)

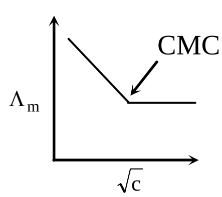
- This section contains **FOUR (04)** questions
- Each question has **FOUR** options. **ONLY ONE** of these four options is correct answer.
- For each question, choose the correct option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking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

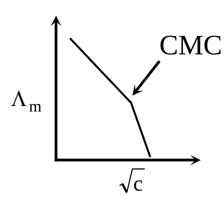
Full Marks	: **+3**	If ONLY the correct option is chosen.
Zero Marks	: **0**	If none of the options is chosen (i.e. the question is unanswered).
Negative Marks	: **–1**	In all other cases.

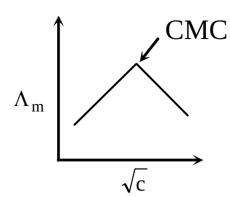
Q.1 Molar conductivity (Λ_m) of aqueous solution of sodium stearate, which behaves as a strong electrolyte, is recorded at varying concentrations (c) of sodium stearate. Which one of the following plots provides the correct representation of micelle formation in the solution ?

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

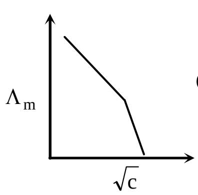
(1) 

(2) 

(3) 

(4) 

Ans. **[3]**

Sol. 

$C_{17}H_{35}COO^{-}Na^{+}$

After CMC, as the conc. increases the aggregation of sodium stearate occurs & Λ_m decreases.

Q.2 Calamine, malachite, magnetite and cryolite, respectively, are -

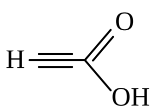
(1) $ZnCO_3$, $CuCO_3$, Fe_2O_3, Na_3AlF_6 (2) $ZnSO_4$, $CuCO_3$, Fe_2O_3, AlF_3

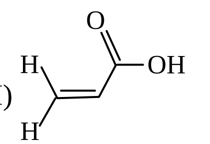
(3) $ZnSO_4$, $Cu(OH)_2$, Fe_3O_4, Na_3AlF_6 (4) $ZnCO_3$, $CuCO_3 \cdot Cu(OH)_2$, Fe_3O_4, Na_3AlF_6

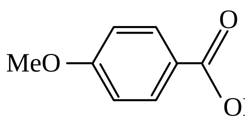
Ans. **[4]**

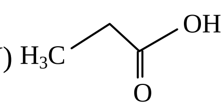
Sol. Calamine = $ZnCO_3$
Malachite = $CuCO_3 \cdot Cu(OH)_2$
Magnetite = Fe_3O_4
Cryolite = Na_3AlF_6

Q.3 The correct order of acid strength of the following carboxylic acids is –

(I) 

(II) 

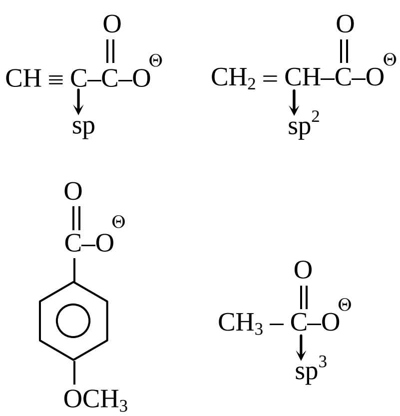
(III) 

(IV) 

(1) I > II > III > IV (2) III > II > I > IV (3) II > I > IV > III (4) I > III > II > IV

Ans. **[1]**

Sol.



I > II > III > IV

Acidic strength $\propto$ stability of conjugate anion

Q.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_2O_3 (4) $Cr_2(B_4O_7)_3$

Ans. **[1]**

Sol. $Na_2B_4O_7 \cdot 10\,H_2O \xrightarrow{\Delta} Na_2B_4O_7 \xrightarrow{\Delta} NaBO_2 + B_2O_3$

$Cr^{3+} + B_2O_3 \rightarrow \underset{\text{Green}}{Cr(BO_2)_3}$

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 option(s).
- For each question, choose(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, both of which are correct options.
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 option is chosen (i.e. the question is unanswered).
Negative Marks	: **–1**	In all other cases.

Q.1 Which of the following statement(s) is (are) true ?

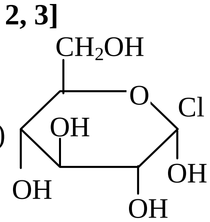
(1) The two six-membered cyclic hemiacetal froms of D–(+)– glucose are called anomers

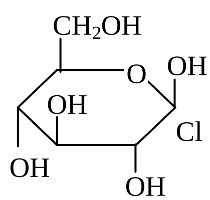
(2) Hydrolysis of sucrose gives dextrorotatory glucose and laevorotatory fructose

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

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

Ans. **[1, 2, 3]**

Sol. (a) 



C_1 is annomeric carbon

(b) $C_{12}H_{22}O_{11} \xrightarrow{H_2O} \underset{\text{(eavulose)}}{C_6H_{12}O_6} + \underset{\text{(Dextross)}}{C_6H_{12}O_6}$

(c) $C_6H_{12}O_6 + H_2O \rightarrow$ No reaction

(d) $C_6H_{12}O_6 + Br_2$ water $\rightarrow$ gluconic acid

Q.2 Choose the reaction(s) from the following option, for which the standard enthalpy of reaction is equal to the standard enthalpy of formation-

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

(2) $2C(g) + 3H_2(g) \rightarrow C_2H_6(g)$

(3) $2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$

(4) $\frac{3}{2}O_2(g) \rightarrow O_3(g)$

Ans. **[1,4]**

Sol. Standard Heat of
Formation (1 mole)

$\frac{1}{8}S_8(s) + O_2(g) \rightarrow SO_2(g)$ it represents standard enthalpy of formation

$2C(g) + 3H_2(g) \rightarrow \underset{(g)}{C_2H_6}$ carbon is not present in elementary state

(C graphite is not present)

$\underset{(g)}{2H_2} + \underset{(g)}{O_2} \rightarrow \underset{(e)}{2H_2O}$ 2 mol product is formed

$\frac{3}{2}\underset{(g)}{O_2} \rightarrow \underset{(g)}{O_3}$ It represent standard enthalpy of formation

Q.3 An 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 monanion having pyramidal geometry. Both Y and Z are neutral compounds. Choose the correct options (s)

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

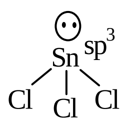
(2) There is a coordinate bond in Y

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

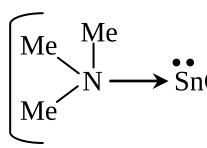
(4) The central atom in X is sp3 hybridized

Ans. **[2, 4]**

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



$SnCl_2 + Me_3N \longrightarrow SnCl_2 \cdot [NMe_3]$



bonded with coordinte bond

(Q) (X)

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

Q.4 Fusion of MnO_2 with KOH in presence of O_2 produces a salt W. Alkaline solution of W upon electrolytic 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) Both Y and Z are coloured and have tetrahedral shape

(2) Y is diamagnetic in nature while Z is paramagnetic

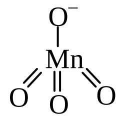
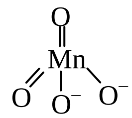
(3) In both Y and Z, π-bonding occurs between p-orbitals of oxygen and d-orbitals of manganese

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

Ans. **[1,3,4]**

Sol. $MnO_2 \xrightarrow[\text{KOH with } O_2]{\text{Fused with}} \underset{\text{Green}}{K_2MnO_4}$ $\underset{(W)}{K_2MnO_4(aq)} \rightleftharpoons 2K^+_{(aq)} + \underset{(y)}{MnO_4^{-2}(aq)}$

$K_2MnO_4 \xrightarrow[\text{oxidation in alkaline solution}]{\text{Electrolytic}} \underset{\text{Purple}}{KMnO_4}$ (X) Anion of X is MnO_4^- (Z)

Structure : MnO_4^-  MnO_4^{2-} 

$\underset{+7}{MnO_4^-}$ (Z) = + 7 oxidation state = 0 unpaired e^- diamagnetic

MnO_4^{2-} (Y) = + 6 oxidation state = 1 unpaired e^- paramagnetic

In acidic solution $3MnO_4^{-2}(aq) + 4H^+ \rightarrow \underset{(Z)}{2MnO_4^-} + MnO_2 + 2H_2O$

Q.5 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) ε_{av} 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 doubled when its temperature is increased four times

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

Ans. **[2, 3, 4]**

Sol. $E_{av} = \frac{3}{2}KT$

$U_{rms} = \sqrt{\frac{3RT}{m}}$

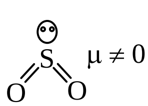
Q.6 Each of the following option contains a set of four molecules, Identify the option(s) where all four molecules posses permanent dipole moment at room temperature -

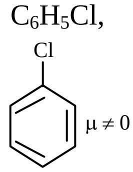
(1) SO_2, C_6H_5Cl, H_2Se, BrF_5 (2) $BeCl_2$, CO_2, BCl_3, $CHCl_3$

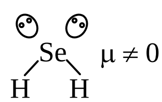
(3) BF_3, O_3, SF_6, XeF_6 (4) NO_2, NH_3, $POCl_3$, CH_3Cl

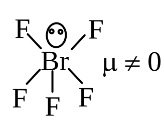
Ans. **[1, 4]**

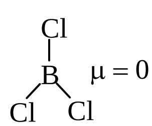
Sol. (1) SO_2, C_6H_5Cl, H_2Se, BrF_5

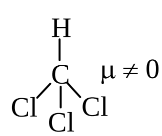


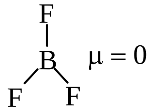


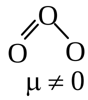


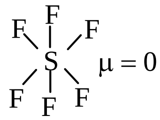


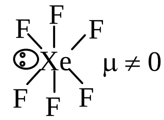
(2) $\underset{\mu=0}{Cl-Be-Cl}$, $\underset{\mu=0}{O=C=0}$, 

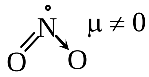


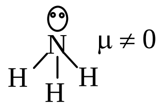
(3) 

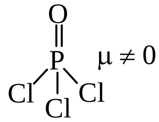


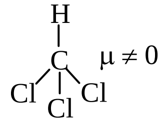




(4) 







Q.7 In the decay sequence

$${}^{238}_{92}U \xrightarrow{-X_1} {}^{234}_{90}Th \xrightarrow{-X_2} {}^{234}_{91}Pa \xrightarrow{-X_3} {}^{234}Z \xrightarrow{-X_4} {}^{230}_{90}Th$$

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

(1) x_3 is γ-ray (2) x_2 is β^-

(3) Z is an isotope of uranium (4) x_1 will deflect towards negatively charged plate

Ans. **[2, 3, 4]**

Sol.

$_{92}U^{238} \rightarrow {}_{90}Th^{234} + {}_2He^4\ (x_1)$

$_{90}Th^{234} \longrightarrow {}_{91}Pa^{234} + \beta^-$ or $_{-1}e^0\ (x_2)$

$_{91}Pa^{234} \longrightarrow {}_{92}Z^{234} + \beta^-$ or $_{-1}e^0\ (x_3)$

$_{92}Z^{234} \longrightarrow {}_{90}Th^{230} + {}_2He^4\ (x_4)$

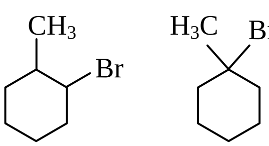
$x_1 = \alpha$
$x_2 = \beta$
$x_3 = \beta$
$x_4 = \alpha$

Q.8 Choose the correct option(s) for the following set of reactions

$$C_6H_{10}O \xrightarrow[\text{(ii) } H_2O]{\text{(i) MeMgBr}} Q \xrightarrow{\text{conc. HCl}} \underset{\text{(major)}}{S}$$

$$Q \xrightarrow{20\%\ H_3PO_4,\ 360K} \underset{\text{(major)}}{R}$$

$$\underset{\text{(major)}}{T} \xleftarrow[\text{(ii) } Br_2, h\nu]{\text{(i) } H_2, Ni} \underset{\text{(major)}}{R} \xrightarrow[\Delta]{\text{HBr, Benzoyl peroxide}} \underset{\text{(major)}}{U}$$

(1) 

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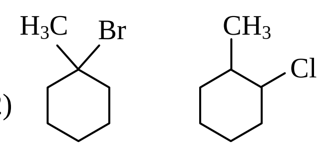
(2) 

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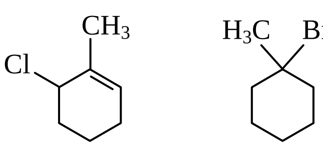
(3) 

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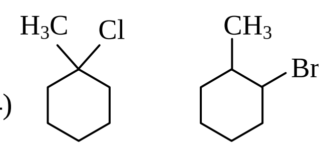
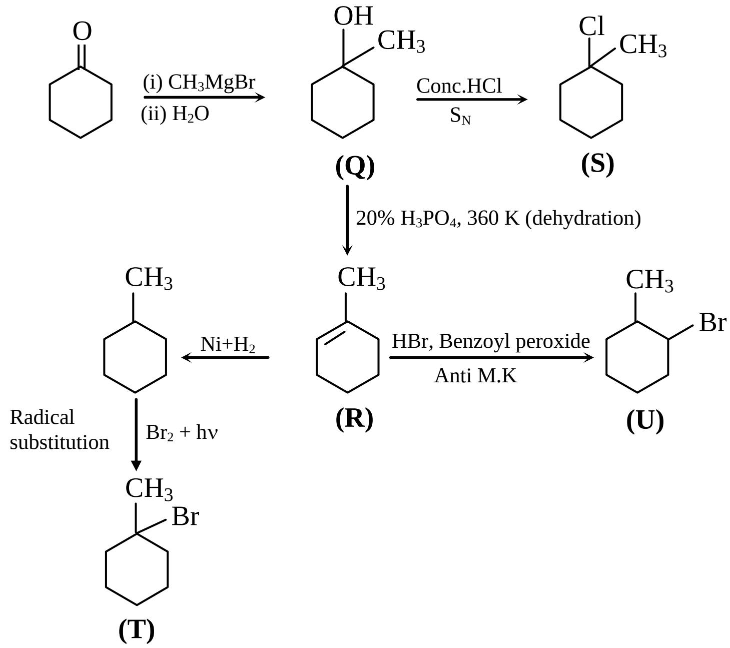
(4) 

S U

Ans. [1,4]

Sol.



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 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 ot 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 as answer.

Zero Marks : 0 In all other cases.

Q.1 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 $Y \times 10^{-5}$ mol dm^{-3} s^{-1}. The value of Y is _____ .

Ans. [6.75]

Sol. $r = K[A]^b[B]^q[C]^n$

$$\frac{r_2}{r_1} = \left[\frac{B_2}{B_1}\right]^q$$

$1 = 2^q$ or $2^0 = 2^q$ $\therefore q = 0$

$$\frac{r_3}{r_2} = \left[\frac{C_3}{C_2}\right]^n$$

$2 = 2^n$ $n = 1$

$$\frac{r_4}{r_1} = \left[\frac{A_4}{A_1}\right]^p \left[\frac{C_4}{C_1}\right]^n$$

$$\frac{9}{6} = \left(\frac{3}{2}\right)^p \times \left(\frac{3}{2}\right)^1 \Rightarrow P = 1$$

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

$$K = \frac{r}{[A][C]} = \frac{6\times10^{-5}}{2\times10^{-2}} = 3\times10^{-3}$$

$r = K[A][C]$

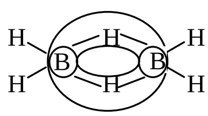
$= 3\times10^{-3} \times 0.15 \times 0.15$

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

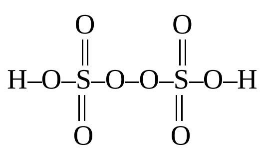
Q.2 Among B_2H_6, $B_3N_3H_6$, N_2O, N_2O_4, $H_2S_2O_3$ and $H_2S_2O_8$ the total number of molecules containing covalent bond between two atoms of the same kind is ____

Ans. [4]

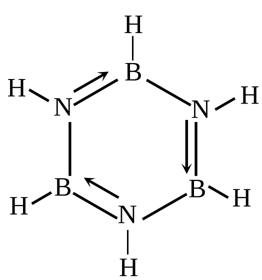
Sol. B_2H_6



$H_2S_2O_8$

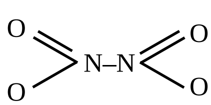


$B_3N_3H_6$

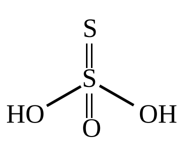


N_2O $N \equiv N \rightarrow O$

N_2O_4



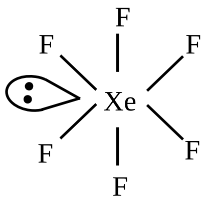
$H_2S_2O_3$



Q.3 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 electron present on the whole molecule of Y is ____

Ans. **[19]**

Sol. $$XeF_4 + O_2F_2 \longrightarrow \underset{(Y)}{XeF_6} + O_2$$



Total no. of lone pair present on the whole molecule of Y = 1 ℓ. p. in Xe + 18. ℓ. p. in F

= 19 total ℓ. p.

Q.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. [1.03]

Sol. $$\frac{P_B^0 - P_S}{P_S} = \frac{n_A}{n_B}$$

$$\frac{650 - 640}{640} = \frac{n_A}{0.5}$$

$$\frac{10 \times 0.5}{640} = n_A = \frac{5}{640}$$

$\Delta T_f = iK_f\, m$

$= (1)\,(5.12)\,\dfrac{5 \times 1000}{640 \times 39}$

= 1.0256 = 1.026

= 1.03

Q.5 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. [8.93]

Sol.

	Fe^{2+} +	S^{2-}	$\rightleftharpoons$ FeS(s)
before mixing	0.06M	0.02 M	
after mixing	0.03 M	0.1 M	

after reaction δ 0.07 M as K_c is very high reaction proceed towards completion

(very small) There fore limiting reagent will be consumed almost completely

Since,

$K_c = K_c = 1.6 \times 10^{17}$ (Very high value)

$$Kc = \frac{1}{[Fe^{+2}][S^{-2}]}$$

$$\delta = [Fe^{+2}] = \frac{1}{[K_c][S^{-2}]}$$

$$= \frac{1}{(1.6\times10^{17})(0.07)}$$

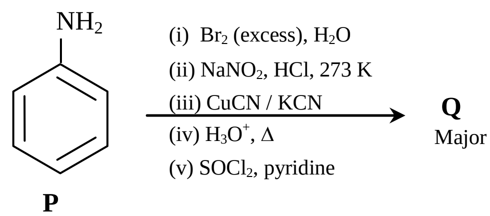
$$= \frac{100}{7\times1.6}\times10^{-17}$$

$= 8.93 \times 10^{-17}$

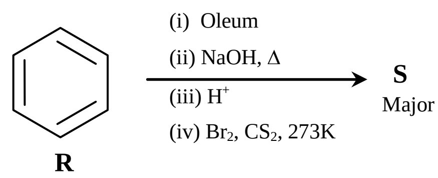
Y = 8.93

Q.6 Schemes 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 _____

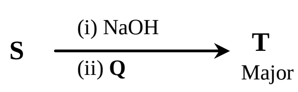
Scheme 1 :



Scheme 2 :

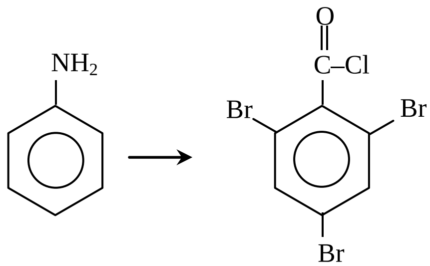


Scheme 3 :



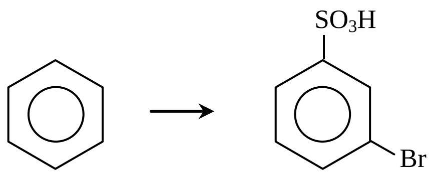
Ans. [4]

Sol. **Scheme 1 :**



(Q)

Scheme 2 :



(S)

Scheme 3 :