JEE Main March 2021

Question Paper With Text Solution

18 March. | Shift-2

CHEMISTRY

MATRIX

JEE Main & Advanced | XI-XII Foundation| VI-X Pre-Foundation

Office : Piprali Road, Sikar (Raj.) | Ph. 01572-241911
Website : www.matrixedu.in ; Email : smd@matrixacademy.co.in

JEE MAIN MARCH 2021 | 18TH MARCH SHIFT-2

SECTION – A

1. Given below are two statements :

Statement I : Bohr's theory accounts for the stability and line spectrum of Li^+ ion.

Statement II : Bohr's theory was unable to explain the splitting of spectral lines in the presence of a magnetic field.

In the light of the above statements, choose the most appropriate answer from the options given below :

(1) Both statement I and statements II are false.

(2) Statement I is false but statement II is true.

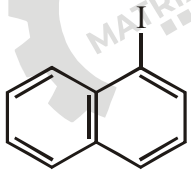
(3) Both statement I and statement II are true.

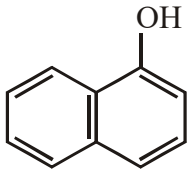
(4) Statement I is true but statement II is false.

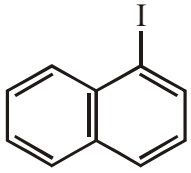
Ans. Official Answer NTA (2)

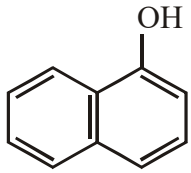
Sol. Bohr's theory accounts for stability and spectrum of single species like H^+, Li^{2+} Not Li^+. Bohr's theory cannot explain the splitting of spectral lines in the presence of magnetic field (zeeman effect) and electric field (stark effect).

2. Main product formed during a reaction of 1-methoxy naphthalene with hydroidic acid are :

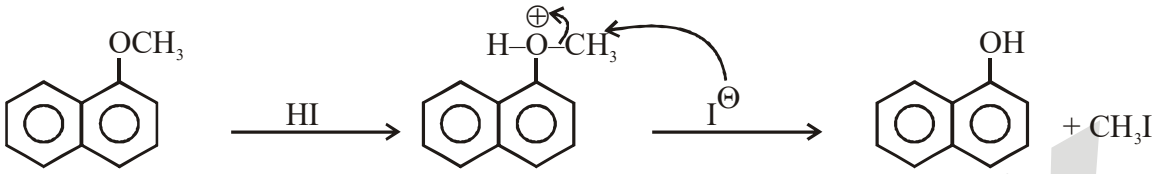
(1)  and CH_3I

(2)  and CH_3OH

(1)  and CH_3OH

(4)  and CH_3I

Ans. Official Answer NTA (4)

Sol. 

3. In basic medium, H_2O_2 exhibits which of the following reactions ?

(A) $Mn^{2+} \rightarrow Mn^{4+}$

(B) $I_2 \rightarrow I^-$

(C) $PbS \rightarrow PbSO_4$

Choose the most appropriate answer from the options given below :

(1) (A), (B) only

(2) (A) only

(3) (A), (C) only

(4) (B) only

Ans. Official Answer NTA (1)

Sol. $Mn^{2+} + H_2O_2 \rightarrow Mn^{+4} + 2OH^-$

$I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

$PbS(s) + 4H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(l)$

4. The charges on the colloidal CdS sol and TiO_2 sol are, respectively :

(1) Negative and positive

(2) Positive and negative

(3) Positive and positive

(4) Negative and negative

Ans. Official Answer NTA (1)

Sol. CdS $\rightarrow$ – ve sol

$TiO_2 \rightarrow$ + ve sol

5. In the reaction of hypobromite with amide, the carbonyl carbon is lost as :

(1) HCO_3^-

(2) CO

(3) CO_3^{2-}

(4) CO_2

Ans. Official Answer NTA (3)

Sol. It is Hoffmann bromamide reaction.

$$R-\underset{\underset{O}{\|}}{C}-NH_2 + Br_2 + 4NaOH \xrightarrow{\Delta} R-NH_2 + 2NaBr + Na_2CO_3 + 2H_2O$$

So carbonyl carbon is lost as CO_3^{2-}

6. Given below are two statements :

Statement I : C_2H_5OH and AgCN both can generate nucleophile.

Statement II : KCN and AgCN both will generate nitrile nucleophile with all reaction conditions.

Choose the most appropriate option.

(1) Statement I is true but statement II is false.

(2) Both statement I and statement II are true.

(3) Statement I is false but statement II is true.

(4) Both statement I and statement II are false.

Ans. Official Answer NTA (1)

Sol. **Statement I :** True

As both can act as nucleophile

Statement II : is incorrect.

KCN is predominantly ionic and provides cyanide ions in solution.

Although both carbon and nitrogen atoms are in a position to donate electron pairs, the attack takes place mainly thourgh carbon atom and not through nitrogen atom since C – C bond is more stable than C – N bond.

However, AgCN is mainly covlant in nature and nitrogen is free to donate electron pair forming isocynaide as the main product.

7. The secondary valency and the number of hydrogen bonded water molecule(s) in $CuSO_4 . 5H_2O$, respectively, are :

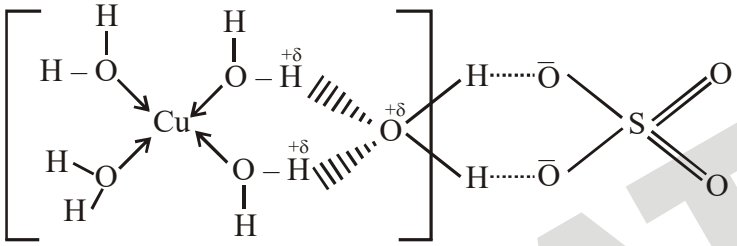
(1) 4 and 1

(2) 5 and 1

(3) 6 and 5

(4) 6 and 4

Ans. Official Answer NTA (1)

Sol. 

Secondary valency/coordinantion number = 4
Number of hydrogen bonded water molecules = 1
Water molecules which are outside coordination sphere form H – bonding.

8. The oxidation states of nitrogen in NO, NO_2, N_2O and NO_3^- are in the order of :

(1) $NO_2 > NO_3^- > NO > N_2O$

(2) $NO > NO_2 > N_2O > NO_3^-$

(3) $N_2O > NO_2 > NO > NO_3^-$

(4) $NO_3^- > NO_2 > NO > N_2O$

Ans. Official Answer NTA (4)

Sol. The oxidation state of Nitrogen are following :

$NO_3^- \rightarrow +5$

$NO_2 \rightarrow +4$

$NO \rightarrow +2$

$N_2O \rightarrow +1$

9. Deficiency of vitamin K causes :

(1) Decrease in blood clotting time

(2) Increase in blood clotting time

(3) Cheilosis

(4) Increase in fragility of RBC's

Ans. Official Answer NTA (2)

Sol. Due to deficiency of vitamin K causes increase in blood clotting time.

10. Match **List-I** with **List-II** :

List-I **(Class of Chemicals)**	**List-II** **(Example)**
(a) Antifertility drug	(i) Meprobamate
(b) Antibiotic	(ii) Alitame
(c) Tranquilizer	(iii) Norethindrone
(d) Artificial Sweetener	(iv) Salvarsan

Choose the most appropriate match :

(1) (a) – (iii), (b) – (iv), (c) – (i), (d) – (ii)

(2) (a) – (iv), (b) – (iii), (c) – (ii), (d) – (i)

(3) (a) – (ii), (b) – (iv), (c) – (i), (d) – (iii)

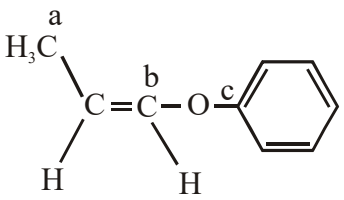
(4) (a) – (ii), (b) – (iii), (c) – (iv), (d) – (i)

Ans. Official Answer NTA (1)

Sol.

Antifertility drug	→	Norethindrone
Antibiotic	→	Salvarsan
Tranquilizer	→	Meprobamate
Artificial Sweetener	→	Alitame

11. In the following molecule,



Hybridisation of Carbon a, b and c respectively are :

(1) sp^3, sp^2, sp^2

(2) sp^3, sp^2, sp

(3) sp^3, sp, sp

(4) sp^3, sp, sp^2

Ans. Official Answer NTA (1)

Sol.

Carbon	a	b	c
Hybridisation	sp^3	sp^2	sp^2

12. Given below are two statements :

Statement I : Non-biodegradable wastes are generated by the thermal power plants.

Statement I : Bio-degradable detergents leads to eutrophication.

In the light of the above statements, choose the most appropriate answer from the options given below :

(1) Statement I is false but statement II is true.

(2) Both statement I and statement II are false.

(3) Statement I is true but statement II is false.

(4) Both statement I and statement II are true.

Ans. Official Answer NTA (4)

Sol. Non – biodegradable wastes are generated by the thermal power plants which produces fly ash. Detergents which are biodegradable causes problem called eutrophication which kills animal life by deprieving it of oxygen.

13. The first ionization energy of magnesium is smaller as compared to that of elements X and Y, but higher than that of Z. The elements X, Y and Z, respectively, are :

(1) Argon, lithium and sodium

(2) Argon, chlorine and sodium

(3) Neon, Sodium and chlorine

(4) Chlorine, lithium and sodium

Ans. Official Answer NTA (2)

Sol. I.E. $\propto Z_{eff}$, I.E. $\propto \frac{1}{n}$

Na < Mg < C*l* < Ar
(z) (y) (x)

These are 3rd period element, so on moving L $\rightarrow$ R in a period z_{eff} increases hence I.E. also increases.

14. A hard substance melts at high temperature and is an insulator in both solid and in molten state. This solid is most likely to be a/an :

(1) Molecular solid

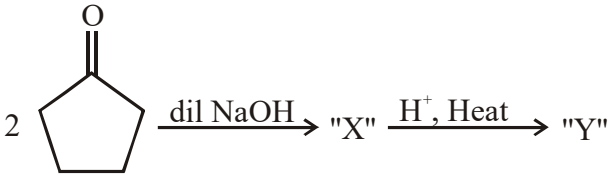
(2) Covalent solid

(3) Metallic solid

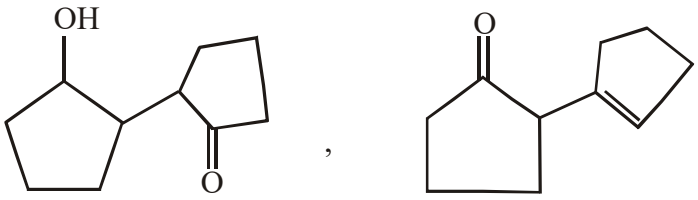
(4) Ionic solid

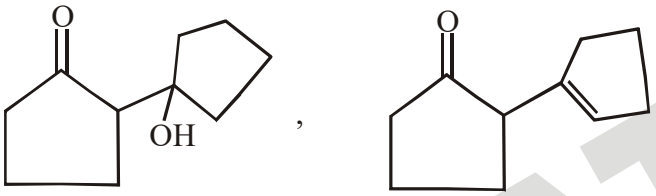
Ans. Official Answer NTA (2)

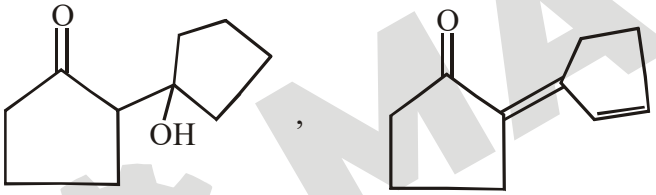
Sol. Covalent or network solid have very high melting point and they are insulators in their solid and molten form.

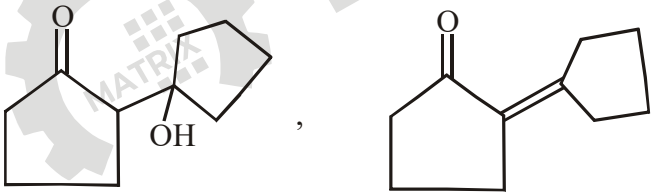
15. 

Consider the above reaction, the product 'X' and 'Y' respectively are :

(1) 

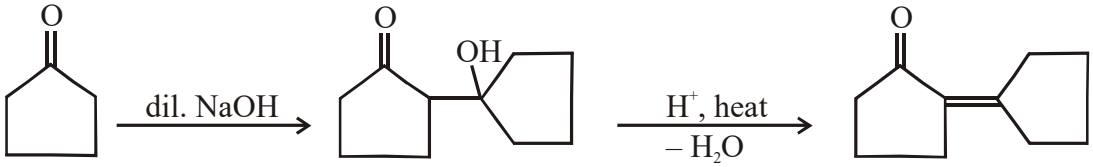
(2) 

(3) 

(4) 

Ans. Official Answer NTA (4)

Sol. It is a simple aldol condensation reaction.



16. The oxide that shows magnetic property is :

(1) SiO_2

(2) Na_2O

(3) MgO

(4) Mn_3O_4

Ans. Official Answer NTA (4)

Sol. Mn_3O_4 oxide shows magnetic properties.

17. Match **List-I** with **List-II** :

List-I	**List-I**
(a) Mercury	(i) Vapour phase refining
(b) Copper	(ii) Distillation Refining
(c) Silicon	(iii) Electrolytic Refining
(d) Nickel	(iv) Zone Refining

Choose the most appropriate answer from the option given below :

(1) (a) – (ii), (b) – (iv), (c) – (iii), (d) – (i)

(2) (a) – (i), (b) – (iv), (c) – (ii), (d) – (iii)

(3) (a) – (ii), (b) – (iii), (c) – (iv), (d) – (i)

(4) (a) – (ii), (b) – (iii), (c) – (i), (d) – (iv)

Ans. Official Answer NTA (3)

Sol. (A) Mercury — Distillation Refining

(B) Copper — Electrolytic Refining

(C) Silicon — Zone Refining

(D) Nickel — Vapour phase refining

18. An organic compound "A" on treatment with benzene sulphonyl chloride gives compound B. B is soluble in dil. NaOH solution. Compound A is :

(1) $C_6H_5 - NHCH_2CH_3$

(2) $C_6H_5 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - NH_2$

(3) $C_6H_5 - CH_2\ NH\ CH_3$

(4) $C_6H_5 - N - (CH_3)_2$

Ans. Official Answer NTA (2)

Sol. It is hinsberg test which is used to distinguish between 1°, 2° and 3° amine.

$R - NH_2 + PhSO_2Cl \xrightarrow{\text{Pyridine}} R - NH - SO_2Ph \xrightarrow{\text{dil. NaOH}}$ Compound is soluble.
(1° Amine)

19. Match **List-I** with **List-II**.

List-I	**List-I**
(a) Be	(i) Treatment of cancer
(b) Mg	(ii) Extraction of metals
(c) Ca	(iii) Incendiary bombs and signals
(d) Ra	(iv) Windows of X-ray tubes
	(v) Bearings for motor engines.

Choose the most appropriate answer from the option given below :

(1) (a) – (iii), (b) – (iv), (c) – (v), (d) – (ii)

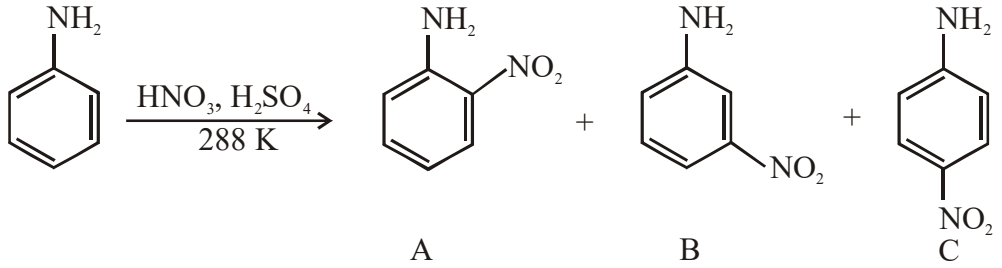
(2) (a) – (iv), (b) – (iii), (c) – (i), (d) – (ii)

(3) (a) – (iv), (b) – (iii), (c) – (ii), (d) – (i)

(4) (a) – (iii), (b) – (iv), (c) – (ii), (d) – (v)

Ans. Official Answer NTA (3)

Sol. (a) Be → it is used in the Windows of X–ray tubes.
(b) Mg → it is used in the Incendiary bombs and signals
(c) Ca → it is used in the Extraction of metals
(d) Ra → it is used in the Treatment of cancer

20. 

A B C

Consider the given reaction, percentage yield of :

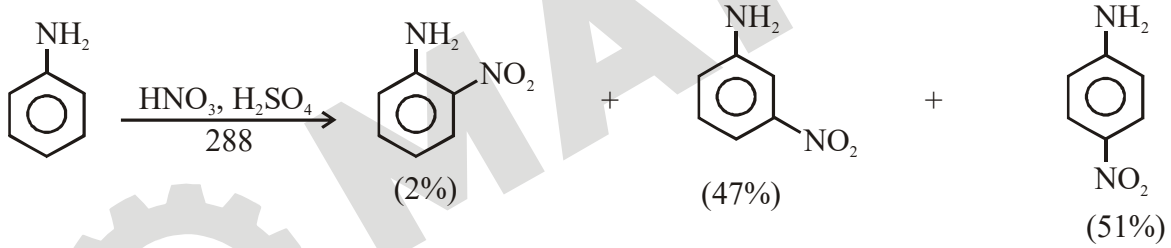
(1) B > C > A

(2) A > C > B

(3) C > B > A

(4) C > B > A

Ans. Official Answer NTA (4)

Sol. 

SECTION – B

1. A solute A dimerizes in water. The boiling point of a 2 molal solution of A is 100.52ºC. The percentage association of A is ____.(Round off to the Nearest Integer).

[Use : K_b for water = 0.52 K kg mol^{-1}

Boiling point of water = 100ºC]

Ans. Official Answer NTA (50)

Sol. Boiling point of pure water = 100ºC

$\Delta T_b = 100.52 - 100$

$= 0.52^\circ C$

$\Delta T_b = i K_b m$

$0.52 \times i \times 0.52 \times 2$

i = 1/2

$2A \rightleftharpoons A_2$

$1-\alpha \qquad \alpha/2$

$i = 1 - \alpha + \alpha/2 = 1 - \frac{\alpha}{2}$

So, $1 - \frac{\alpha}{2} = \frac{1}{2}$

$\alpha = 1$

means : 100% association.

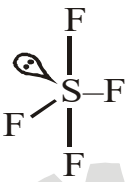
2. The number of species below that have two lone pairs of electrons in their central atom is _____.

(Round off to the Nearest Integer).

SF_4, BF_4^- ,ClF_3, AsF_3, PCl_5, BrF_5, XeF_4, SF_6

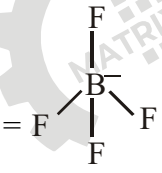
Ans. Official Answer NTA (2)

Sol. SF_4 =



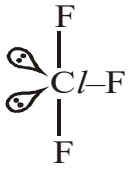
l.P = 1

BF_4^- =



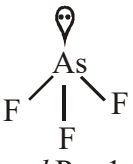
l.P = 0

ClF_3 =

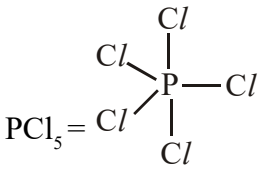


l.P = 2

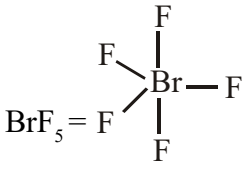
AsF_3 =



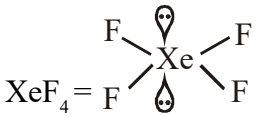
l.P = 1



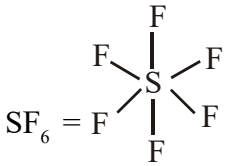
$l.P = 0$



$l.P = 0$



$l.P = 2$



$l.P = 0$

3. In Tollen's test for aldehyde, the overall number of electron(s) transferred to the Tollen's reagent formula $[Ag(NH_3)_2]^+$ per aldehyde group to form silver mirror is _____. (Round off to the Nearest Integer).

Ans. Official Answer NTA ()

Sol. $R - CHO + 2[Ag(NH_3)_2]^{\oplus}\ OH^{\ominus} + H_2O \longrightarrow R - COOH + 2Ag + 4NH_3 + 2H_2O$

So two electrons are transferred to the tollen's reagent per aldehyde group.

4. The molar conductivities at infinite dilution of barium chloride, sulphuric acid and hydrochloric acid are 280, 860 and 426 S cm^2 mol^{-1} respectively. The molar conductivity at infinite dilution of barium sulphate is _____ S cm^2 mol^{-1}.(Round off to the Nearest Integer).

Ans. Official Answer NTA (288)

Sol. Molar conductivity of $BaSO_4$ can be written as.

$$\Lambda_m^{\infty}(BaSO_4) = \Lambda_m^{\infty}(Ba^{2+}) + \Lambda_m^{\infty}(SO_4^{2-})$$

$$\Lambda_m^{\infty}(BaSO_4) = \Lambda_m^{\infty}(BaCl_2) + \Lambda_m^{\infty}(H_2SO_4)$$

$-2\ \Lambda_m^{\infty}(HCl)$

$= 280 + 860 - 2(426)$

$= 288\ Scm^2\ mol^{-1}$

5. The gas phase reaction

$2A(g) \rightleftharpoons A_2(g)$

at 400 K has $\Delta G^o = +25.2\ kJ\ mol^{-1}$

The equilibrium constant K_C for this reaction is _____$\times 10^{-2}$. (Round off the Nearest Integer).

[Use : $R = 8.3\ J\ mol^{-1}\ K^{-1}$, $\ln 10 = 2.3$

$\log_{10}2 = 0.30$, 1 atm = 1 bar]

[antilog (–0.3) = 0.501]

Ans. Official Answer NTA (166)

Sol. $2A_{(g)} \rightleftharpoons A_{2(g)}$

$\Delta G^o = -RT \ln K_{eq}$

$25,200 = -2.3 \times 8.3 \times 400 \log k_p$

$\log k_p = -3.3$

$k_p = 10^{-3.3} = 0.50 \times 10^{-9}\ Pa^{-1}$

$k_p = k_c\ (RT)^{\Delta n_g}$

$\Delta ng = -1$

$k_c = k_p\ (RT) = 5.0 \times 10^{-9} \times 8.3 \times 400$

$= 1.66 \times 10^{-5}\ m^3/mol$

$k_c = 1.66 \cdot 10^{-2}\ L/mol$

Ans. 2

6. 10.0 mL of Na_2CO_3 solution is titrated against 0.2 M HCl solution. The following titre values were obtained in 5 readings :

4.8 mL, 4.9 mL, 5.0 mL, 5.0 mL and 5.0 mL.

Based on these readings, and convention of titrimetic estimation the concentration of Na_2CO_3 solution is _____ mM.

Ans. Official Answer NTA (50)

Sol. Volume of HCl = 5 ml (in calculation)

$meq_{Na_2Co_3} = meq_{HCl}$

$M \times V_{me} \times$ n-factor $= M \times V_{me} \times$ n-factor

$M \times 10 \times 2 = 0.2 \times 5 \times 1$

$M = \frac{1}{20} = 0.05$

$M = 50 \times 10^{-3}$ M = 50 mM

7. A reaction has half life of 1 min. The time required for 99.9% completion of the reaction is _____ min. (Round off to the Nearest Integer).

[Use : ln 2 = 0.69; ln 10 = 2.3]

Ans. Official Answer NTA (10)

Sol. $t_{99.9\%} = \frac{1}{K} ln\left(\frac{100}{0.1}\right)$

$t_{50\%} = \frac{1}{K} ln\left(\frac{100}{50}\right)$

$\frac{t_{(99.9\%)}}{t_{(50\%)}} = \frac{ln\,10^3}{ln\,2} = \frac{3 \times 2.3 \times 1}{2.3 \times 0.3}$

$t_{99.9\%} = 10 \times t_{50\%}$

$= 10$ min

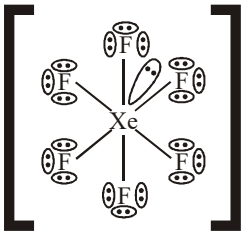
8. A xenon compound 'A' upon partial hydrolysis gives XeO_2F_2. The number of lone pair of electrons present in compound A is _____. (Round off to the Nearest Integer).

Ans. Official Answer NTA (1)

Sol. $XeF_6 + 2H_2O \rightarrow XeO_2F_2 + 4HF$

(A) (Limited water)

Structure of 'A'



Total lone – pair on (A) = 19

9. The solubility of $CdSO_4$ in water is 8.0×10^{-4} mol L^{-1}. Its solubility in 0.01 M H_2SO_4 solution is ..... $\times 10^{-6}$ mol L^{-1}. (Round off to the Nearest Integer).

(Assume that solubility is much less than 0.01 M)

Question Type : SA
Question ID : 8643515635

Ans. Official Answer NTA (64)

Sol. In water :

$CdSO_4 \rightleftharpoons Cd^{2+} + SO_4^{2-}$

$K_{SP} = S^2 = (8\times10^{-4})^2 = 64 \times 10^{-8}$

In 0.01M H_2SO_4 :

$H_2SO_4 \rightleftharpoons 2H^+ + SO_4^{2-}$

0.01 – 0.02 (0.01 + x)

$CdSO_4 \rightleftharpoons Cd^{2+} + SO_4^{2-}$

x – x (x + 0.01)

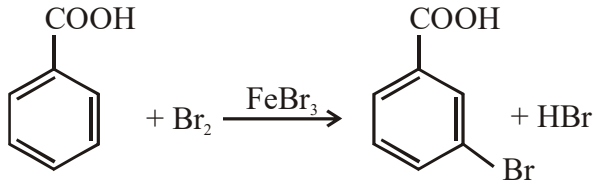
$K_{SP} = x(x + 0.01) = 64 \times 10^{-8}$

$\because$ x <<< 0.01

$(x + 0.01) \approx 0.01$

$x \times 0.01 = 64 \times 10^{-8}$

$x = 64 \times 10^{-6}$ M

10. 

Consider the above reaction where 6.1 g of Benzoic acid is used to get 7.8 g of m-bromo benzoic acid.

The percentage yield of the product is .....

(Round off to the Nearest Integer).

[Given : Atomic masses : C : 20 u, H : 1.0 u, O : 16.0 u, Br : 80.0 u]

Question Type : SA
Question ID : 8643515639

Ans. Official Answer NTA (78)

Sol. Moles of Benzoic Acid = $\frac{6.1}{722} = 0.05$

So, moles of m–bromobenzoic Acid = 0.05

$\frac{w}{201} = 0.05$

w = 10.05 gm

$\%\ \text{yield} = \frac{7.8}{10.05} \times 100$

≈ 78