FINAL JEE–MAIN EXAMINATION – JULY, 2022

(Held On Wednesday 27th July, 2022) **TIME : 9 : 00 AM to 12 : 00 NOON**

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

1. 250 g solution of D-glucose in water contains 10.8% of carbon by weight. The molality of the solution is nearest to

(Given: Atomic Weights are H, 1u ; C, 12u ; O, 16u)

(A) 1.03 (B) 2.06

(C) 3.09 (D) 5.40

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. $C_6H_{12}O_6 \rightarrow$ Glucose

We know: $\frac{\text{mass of C}}{\text{mass of glucose}} = \frac{72}{180}$

Given: $\%C = 10.8 = \frac{\text{mass of C}}{\text{mass of solution}} \times 100$

$\frac{10.8 \times 250}{100} = \text{mass of C} \Rightarrow \text{Mass of C} = 27 \text{ gm}$

$\therefore$ mass of glucose = 67.5 gm

$\therefore$ moles of glucose = 0.375 moles

Mass of solvent = 250 – 67.5 gm = 182.5 gm

$\therefore$ Molality $= \frac{0.375}{0.1825} = 2.055 \approx 2.06$

2. Given below are two statements.

Statement I : O_2 , Cu^{2+} and Fe^{3+} are weakly attracted by magnetic field and are magnetized in the same direction as magnetic field.

Statement II : NaCl and H_2O are weakly magnetized in opposite direction to magnetic field.

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

(A) Both Statement I and Statement II are correct.

(B) Both Statement I and Statement II are incorrect.

(C) Statement I is correct but Statement II is incorrect.

(D) Statement I is incorrect but Statement II is correct.

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. O_2, Cu^{2+} and Fe^{3+} are paramagnetic,

$\therefore$ Weakly attracted by magnetic field.

NaCl and H_2O are diamagnetic,

$\therefore$ Weakly repelled by magnetic field.

3. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A : Energy of 2s orbital of hydrogen atom is greater than that of 2s orbital of lithium.

Reason R : Energies of the orbitals in the same subshell decrease with increase in the atomic number.

In the light of the above statements, choose the ***correct*** answer from the options given below.

(A) Both **A** and **R** are true and **R** is the correct explanation of **A.**

(B) Both **A** and **R** are true but **R** is NOT the correct explanation of **A.**

(C) **A** is true but **R** is false.

(D) **A** is false but **R** is true.

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Energy of orbitals decreases on increasing the atomic number.

4. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A : Activated charcoal adsorbs SO_2 more efficiently than CH_4.

Reason R : Gases with lower critical temperatures are readily adsorbed by activated charcoal.

In the light of the above statements, choose the correct answer from the options given below.

(A) Both **A** and **R** are correct and **R** is the correct explanation of **A.**

(B) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A.**

(C) **A** is correct but **R** is not correct.

(D) **A** is not correct but **R** is correct.

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. SO_2 is absorbed to a greater extent than CH_4 on activated charcoal under same conditions.

Gases with **higher critical temperature** are readily absorbed by activated charcoal.

5. Boiling point of a 2% aqueous solution of a non-volatile solute A is equal to the boiling point of 8% aqueous solution of a non-volatile solute B. The relation between molecular weights of A and B is.

(A) $M_A = 4M_B$ (B) $M_B = 4M_A$

(C) $M_A = 8M_B$ (D) $M_B = 8M_A$

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. **For A :** 100 gm solution $\rightarrow$ 2 gm solute A

$$\therefore \text{ Molality} = \frac{2/M_A}{0.098}$$

For B : 100 gm solution $\rightarrow$ 8 gm solute B

$$\therefore \text{ Molality} = \frac{8/M_B}{0.092}$$

$$\because (\Delta T_B)_A = (\Delta T_B)_B$$

$\therefore$ Molality of A = Molality of B

$$\therefore \frac{2}{0.098M_A} = \frac{8}{0.092M_B}$$

$$\frac{2}{98} \times \frac{92}{8} = \frac{M_A}{M_B}$$

$$\frac{1}{4.261} = \frac{M_A}{M_B}$$

$$\therefore M_B = 4.261 \times M_A$$

6. The **incorrect** statement is

(A) The first ionization enthalpy of K is less than that of Na and Li

(B) Xe does not have the lowest first ionization enthalpy in its group

(C) The first ionization enthalpy of element with atomic number 37 is lower than that of the element with atomic number 38.

(D) The first ionization enthalpy of Ga is higher than that of the d-block element with atomic number 30.

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. Ionization enthalpy order :

Li > Na > K

He > Ne > Ar > Kr > Xe > Rn

Sr > Rb

Zn > Ga

7. Which of the following methods are not used to refine any metal?

(A) Liquation (B) Calcination

(C) Electrolysis (D) Leaching

(E) Distillation

Choose the **correct** answer from the options given below:

(A) B and D only (B) A, B, D and E only

(C) B, D and E only (D) A, C and E only

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Calcination and leaching are the methods of concentration of ore and not that of refining.

8. Given below are two statements:

Statement I : Hydrogen peroxide can act as an oxidizing agent in both acidic and basic conditions.

Statement II: Density of hydrogen peroxide at 298 K is lower than that of D_2O.

In the light of the above statements. Choose the ***correct*** answer from the options.

(A) Both statement I and Statement II are ture

(B) Both statement I and Statement II are false

(C) Statement I is true but Statement II is false

(D) Statement I is false but Statement II is true

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. Depending on the nature of reducing agent H_2O_2 can act as an oxidising agent in both acidic as well as basic medium.

Density of D_2O = 1.1 g/cc

Density of H_2O_2 = 1.45 g/cc

9. Given below are two statements:

Statement I : The chlorides of Be and Al have Cl-bridged structure. Both are soluble in organic solvents and act as Lewis bases.

Statement II: Hydroxides of Be and Al dissolve in excess alkali to give beryllate and aluminate ions.

In the light of the above statements. Choose the correct answer from the options given below.

(A) Both statement I and Statement II are true

(B) Both statement I and Statement II are false

(C) Statement I is true but Statement II is false

(D) Statement I is false but Statement II is true

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. Be_2Cl_4 is lewis acid and Al_2Cl_6 has complete octet. Be and Al are amphoteric metals therefore dissolve in acid as well as alkaline solution and form beryllate and aluminate ions in excess alkali.

10. Which oxoacid of phosphorous has the highest number of oxygen atoms present in its chemical formula?

(A) Pyrophosphorous acid

(B) Hypophosphoric acid

(C) Phosphoric acid

(D) Pyrophosphoric acid

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. Pyrophosphorous acid $\rightarrow H_4P_2O_5$.

Hypophosphoric acid $\rightarrow H_4P_2O_6$.

Phosphoric acid $\rightarrow H_3PO_4$.

Pyrophosphoric acid $\rightarrow H_4P_2O_7$.

11. Given below are two statements:

Statement I : Iron (III) catalyst, acidified $K_2Cr_2O_7$ and neutral $KMnO_4$ have the ability to oxidise I^- to I_2 independently.

Statement II: Manganate ion is paramagnetic in nature and involves $p\pi - p\pi$ bonding.

In the light of the above statements, choose the ***correct*** answer from the options.

(A) Both statement I and Statement II are ture

(B) Both statement I and Statement II are false

(C) Statement I is true but Statement II is false

(D) Statement I is false but Statement II is true

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Neutral $KMnO_4$ oxidises I^- to IO_3^-

Manganate ion has $d\pi$-$p\pi$ bonding.

12. The total number of Mn = O bonds in Mn_2O_7 is

_____

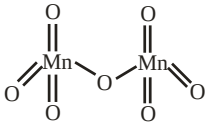
(A) 4 (B) 5

(C) 6 (D) 3

Official Ans. by NTA (C)

Allen Ans. (C)

Sol.



13. Match List I with List II

List I Pollutant	List II Disease /sickness
A. Sulphate (>500 ppm)	I. Methemoglobinemia
B. Nitrate (>50 ppm)	II. Brown mottling of teeth
C. Lead (> 50 ppb)	III. Laxative effect
D. Fluoride (>2 ppm)	IV. Kidney damage

Choose the correct answer from the options given below:

(A) A-IV, B –I, C-II, D-III

(B) A-III, B –I, C-IV, D-II

(C) A-II, B –IV, C-I, D-III

(D) A-II, B –IV, C-III, D-I

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. A. Sulphate (>500 ppm) - Causes Laxative effect that leads to dehydration

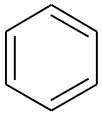
B. Nitrate (>50 ppm) - Causes Methemoglobinemia, skin appears blue

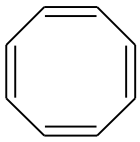
C. Lead (> 50 ppb) – It damage kidney and RBC

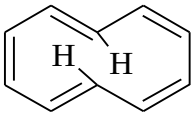
D. Fluoride (>2 ppm) – It Causes Brown mottling of teeth

14. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A : [6] Annulene. [8] Annulene and cis –[10] Annulene, are respectively aromatic, not-aromatic and aromatic.

[6] Annulene 

[8] Annulene 

Cis-[10] Annulene 

Reason R : Planarity is one of the requirements of aromatic systems.

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

(A) Both **A** and **R** are correct and **R** is the correct explanation of **A.**

(B) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A.**

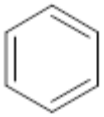
(C) **A** is correct but **R** is not correct.

(D) **A** is not correct but **R** is correct.

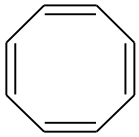
Official Ans. by NTA (A)

Allen Ans. (D)

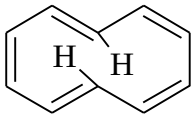
Sol. Assertion A : Not correct , Reason R : correct



[6] – annulene

 - Not aromatic

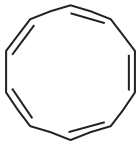
[8] – annulene



- Not aromatic

[10] – annulene

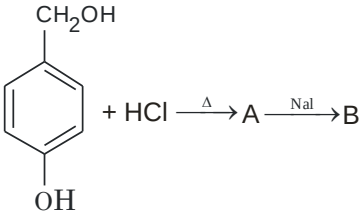
In [10] –Annulene – the hydrogen atoms in the 1 and 6 position interfere with each other and force the molecule out of planarity



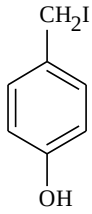
all -cis(10)annulene

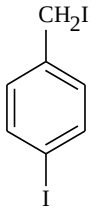
If this annulene with five cis double bonds were planar, each internal angle would be 144°. Since a normal double bond has bond angle of 120°, this would be from ideal. This compound can be made but it does not adopt a planar conformation and therefore is not aromatic even though it has ten π electrons.

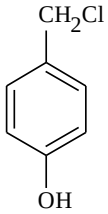
15.

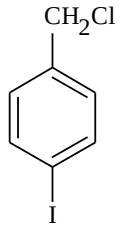


In the above reaction product B is:

(A) 

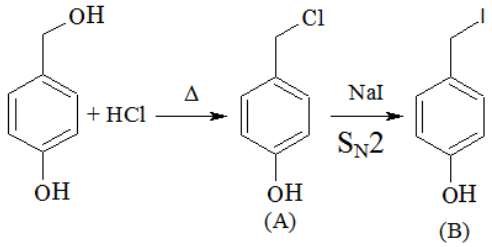
(B) 

(C) 

(D) 

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. 

16. Match **List I** with **List II**

List I **Polymers**	**List II** **Commenrcial names**
A. Phenol-formaldehyde resin	I. Glyptal
B. Copolymer of 1,3-butadiene and styrene	II. Novolac
C. Polyester of glycol and phthalic acid	III. Buna-S
D. Polyester of glycol and terephthalic acid	IV. Dacron

Choose the correct answer from the options given below:

(A) A-II, B –III, C-IV, D-I

(B) A-II, B –III, C-I, D-IV

(C) A-II, B –I, C-III, D-IV

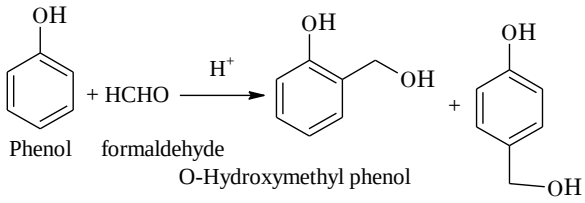
(D) A-III, B –II, C-IV, D-I

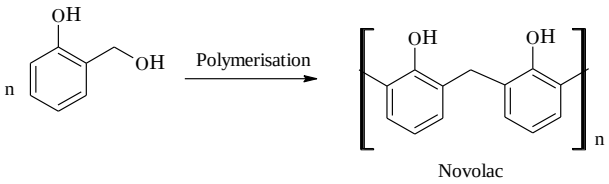
Official Ans. by NTA (B)

Allen Ans. (B)

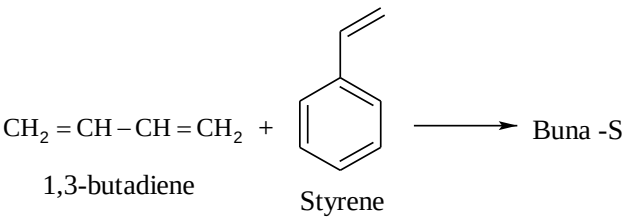
Sol.

(A)

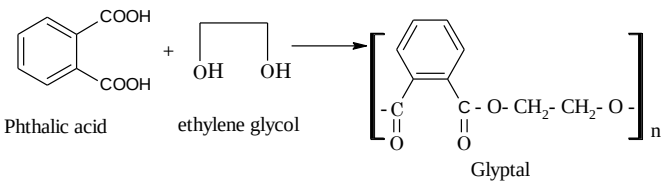




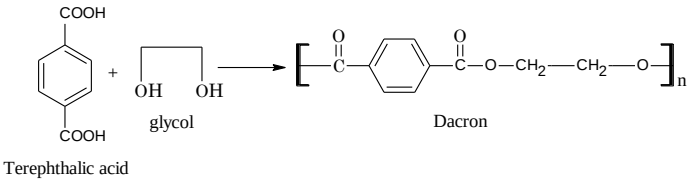
(B)



(C)



(D)



17. A sugar 'X' dehydrates very slowly under acidic condition to give furfural which on further reaction with resorcinol gives the coloured product after sometime. Sugar 'X' is

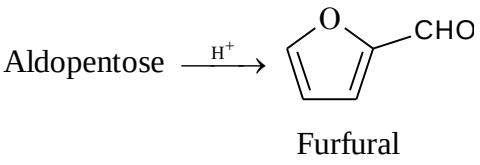
(A) Aldopentose (B) Aldotetrose

(C) Oxalic acid (D) Ketotetrose

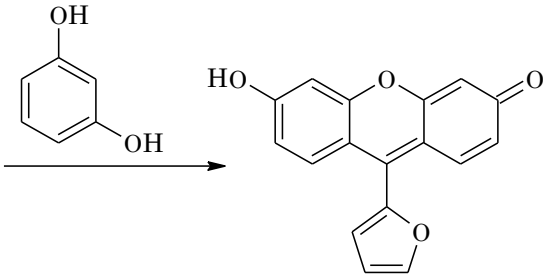
Official Ans. by NTA (A)

Allen Ans. (A)

Sol.

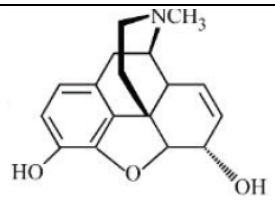
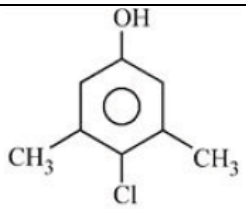
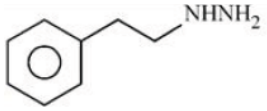
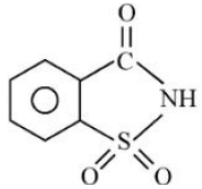


Furfural



Cherry red product
(seliwanoff's test)

18. Match **List I** with **List II**

List I	**List II**
A. 	I. Anti-depressant
B. 	II. 550 times sweeter than cane sugar
C. 	III. Narcotic analgesic
D. 	IV. Antiseptic

Choose the correct answer from the options given below:

(A) A-IV, B –III, C-II, D-I

(B) A-III, B –I, C-II, D-IV

(C) A-III, B –IV, C-I, D-II

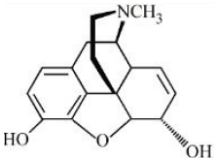
(D) A-III, B –I, C-IV, D-II

Official Ans. by NTA (C)

Allen Ans. (C)

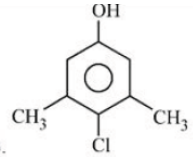
Sol.

(A)



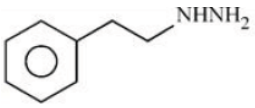
It is morphine use for relief for pain, known for narcotic analgesic

(B)



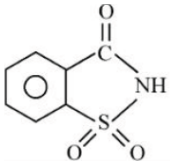
Chloroxylenol used as an antiseptic

(C)



Phenelzine (Nardil) use as Antidepressant

(D)



Saccharin 550 times sweeter than cane sugar

19. In Carius method of estimation of halogen. 0.45 g of an organic compound gave 0.36 g of AgBr. Find out the percentage of bromine in the compound.

(Molar masses : AgBr = 188 g mol^{-1}: Br = 80 g mol^{-1})

(A) 34.04% (B) 40.04%

(C) 36.03% (D) 38.04%

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Mass of organic compound = 0.45 gm

Mass of AgBr obtained = 0.36 gm

$\therefore$ Moles of AgBr = $\frac{0.36}{188}$

$\therefore$ Mass of Bromine = $\frac{0.36}{188} \times 80 = 0.1532\text{gm}$

$\therefore$ % Br in compound = $\frac{0.1532}{0.45} \times 100 = 34.04\%$

20. Match **List I** with **List II**

List I	List II
A. Benzenesulphonyl chloride	I. Test for primary amines
B. Hoffmann bromamide reaction	II. Anti Saytzeff
C. Carbylamine reaction	III. Hinsberg reagent
D. Hoffmann orientation	IV. Known reaction of Isocyanates.

Choose the correct answer from the options given below:

(A) A-IV, B –III, C-II, D-I

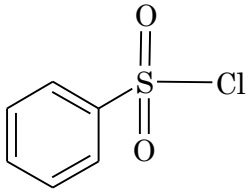
(B) A-IV, B –II, C-I, D-III

(C) A-III, B –IV, C-I, D-II

(D) A-IV, B –III, C-I, D-II

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. **(A)**  → Hinsberg reagent

Benzen sulphonyl chloride

(B) Hoffmann bromamide reaction → known reaction of isocynates

$R-CO-NH_2 + X_2 + 4\,NaOH \rightarrow R\text{-}NH_2 + 2NaX + Na_2CO_3 + 2H_2O$

Intermediate : R- N = C = O (isocyanate)

(C) Carbylamine reaction → Test for primary amine

$R\text{-}NH_2$ or $Ar - NH_2 + CHCl_3 + 3KOH \rightarrow RNC$ or Ar - NC+ $3KCl + 3H_2O$

(D) Hoffmann orientation → Anti saytzeff (Formation of less substituted alkene as major product)

SECTION-B

1. 20 mL of 0.02 M $K_2Cr_2O_7$ solution is used for the titration of 10 mL of Fe^{2+} solution in the acidic medium.

The molarity of Fe^{2+} solution is _____ $\times 10^{-2}$ M. (Nearest Integer)

Official Ans. by NTA (24)

Allen Ans. (24)

Sol. Eq. of $K_2Cr_2O_7$ = Eq. of Fe^{2+}

$\Rightarrow$ (Molarity × volume × n.f) of $K_2Cr_2O_7$ = (molarity × volume × n.f) of Fe^{2+}

$\Rightarrow 0.02 \times 20 \times 6 = M \times 10 \times 1$

$\Rightarrow$ M = 0.24

$\Rightarrow$ Molarity = 24×10^{-2}

2. $2NO + 2H_2 \rightarrow N_2 + 2H_2O$

The above reaction has been studied at 800°C. The related data are given in the table below

Reaction serial number	Initial pressure of H_2 / kPa	Initial Pressure of NO/ kPa	Initial rate $\left(\frac{-dp}{dt}\right)/(kPa/s)$
1	65.6	40.0	0.135
2	65.6	20.1	0.033
3	38.6	65.6	0.214
4	19.2	65.6	0.106

The order of the reaction with respect to NO is____

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. On decreasing pressure of NO by a factor of '2' the rate of reaction decreases by a factor of '4'.

$\therefore$ Order of reaction w.r.t. 'NO' = 2

3. Amongst the following the number of oxide(s) which are paramagnetic in nature is

Na_2O, KO_2, NO_2, N_2O, ClO_2, NO, SO_2, Cl_2O

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. KO_2, NO_2, ClO_2, NO are paramagnetic.

4. The molar heat capacity for an ideal gas at constant pressure is 20.785 J $K^{-1}mol^{-1}$. The change in internal energy is 5000 J upon heating it from 300K to 500K. The number of moles of the gas at constant volume is ___ [Nearest integer]

(Given: R = 8.314 J K^{-1} mol^{-1})

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. $C_{p,m} = C_{v,m} + R$

$\Rightarrow C_{v,m} = 20.785 - 8.314 = 12.471$ J k^{-1} ml^{-1}

$\Delta U = nC_{v,m}\Delta T$

$$\Rightarrow n = \frac{5000}{12.471\times 200} = \frac{25}{12.471} \approx 2$$

5. According to MO theory, number of species/ions from the following having identical bond order is_____:

$CN^-, NO^+, O_2, O_2^+, O_2^{2+}$

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. CN^-, NO^+, O_2^{2+} have bond order = 3

6. At 310 K, the solubility of CaF_2 in water is 2.34×10^{-3}g /100 mL. The solubility product of CaF_2 is ___ $\times 10^{-8}$ $(mol/L)^3$. (Given molar mass : CaF_2 = 78 g mol^{-1})

Official Ans. by NTA (0)

Allen Ans. (0)

Sol. Solubility of CaF_2 = S mole/L

$$S = \frac{2.34\times 10^{-3}}{0.1\times 78} = \frac{2.34}{78}\times 10^{-2} = 3 \times 10^{-4} \text{ mol/L}$$

$K_{sp}(CaF_2) = 4S^3 = 4(3 \times 10^{-4})^3$

$= 108 \times 10^{-12}$

$= 0.0108 \times 10^{-8}$ $(mol/L)^3$

7. The conductivity of a solution of complex with formula $CoCl_3(NH_3)_4$ corresponds to 1 : 1 electrolyte, then the primary valency of central metal ion is_____

Official Ans. by NTA (1)

Allen Ans. (3)

Sol. $[Co(NH_3)_4Cl_2]Cl$

Primary valency = oxidation no. = +3

8. In the titration of $KMnO_4$ and oxalic acid in acidic medium, the change in oxidation number of carbon at the end point is_____

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. Oxidation state of carbon changes from +3 to +4.

$$2KMnO_4 + 5H_2C_2O_4 + 3H_2SO_4(\text{dil.}) \rightarrow$$

$$K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$$

9. Optical activity of an enantiomeric mixture is +12.6° and the specific rotation of (+) isomer is +30°. The optical purity is____%

Official Ans. by NTA (42)

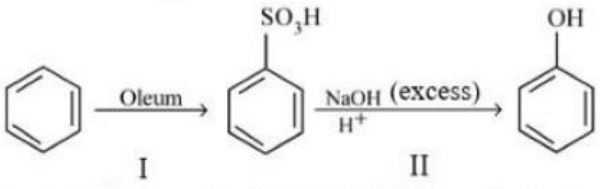
Allen Ans. (42)

Sol.

$$\%\text{ optical purity} = \frac{\text{observed rotation of mixture}\times 100}{\text{rotation of pure enantiomer}}$$

$$= \frac{+12.6^\circ}{+30^\circ}\times 100 = 42$$

10. In the following reaction



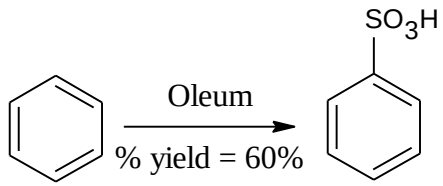
The % yield for reaction I is 60% and that of reaction II is 50%. The overall yield of the complete reaction is ___% [nearest integer]

Official Ans. by NTA (30)

Allen Ans. (30)

Sol.

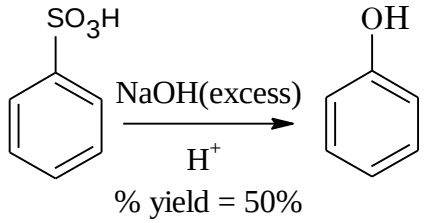
(I)



Let initial moles of reactant taken = n

Total moles obtained for benzene sulphonic acid (with % yield = 60%) = 0.6n

(II)



Moles of benzene sulphonic acid before reaction II = 0.6n

Moles obtained for phenol (with % yield = 50%) = 0.6×0.5n =0.3n

So over all % yield of complete reaction = $\frac{0.3n}{n}\times 100 = 30$