Solved Examples

JEE Main/Boards

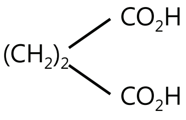
Example 1: Ethylamine and diethylamine cannot be distinguished by

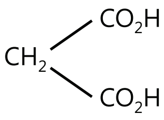
(A) Hinsberg test (B) Carbylamine test

(C) Iodoform test (D) Both (a) and (b)

Sol: Only primary amine gives carbylamine test and hinsberg reagent gives different product with primary and secondary amine. A primary amine will form a soluble sulfonamide salt which precipitates after addition of diluted hydrochloric acid. A secondary amine in the same reaction will directly form an insoluble sulfonamide. Thus these tests can be used. (C) 1° and 2° amines can be distinguished by Hinsberg test and carbylamine test.

Example 2: Which of the following give positive Tollen's reagent test.

(A) 

(B) 

(C) 

(D) HCO_2H

Sol: Formic acid will get oxidized to carbon dioxide and water, this is due to the carbonyl-containing carbon in aldehydes having an attached hydrogen. (D) Formic acid is the only acid giving tollen's reagent test.

Example 3: Sodium nitroprusside when added to an alkaline solution of sulphide ions produces a colouration which is:

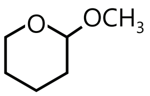
(A) Prussian blue (B) Purple

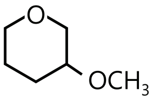
(C) Blood red (D) Turnbull Blue

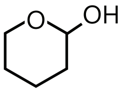
Sol: (C) $Na + N + C + S \longrightarrow NaCNS$ (Sodium thiocyanate)

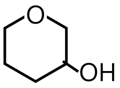
$$\underset{\text{Thiocyanate ion}}{3CNS^-} + Fe^{+3} \longrightarrow \underset{\substack{\text{Ferric thiocyanate} \\ \text{(Blood-red colour)}}}{Fe(CNS)_3}$$

Example 4: Which of the following give positive Tollen's test:

(A) 

(B) 

(C) 

(D) 

Sol: Hemiacetal due to presence of hydrogen atom at chiral carbon gives positive test with Tollen's reagent.

(C) Hemiacetals give positive Tollen's test.

Example 5: Give test to differentiate between 1,1-dichloroethane and 1,2-dichloroethane:

(A) 2,4-DNP then aq. KOH

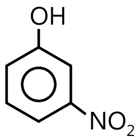
(B) Aq. KOH then 2,4- DNP

(C) $NaHSO_3$

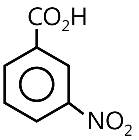
(D) Lucas reagent

Sol: (B) Gem dihalide forms aldehyde or ketone which gives test of 2,4-DNP

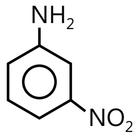
Example 6:



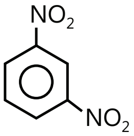
(m-nitrophenol)



(m-nitro benzoic acid)



(m-nitro aniline)



(m-dinitro benzene)

Above compounds can be differentiated by which of the following chemical test used in same order?

(A) NaOH, $NaHCO_3$, HCl (B) HCl, NaOH, $NaHCO_3$

(C) $NaHCO_3$, NaOH, HCl (D) NaOH, HCl, $NaHCO_3$

Sol: $NaHCO_3$ separates carboxylic acid, NaOH separates phenol. HCl further separates amine.

Example 7: Which of the following reagent is used for the separation of acetaldehyde from acetophenone?

(A) NH_2OH (B) NaOI

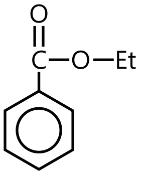
(C) Tollen's reagent (D) $C_6H_5NHNH_2$

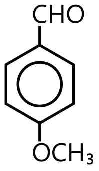
Sol: ketone and aldehydes can be distinguished by Tollen's reagent as Ketones do not give Tollen's reagent test, while aldehydes do not give.

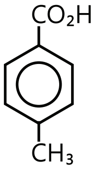
(C) Ketones do not give Tollen's reagent test, while aldehydes do not give.

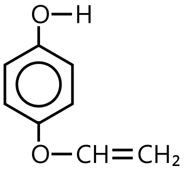
JEE Advanced/Boards

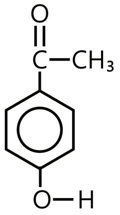
Example 1: Given are the isomers of $C_8H_8O_2$.

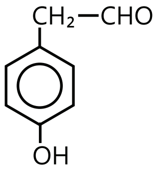

(A)


(B)


(C)


(D)


(E)


(F)

(i) Which isomer gives positive iodoform test?

(A) a (B) b (C) d (D) e

(ii) Which isomer gives +ve Tollen's test, also reacts with $FeCl_3$?

(A) b (B) f (C) c (D) d

(iii) Which isomer reacts with $NaHCO_3$?

(A) c (B) b (C) e (D) f

(iv) Which isomer on hydrolysis gives 1, 4-di hydroxybenzene?

(A) a (B) d (C) e (D) f

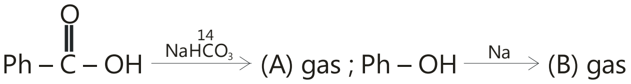
Sol: (i) (D) Iodoform test is given by compounds having free methyl group.

(ii) (B) Tollens test is given by aldehyde as Aldehydes are readily oxidized to carboxylic acids

(iii) (A) Acid with NaHCO3 gives brisk effervescence due to formation of Carbon dioxide

(iv) (B) Ether on hydrolysis give alcohol.

Example 2:



$$Ph-\overset{O}{\overset{\|}{C}}-OH \xrightarrow{Na\overset{14}{H}CO_3} (A)\ \text{gas} ;\ Ph-OH \xrightarrow{Na} (B)\ \text{gas}$$

Sum of molecular mass of gas (A + B = ?)

Sol: Molecular mass of gas is 48; The gas formed in first reaction is $C^{14}O_2$ and from other reaction is H_2.

Example 3: Statement-I: Aniline on reaction with $NaNO_2$/HCl at 0°C followed by coupling with β-naphthol gives a dark blue coloured precipitate. and

Statement-II: The colour of the compound formed in the reaction of aniline with $NaNO_2$/HCl at 0°C followed by coupling with β-naphthol is due to the extended conjugation.

(A) Statement-I is true, statement-II is true; statement-II is correct explanation for statement-I

(B) Statement-I is true, statement-II is true; statement-II is not a correct explanation for statement-I

(C) Statement-I is true, statement-II is false

(D) Statement-I is false, statement-II is true

Sol: (D) $C_6H_5N_2Cl$ gives scarlet red coloured dye with β-naphthol.

Example 4: Propyne and propene can be distinguished by

(A) Conc. H_2SO_4 (B) Br_2 in CCl_4

(C) Dil. $KMnO_4$ (D) $AgNO_3$ in ammonia

Sol: Propyne being terminal alkyne forms silver ppt. with $AgNO_3$ in ammonia.

$$RC\equiv C-H + Ag(NH_3)_2^+ (\text{in } NH_4OH) \longrightarrow$$

$$RC\equiv C-Ag\ (\text{insoluble}) + NH_3 + NH_4^+$$

(D) Propyne being terminal alkyne forms silver ppt. with $AgNO_3$ in ammonia.

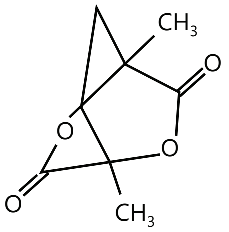
Example 5: 2,4-pentadione is treated with excess of KCN in acetic acid solution and finally hydrolysed with dilute

H_2SO_4 giving products only with molecular formula $C_7H_{12}O_6$ (dicarboylic acids). The correct statement regarding product(s) of this reaction is/are

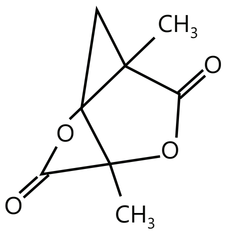
(A) Product mixture contains four stereoisomers which on fractional crystallization gives two fractions.

(B) Product mixture contains three stereoisomers which on fractional crystallization gives two fractions.

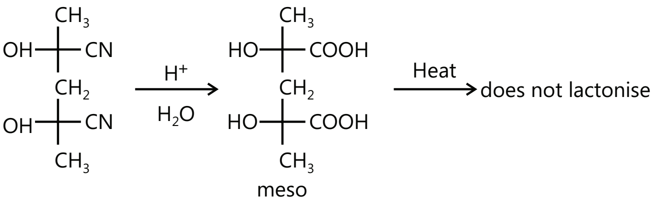
(C) Product of either fraction obtained after crystallization, on strong heating lactonizes to give the following compound:

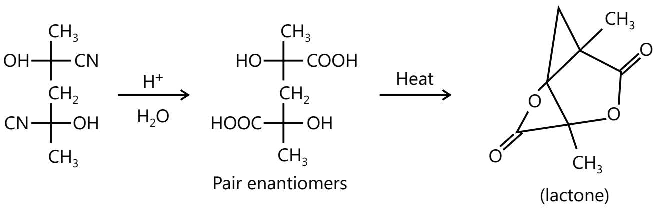


(D) Product of only one fraction obtained after crystallization, on strong heating lactonizes to give following compound:



Sol: (B,D) The reaction with KCN in acetic acid solution and hydrolysis with dilute H_2SO_4, gives a product with two chiral centers giving three stereoisomers. Nucleophilic addition occur at sp^2 carbons, both front and back side are equally probable. Since, product is symmetric, one meso product and a pair of enantiomers. Enantiomers having same solubility form same fraction after fractional crystallization.





Example 6: A hydrocarbon (A) of molecular weight 54 reacts with an excess of Br_2 in CCl_4 to give a compound (B) whose molecular weight is 593% more than that of (A). However, on catalytic hydrogenation with excess of hydrogen, (A) forms (C) whose molecular weight is only 7.4% more than that of (A). (A) reacts with CH_3CH_2Br in the presence of $NaNH_2$ to give another hydrocarbon (D) which on ozonolysis yields diketone (E). (E) on oxidation gives propionic acid. Give the structures of (A) to (E) with reason.

Sol: To determine the molecular weights of compounds (B) and (C).

(i)The molecular weight of a compound (A) is 54 while that of compound (B), which gives on treatment with an excess of Br_2 in CCl_4, is 593% more than that of (A).

$$\therefore \text{ Molecular weight of (B)} = \frac{(100+593)}{100} \times 54 = 374.22$$

Thus, the increase in weight due to addition of Br atoms is 374.22 – 54.0 = 320.22

Since, the atomic weight of Br is 80, the number of Br atoms added = 320.22/80 = 4

As such the hydrocarbon (A) must be an alkyne.

(ii) Further, since the molecular weight of compound (C), which hydrocarbon (A) gives on catalytic hydrogenation, is only 7.4% more than that of (A), the molecular weight of (C) is

$$\frac{(100+7.4)\times 54}{100} = 57.994 = 58 \text{ (approx.)}$$

Thus, the increase in weight due to addition of H atoms = 58 – 54 = 4

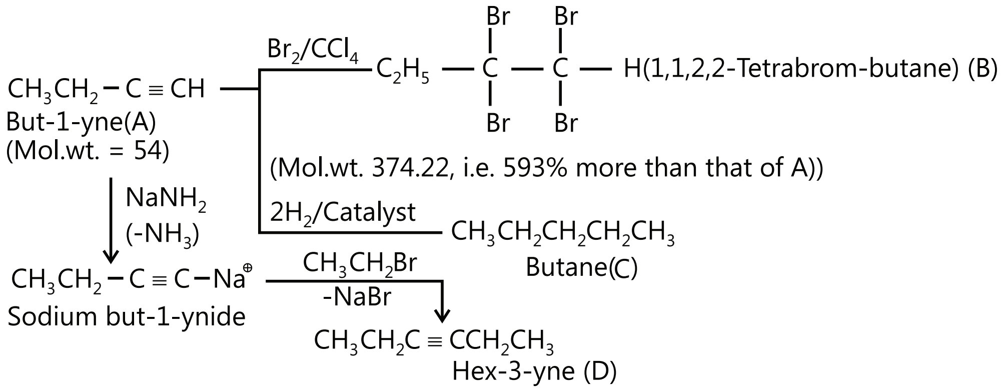
Since, the atomic weight H is 1, the number of H atoms added during catalytic hydrogenation is 4/1 = 4. Therefore, hydrocarbon (A) must be an alkyne.

To determine the structures of the hydrocarbons (A), (B), (C) and (D).

(i) The two possible structures of hydrocarbon (A) i.e. an alkyne with molecular weight 54 (C_4H_6) are: $CH_3CH_2 - C \equiv CH$ (But-1-yne) (I) ; $CH_3 - C \equiv CH_3$ (But-2-yne) (II)

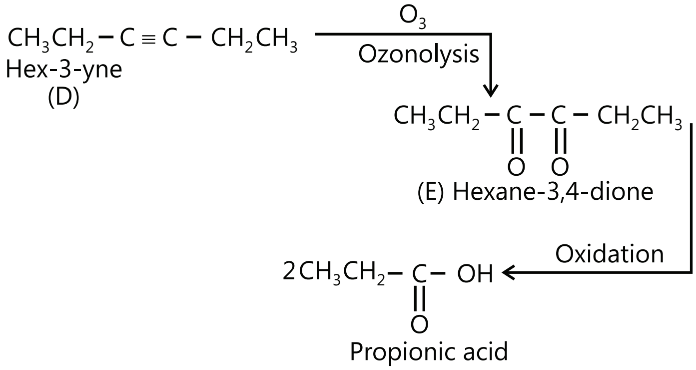
(ii) Since, (A) reacts with CH_3CH_2Br in the presence of $NaNH_2$ to give another hydrocarbon (D), (A) must be a terminal alkyne i.e. but-1-yne and not but-2-yne.

(iii) If hydrocarbon (A) is but-1-yne, then the structure of the compounds (B), (C) and (D) may be worked out as follows:



To determine the structure of the diketone of (E).

Since the hydrocarbon (D) i.e. hex-3-yne on ozonolysis gives a diketone (E) which on further oxidation gives propionic acid, the diketone (E) must be hexane-3,4-dione as explained below:



Thus,

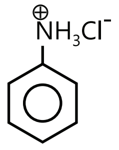
(A) = But-1-yne, (B) = 1,1,2,2 -Tetrabromobutane, (C) = Butane (D) = Hex-3-yne, and

(E) = Hexane-3, 4-dione

JEE Main/Boards

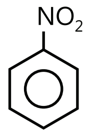
Exercise 1

Q.1 Compounds (P) and (Q) can be differentiated by:



(P)

and



(Q)

Q.2 0.002 gm of an organic compound was treated according to Kjeldahl's method.

0.2×10^{-4} mol of H_2SO_4 was required to neutralize NH_3. Calculate the percentage of N_2.

Q.3 0.12 gm of an organic compound containing phosphorous gave 0.22 gm of $Mg_2P_2O_7$ by the usual analysis. Calculate the percentage of phosphorous in the compound.

Q.4 An organic compound containing sulphur is estimated by Carius method in which fuming HNO_3 is used to convert S into?

Q.5 In organic layer test, CS_2 or CCl_4 is added to Lassaigne's extract and then Cl_2 water or $KMnO_4$ is added. This test is used to distinguish between?

Q.6 A Dumas bulb full of air weighs 22.567 gm at 20°C and 755 mm pressure. Full of vapours of a substance at 120°C and the same pressure, it weighs 22.8617 gm. The capacity of the bulb is 200 ml. Find out the molecular mass of the substance.

[Density of air = 0.00129 gm/ml

Q.7 Percentage composition of an organic compound is as follows: $C = 10.06, H = 0.84, Cl = 89.10$

What is its molecular formula if the vapour density is 60.0?

Q.8 The empirical formula of a compound is CH_2. One mole of the compound has mass of 42 g, its molecular formula is?

Q.9 How will you separate a mixture of o-nitro-phenol and p-nitrophenol ?

Q.10 How will you separate benzoic acid from a mixture of naphthalene and benzoic acid?

Q.11 Suggest methods for the separation of the following mixtures:

(A) A mixture of liquid A (b.p. 365 K) and liquid B (b.p.355 K)

(B) A mixture of liquid C (b.p. 348 K) and liquid D (b.p. 478 K).

Q.12 Will a precipitate of AgCl be formed on treating $CHCl_3$ with $AgNO_3$? Explain :

Q.13 Name two compounds which are purified by sublimation.

Q.14 What is the basic principle of chromatography?

Q.15 What conclusions would you draw if the Lasagne's extract gives a blood red colouration with $FeCl_3$?

Q.16 0.257 g of an organic substance was heated with conc. H_2SO_4 and then distilled with excess of strong alkali. The ammonia gas evolved was absorbed in 50 mL of M/10 which required 23.2 mL of M/10 NaHO for neutralisation at the nitrogen in the compound.

Q.17 0.85 g of an organic substance was Kjeldahlised and the ammonia obtained was passed into 100 mL of M/10 H_2SO_4. The excess acid required 154 mL of M/10 NaOH for neutralisation. Calculate .the percentage of nitrogen in the compound.

Q.18 A ample of a 0.50 g on organic compound was heated according to Kjerldahl's method. The ammonia evolved by absorbed in 50 mL of 0.5 M H_2SO_4.The residual acid required 60 mL of 0.5 M solution of NaOH for neutralisation. Find the percentage composition of nitrogen in the compound.

Q.19 0.15 g of an organic compound gave 0.12 g AgBr by carious method. Find the percentage of bromine in the compound.

Q.20 0.395 g of an organic compound by Carius method for the estimation of sulphur gave 0.582 g of $BaSO_4$. Calculate the percentage of sulphur in the compound.

Exercise 2

Single Correct Choice Type

Q.1 In Kjeldahl's method, nitrogen present is estimated as:

(A) N_2 (B) NH_3

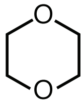
(C) NO_2 (D) None of these

Q.2 A compound which doesn't give a positive test in Lassaigne's test for nitrogen is:

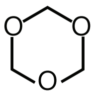
(A) Urea (B) Hydrazine

(C) Azobenzene (D) Phenyl hydrazine

Q.3 Compounds (X) and (Y) can be differentiated by:



and



(X) (Y)

(A) H_3O^+, Na (B) H_3O^+, then Fehling test

(C) H_3O^+, then Na (D) Both (B) and (C)

Q.4 In Kjeldahl's method of estimation of nitrogen K_2SO_4 acts as:

(A) An oxidant (B) Catalytic reagent

(C) Hydrolyzing agent (D) Boiling point elevator

Q.5 The Prussian blue colour obtained during the test of nitrogen by Lassaigne's test is due to formation of :

(A) $Fe_4[Fe(CN)_6]_3$ (B) $Na_3[Fe(CN)_6]$

(C) $Fe[Fe(CN)_6]$ (D) $Na_4[Fe(CN)_5NOS]$

Q.6 A compound of carbon, hydrogen, and nitrogen contains the elements in the ratio 18 : 2 : 7. Calculate its empirical formula and molecular formula if its molecular mass is 108.

(A) C_3H_4N, $C_6H_8N_2$ (B) CHN, $C_5H_6N_3$

(C) $C_5H_6N_3$, $C_5H_6N_3$ (D) C_2H_4N, $C_4H_8N_2$

Q.7 In Dumas's method for the estimation of nitrogen in an organic compound, nitrogen is estimated in the form of:

(A) Gaseous nitrogen (B) Sodium cyanide

(C) Ammonium sulphate (D) Gaseous ammonia

Q.8 In Leibig's combustion method for estimation of C and H, if the compound contains N, which of the following is kept near the exit of the combustion tube?

(A) Silver wire (B) $PbCrO_4$

(C) Both A and B (D) Cu gauge

Q.9 Which of the following statements are wrong? (multiple choice)

(A) The gas displaced in Victor Meyer's method is air.

(B) The simplest formula that shows the ratio of the constituent atoms present in the molecule is called molecular formula.

(C) Estimation of oxygen in an organic compound is also done by Aluise's method.

(D) An organic monobasic base B on reaction with H_2PtCl_6 forms an insoluble compound $B_2H_2PtCl_6$.

Q. 10 Which of the following statement(s) is/are correct?

(A) Nitroprusside ion is $[Fe(CN)_5NO]^{2-}$.

(B) Nitroprusside ion is $[Fe(CN)_5NOS]^{2-}$

(C) Prussian blue and turn bull blue are respectively $Fe_4[Fe(CN)_5]_3$ and $Fe_3[Fe(CN)_6]_2$.

(D) Prussian blue and turn bull blue are respectively $Fe_3[Fe(CN)_6]_2$ and $Fe_4[Fe(CN)_6]_3$.

Q.11. Sulphur cannot be detected by

(A) Beilstein test (B) Lassaigne test

(C) Lead acetate test (D) Sodium nitroprusside test

Q.12 If an organic compound contains both N and S; the appearance of blood red colour takes place in Lassaigne-test due to formation of

(A) NaCNS (B) $Fe(CNS)_3$ (C) NaSCN (D) $Fe(CN)_2$

Q. 13 Layer test is used to detect the presence of

(A) Chlorine (B) Phosphorus

(C) Bromine (D) Fluorine

Q.14 Carius method is used for the estimation of

(A) Halogens (B) Sulphur

(C) Phosphorus (D) All of these

Q.15 During estimation of Duma's method 2.36 g of an organic compound gave 448 mL of N_2 (g) at NTP. The % of N in the compound is

(A) 23.7% (B) 40% (C) 47.4% (D) 12%

Q.16 Estimation of C and H in an organic compound is done by

(A) Duma's method (B) Leibig's method

(C) Lassaigne method (D) Carius method

Q.17 The principle involved in paper chromatography is

(A) Partition (B) Sublimation

(C) Adsorption (D) Solubility

Q.18 Naphthalene and benzoic acid can be separated from each other best by the method of

(A) Crystallisation (B) Sublimation

(C) Distillation (D) Chromatography

Q.19 Which of the following compound will not give Lassaigne's test for nitrogen?

(A) Azobenzene (B) Hydrazine

(C) Phenylhydrazine (D) Urea

Q.20 What happens when $AgNO_3$ solution is added to bromo methane?

(A) Gives yellow ppt

(B) Will gives white ppt

(C) Gives yellow ppt only in presence of KOH

(D) Gives white ppt only in presence of KOH

Previous Years Questions

Q.1 Which of the following compounds can be detected by Molisch'stest? ***(2012)***

(A) Nitro compounds (B) Sugars

(C) Amines (D) Primary alcohols

Q.2 Silver Mirror test is given by which ***(2011)***

one of the following compounds ?

(A) Acetone (B) Formaldehyde

(C) Benzophenone (D) Acetaldehyde

Q.3 Which of the following reagents may be used to distinguish between phenol and benzoic acid? ***(2011)***

(A) Tollen's reagent (B) Molisch reagent

(C) Neutral $FeCl_3$ (D) Aqueous NaOH

Q.4 Biuret test is not given by ***(2010)***

(A) Carbohydrates (B) Polypeptides

(C) Urea (D) Proteins

Q.5 The ammonia evolved from the treatment of 0.30 g of an organic compound for the estimation of nitrogen was passed in 100 mL of 0.1 M sulphuric acid. The excess of acid required 20 mL of 0.5 M sodium hydroxide solution for complete neutralization. The organic compound is ***(2004)***

(A) Acetamide (B) Thiourea

(C) Urea (D) Benzamide

Q.6 Among the following the one that gives positive iodoform test upon reaction with I_2 and NaOH is: ***(2006)***

(A) $CH_3CH_2CH(OH)CH_2CH_3$ (B) $C_6H_5CH_2CH_2OH$

(C) $CH_3CH(CH_3)-CH_2OH$ (D) $Ph-CH(OH)CH_3$

Q.7 Iodoform can be prepared from all except: ***(2012)***

(A) Ethyl methyl ketone

(B) Isopropyl alcohol

(C) 3–Methyl – 2– butanone

(D) Isobutyl alcohol

Q.8 29.5 mg of an organic compound containing nitrogen was digested according to Kjeldahl's method and the evolved ammonia was absorbed in 20 mL of 0.1 M HCl solution. The excess of the acid required 15 mL of 0.1 M NaOH solution for complete neutralization. The percentage of nitrogen in the compound is ***(2010)***

(A) 59.0 (B) 47.4

(C) 23.7 (D) 29.5

Q.9 For the estimation of nitrogen, 1.4 g of an organic compound was digested by Kjeldahl method and the evolved ammonia was absorbed in 60 mL of $\frac{M}{10}$ sulphuric acid. The unreacted acid required 20 mL of $\frac{M}{10}$ sodium hydroxide for complete neutralization. The percentage of nitrogen in the compound is ***(2014)***

(A) 6% (B) 10% (C) 3% (D) 5%

Q.10 In Carius method of estimation of halogens, 250 mg of an organic compound gave 141 mg of AgBr. The percentage of bromine in the compound is:

(at. mass Ag = 108 ; Br = 80) ***(2015)***

(A) 24 (B) 36 (C) 48 (D) 60

Q.11 The hottest region of Bunsen flame shown in the figure below is: ***(2016)***

(A) Region 2 (B) Region 3

(C) Region 4 (D) Region 1

Q.12 The distillation technique most suited for separating glycerol from spent-lye in the soap industry is: ***(2016)***

(A) Fractional distillation

(B) Steam distillation

(C) Distillation under reduced pressure

(D) Simple distillation

JEE Advanced/Boards

Exercise 1

Q.1 0.92 gm of an organic compound containing carbon, hydrogen, and oxygen was analysed by Leibig's combustion method. The increase in the mass of U-tube and the potash bulbs at the end of the operation was found to be 1.08 gm and 1.76 gm, respectively. Determine the percentage composition of the compound.

Q.2 In an estimation of sulphur by the Carius method 0.2175 g of the substance gave 0.5825 g of Ba_2SO_4. What is the percentage of sulphur in the substance?

Q.3 An organic compound having molecular mass 60 is found to contain $C = 20\%$ **,** $H = 6.67\%$ and $N = 46.67\%$ while rest is oxygen .On heating it given NH_3 along with a solid residue. The solid residue give violet colour with alkaline copper sulphate solution. The compound is:

Q.4 An hydrocarbon contains 10.5 g carbon and 1 g hydrogen. Its 2.4 g has 1 L volume at 1 atm and 127° C. Determine the molecular formula of the Hydrocarbon.

Q.5 0.1877 g of an organic compound when analysed by the Duma's method yields 32 mL of most nitrogen measured at 287 k and 758 mm mercury pressure. What is percentage of nitrogen in the organic compound? (aqueous tension at $287K = 12mm$)

Q.6 If 0.228 g of silver salt of dibasic acid gave a residue of 0.162 g of silver on ignition then what is the molecular weight of the acid?

Q.7 0.5 g of hydrocarbon gave 0.9 water on combustion. Calculate the percentage of carbon in hydrocarbon.

Q.8 In a compound, C,H and N are present in $9:1:3.5$ by weight. If molecular weight of the compound is 108, then determine the molecular formula of the compound.

Q.9 Name a method suitable for separating the mixture of iodine and sodium chloride.

Q.10 Why is nitric acid added to sodium extract before adding silver nitrate solution for testing halogens?

Q.11 Why is it necessary to use acetic acid and not sulphuric acid for acidification of sodium extract for testing sulphur by lead acetate test?

Q.12 The R_f value of A and B in a mixture determined by TLC in a solvent mixture are 0.65 and 0.42 respectively. If the mixture is separated by column chromatography using the same solvent mixture on a mobile phase, which of the two components A or B elute first?

Q.13 A mixture contains 71 per cent of calcium sulphate and 29 per cent of camphor. Name a suitable technique of separation of the components of the mixture?

Q.14 Suggest a suitable technique of separating naphthalene from kerosene present in a mixture.

Q.15 Write the molecular formula of iron (III) hexacyanoferrate (II).

Q.16 0.2475 g of an organic compound gave on combustion 0.4950 g of carbon dioxide and 0.2025 g of water. Calculate the percentage of carbon and hydrogen in it.

Q.17 An organic compound contains 69% carbon and 4.8% hydrogen, the remainder being oxygen. Calculate the masses of carbon dioxide and water produced when 0.20 g of this substance is subjected to complete combustion.

Q.18 On complete combustion, 0.246 g of an organic compound gave 0.198 g of carbon dioxide and 0.1014 g of water calculate the percentage composition of carbon and hydrogen in the compound.

Q.19 In a Duma's nitrogen estimation 0.3 g of an organic compound gave 50 mL of nitrogen collected at 300 K and 715 mm pressure. Calculate the percentage of nitrogen in the compound.

(vapour pressure of water at 300 K is 15 mm).

Q.20 During nitrogen estimation of an organic compound by Kjeldahl's method, the ammonia evolved by 0.5 g of the compound neutralised 10 mL of 1 MH_2SO_4. Calculate the percentage of nitrogen in the compound.

Exercise 2

Single Correct Choice Type

Q.1 Prussian is formed when

(A) Ferrous sulphate reacts with $FeCl_3$

(B) Ferric sulphate reacts with $Na_4[Fe(CN)_6]$

(C) Ferrous ammonium sulphate reacts with $FeCl_3$

(D) Ammonium sulphate reacts with $FeCl_3$

Q.2 Lassaigne's test is used to detect

(A) Nitrogen (B) Sulphur (C) Chlorine (D) All of these

Q.3 Kjeldahl's method is used in the estimation of

(A) Nitrogen (B) Halogens (C) Sulphur (D) Oxygen

Q.4 In sodium fusion test of organic compounds, the nitrogen of the organic compound is converted into

(A) Sodamide (B) Sodium cyanide

(C) Sodium nitrite (D) Sodium nitrate

Q.5 A is a lighter phenol and B is an aromatic carboxylic acid. Separation of a mixture of A and B can be carried out easily by using a solution of

(A) Sodium hydroxide (B) Sodium sulphate

(C) Calcium chloride (D) Sodium bicarbonate

Q.6 The most suitable method for separation of 1:1 mixture of ortho and para nitrophenols is

(A) Sublimation (B) Chromatography

(C) Crystallisation (D) Steam distillation

Q.7 Lassaigne's test for the detection of nitrogen fails in:

(A) $NH_2CONHNH_2.HCl$ (B) $NH_2NH_2.HCl$

(C) NH_2CONH_2 (D) $C_6H_5NHNH_2.HCl$

Q.8 An organic compound contains C = 40% O = 53.34% and H = 6.60%. The empirical formula of the compound is:

(A) CH_2O (B) CHO (C) CH_4O_2 (D) C_2H_2O

Q.9 Which of the following techniques is most suitable for purification of cyclohexanone from a mixture containing benzoic acid, isoamyl alcohol, cyclohexane and cyclohexanone?

(A) Crystallisation (B) IR spectroscopy

(C) Sublimation (D) Evaporation

Q.10 An organic compound containing C, H and N gave the following results on analysis C = 40%, H = 13.33%, N = 46.67%. Its empirical formula would be

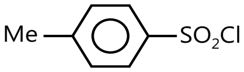
(A) $C_2H_7N_2$ (B) CH_5N (C) CH_4N (D) C_2H_7N

Q.11 A dibasic organic acid gave the following results: C = 34.62%, H = 3.84%. Also, 0.1075 gm of this acid consumers 20 ml of 0.1 N NaOH for complete neutralisation the molecular formula of the acid.

(A) $C_4H_8O_2$ (B) C_2H_6O (C) $C_3H_4O_4$ (D) $C_8H_9O_3$

Match the Columns

Q. 12 Match the columns with compounds in column I and the reagent to separate them in column II

Column I	**Column II**
Compounds	**Reagent for separation**
(A) 1° and 2° amines	(p) $NaHSO_3$
(B) Ethanal and ethanol	(q) Hinsberg reagent ($PhSO_2Cl$) or 
(C) $(C_2H_5)_2NH$ and butanol	(r) Dil. NaOH and distillation
(D) $(C_2H_5)_2C = 0$ and CH_3COOH	(s) Dil. H_2SO_4 and steam distillation

Q.13 Match the columns with method of sepretion in column I with the compounds in column II

Column I	**Column II**
Methods of separation(I)	**Compound(II)**
(A) Separated by treatment with dil. NaOH	(p) Toluene and aniline
(B) Extraction with dil. HCl, a compound passes into the aqueous layer in the form of hydrochloride salt and recovered by neutralization.	(q) Toluene and phenol
(C) Separated by $NaHCO_3$ solution, a compound forms salt and is recovered after acidification.	(r) Diethyl ether and chlorobenzene
(D) Separated by conc. H_2SO_4, which dissolves a compound and recovered from solution by dilution with H_2O	(s) o-Cresol and benzoic acid

Comprehension Type

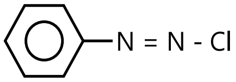
Paragraph (14-23)

Qualitative analysis of organic compounds is performed by Lassaigne's test by fusion with sodium metal, by which the covalent compounds are converted to ionic compounds. Extra elements like N, S, P and halogens are detected by their usual tests.

Q.14 Which of the following compounds will give positive Lassaigne's test for nitrogen?

(A) NH_2OH (B) NH_2NH_2

(C) KCN (D)

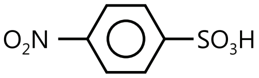


Q.15 Which of the following will give blood red colour in Lassaigne's test for nitrogen ?

(A) $PhNH_2$

(B) $PhNO_2$

(C)



(D) $PhSO_3H$

Q.16 Prussian blue colour in the detection of nitrogen in Lassaigne's test is due to formation of:

(A) $Fe_3[Fe(CN)_6]$ (B) $Fe_4[Fe(CN)_6]_3$

(C) $Fe_3[Fe(CN)_6]_2$ (D) $Fe[Fe(CN)_6]$

Q.17 Violet colour in the detection of sulphur with sodium nitroprusside is due to formation of

(A) $Na_3[Fe(CN)_5NOS]$ (B) $Na_4[Fe(CN)_5NOS]$

(C) $Na_4[Fe(CN)_4S]$ (D) $Na_2[Fe(CN)_5S]$

Q.18 An organic compound containing N,S, and O as extra elements is fused with metallic sodium and then extracted with distilled water. Which species is not present in the Lassaigne's extract?

(A) NO_3^- (B) CN^- (C) CNS^- (D) S^{2-}

Q.19 The Lassaigne's extract is boiled with dil.HNO_3 before testing for halogens because

(A) AgCN is soluble in HNO_3

(B) Silver halides are soluble in HNO_3

(C) NaCN and Na_2S are decomposed by HNO_3.

(D) Ag_2S is soluble in HNO_3.

Q.20 Black precipitate in the detection of sulphur with lead acetate and acetic acid is due to formation of:

(A) Pb_2S (B) PbS (C) PbS_2 (D) $PbSO_4$

Q.21 Blood-red colour in the detection of both N and S in the Lassaigne's extract is due to formation of :

(A) $Fe(CNS)_2$ (B) $Fe(CNS)_3$

(C) $K_4[Fe(CN)_6]$ (D) $K_3[Fe(CN)_6]$

Q.22 Yellow precipitate in the detection of phosphorous when an organic compound is heated with Na_2O_2 and then boiled with conc. HNO_3 followed by the addition of ammonium molybdate is due to formation of:

(A) $(NH_4)_3 . PO_4 . 12MoO_3$ (B) $(NH_4)_3 . PO_4 . 6MoO_3$

(C) $(NH_4)_3 . PO_4 . 12MoO_2$ (D) $(NH_4)_3 . PO_4 . 6MoO_2$

Q.23 Beilstein test is given by:

(A) RX (X = Cl, Br, I) (B) Urea

(C) Thiourea (D) All of these

Assertion Reasoning Type

(A) If both assertion and reason are correct and reason is correct explanation of assertion.

(B) If both assertion and reason are correct and reason is not a correct explanation of assertion.

(C) If assertion is correct and reason is incorrect.

(D) If assertion is incorrect and reason is correct.

(E) If both assertion and reason are incorrect.

Q.24 Assertion: In organic layer test, Cl_2 water is added to sodium extract, which oxidises Br^- and I^- ions to Br_2 and I_2 respectively.

Reason: Reduction potential of Cl_2 is greater than that of Br_2 and I_2.

Q.25 Assertion: Hydroxylamine (NH_2OH) contains N, and hence gives Lassaigne's test.

Reason: Hydroxylamine does not contain C, so with Na metal, CN^- ion is not formed.

Q.26 Assertion: Benzene (b.p. 353K) and methanol (b.p. 338K) are separated by simple distillation.

Reason: Fractional distillation is used to separate two liquids from their mixture when their boiling points differ by 20° or so.

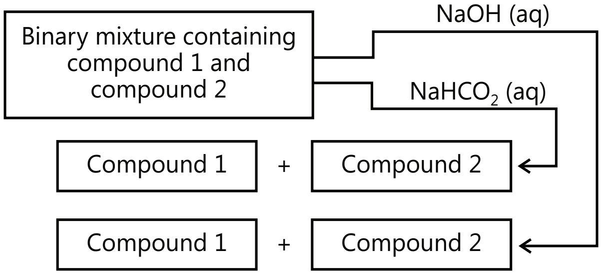
Previous Years Questions

Q.1 The compound that does NOT liberate CO_2, on treatment with aqueous sodium bicarbonate solution, is ***(2013)***

(A) Benzoic acid (B) Benzenesulphonic acid

(C) Salicylic acid (D) Carbolic acid (Phenol)

Q.2 Identify the binary mixture(s) that can be separated into individual compounds, by differential extraction, as shown in the given scheme. ***(2012)***



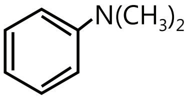
(A) C_6H_5OH and C_6H_5COOH

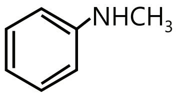
(B) C_6H_5COOH and $C_6H_5CH_2OH$

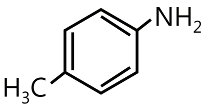
(C) $C_6H_5CH_2OH$ and C_6H_5OH

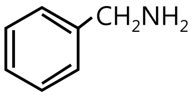
(D) $C_6H_5CH_2OH$ and $C_6H_5CH_2COOH$

Q.3 Amongst the compounds given, the one that would form a brilliant coloured dye on treatment with $NaNO_2$ in dil. HCl followed by addition to an alkaline solution of β -naphthol is ***(2011)***

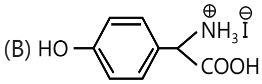
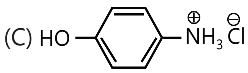
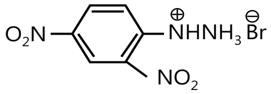
(A) 

(B) 

(C) 

(D) 

Q.4 Match the compounds in column I with their characteristic test(s) / reaction(s) given in column II. ***(2008)***

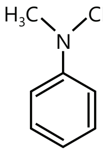
Column I	**Column II**
(A) $H_2N-\overset{\oplus}{N}H_3\overset{-}{Cl}$	(p) Sodium fusion extract of the compound gives Prussian blue colour with $FeSO_4$.
(B) 	(q) Gives positive $FeCl_3$ test.
(C) 	(r) Gives white precipitate with $AgNO_3$
(D) 	(s) Reacts with aldehydes to form the corresponding hydrazone derivative.

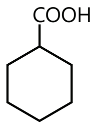
Q.5 A hydrocarbon contains 10.5 gm of carbon for each 1 gm of hydrogen. The mass of 1 litre of hydrocarbon vapours at 127°C and 1 atm is 2.8 gm. Find out the molecular formula of the hydrocarbon. ***(1980)***

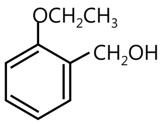
Q.6 Match the compounds/ions in Column I with their properties / reactions in Column II. Indicate your answer by darkening the appropriate bubbles of the 4×4 matrix given in the ORS**.** ***(2007)***

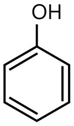
Column I	**Column II**
(A) C_6H_5CHO	(p) Gives precipitate with 2,3 dinitrophenylhydrazine
(B) $CH_3C\equiv CH$	(q) Gives precipitate with $AgNO_3$
(C) CN^-	(r) Is a nucleophile
(D) I^-	(s) Is involved in cyanohydrin formation

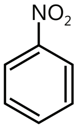
Q.7 Amongst the following, the total number of compounds soluble in aqueous NaOH is: ***(2010)***

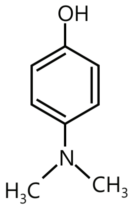


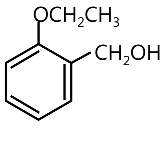


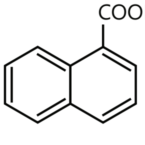












MASTERJEE Essential Questions

JEE Main/Boards

Exercise 1

Q.3 Q.5 Q.9

Exercise 2

Q.1 Q.6

Previous Years' Questions

Q.4 Q.6 Q.7

JEE Advanced/Boards

Exercise 2

Q.2 Q.3 Q.5

Previous Years' Questions

Q.2 Q.4

Answer Key

JEE Main/Boards

Exercise 1

Q.1 Ammonical $AgNO_3$ and NaOH **Q.2** 28% **Q.3** 51.20% **Q.4** SO_4^-

Q.5 Br^- and I^- **Q.6** 86.69 **Q.7** $CHCl_3$ **Q.8** C_3H_6

Q.9 Steam distillation **Q.10** Hot water

Q.11 (a) Fractional distillation (b) Simple distillation **Q.12** $CHCl_3$ is a covalent

Q.13 Camphor, naphthalene **Q.14** Adsorption **Q.15** Presence of N and S

Q.16 14.6% **Q.17** 18.4% **Q.18** 56% **Q.19** 34.04% **Q.20** 20.24%

Exercise 2

Single Correct Choice Type

Q.1 B **Q.2** B **Q.3** D **Q.4** D **Q.5** A **Q.6** A

Q.7 A **Q.8** D **Q.9** B **Q.10** A **Q.11** B **Q.12** D

Q.13 C **Q.14** A **Q.15** A **Q.16** D **Q.17** A **Q.18** A

Q.19 B **Q.20** C

Previous Years' Questions

Q.1 B **Q.2** B,D **Q.3** C **Q.4** A **Q.5** C **Q.6** D

Q.7 D **Q.8** C **Q.9** B **Q.10** A **Q.11** A **Q.12** C

JEE Advanced/Boards

Exercise 1

Q.1 % of C = 60.03%, % of H = 13.30%, % of O = 26.67% **Q.2** 36.78%

Q.3 NH_2CONH_2 **Q.4** m = 79 **Q.5** 19.90%

Q.6 90 **Q.7** 80% **Q.8** $C_6H_8N_2$

Q.9 Sublimation **Q.12** A will be eluted first **Q.14** By differential extraction.

Q.15 $Fe_4[Fe(CH)_6]_3$ **Q.16** 9.09 **Q.17** 0.506g; 0.0864g

Q.18 4.58% **Q.19** 17.49% **Q.20** 56%

Exercise 2

Single Correct Choice Type

Q.1 B **Q.2** D **Q.3** A **Q.4** B **Q.5** D **Q.6** D

Q.7 B **Q.8** A **Q.9** B **Q.10** C **Q.11** C

Match the Columns

Q.12 A → q; B → p; C → s; D → r **Q.13** A → q; B → p; C → s; D → r

Comprehension Type

Q.14 C **Q.15** C **Q.16** B **Q.17** B **Q.18** A **Q.19** C

Q.20 B **Q.21** B **Q.21** A **Q.22** D

Assertion Reasoning Type

Q.23 A **Q.24** D **Q.25** C

Previous Years' Questions

Q.1 D **Q.2** B,D **Q.3** C **Q.4** A → r, s; B → p, q; C → p, q, r; D → p

Q.5 C_7H_8 **Q.6** A → p, q, s; B → q; C → q, r, s; D → q, r

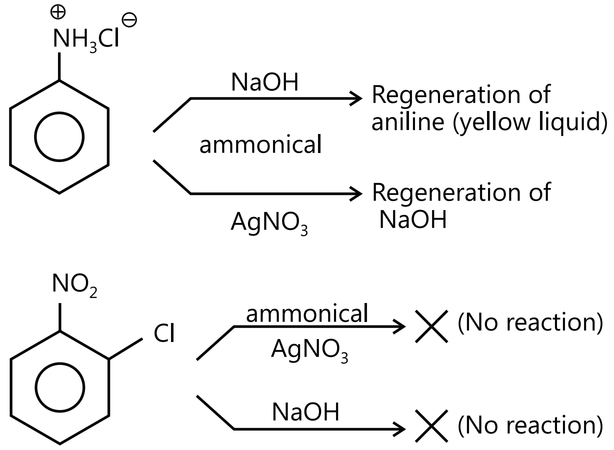
Q.7 5

Solutions

JEE Main/Boards

Exercise 1

Sol 1: Only phenols show colour change.



Sol 2: $\%N = \dfrac{(\text{Normality})_{H_2SO_4} \times (a-b) \times 0.014}{\text{Mass of sample}} \times 100 = 28\%$

Sol 3:

$$\%P = \frac{\text{At.mass of P}}{\text{Molar mass of } Mg_2P_2O_7} \times \frac{\text{Mass of } Mg_2P_2O_7}{\text{mass of compound}} \times 100$$

= 51.20%

Sol 4: An organic compound containing sulphur is estimated by Carius method in which fuming HNO_3 is used to convert S into SO_4^-

Sol 5: Br^- and I^- forms a separate layer.

Sol 6: Wt. of bulb = 22.567 gm; P = 755 mm

Wt. of bulb with substance = 22.8617 gm

Capacity of bulb = 200 ml.

Density of air = 0.0012.9 gm/ml

Wt. of substance = 22.8617 – 22.567 = 0.2947 gm.

m = 86.69

Sol 7:

Atom	Atomic mass (a)	Percentage (b)	$\frac{b}{a} = x$	Ration
C	12	10.06	$\frac{10.06}{12} = 0.83$	1
H	1	0.84	$\frac{0.84}{1} = 0.84$	1
Cl	35.5	89.10	$\frac{89.10}{35.5} = 2.50$	3

Empirical formula = $CHCl_3$

Empirical formula mass = 12 + 1 + 106.5 = 119.5 ≈ 120

Molecular mass = 2 × VD = 2 × 60 = 120

$$n = \frac{\text{molar mass}}{\text{empirical formula mass}} = \frac{60}{60} = 1$$

Molecular formula $= (CHCl_3)_1 = CHCl_3$

Sol 8: Mass of 1 mol. of compound = Mol. Wt. of compound =42 mol

$\therefore$ Molecular formula = empirical formula $\times \frac{\text{Mol. wt}}{\text{EF wt.}}$

$$= CH_2 \times \frac{42}{14} = C_3H_6$$

Sol 9: A mixture of o-nitro phenol and p-nitro phenol can be separated by steam distillation. O-nitrophenol being less volatile distils over along with water while p-nitrophenol being non-volatile in the flask.

Sol 10: Benzoic acid can be separated from naphthalene by treating the mixture with hot water. Benzoic acid dissolves but naphthalene remains insoluble. On cooling pure benzoic acid crystallises out.

Sol 11: (a) Fractional distillation because the boiling of the two liquids differ by only 10°.

(b) Simple distillation because the boiling points of the two liquids differ much

Sol 12: The precipitate of AgCl will not be formed because $CHCl_3$ is a covalent compounds and does not ionize to give Cl^- ions. Therefore, Ag^+ ions (from $AgNO_3$) to from ppt. of AgCl

Sol 13: Camphor, naphthalene.

Sol 14: The method of chromatography is based on the difference in the which the compounds of mixture are adsorbed on a suitable absorbent.

Sol 15: It indicates that the compound contains both N and S. During fusion, sodium thiocyanate is formed which given blood red colouration.

$$3NaSCN + FeCl_3 \rightarrow \underset{\text{Blood red}}{Fe(SCN)_3} + 3NaCl$$

Sol 16: Volume of $\frac{M}{10}NaOH = 23.2\,mL.of\ \frac{M}{10}HCl$

Volume of $\frac{M}{10}$ HCl unused =23.2 mL

$\therefore$ Volume of $\frac{M}{10}HCl$ required for neutralisation of

NH_3 = 50 – 23.2 = 26.8mL

26.8 mL of $\frac{M}{10}HCl = 26.8mL\ of\ M/10NH_3$

1000 mL of 1 NH_3 solution contains nitrogen = 14 g

26.8 ml of $\frac{M}{10}NH_3$ solution contains nitrogen

$$= \frac{14 \times 26.8}{10 \times 1000}$$

Percentage of nitrogen $= \frac{14 \times 26.8 \times 100}{10 \times 1000 \times 0.257} = 14.6\%$

Q.17: Vol. of M/10 H_2SO_4 taken =100 mL Let us first calculate the volume of excess M/10 H_2SO_4 which was neutralised by 154 mL of M/10 NaOH

$$154\ mL\ of\ \frac{M}{10}NaOH = \frac{154}{2}mL\ of\ \frac{M}{10}H_2SO_4$$

$\therefore$ Volume of $\frac{M}{10}H_2SO_4$left unused = 77mL

Volume of $\frac{M}{10}H_2SO_4$ used for neutralisation of NH_3

$$100 - 77 = 23\ mL$$

Now,

$$23\ mL\ of\ \frac{M}{10}H_2SO_4 = 2 \times 23mL\ of\ \frac{M}{10}NH_3$$

$$= 46\ mL\ of\ \frac{M}{10}NH_3$$

Now 1000 mL of 1 M NH_3 contain nitrogen =14 g

46 mL of $\frac{M}{10}$ NH_3 contain nitrogen $= \frac{14}{1000} \times \frac{46 \times 1}{10}$

$\therefore$ Percentage of nitrogen $= \frac{14 \times 46 \times 100}{1000 \times 10 \times 0.35} = 18.4\%$

Sol 18: Mass of organic compound taken = 0.50 g

Vol. of 0.5 M H_2SO_4 taken = 50 mL

The residual acid required 60 mL of 0.5 M solution of NaOH for neutralisation

60 mL of 0.5 M NaOH solution

$$= \frac{60}{2}mL\ of\ 0.5\ M\ H_2SO_4\ \text{solution}$$

$$= 30mL\ of\ 0.5\ M\ H_2SO_4\ \text{solution}$$

Volume of 0.5 M H_2SO_4 used = 50 – 30 = 20mL

Now, 20 mL of 0.5 M H_2SO_4 = 2 × 20mL of 0.5 M NH_3 solution

Or 1000 mL 0.5 M NH_3 contain nitrogen = 14

40 mL of 0.5 M NH_3 contain $= \frac{14 \times 40 \times 0.5}{1000}$

$$\% \text{ of N} = \frac{14\times40\times0.5}{1000\times0.50}\times100 \ = 56\%$$

Sol 19: Mass of $AgBr$ formed $= 0.12g$

$AgBr = Br$

$188 \quad 80$

188 g of $AgBr$ contain bromine = 80 g

0.12 g of $AgBr$ contain bromine $= \frac{80\times0.12}{188} = 0.051$

Percentage of bromine $= \frac{0.051}{0.15}\times100$ = 34.04%

Sol 20: Mass of $BaSO_4 = 0.582$ g

We know $BaSO_2 = S$

$233 = 32$

233 g $BaSO_2$ contain sulphur 32 g

0.582 of $BaSO_2$ contain sulphur $= \frac{32}{233}\times0.582$

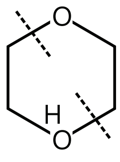
Percentage of sulphur $= \frac{\text{Wt. of sulphur}}{\text{Wt. of xompound}}\times100$

$$= \frac{32\times0.582}{233\times0.395}\times100 = 20.24\%$$

Exercise 2

Sol 1: (B) Refer kjeldahl's method.

Sol 2: (B) $H_2N{-}NH_2$: Does not form complex.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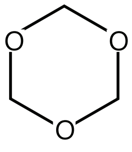
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Fehling test identifies carbonly compounds.

Sol 3: (D) Fehling test identifies carbonyl compounds.

Sol 4: (D) Self-explanatory.

Sol 5: (A) Self-explanatory.

Sol 6: (A)

C:	H:	N:
18 g :	2g :	7 g :
$\frac{18}{12}=\frac{3}{2}:$	$\frac{2}{1}=2:$	$\frac{7}{7}=1$

$\therefore \ C_3H_4N_3$

$$n = \frac{\text{molecular weight}}{\text{e.f.w.}} = \frac{108}{54} = 2$$

$\therefore$ Molecular formula $= C_6H_8N_4$

Sol 7: (A) In Dumas's method for the estimation of nitrogen in an organic compound, nitrogen is estimated in the form of gaseous nitrogen

Sol 8: (D) Refer text-Liebig's Combustion Method

Sol 9: (B) Formula showing simplest ratio is the empirical formula.

Sol 10: (A) Self-explanatory

Sol 11: (B) Belistein test is a method of determining halogens in a given compound.

Sol 12: (D) If both nitrogen and sulphur are present in an organic compound, sodium thiocyanate is formed which then react with Fe^{3+} to form blood colour complex $[Fe(SCN)]^{2+}$

$Na \ + \ C \ +N+S \rightarrow NaSC$

$Fe^{3+} + 2Na \rightarrow \left[Fe\left(SCN\right)\right]^{2+}$

Sol 13: (C) In Lassaigne's extract when sodium iodide is treated with chlorine water the bromide oxidise to the corresponding halogens. This halogen dissolves in carbon di sulphide. Bromine impart orange colour in carbon disulphide layer.

Sol 14: (A) To determination of halogens.

Sol 15 :(A) Mass of the organic compound taken = w g

Volume of nitrogen collected = v g

1 mol of nitrogen = 28 gm = 22400ml

28v/22400 x 100/w

Percentage of nitrogen in the compound

= 28 × 448/22400 × 100/ 2.36

= 23.72 %

Sol 16: (D) Carbon and hydrogen present in an organic compound are estimated by 'Liebig's method'.

Sol 17: (A) This is useful for separating complex mixtures of compounds having similar polarity. The mobile phase is developing solutions that can travel up to the stationary phase carrying the sample along with it. In paper chromatography, the stationary phase is a uniform absorbent paper. The mobile phase is a suitable liquid solvent.

Sol 18: (A) Crystallisation.

Sol 19: (B) Hydrazine does not have C atoms, so it does not form NaCN and hence does not give a positive Lassaigne's test for nitrogen. In order to test the presence of N in such compounds, during fusion with Na, some charcoal or starch is added to supply C atoms. Under these conditions, NaCN is obtained and it will give a positive test.

Sol 20: (C) It would not give pale-yellow precipitate of AgBr because CH_3Br is a covalent compound and hence does not contain Br^{Θ} ion. To get the precipitate of AgBr, CH_3Br is treated first with aqueous KOH to get CH_3OH and Br^{Θ} and then the addition of $AgNO_3$. It would now give the precipitate of AgBr partly soluble in NH_3 or NH_4OH.

Previous Years Questions

Sol 1: (B) Molisch's Test : when a drop or two of alcoholic solution of α–naphthalene added to sugar solution and then conc. H_2SO_4 is added along the sides of test tube, formation of violet ring takes place at the junction of two liquids.

Sol 2: (B, D) Silver mirror test is tollen's reagent test given by all aldehydes.

Sol 3: (C) Phenol gives violet coloured complex compound with neutral $FeCl_3$, benzoic acid gives pale dull yellow ppt. with neutral $FeCl_3$.

Sol 4: (A) It is a test characteristic of amide linkage. Urea also has amide linkage like proteins.

Sol 5: (C) On solving we get that 5×10^{-3} mol of H_2SO_4 was used in reaction with organic compound.

Therefore

Moles of base × acidity of base = 2 × mol of H_2SO_4

Solving we get molecular mass = 60 and acidity = 2 solution. Therefore urea is the answer.

Sol 6: (D) Compound consists of $(CH_3-CH(OH)-)$ group which is easily oxidisable to give methyl ketone which gives iodoform reaction.

Sol 7: (D) Iodoform is given by (1) methyl ketones $R-CO-CH_3$

(2) Alcohols of the type $R-CH(OH)CH_3$ where R can be hydrogen also

Sol 8: (C) Moles of HCl reacting with

Ammonia = (moles of HCl absorbed) – (moles of NaOH solution required)

$$=\left(20\times0.1\times10^{-3}\right)-\left(15\times0.1\times10^{-3}\right)$$

= moles of NH_3 evolved.

= moles of nitrogen in organic compound

$\therefore$ wt. of nitrogen in org. comp = $0.5\times10^{-3}\times14$

$= 7\times10^{-3}$ g

$$\%\text{ wt}=\frac{7\times10^{-3}}{29.5\times10^{-3}}=23.7\%$$

Sol 9: (B) As per question

	Normality	**Volume**
H_2SO_4	$\frac{N}{5}$	60 mL
NaOH	$\frac{N}{10}$	20 mL

$$\left(n_{geq}\right)_{H_2SO_4}=\left(n_{geq}\right)_{NaOH}+\left(n_{geq}\right)_{NH_3}$$

$$\frac{1}{5}\times\frac{60}{1000}=\frac{1}{10}\times\frac{20}{1000}+\left(n_{geq}\right)_{NH_3}$$

$$\frac{6}{500}=\frac{1}{500}+\left(n_{geq}\right)_{NH_3}$$

$$\left(n_{geq}\right)_{NH_3}=\frac{5}{500}=\frac{1}{100}$$

$$\left(n_{mol}\right)_N=\left(n_{mol}\right)_{NH_3}=\left(n_{geq}\right)_{NH_3}=\frac{1}{100}$$

$$\left(\text{Mass}\right)_N=\frac{14}{100}=0.14\text{ g}$$

$$\text{Percentage of "N"}=\frac{0.14}{1.4}\times100=10\%$$

Sol 10: (A)

$$\%\,X=\frac{\text{Atomic mass of Br}}{\text{Molecular mass of AgBr}}\times\frac{\text{Wt. of AgBr}}{\text{Wt. of organic Bromide}}\times100$$

$$\text{Thus \% Br}=\frac{80}{188}\times\frac{141}{250}\times100=24$$

Sol 11: (A) It is fact.

Sol 12: (C) Glycerol is high boiling liquid with B.P. $290°C$. It can be separated from spent-lye by distillation under reduced pressure. Liquid is made to boil at lower temperature than normal temperature by lowering pressure on its surface, so external pressure is reduced and B.P. of liquid is lowered hence glycerol is obtained without decomposition at high temperature.

JEE Advanced/Boards

Exercise 1

Sol 1: Leibig's Combustion Method

Potash tube: Wt. = 1.76 gm (increase)

44 gm of $CO_2 \rightarrow 12$g C

$\therefore 1.76$ gm of $CO_2 \rightarrow$ 'a' g C $\quad \therefore \%C=\frac{a}{0.92}\times100$

U-tube: Increase = 1.08 gm

If 18 gm $H_2O \rightarrow 2$gm of H_2

$\therefore 1.08$ gm $H_2O \rightarrow$ 'b' g H_2

$\therefore \%H=\frac{b}{0.92}\times100$

$\therefore \%O=100-(\%H+\%C)$

Sol 2: $\underset{32g}{S}$ in organic substance $\xrightarrow[(II)BaCl_2]{(I)HNO_3\Delta}\underset{233\text{ g}}{BaSO_4}$

$$\%\text{ of S}=\frac{32}{233}\times\frac{\text{Weight of }BaSO_4}{\text{weight of substance}}\times100$$

$$=\frac{32}{233}\times\frac{0.5825}{0.2175}\times100=36.78\%$$

Sol 3:

Atom	**Atomic Mass (a)**	**Percentage (b)**	$\frac{b}{a}=x$	**Simple ratio**
C	12	20.0	$\frac{20}{12}=1.66$	$\frac{1.66}{1.66}=1$
H	1	6.67	$\frac{6.67}{1}=6.67$	$\frac{6.67}{1.66}=4$
N	14	46.67	$\frac{46.67}{14}=3.33$	$\frac{3.33}{1.66}=2$
O	16	26.66	$\frac{26.66}{16}=1.66$	$\frac{1.66}{1.66}=1$

Empirical formula $=CH_4N_2O$

Empirical formula mass $= 12+4+28+16=60$

$$n = \frac{\text{molecular mass}}{\text{empirical formula mass}} = \frac{60}{60} = 1$$

$\therefore$ Molecular formula $= \left(CH_4N_2O\right)_1 = CH_4N_2O$

$\because$ The compound gives biuret test hence, given compound is urea, i.e., NH_2CONH_2

Sol 4: $C = 10.5g = \frac{10.5}{12} mol = 0.87\ mol$

$$H = 1g = \frac{1}{2} mol = 1 mol$$

$$\therefore\ \left(C_{0.87}H_1\right)_7 = C_{6.09}H_7$$

$$PV = nRT = \frac{w}{m}RT$$

$$\approx C_6H_7$$

$$1\times 1 = \frac{2.4}{m}\times 0.082\times 400$$

$$m = 79$$

Sol 5: Pressure = 785 mm,

Aqueous tension = 12 mm

$\therefore$ Actual pressure of dry N_2 at K = 758 – 12 = 746 mm

Volume of N_2 gas collected = 32 mL

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{760\times V_1}{273} = \frac{746\times 32}{287}$$

$$V_1 = 29.88\ mL\ (\text{at STP})$$

$$\%\,\text{of}\,N = \frac{28\times V\times 100}{22400\times w}$$

$$= \frac{28\times 29.88\times 100}{22400\times 0.1877} = 19.90\%$$

Sol 6: Mass of silver salt = 0.228 g

Mass of silver left = 0.162 g

Basicity of acid = 2

$$\frac{\text{equivalent mass of silver salt}}{\text{equivalent mass of silver}} = \frac{\text{mass of acid taken}}{\text{mass of silver left}}$$

$$\frac{E}{108} = \frac{0.228}{0.162}$$

$$E = 152$$

Equivalent mass of acid = equivalent mass od silver salt – Equivalent mass of Ag + basicity

= 152 – 108 + 1

= 45

$\therefore$ Mol mass of acid = equivalent mass of acid $\times$ basicity

= 45 × 2 = 90

Sol 7:

$$\%\text{ of }H = \frac{2}{18}\times\frac{\text{weight of }H_2O}{\text{weight of organic compound}}\times 100$$

$$\frac{\text{weight of }H_2O}{\text{weight of organic compound}}\times 100$$

$$= \frac{2}{18}\times\frac{0.9}{0.5}\times 100$$

$$= 20\%$$

$\therefore$ The percentage of carbon = 100 – 20 =80%

Sol 8:

	C	H	N
Ratio of weights	9	1	3.5
Ration of atoms	$9/12 = 0.75$	$1/1 = 1$	$3.5/14 = 0.25$
	$\frac{0.75}{0.25} = 3$	$\frac{1}{0.25} = 4$	$\frac{0.25}{0.25} = 1$

$\therefore$ Empirical formula C_3H_4N

$$n = \frac{108}{54} = 2$$

Hence, molecular formula $= \left(C_3H_4N\right)\times 2 = C_6H_8N_2$

Sol 9: Sublimation is used to separate the mixture of iodine and sodium chloride iodine sublimes readily.

Sol 10: Sodium extract is boiled with nitric acid to decompose NaCN and NaS if present.

$$NaCN + HNO_3 \rightarrow NaNO_3 + HCN\uparrow$$

$$Na_2S + HNO_3 \rightarrow 2NaNO_3 + H_2S\uparrow$$

If cyanide and sulphide ions are not decomposed, they will interfere with the test by forming precipitate of AgCN and Ag_2S

$$NaCN + AgNO_3 \rightarrow \underset{\text{White ppt}}{AgCN} + NaNO_3$$

$$Na_2S + 2AgNO_3 \rightarrow \underset{\substack{\text{Silver sulphide}\\\text{(Black ppt)}}}{Ag_2S} + 2NaNO_3$$

Sol 11: For testing sulphur, the sodium extract is acidified with acetic acid because lead acetate is soluble and does not interfere with the test. If H_2SO_4 were, lead acetate will react with it forming white precipitate of lead sulphate.

$$\left(CH_3COO\right)_2 + H_2SO_4 \rightarrow \underset{\text{White ppt}}{PbSO_4} + 2CH_3COOH$$

Sol 12: R_f value of A is 0.65, therefore, it is less strongly adsorbed as compared to compound B which has R_f value of 0.42. Therefore, A will be eluted first.

Sol 13: The mixture can be separated by the process of sublimation. Camphor will sublime whereas calcium sulphate will be left behind.

Sol 14: By differential extraction.

Sol 15: $Fe_4\left[Fe\left(CH\right)_6\right]_3$

Sol 16: Wt. of organic compound $= 0.2475$ g

Wt. of CO_2 produced $= 0.4950$ g

Wt. of H_2O produced $= 0.2025$ g

$$\text{Percentage of carbon } = \frac{22}{44} \times \frac{\text{Wt. of } CO_2}{\text{Wt. of compound}} \times 100$$

$$= \frac{12}{44} \times \frac{0.4950}{0.2475} \times 100 = 54.54$$

$$\text{Percentage of hydrogen } = \frac{2}{18} \times \frac{\text{Wt. of } H_2O}{\text{Wt. of compound}} \times 100$$

$$= \frac{2}{18} \times \frac{0.2025}{0.2475} \times 100 = 9.09$$

Sol 17: Percentage of carbon $= 69\%$

Amount of carbon in 0.20 g of compound $= 0.2 \times \frac{69}{100}$

$= 0.138$ g

Percentage of hydrogen $= 4.8\%$

Amount of hydrogen in 0.20 g of compound $= \frac{0.2 \times 4.8}{100}$

Now, $= 0.0096$ g

12g of carbon on combustion give $CO_2 = 44$g

0.138g of carbon on combustion give $CO_2 = \frac{44}{12} \times 0.138$

$= 0.506$ g

$2H = H_2O$

2 g of hydrogen on combustion give water = 18

0.0096 g of hydrogen on combustion give water

$$= \frac{18}{2} \times 0.0096 \quad = 0.0864 \text{ g}$$

Sol 18: Wt. of organic compounds $= 0.246$ g

Wt. of CO_2 produced $= 0.198$ g

Wt. of H_2O produced $= 0.1014$ g

$$\text{Percentage of carbon } = \frac{12}{44} \times \frac{0.198 \times 100}{0.246}$$

$= 20.95\%$

$$\text{Percentage of hydrogen } = \frac{2}{18} \times \frac{0.1014 \times 100}{0.246} = 4.58\%$$

Sol 19: To calculate the volume of N_2 at S.T.P

$V_1 = 50\,mL \quad V_2 = ?$

$P_1 = 700\,mm \quad P_2 = 760\,mm$

$T_1 = 300K \quad T_2 = 273$ K

Applying $\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$

Or $\quad V_2 = \frac{p_1V_1T_2}{p_2T_1}$

$$\therefore \quad V_2 = \frac{700 \times 50 \times 273}{760 \times 300} = 41.9 \text{ mL}$$

22400 mL of nitrogen at S.T.P. weigh = 28 g

41.9 mL of nitrogen at S.T.P weigh $= \frac{28 \times 41.9}{22400} = 0.0524$g

$$\text{Percentage of nitrogen } = \frac{0.0524}{0.3} \times 100 = 17.49\%$$

Sol 20: 1 M of 10 mL H_2SO_4 = 1 M of 20 mL of NH_3

1000 mL of 1 M ammonia contain = 14g nitrogen

20 mL of 1 M ammonia contain $= \frac{14 \times 20}{1000}$g nitrogen

$$\therefore \text{ Percentage of nitrogen } = \frac{14 \times 20}{1000 \times 0.5} \times 100 \quad = 56.0\%$$

Exercise 2

Single Correct Choice Type

Sol 1: (B) Prussian is formed when Ferric sulphate reacts with $Na_4[Fe(CN)_6]$. Carbon and nitrogen of organic compound on fusion with Na gives NaCN, water soluble. This converted in sodium ferrocyanide by addition of $FeSO_4$. Ferric ions generated react with Ferro cyanide to form prussion blue ppt of ferric Ferro cyanide.

$Na + C + N \rightarrow NaCN$

$6NaCN + FeSO_4 \rightarrow Na_4[Fe(CN)_6] + Na_2SO_4$

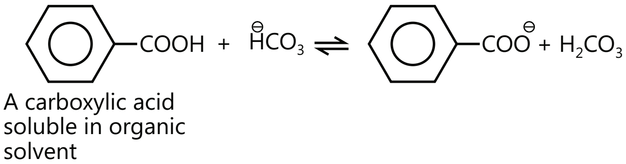
$Na_4[Fe(CN)_6 + Fe^{3+} \rightarrow Fe_4[Fe(CN)_6]_3$

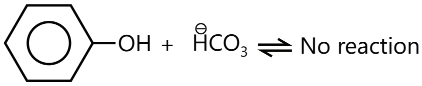
Sol 2: (D) Lassaigne's test is used for detection of nitrogen, halogen and sulphur.

Sol 3: (A) Kjeldahl's method is used in the estimation of Nitrogen

Sol 4: (B) Sodium cyanide

Sol 5: (D) Sodium bicarbonate ($NaHCO_3$). Since carboxylic acids dissolve in $NaHCO_3$ but phenol do not.





Sol 6: (D) Due to intra molecular hydrogen bonding Ortho nitro phenol is more volatile than para nitro phenol which have intermolecular hydrogen bonding. In steam distillation orthonitro phenol is distil over with water and para nitro phenol remains in the flask.

Sol 7: (B) Hydrazine does not have C atoms, so it does not form NaCN and hence does not give a positive Lassaigne's test for nitrogen.

Sol 8: (A)

Element	Percentage	At. Mass	Relative number of atoms	Simplest ratio
Carbon	40/12 = 3.33	12	3.33	1
Hydrogen	6.60/1 = 6.60	1	6.60	2
Oxygen	53.34/16 = 3.33	16	3.33	1

Empirical formula = CH_2O

Sol 9: (B) As in IR spectroscopy each functional group appears at a certain peak. So it is used for the purification of cyclohexane from a mixture of benzoic acid, iso amyl alcohol, cyclohexane and cyclohexanone.

Sol 10: (C)

Element	**Percentage**	**At. Mass**	**Relative number of atoms**	**Simplest ratio**
Carbon	40/12 = 3.33	12	3.33	1
Hydrogen	13.33/1 = 13.33	1	13.33	4
Nitrogen	46.67/14 = 3.33	14	3.33	1

Empirical formula = CH_4N

Sol 11: (C)

Sol: Calculation of empirical formula:

Element	**Percentage**	**At. mass**	**Relative number or atoms**	**Simplest ratio of atoms**
Carbon	34.62	12	$\frac{34.62}{12} = 2.88$	$\frac{2.88}{2.88} = 1 \times 3 = 3$
Hydrogen	3.84	1	$\frac{3.84}{1} = 3.84$	$\frac{3.84}{2.88} = 1.33 \times 3 = 4$
Oxygen	61.54 (by difference)	16	$\frac{16.54}{16} = 3.84$	$\frac{3.84}{2.88} = 1.33 \times 3 = 4$

Empirical formula of the acid = $C_3H_4O_4$

Empirical formula =

$$(3\times12)+(4\times1)+(4\times16)=104$$

Calculation of molecular mass:

20 ml 0.1 N NaOH $\equiv$ 0.1075 gm acid

20×0.1 ml 1 N NaOH $\equiv$ 0.1075 gm acid

$$\Rightarrow 1000 \text{ ml } 1 \text{ N NaOH} \equiv \frac{0.1075}{20\times0.1}\times1000 \text{ gm acid}$$

$$\equiv 53.75 \text{ gm acid}$$

Equivalent mass of the acid = 53.75

Molecular mass of the acid = Equivalent mass × basicity

= 53.75 × 2 = 107.50

$$n = \frac{\text{Molecular mass}}{\text{Empirical mass}} = \frac{107.50}{104.0} \approx 1$$

Molecular formula = $C_3H_4O_4$

Match the Columns

Sol 12: A → q; B → p; C → s; D → r

1° amine + Hinsberg reagent → soluble sulfonamide $\xrightarrow[\text{dil.}]{\text{HCl}}$ ppt

2° amine + Hinsberg reagent → ppt.

(b) – p

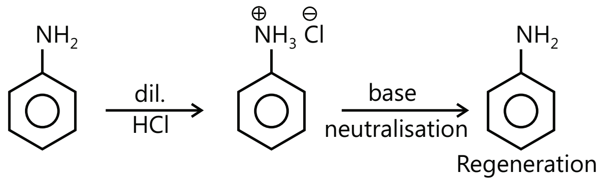
$$\begin{tikzcd}
NaHSO_3 \arrow[r] \arrow[d, "C_2H_5OH"] & \text{Addition bisulphite product (white crystails)} \\
\text{No addition product} &
\end{tikzcd}$$

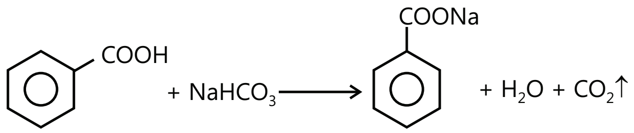
(c) – s Dil. H_2SO_4 converts butanol to ether, which can be separated by distillation.

(d) – r $CH_3COOH + NaOH \rightarrow \underset{\text{soluble sodium salt}}{CH_3COONa}$

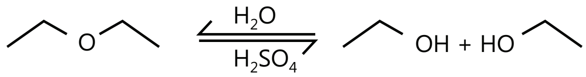
Sol 13: A → q; B → p; C → s; D → r

(b) – p. Aniline with dil. HCl gives anilium chloride.





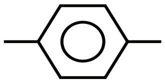
(c) – s.



(d) – r self explanatory

Comprehension Type

Sol 14: (C) KCN will give positive Lassaigne's test for nitrogen.

Sol 15: (C) O_2N––SO_2H will give blood red colour in Lassaigne's test for nitrogen.

Sol 16: (B) Prussian blue colour in the detection of nitrogen in Lassaigne's test is due to formation of $Fe_4[Fe(CN)_6]_3$

Sol 17: (B) Violet colour in the detection of sulphur with sodium nitroprusside is due to formation of $Na_4[Fe(CN)_5NOS]$

Sol 18: (A) NO_3^-

Sol 19: (C) NaCN and Na_2S are decomposed by HNO_3

Sol 20: (B) Black precipitate in the detection of sulphur with lead acetate and acetic acid is due to formation of PbS.

Sol 21: (B) Blood-red colour in the detection of both N and S in the Lassaigne's extract is due to formation of $Fe(CNS)_3$.

Sol 22: (A) Yellow precipitate in the detection of phosphorous when an organic compound is heated with Na_2O_2 and then boiled with conc. HNO_3 followed by the addition of ammonium molybdate is due to formation of $(NH_4)_3 . PO_4 . 12MoO_3$

Sol 23: (D) Beilstein test is given by all of these.

Assertion Reasoning Type

Sol 24: (A) In organic layer test, Cl_2 water is added to sodium extract , which oxidises Br^- and I^- ions to Br_2 and I_2 respectively as reduction potential of Cl_2 is greater than that of Br_2 and I_2.

Sol 25: (D) Hydroxylamine (NH_2OH) does not gives Lassaigne's test.

Sol 26: (C) Benzene (b.p. 353K) and methanol (b.p. 338K) cannot be separated by fractional distillation as fractional distillation is used to separate two liquids from their mixture when their boiling points differ by 20° or so.

Previous Years' Questions

Sol 1: (D) pKa of PhOH (carbolic acid) is 9.98 and that of carbonic acid (H_2CO_3) is 6.63 thus phenol does not give effervescence with HCO_3^- ion.

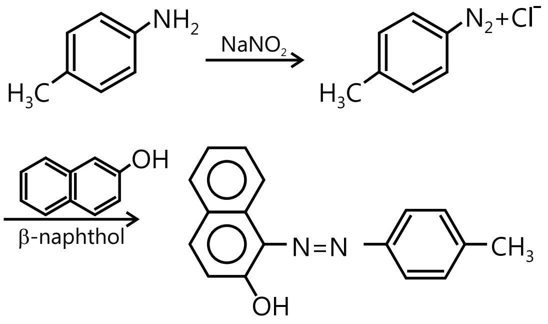
Sol 2: (B, D) (A) Both are soluble in NaOH, hence inseparable.

(B) Only benzoic acid (C_6H_5COOH) is soluble in NaOH and $NaHCO_3$, while benzyl alcohol ($C_6H_5CH_2OH$) is not. Hence, separable.

(C) Although NaOH can enable separation between benzyl alcohol ($C_6H_5CH_2OH$) and phenol (C_6H_5OH) as only the later is soluble in NaOH. However, in $NaHCO_3$, both are insoluble. Hence, inseparable.

(D) α-phenyl acetic acid ($C_6H_5CH_2COOH$) is soluble in NaOH and $NaHCO_3$. While benzyl alcohol ($C_6H_5CH_2OH$) is not. Hence, separable.

Sol 3: (C) Only aromatic primary amines give this azo-dye test. Amine in option (d) is not aromatic.



Sol 4: A → r, s; B → p, q; C → p, q, r; D → p

Sodium fusion extract gives Prussian blue colouration, nitrogen and carbon both are present in the compound.

Phenolic group and salt of carboxylic acid gives $FeCl_3$ test. Chloride salt gives white precipitate of AgCl on treatment with $AgNO_3$.

Hydrazone formation occur effectively at pH = 4.5. The reaction proceeds in that condition only

when H^+ concentration is sufficient to activate the following enolization.

Sol 5: Carbon: Hydrogen: : 10.5 : 1

Calculation of empirical formula

Element	Percentage	At. Mass	Relative number of atoms	Simplest ratio
Carbon	$\frac{10.5}{11.5}\times 100 = 91.3$	12	$\frac{91.3}{12} = 7.6$	$\frac{7.6}{7.6} = 1\times 7 = 7$
Hydrogen	$\frac{1}{11.5}\times 100 = 8.7$	1	$\frac{8.7}{1} = 8.7$	$\frac{8.7}{7.6} = 1.14\times 7 = 8$

Empirical formula = C_7H_8 ; Empirical formula mass = (12 × 7) + (1 × 8) = 92

Calculation of molecular mass: Experimental conditions STP Conditions

$V_1 = 1$ litre $V_2 = ?; P_1 = 1$ atm $P_2 = 1$ atm; $T_1 = 127 + 273 = 400$ K; $T_2 = 273$ K

Applying the gas equation, we get

$$V_2 = \frac{P_1V_1}{T_1}\times\frac{T_2}{P_2} = \frac{1\times 1\times 273}{400\times 1} = 0.6825 \text{ Litre}$$

0.6825 litre of the gas weighs 2.8 gm.

$\therefore$ 22.4 litre of the gas weighs $\frac{2.8}{0.6825}\times 22.4 = 91.89 = 92$

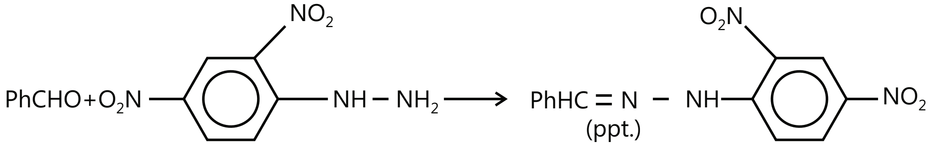
$$N = \frac{\text{Molecular mass`}}{\text{Empirical mass}} = \frac{92}{92} = 1$$

$\therefore$ Molecular formula = Empirical formula = C_7H_8

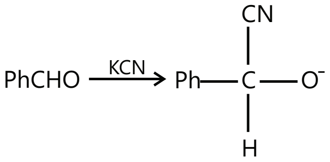
Sol 6 : A → p, q, s; B → q; C → q, r, s; D → q, r

(Note: Assuming $AgNO_3$ in ammoniac)

(A)



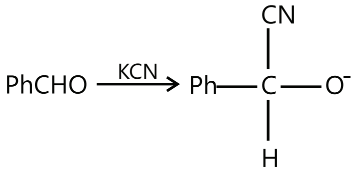
$PhCHO + Ag_2O \xrightarrow{NH_3} PhCOO^- + Ag\downarrow$
(White ppt.)



$$PhCHO \xrightarrow{KCN} Ph-\overset{\displaystyle CN}{\underset{\displaystyle H}{C}}-O^-$$

$CH_3C \equiv CH \xrightarrow{\text{ammonical } AgNO_3} CH_3C{\equiv}C^-\ \ Ag^+\downarrow$
(White ppt.)

(B)



$$PhCHO \xrightarrow{KCN} Ph-\overset{\displaystyle CN}{\underset{\displaystyle H}{C}}-O^-$$

(C) $AgNO_3 + CN^- \longrightarrow AgCN\downarrow$

(D) $AgNO_3 + I^- \longrightarrow AgI\downarrow$

Sol 7 : (5)

Are soluble in aqueous NaOH.