Q) Differentiate between the principle of estimation of nitrogen in an organic compound by: (i) Dumas method and (ii) Kjeldahl's method.

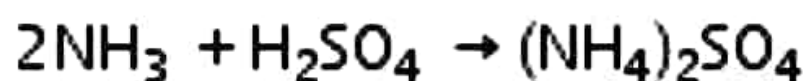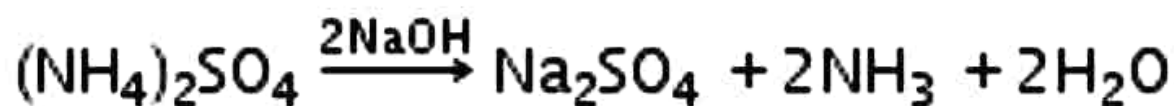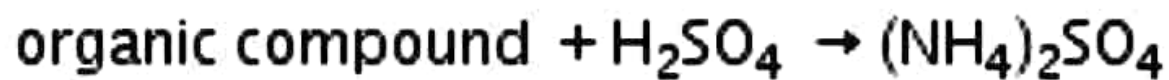Ans) There are two methods for estimation of nitrogen: (i) Dumas method and (ii) Kjeldahl's method.

(i) Dumas method: The nitrogen-containing organic compound, when heated with copper oxide in an atmosphere of carbon dioxide, yields free nitrogen in addition to carbon dioxide and water.

$$C_xH_yN_z + (2x + y/2) \, CuO \longrightarrow$$
$$x \, CO_2 + y/2 \, H_2O + z/2 \, N_2 + (2x + y/2) \, Cu$$
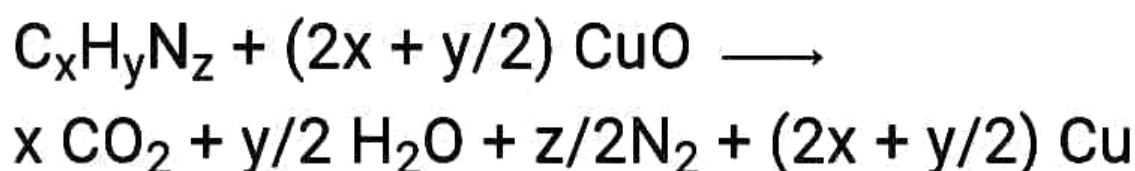
Traces of nitrogen oxides formed if any are reduced to nitrogen by passing the gaseous mixture over a heated copper gauze. The mixture of gases so produced is collected over an aqueous solution of potassium hydroxide which absorbs carbon dioxide. Nitrogen is collected in the upper part of the graduated tube.

ii) Kjeldahl's method: The compound containing nitrogen is heated with concentrated sulphuric acid. Nitrogen in the compound gets converted to ammonium sulphate. The resulting acid mixture is then heated with an excess of sodium hydroxide. The liberated ammonia gas is absorbed in an excess of a standard solution of sulphuric acid.

The amount of ammonia produced is determined by estimating the amount of sulphuric acid consumed in the reaction.

organic compound $+ H_2SO_4 \rightarrow (NH_4)_2SO_4$

$(NH_4)_2SO_4 \xrightarrow{2NaOH} Na_2SO_4 + 2NH_3 + 2H_2O$

$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$

Q) In Carius method of estimation of halogen, 0.15 g of an organic compound gave 0.12 g of AgBr. Find out the percentage of bromine in the compound.

A) Mass of organic compound 0.15g

Mass of AgBr = 0.12g

Molecular mass of AgBr = 108+80 = 188 g mol^{-1}

Now 188g AgBr contains 80 g bromine

$\therefore$ 0.12g AgBr would contain $\dfrac{80}{188} \times 0.12$ bromine

$= 0.05$ bromine

$\therefore$ Percentage of bromine $= \dfrac{0.05}{0.15} \times 100$

$= 33.3\%$

Q) In sulphur estimation, 0.157 g of an organic compound gave 0.4813 g of barium sulphate. What is the percentage of sulphur in the compound?

A) Mass of Organic compound = 0.157 g

Mass of barium sulphate = 0.4813 g

Molecular mass of $BaSO_4$

$$= 137 + 32 + 64 = 233 \text{ g mol}^{-1}$$

233 g $BaSO_4$ contains 32 g sulphur

$\therefore$ 0.4813 $BaSO_4$ would contain

$$= \frac{32}{233} \times 0.4813 \text{ g sulphur}$$

$$= 0.066 \text{ g of sulphur}$$

$\therefore$ Percentage of sulphur $= \dfrac{0.066}{0.157} \times 100 = 42.10\%$