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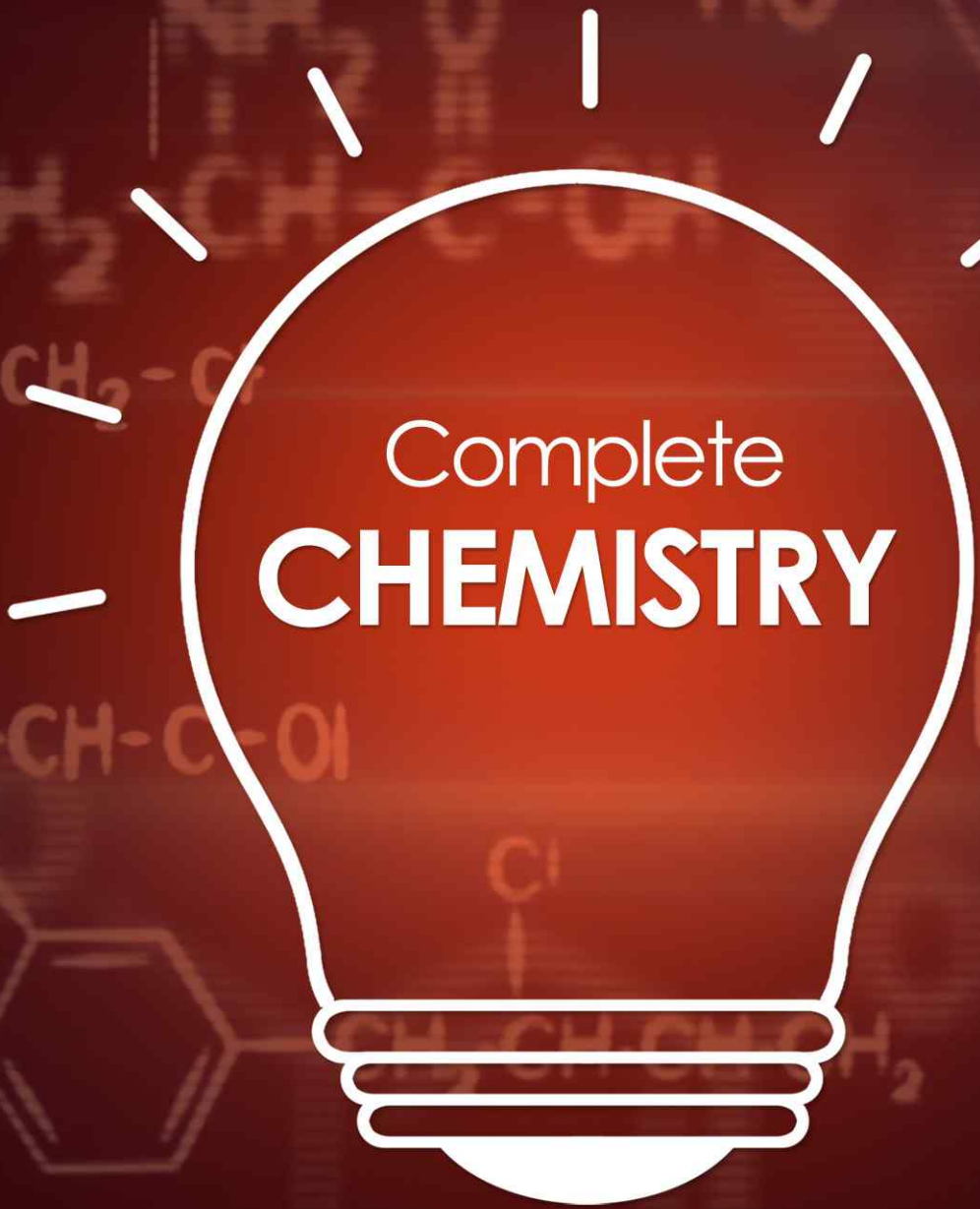

Complete CHEMISTRY

IIT-JEE · NEET · CBSE eBOOKS

CLASS 11&12th

CLASS 11th

States of Matter

01. Measurable Properties of Gases

Mass : The mass of gas is generally used in the form of number of moles which is related as

(i) $\text{no. of moles} = \dfrac{\text{wt. in gm}}{\text{molecular mass of gases}} \left(n = \dfrac{w}{M}\right)$

Two other useful formulae to calculate number of moles of gas are–

(ii) $\text{no. of moles} = \dfrac{\text{no. of molecules of given gas}}{\text{Avogardro's number of molecules}} \left(n = \dfrac{N}{N_A}\right)$

(iii) $\text{no. of moles} = \dfrac{\text{volume of given gas in litre at STP}}{22.4\,L} \left(n = \dfrac{N}{N_A}\right)$

Volume : Volume of gas is volume of the container in which it is present, i.e., space which the gas molecules can occupy.

Temperature : Degree of hotness or coldness of a body is measured by temperature.

$$\frac{C}{100} = \frac{K-273}{100} = \frac{F-32}{180}$$

C – Celcius scale, K – Kelvin scale, F – Fahrenheit scale

NOTE ☞ *In all the problems of gaseous state (i.e. in all gas law equations), temperature must be expressed in kelvin scale. i.e.,* ***t°C+273.15 = TK***

Pressure : Pressure of gas is defined as the force exerted by the gas on the walls of its container. It is often assumed that pressure is isotopic, i.e. it is the same in all the three directions.

02. Measurement of Pressure

Barometer : The instrument used for the measurement of atmospheric pressure is called Barometer. It consists inverted a tube filled with mercury in a dish of mercury. The height of the mercury column is a measure of the atmospheric pressure at that place.

vol. of Hg = Area×Height = A×h

Mass of Hg = Volume & Density = A×h×d

Force of mercury = Mass×g = A×h×d×g

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}} = \frac{A\times h\times d\times g}{A} = hdg$$

$$P = hdg$$

$$h = \frac{P}{dg}$$

$P = 1\ \text{atm} = 1.01325\times10^5$ Pascal.

Manometer : The instrument used for the measurement of the pressure of a gas called a manometer. It simply consists of a U shaped tube containing mercury usually. One limb of the tube is longer than the other. Two types of manometer are used. These are

(I) Open Manometer

(i) If level of Hg in the two limbs is same then $P_{gas} = P_{atm}$

(ii) If level of Hg is shorter limb is higher than that of longer limb

$P_{atm} = P_{gas} + hdg$

$P_{gas} = P_{atm} - hdg$

(iii) If level of Hg in longer limb is higher than that of shorter limb

$P_{gas} = P_{atm} + hdg$

(II) Closed Manometer-

(i) If level of mercury in longer limb is higher than that of shorter limb

$P_{gas1} = P_{gas2} + hdg$

(ii) If level of mercury in longer limb is lower than that of shorter limb

$P_{gas1} + hdg = P_{gas2}$

03. Gas Laws

Boyle's Law

It relates the volume and the pressure of a given mass of a gas at constant temperature. Boyle's law states that, "at constant temperature, the volume of a sample of a gas varies inversely with the pressure"

$\therefore \quad P \propto \frac{1}{V}$ (when temperature and number of moles are kept constant)

The proportionality can be changed into an equality by introducing a constant k, i.e.,

$P = \frac{K}{V}$ or $PV = k$

Charle's Law

It states "at constant pressure, the volume of a given mass of a gas, increases or decrease by $\frac{1}{273.15}$th of its volume at 0°C for every rise or fall of one degree in temperature".

$$\frac{V_t}{V_0} = 1 + \frac{t}{273.15}t \quad \text{(constant n and P)}$$

or $$V_t = V_0\left(1 + \frac{t}{273.15}\right) \quad \text{or} \quad V_t = \frac{V_0(273.15 + t)}{273.15}$$

0°C on the Celsius scale is equal to 273.15 K at the Kelvin or absolute scale.

i.e. T_t (Temperature in Kelvin scale) = 273.15 + t

Gay-Lussac's Law

(i) It states that at constant volume, the pressure of a given mass of a gas is directly proportional to its absolute temperature.