

Problem Based on Charle's Law

VERY SHORT ANSWER TYPE QUESTIONS :

VSA.1 At what temperature a graph between volume (in L) vs temperature (in °C) at constant pressure on extrapolation cuts the temperature axis.

Sol. - 273°C.

VSA.2 What are Isobars ?

Sol. Plots between V and T at constant temperature are known as isobars.

VSA.3 Define the term absolute zero ?

Sol. The lowest hypothetical or theoretical temperature of - 273°C at which a gas is supposed to have zero volume is called absolute zero.

VSA.4 What type of graph will you get when V is plotted against T at constant pressure ?

Sol. A straight line passing through the origin.

SHORT ANSWER TYPE QUESTIONS :

SA.1 What is the increase in volume, when the temperature of 600 ml of air increases from 27°C to 47°C under constant pressure.

Sol.
$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$V_1 = \frac{T_1}{T_2} \times V_2$$

$$V_1 = \frac{320\text{K}}{300\text{K}} \times 600 \text{ ml.}$$

$$V_1 = 640 \text{ ml.}$$

Increase in volume of air = 640 - 600 = 40 ml.

SA.2 At what temperature centigrade will the volume of a gas at 0°C double itself, pressure remaining constant ?

Sol. Let the volume of the gas at 0°C = v ml.

Thus we have

$$V_1 = V \text{ ml}$$

$$V_2 = 2V \text{ ml}$$

$$T_1 = 0 + 273 = 273 \text{ K}$$

$$T_2 = ?$$

By applying Charle's Law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{V}{273} = \frac{2V}{T_2}$$

$$T_2 = \frac{2V \times 273}{V} = 546 \text{ K}$$

$$T_2 = 546 - 273 = 273^\circ\text{C.}$$

Problem Based on Charle's Law

SA.3 Define charle's law. Give this mathematical formulae.

Sol. Pressure remaining constant, the volume of a given mass of a gas increases or decreases by $\frac{1}{273}$ of its volume at 0°C for every one degree centigrade rise or fall in temperature.

Mathematically

$$V_t = V_0 + \frac{V_0}{273} \times t$$

$$V_t = V_0 \left(1 + \frac{t}{273}\right)$$

$$V_t = V_0 \left(\frac{273+t}{273}\right)$$

Where V_t is the volume of the gas at $t^{\circ}\text{C}$ and V_0 is the volume at 0°C . Putting $273 + t = T$, the corresponding temperature on the kelvin scale, we get

$$V_t = V_0 \frac{T}{273}$$

As V_0 and 273 are constant hence

$$V_t \propto T \text{ or simply } V \propto T$$

SA.4 How is Charle's law made use of in the meterological observations ?

Sol. Air expands on heating and hence its density decreases. Thus hot air is lighter than the atmospheric air. This fact is made use of in filling hot air in the balloons which rise up for meteorological observations.