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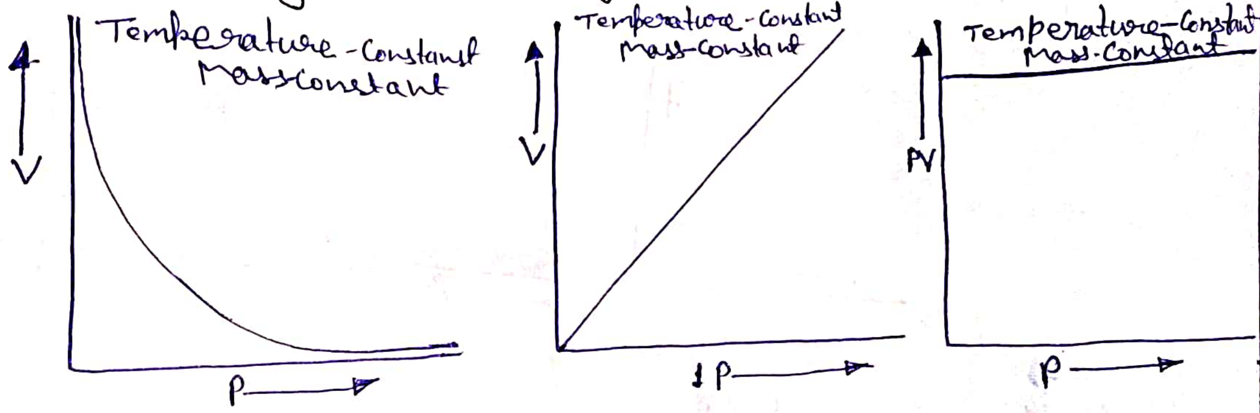
Part-I

GASEOUS STATE (sub)

Boyle's law Can be Verified by any one of the following three ways graphically.

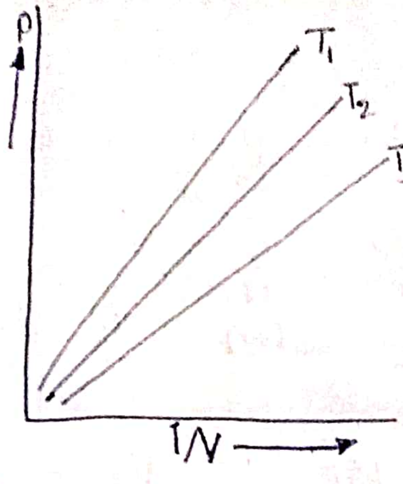


Alternatively, Boyle's law can also be stated as follows:
"Temperature remaining constant, the product of pressure and volume of a given mass of a gas is Constant".

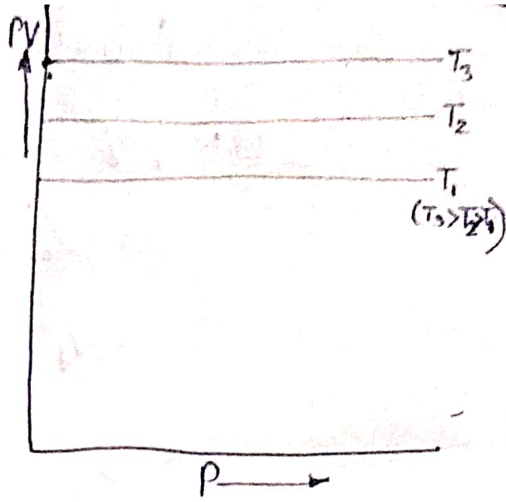
The Value of the Constant depends upon the amount of a gas and the temperature. Mathematically, it Can be written as,

$$P_1V_1 = P_2V_2 = P_3V_3 = \text{----}$$

Location of Straight line and Curve changes with temperature in the isotherm shown in the following figure.



(D)



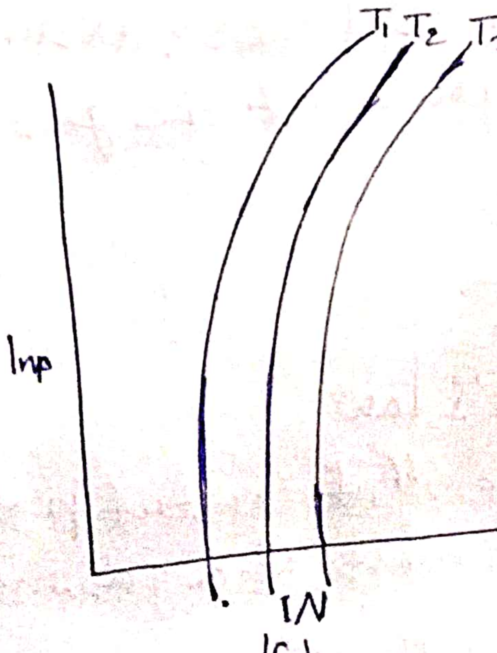
(E)

According to Boyle's law, PV = Constant at Constant temperature

(F)

∴ Log P + Log V = Constant

log P = − log V = Constant



$PV = K$

$\ln P + \ln V = K'$

$\ln P = \ln V + K'$

$\ln P = -\ln V + K'$

$\ln P = \ln W + K'$

$y = \ln x + C'$

(G)

1. A gas is present at a Pressure of 2 atm. What should be the increase in pressure so that the volume of the gas can be decreased to 1/4th of the initial value if the temperature is maintained

Constant.

Solⁿ: PV = Constant for a given mass of gas at constant pressure

$\Rightarrow P_1V_1 = P_2V_2$ $P_1 = 2atm$ $V_1 = V$ $V_2 = V/4$ $P_2 = ?$

Now, $2 \times V = P_2 \times \frac{V}{4} \Rightarrow P_2 = 8atm$

∴ Pressure should be increased from 2 to 8 atm

∴ total increase = 8 − 2 = 6 atm.

Ques A sample of gas occupies 10 litre under a pressure of 1 atmosphere. What will be its volume if the pressure is increased to 2 atmospheres? Assume that the temperature of the gas sample does not change.

Ans 5 litre

5.2 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"

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

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

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

∴ From the above equation we get $\frac{V_t}{V_0} = \frac{T_t}{T_0}$

$$\text{or } \frac{V_t}{T_t} = \frac{V_0}{T_0}$$

i.e. The Volume of a given gas is proportional to the absolute temperature.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \text{ (at Constant P)}$$