"आज PHYSICS में मचाते हैं।"

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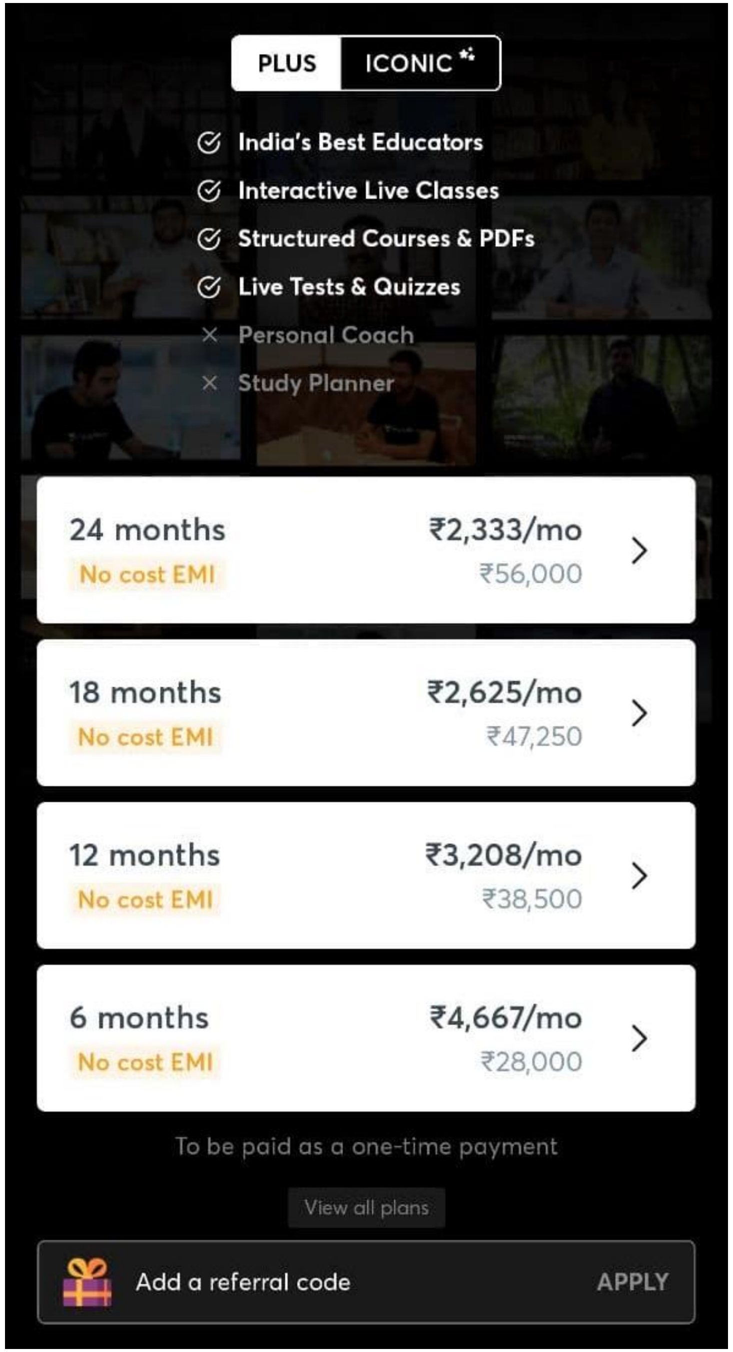

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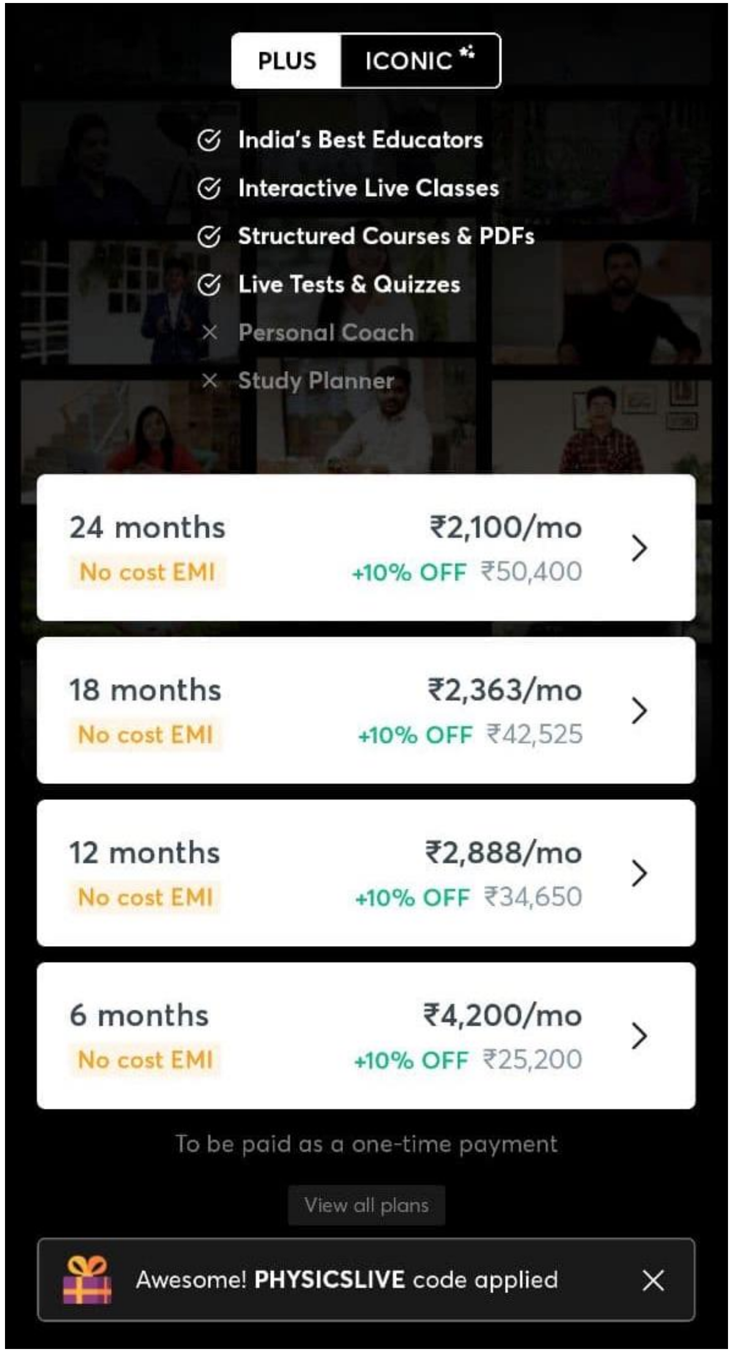

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Physics DPP

DPP- 1 kinetic theory of gases

By Physicsaholics Team

Q) The postulates of kinetic theory will be true if the number of molecules be -

(a) Any

(b) Very large

(c) Very small

(d) Avogadro's number

Ans. b

Solution:

According to Kinetic theory all directions are equaly favourabl for motion of moleculs. This assumbtion is true only if there are large no of molecules

ANS(b)

Q) Which of the following statements about kinetic theory of gases is wrong

(a) The molecules of a gas are in continuous random motion
(b) The molecules continuously undergo inelastic collisions
(c) The molecules do not interact with each other except during collisions
(d) The collisions amongst the molecules are of short duration

Ans. b

Solution:

In KTG the assumption of collision is elastic not inelastic.

Q) Under which of the following conditions is the law $PV = RT$ obeyed most closely by a real gas

(a) High pressure and high temperature
(b) Low pressure and low temperature
(c) Low pressure and high temperature
(d) High pressure and low temperature

Ans. c

Solution:

At low pressure and high temperature real gas obey PV = RT i.e. they behave as ideal gas because at high temperature we can assume that there is no force of attraction or repulsion works among the molecules and the volume occupied by the molecules is negligible in comparison to the volume occupied by the gas.

Q) A certain sample of gas has a volume of 0.2 litre measured at 1 atm pressure and 0 °C. At the same pressure but at 273 °C, its volume will be

(a) 0.4 litres
(b) 0.8 litres
(c) 27.8 litres
(d) 55.6 litres

Ans. a

at; P = const.

$$P\cancel{V} = nRT$$

$$\frac{V}{T} = \text{const}$$

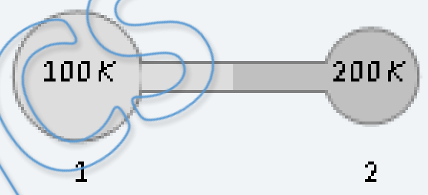
$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{0.2}{273} = \frac{V_2}{(273+273)}$$

$$\frac{0.2}{\cancel{273}} = \frac{V_2}{2 \times \cancel{273}}$$

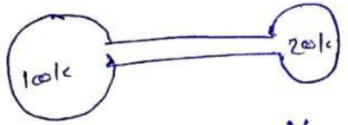
$$\boxed{V_2 = 0.4 \text{ Ltr}}$$

Q) Figure shows two flasks connected to each other. The volume of the flask 1 is twice that of flask 2. The system is filled with an ideal gas at temperature 100 K and 200 K respectively. If the mass of the gas in 1 be m then what is the mass of the gas in flask 2



(a) m
(b)m/2
(c) m/4
(d)m/8

Ans. c



V_1 $\quad\quad$ V_2

$T_1 = 100k.$ $\quad\quad$ $T_2 = 200k$

m $\quad\quad$ $m_2 = ?$

$V_2 = 2V_1$ (given)

as both container/ ~~flask~~ flask are connected

$\Rightarrow$ $P =$ same in both

$$PV = nRT$$

$$P = \frac{nRT}{V}$$

$$P = \text{const}$$

$$\frac{n_1 R T_1}{V_1} = \frac{n_2 R T_2}{V_2}$$

$$\frac{n_1 \cancel{R} (\cancel{100})}{(2\cancel{V_2})} = \frac{n_2 \cancel{R} (\overset{2}{\cancel{200}})}{\cancel{V_2}}$$

$$\boxed{n_2 = n_1/4}$$

multiply this equation by molecular mass of gas. M

$$n_2 \times M = \frac{n_1 M}{4}$$

$$\boxed{m_2 = \frac{m_1}{4}}$$

$m_1 =$ mass of gas in flask 1

$, m_1 = m$

$$\therefore \boxed{m_2 = \frac{m}{4}}$$

Q) If the pressure of an ideal gas contained in a closed vessel is increased by 0.5%, the increase in temperature is 2 K. The initial temperature of the gas is

(a) $27°C$
(b) $127°C$
(c) $300°C$
(d) $400°C$

Ans. b

Closed vassel ⇒ Volume is constant - & n = constant

$PV = nRT$

$\Rightarrow \frac{nRT}{P} = \text{constant}$

when $P_2 \rightarrow P_1 + \frac{0.5}{100} P_1$

$P_2 = P_1 + 0.005 P_1 = 1.005 P_1$

&

& $T_2 = T_1 + 2$

$\therefore \frac{RT_1}{P_1} = \frac{RT_2}{P_2} \Rightarrow \frac{T_1}{\cancel{P_1}} = \frac{T_1 + 2}{1.005 \cancel{P_1}}$

$1.005 T_1 = T_1 + 2$

$0.005 T_1 = 2$

$T_1 = \frac{2}{5 \times 10^{-3}} = \frac{2000}{5}$

$\boxed{T_1 = 400 K}$

$\therefore T_1 = (400 - 273)°C$

$\boxed{T_1 = 127°C}$

Q) Air is pumped into an automobile tube upto a pressure of 200 kPa in the morning when the air temperature is 22°C. During the day, temperature rises to 42°C and the tube volume expands by 2%. The pressure of the air in the tube at this temperature, will be approximately

(a) 212 kPa (b) 206 kPa

(c) 209 kPa (d) 200 kPa

Ans. c

$$PV = nRT$$

$$n = \text{const.}$$

$$\therefore \frac{PV}{T} = \text{const.}$$

$$P_1 = 200 \text{ kPa}$$

$$T_1 = 22 + 273 = 295 \text{ K}$$

$$V_1 = V$$

Now $P_2 = ?$; $T_2 = 42^\circ C = 42 + 273$

$$= 315 \text{ K}$$

$$V_2 = V + \frac{2}{100} V = 1.02 V$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \Rightarrow \frac{(200 \text{ kPa}) \times V}{295} = \frac{P_2 (1.02 V)}{315}$$

$$\boxed{P_2 \simeq 209 \text{ kPa}}$$

Q) A vessel is filled with an ideal gas at a pressure of 10 atmospheres and temperature 27 °C. Half of the mass of the gas is removed from the vessel and temperature of the remaining gas is increased to 87’C. Then the pressure of the gas in the vessel will be

(a) 5 atm
(b) 6 atm
(c) 7 atm
(d) 8 atm

Ans. b

$P_1 = 10$ atm.

$T_1 = 27°C = 300$ K

$n_1 =$ no. of moles

Now Half gas is removed

$\therefore \quad n_2 = \frac{n_1}{2}$

$T_2 = 87°C = 360$ K.

$P_2 = ?$

$PV = nRT$

$$\frac{P_1 V_1}{n_1 R T_1} = \frac{P_2 V_2}{n R T_2}$$

$$\frac{10 \times \cancel{V}}{n_1 \times R \times 300} = \frac{P_2 \times \cancel{V}}{\left(\frac{n_1}{2}\right) R (360)}$$

$$\cancel{2} P_2 = \frac{\cancel{10}^{5}}{300} \times 360$$

$$P_2 = \frac{1800}{300}$$

$$\boxed{P_2 = 6 \text{ atm}}$$

Q) The pressure P, volume V and temperature T of a gas in the jar A and the other gas in the jar B at pressure $2P$, volume $V/4$ and temperature $2T$, then the ratio of the number of molecules in the jar A and B will be-

(a) 1 : 1
(b) 2 : 1
(c) 1 : 2
(d) 4 : 1

Ans. d

$$n = \frac{PV}{RT}$$

$$\frac{n_1}{n_2} = \left(\frac{P_1V_1}{RT_1}\right) \Big/ \left(\frac{P_2V_2}{RT_2}\right) = \left(\frac{PV}{RT}\right) \Big/ \left(\frac{2P \times \frac{V}{4}}{R \times 2T}\right)$$

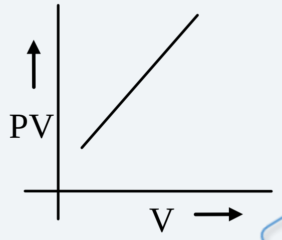
$$\frac{n_1}{n_2} = \frac{4}{1}$$ [n_1 & n_2 are no. of moles of gas in jar A & B]

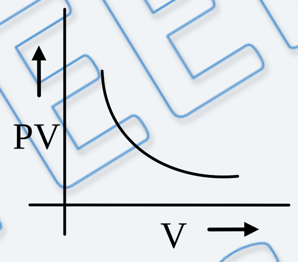
$$\frac{N_1/N_A}{N_2/N_A} = \frac{4}{1}$$ [N_1 & N_2 are no. of molecules in jar A & B]

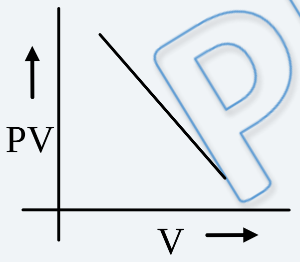
and N_A = Avagadro number.

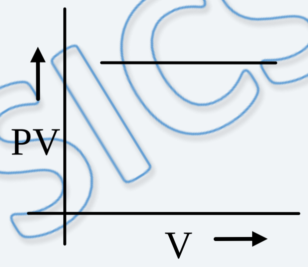
$$\boxed{\frac{N_1}{N_2} = \frac{4}{1}}$$

Q) Which one of the following graphs represents the behavior of an ideal gas when temperature is constant ?

(a) 

(b) 

(c) 

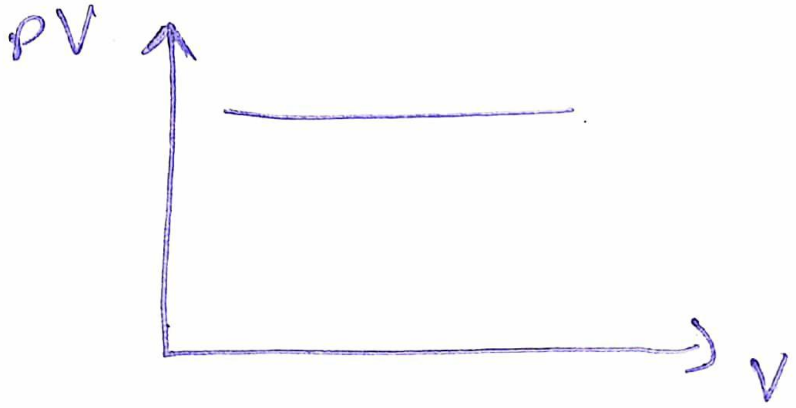
(d) 

Ans. d

$$PV = nRT$$

when; $T =$ constant

$\Rightarrow PV =$ constant



Q) During an experiment an ideal gas is found to obey an additional law VP^2 = constant. The gas is initially at temperature T and volume V, when it expands to volume 2V, the resulting temperature is -

(a) $T/2$

(b) $T/\sqrt{2}$

(c) $T\sqrt{2}$

(d) $2T$

Ans. c

$$VP^2 = \text{constant}$$

$$PV = nRT$$

$$P = \frac{nRT}{V}$$

$$\Rightarrow V\left(\frac{nRT}{V}\right)^2 = \text{constant}$$

$$(nR)^2 \frac{T^2}{V} = \text{const}$$

$$\Rightarrow \frac{T^2}{V} = \text{constant}$$

$$\frac{T_1^2}{V_1} = \frac{T_2^2}{V_2} \Rightarrow \frac{T^2}{V} = \frac{T_2^2}{2V}$$

$$T_2^2 = 2T^2$$

$$\boxed{T_2 = \sqrt{2}\,T}$$

Q) A vessel has 6 g of hydrogen at pressure P and temperature 500 K. A small hole is made in it so that hydrogen leaks out. How much hydrogen leaks out if the final pressure is P/2 and temperature falls to 300 K -

(a) 2 g
(b) 4 g
(c) 3 g
(d) 1g

Ans. d

$\Rightarrow \because \quad PV = nRT$

initially $\Rightarrow \quad P(V) = 3 \times R\ 500 \quad -①$

finally $\Rightarrow \quad \frac{P}{2}(V) = n_2 \times R\ 300 \quad -②$

$\frac{①}{②} \Rightarrow \quad \frac{PV}{\frac{P}{2}V} = \frac{3R \times 500}{n_2 R \times 300}$

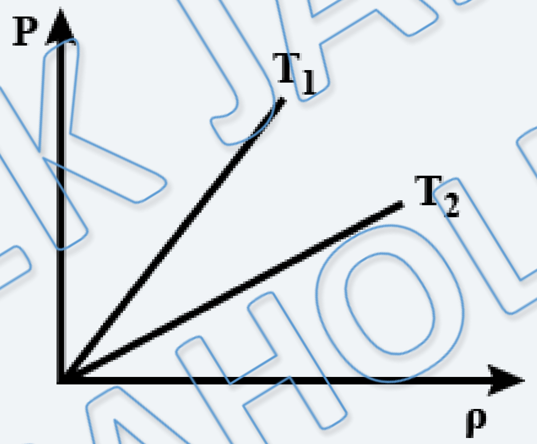
$2 = \frac{5}{n_2} \Rightarrow n_2 = 2.5$ moles

mass of H_2 gas in 2.5 mole $= 2.5 \times 2$

$= 5$ gm.

$\therefore$ mass of leaked H_2 gas $= 6 - 5 = \underline{\underline{1 \text{ gm}}}$

Q) The figure shows pressure versus density graph for an ideal gas at two temperature T_1 and T_2:



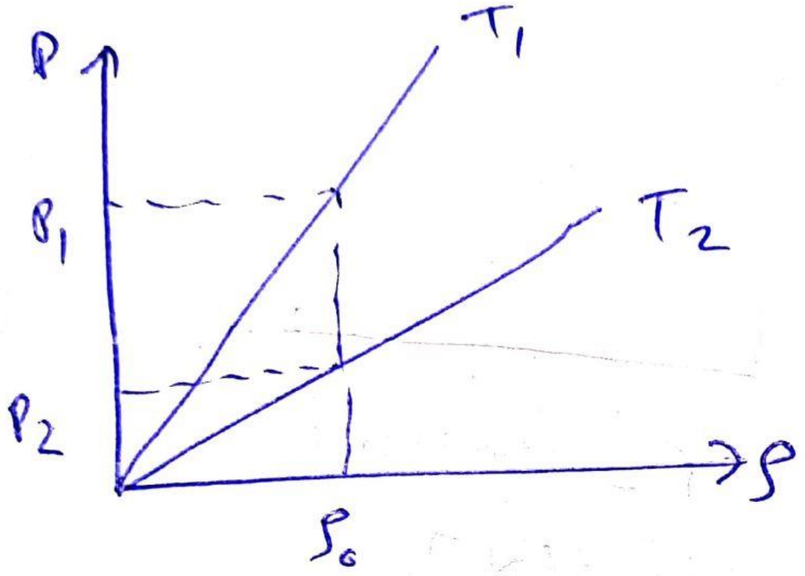
(a) $T_1 > T_2$

(b) $T_1 < T_2$

(c) $T_1 = T_2$

(d) None of these

Ans. a



$$P = \frac{\rho R T}{M}$$

at constant ρ

$P \propto T$ or $T \propto P$

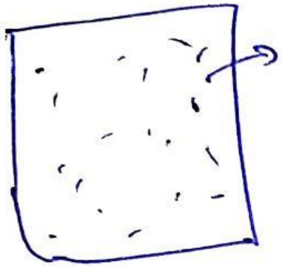
as from diagram: $P_1 > P_2$

$$\Rightarrow \boxed{T_1 > T_2}$$

Q) A vessel is filled with a gas at a pressure of 76 cm of mercury at a certain temperature. The mass of the gas is increased by 50 % by introducing more gas in the vessel at the same temperature. The resultant pressure, in cm of Hg, is -

(a) 76
(b) 114
(c) 152
(d) 1117

Ans. b



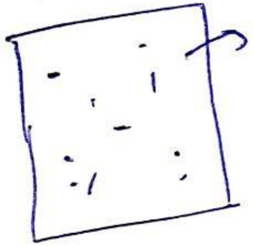
Pr. = 76 cm of Hg

Temp. = T

mass of gas = m

M = Molecular mass of gas.

$\therefore n = \frac{m}{M}$



Now $m \to 1.5m$.

$\therefore n_2 = \frac{1.5m}{M} = 1.5n$

Temp. = T

Pr = P_2 = ?

[V = Volume = Constant]

at T = constant $\Rightarrow \frac{PV}{n}$ = constant

$$\frac{(76 \text{ cm of Hg}) \cancel{V}}{\cancel{n}} = \frac{P_2 \times \cancel{V}}{1.5 \cancel{n}}$$

$$\boxed{P_2 = 114 \text{ cm of Hg}}$$

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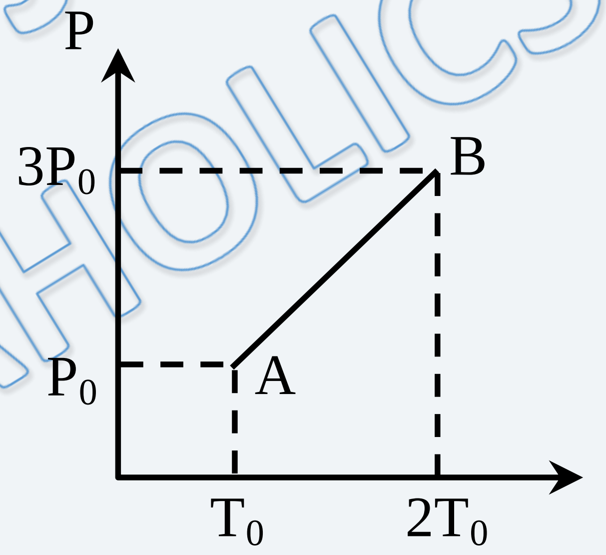
Q)Pressure versus temperature graph of an ideal gas is as shown in figure. Density of the gas at point A is ρ_0. Density at B will be



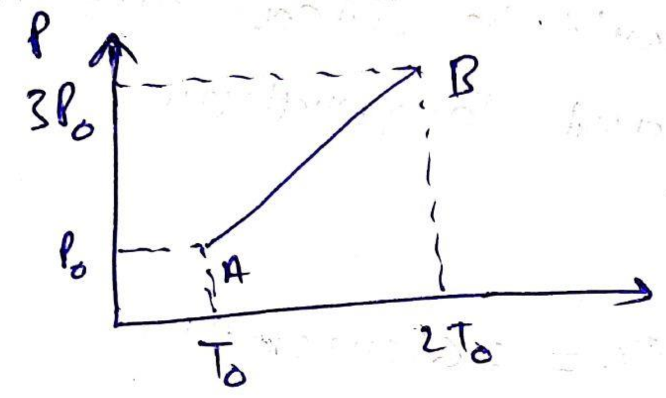
(a) $\frac{3}{4}\rho_0$

(b) $\frac{3}{2}\rho_0$

(c) $\frac{4}{3}\rho_0$

(d) $2\rho_0$

Ans. b



$$P = \frac{\rho R T}{M}$$

$$\frac{P}{\rho T} = \frac{R}{M} = \text{constant}$$

$$\left(\frac{P_0}{\rho T}\right)_A = \left(\frac{P}{\rho \cdot T}\right)_B \Rightarrow \frac{\cancel{P_0}}{\rho_A \cancel{T_0}} = \frac{3\cancel{P_0}}{\rho_B (2\cancel{T_0})}$$

$$\frac{1}{\rho_0} = \frac{3}{2\rho_B}$$

$$\boxed{\rho_B = \frac{3}{2}\rho_0}$$

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