DPP
DAILY PRACTICE PROBLEMS

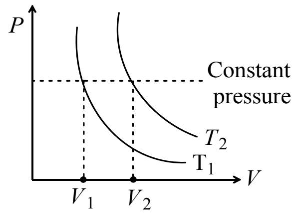
CLASS : XIth | **Solutions** | **SUBJECT : PHYSICS**

Date : | | **DPP No. : 2**

Topic :- KINETIC THEORY

1 **(c)**

For a given pressure, volume will be more if temperature is more [Charle's law]



From the graph it is clear that $V_2 > V_1 \Rightarrow T_2 > T_1$

2 **(d)**

$C_{\text{rms}} = \sqrt{\frac{3RT}{M}}$

Or $M = \frac{3RT}{C_{\text{rms}}^2} = \frac{3 \times 8.31 \times 300}{(1920)^2}$

$= 2 \times 10^{-3}$ kg = 2g

Since, M = 2 for the hydrogen molecule. Hence, the gas is hydrogen.

3 **(d)**

$v_{rms} = \sqrt{\frac{3P}{\rho}} = P \propto \rho$ [v_{rms} is constant for fixed temperature]

4 **(c)**

According to Boyle's law

$$p_1 V_1 = p_2 V_2$$

As the pressure is decreased by 20%, so

$$p_2 = \frac{80}{100} p_1$$

$$p_1 V_1 = \frac{80}{100} p_1 V_2$$

$$V_1 = \frac{80}{100} V_2$$

Percentage increase in volume

$$= \frac{V_2 - V_1}{V_1} \times 100$$

$$= \frac{100 - 80}{80} \times 100 = 25\%$$

5 **(d)**

Root mean square velocity,

$$c = \sqrt{\frac{3pV}{M}} = \sqrt{\frac{3RT}{M}}$$

$$c_1 = \sqrt{\frac{3R(T/2)}{2M}} = \frac{1}{2}\sqrt{\frac{3RT}{M}}$$

$$= \frac{c}{2} = \frac{300}{2} = 150 \text{ ms}^{-1}$$

6 **(c)**

At TK, pressure of gas (P) in the jar

= Total pressure – saturated vapour pressure

$\Rightarrow P = (830 - 30) = 800 mm\ of\ Hg$

New temperature $T' = \left(T - \frac{T}{100}\right) = \frac{99T}{100}$

Using Charle's law $\frac{P}{T} = \frac{P'}{T'} \Rightarrow P' = \frac{PT'}{T}$

$$= \frac{800 \times 99T}{100T} = 792 mm\ of\ Hg$$

Saturated vapour pressure at $T' = 25\ mm\ of\ Hg$

$\therefore$ Total pressure in the jar

$=$ Actual pressure of gas $+$ Saturated vapour pressure

$= 792 + 25 = 817\ mm$ of Hg

8 **(c)**

$$\mu_1 = \frac{PV}{RT}, \mu_2 = \frac{PV}{RT}$$

$$P' = \frac{(\mu_1 + \mu_2)RT}{V} = \frac{2PV}{RT} \times \frac{RT}{V} = 2P$$

9 **(d)**

Average kinetic energy $E = \frac{f}{2}kT$

Sinec f and T are same for both the gases so they will have equal energies also

10 **(b)**

$$V_{rms} = \sqrt{\frac{3RT}{M}} \Rightarrow \frac{(V_{rms})_{O_2}}{(V_{rms})_{H_2}} = \sqrt{\frac{T_{O_2}}{T_{H_2}} \times \frac{M_{H_2}}{M_{O_2}}}$$

$$\Rightarrow \frac{(V_{rms})_{O_2}}{(V_{rms})_{H_2}} = \sqrt{\frac{900}{300} \times \frac{2}{32}} = \frac{\sqrt{3}}{4}$$

$$\Rightarrow (v_{rms})_{O_2} = 836 m/s$$

11 **(a)**

As degree of freedom is defined as the number of independent variables required to define body's motion completely. Here $f = 2$ (1 Translational + 1 Rotational)

12 **(b)**

$$\frac{E_1}{E_2} = \frac{A_1}{A_2} \cdot \left(\frac{T_1}{T_2}\right)^4 = \frac{4\pi r_1^2}{4\pi r_2^2} \times 1 = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

13 **(c)**

$$V_{rms} = \sqrt{\frac{3P}{\rho}} \text{ or } P = \frac{\rho V_{rms}^2}{3}$$

$$= \frac{8.99 \times 10^{-2} \times 1840 \times 1840}{3} = 1.01 \times 10^5 N/m^2$$

14 **(b)**

$$v_{\rm rms} = \sqrt{\frac{3RT}{M}} \qquad \text{or} \qquad v_{\rm rms} \propto \sqrt{T}$$

$v_{\rm rms}$ is to reduce two times, *ie*, the temperature of the gas will have to reduce force times or

$$\frac{T'}{T} = \frac{1}{4}$$

During adiabatic process,

$$TV^{\gamma\text{-}1} = T'V'^{\gamma\text{-}1}$$

or $$\frac{V'}{V} = \left(\frac{T}{T'}\right)^{\frac{1}{\gamma\text{-}1}}$$

$$= (4)^{\frac{1}{1.5-1}} = 4^2 = 16$$

$\therefore$ $$V' = 16\, V$$

15 **(a)**

$(\Delta Q)_V = \mu C_V \Delta T \Rightarrow (\Delta Q)_V = 1 \times C_V \times 1 = C_V$

For monoatomic gas $C_V = \frac{3}{2}R$

$$\therefore (\Delta Q)_V = \frac{3}{2}R$$

16 **(a)**

Root mean square velocity

$$v_{rms} \propto \frac{1}{\sqrt{M}}$$

So $$\frac{(v_{rms})_{\rm O2}}{(v_{rms})_{\rm H2}} = \sqrt{\frac{M_{\rm H2}}{M_{\rm O2}}}$$

$$= \sqrt{\frac{2}{32}} = \frac{1}{4}$$

17 **(c)**

At constant pressure $V \propto T \Rightarrow \frac{\Delta V}{V} = \frac{\Delta T}{T}$

Hence ratio of increase in volume per degree rise in kelvin temperature to it's original volume $= \frac{(\Delta V/\Delta T)}{V} = \frac{1}{T}$

18 **(c)**

$\rho = \frac{PM}{RT}$

Density ρ remains constant when P/T or volume remains constant.

In graph (i) Pressure is increasing at constant temperature hence volume is decreasing so density is increasing. Graphs (ii) and (iii) volume is increasing hence, density is decreasing. Note that volume would had been constant in case the straight line the graph (iii) had passed through origin

19 **(d)**

According to Newton's law

$$\frac{\theta_1 - \theta_2}{t} = K\left[\frac{\theta_1 + \theta_2}{2} - \theta_0\right]$$

$$\therefore \frac{60 - 50}{10} = K\left[\frac{60 + 50}{2} - 25\right] \quad \text{....(i)}$$

Let θ be the temperature after another 10 min

$$\therefore \frac{50 - \theta}{10} = K\left[\frac{\theta + 50}{2} - 25\right] \quad \text{....(ii)}$$

Dividing Eq.(i) by Eq. (ii), we get

$$\frac{10}{50 - \theta} = \frac{30 \times 2}{\theta} \quad \therefore \theta = 42.85°\text{C}$$

20 **(c)**

$$\left(\frac{\Delta Q}{\Delta t}\right)_{\text{inner}} + \left(\frac{\Delta Q}{\Delta t}\right)_{\text{outer}} = \left(\frac{\Delta Q}{\Delta t}\right)_{\text{total}}$$

$$\frac{K_1\pi r^2(T_2 - T_1)}{l} + \frac{K_2\pi[(2r)^2 - r^2](T_2 - T_1)}{l} = \frac{K\pi(2r)^2(T_2 - T_1)}{l}$$

or $(K_1 + 3K_2)\frac{\pi r^2(T_2 - T_1)}{l} = \frac{K\pi\, 4\, r^2(T_2 - T_1)}{l}$

$$\therefore K = \frac{K_1 + 3K_2}{4}$$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	C	D	D	C	D	C	D	C	D	B
Q.	11	12	13	14	15	16	17	18	19	20
A.	A	B	C	B	A	A	C	C	D	C