DPP
DAILY PRACTICE PROBLEMS

CLASS : XIth
Date :

Solutions

SUBJECT : PHYSICS
DPP No. : 6

Topic :- KINETIC THEORY

1 **(d)**

Let initial conditions $= V, T$

And final conditions $= V', T'$

By Charle's law $V \propto T$ [P remains constant]

$$\frac{V}{T} = \frac{V'}{T'} \Rightarrow \frac{V}{T} = \frac{V'}{1.2T'} \Rightarrow V' = 1.2V$$

But as per question, volume is reduced by 10% means

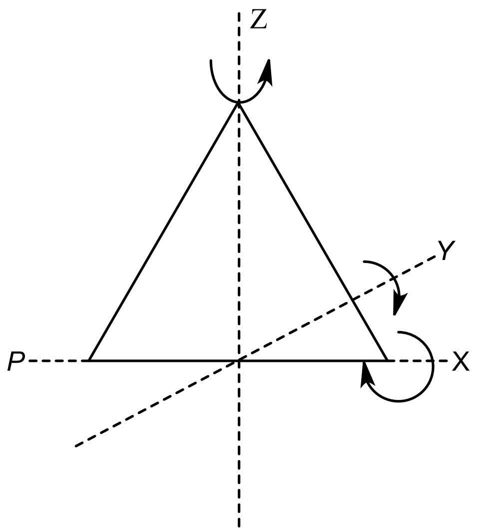
$V' = 0.9V$

So percentage of volume leaked out

$$= \frac{(1.2 - 0.9)V}{1.2V} \times 100 = 25\%$$

2 **(c)**

As temperature requirement is not given so, the molecule of a triatomic gas has a tendency of rotating about any of three coordinate axes. So, it has 6 degrees of freedom; 3 translational and 3 rotational.



Thus,

(3 translational+3 rotational) at room temperature.

3 **(c)**

We have $v_{\text{rms}} = \sqrt{\frac{v_1^2 + v_2^2 + ... + v_n^2}{n}}$

$= \sqrt{\frac{4 + 25 + 9 + 36 + 9 + 25}{6}}$

$= \sqrt{\frac{108}{6}} = \sqrt{18} = 3\sqrt{2} = 3 \times 1.414 = 4.242$ unit.

4 **(a)**

According to ideal gas equation

$PV = nRT$ or $\frac{V}{T} = \frac{nR}{P}$

At constant pressure

$\frac{V}{T} =$ constant

Hence graph (a) is correct

5 **(a)**

Temperatures $T_1 = 15°\text{C} = 15 + 273 = 288$ K

$T_2 = 35°\text{C} = 35 + 273 = 308$ K

Volume remains constant.

So, $\frac{p_1}{T_1} = \frac{p_2}{T_2}$

$\frac{p_1}{p_2} = \frac{T_1}{T_2} \Rightarrow \frac{p_1}{p_2} = \frac{288}{308}$

$\frac{p_2}{p_1} = \frac{308}{288}$

% increases in pressure$=\frac{p_2 - p_1}{p_1} \times 100$

$= \frac{308 - 288}{288} \times 100 \approx 7\%$

6 **(c)**

$v_{av} = \sqrt{\frac{8RT}{\pi M}} \Rightarrow T \propto M$ [$\because v_{av}, R \rightarrow$constant]

$\Rightarrow \frac{T_{H_2}}{T_{O_2}} = \frac{M_{H_2}}{M_{O_2}} \Rightarrow \frac{T_{H_2}}{(273 + 31)} = \frac{2}{32}$

$\Rightarrow T_{H_2} = 19\ K = -254°\text{C}$

7 **(d)**

Kinetic energy per $g\ mole\ E = \frac{f}{2}RT$

If nothing is said about gas then we should calculate the translational kinetic energy

$i.e., E_{\text{Trans}} = \frac{3}{2}RT = \frac{3}{2} \times 8.31 \times (273 + 0) = 3.4 \times 10^3 J$

8 **(a)**

According to Gay Lussac's law $p \propto T$

$$\therefore \quad \frac{dp}{p} \times 100 = \frac{dT}{T} \times 100$$

$$1 = \frac{1}{T} \times 100$$

$$\Rightarrow \quad T = 100 \text{ K}$$

9 **(c)**

Specific heat at constant pressure (C_p) is the amount of heat (Q) required to raise n moles of substance by $\Delta\theta$ when pressure is kept constant. Then

$$C_p = \frac{Q}{n\Delta\theta}$$

Given, Q=70 cal, $n = 2$,

$\Delta\theta = (35 - 35)°\text{C} = 5°\text{C}$

$$\therefore \quad C_p = \frac{70}{2 \times 5} = 7 \text{ cal mol}^{-1} \text{ -K}^{-1}$$

From Mayer's formula C_p - $C_V = R$

where R is gas constant ($= 2$ cal mol^{-1})

$$\therefore \quad 7 - C_V = 2$$

$$\Rightarrow \quad C_V = 5 \text{ cal mol}^{-1} \text{ - K}^{-1}$$

Hence, amount of heat required at constant volume (C_V) is

$$Q' = nC_V\Delta\theta$$

$$Q' = 2 \times 5 \times 5 = 50 \text{ cal}$$

10 **(b)**

$v_{rms} \propto \sqrt{T}$; To double the rms velocity temperature should be made four times, *i.e.*, $T_2 = 4T_1 = 4(273 + 0) = 1092K = 819°\text{C}$

11 **(b)**

In a given mass of the gas

$$n = \frac{pV}{kT}$$

k being Boltzmann's constant.

12 **(d)**

$$PV = NkT \Rightarrow \frac{N_A}{N_B} = \frac{P_A V_A}{P_B V_B} \times \frac{T_B}{T_A}$$

$$\Rightarrow \frac{N_A}{N_B} = \frac{P \times V \times (2T)}{2P \times \frac{V}{4} \times T} = \frac{4}{1}$$

13 **(b)**

$VP^3 =$ constant $= k \Rightarrow P = \frac{k}{V^{1/3}}$

Also $PV = \mu RT \Rightarrow \frac{k}{V^{1/3}} . V = \mu RT \Rightarrow V^{2/3} = \frac{\mu RT}{k}$

Hence $\left(\frac{V_1}{V_2}\right)^{2/3} = \frac{T_1}{T_2} \Rightarrow \left(\frac{V}{27V}\right)^{2/3} = \frac{T}{T_2} \Rightarrow T_2 = 9T$

14 **(d)**

Vander waal's equation is followed by real gases

15 **(b)**

Molecular mass of $He; M = 4g$

$\Rightarrow$ Molar value of $C_V = Mc_V = 4 \times 3 = 12 \frac{J}{mole\text{ - }kelvin}$

At constant volume $P \propto T$, therefore on doubling the pressure temperature also doubles $i.e., T_2 = 2T_1 \Rightarrow \Delta T = T_2 - T_1 = 273K$

Also $(\Delta Q)_V = \mu C_V \Delta T = \frac{1}{2} \times 12 \times 273 = 1638J$

16 **(a)**

Here, $h_1 = 50$ cm, $t_1 = 50°C$

$h_2 = 60$ cm, $t_2 = 100°C$

Now, $\frac{h_1}{h_2} = \frac{d_2}{d_1} = \frac{d_0}{1 + \gamma t_2} \times \frac{1 + \gamma t_1}{d_0}$

$$\frac{50}{60} = \frac{1 + \gamma \times 50}{1 + \gamma \times 100}$$

$$\therefore \gamma = \frac{1}{200} = 0.005°C^{-1}$$

17 **(d)**

Vander Waal's gas constant $b = 4 \times$ total volume of all the molecules of the gas in the enclosure

Or $b = 4 \times N \times \frac{4}{3}\pi\left(\frac{d}{2}\right)^3 = \frac{2}{3}\pi N d^3$

$$= \frac{2}{3} \times 3.14 \times 6.02 \times 10^{23} \times (2.94 \times 10^{-10})^3 = 32 \times 10^{-6} \frac{m^3}{mol}$$

18 **(a)**

From ideal gas equation

$$pV = nkT$$

$$p = \frac{n}{V} kT$$

Here, $\frac{n}{V} = 5/\text{cm}^3 = 5 \times 10^6/\text{m}^3$

$$\therefore \quad p = (5 \times 10^6/\text{m}^3)(1.38 \times 10^{-23}/\text{JK}^{-1}) \times 3\text{K}$$

$$p = 20.7 \times 10^{-17} \text{ Nm}^{-2}$$

19 **(d)**

Escape velocity from the earth's surface is 11.2 km/sec

So, $v_{rms} = v_{\text{escape}} = \sqrt{\frac{3RT}{M}} \Rightarrow T = \frac{(v_{\text{escape}})^2 \times M}{3R}$

$$= \frac{(11.2 \times 10^3)^2 \times (2 \times 10^{-3})}{3 \times 8.31} = 10063K$$

20 **(d)**

$$v = \sqrt{\frac{\gamma P}{\rho}} = \sqrt{\frac{\frac{5}{3} \times 10^3}{2.6}} = 25 m/s$$

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