DPP
DAILY PRACTICE PROBLEMS

Class : XIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 3

Topic :- KINETIC THEORY

1 **(d)**

$$\gamma_{\text{mixture}}=\frac{\frac{\mu_1\gamma_1}{\gamma_1-1}+\frac{\mu_2\gamma_2}{\gamma_2-1}}{\frac{\mu_1}{\gamma_1-1}+\frac{\mu_2}{\gamma_2-1}}$$

$\mu_1=$ moles of helium $=\frac{16}{4}=4$

$\mu_2=$ moles of oxygen $=\frac{16}{32}=\frac{1}{2}$

$$\Rightarrow\gamma_{\text{mix}}=\frac{\frac{4\times 5/3}{\frac{5}{3}-1}+\frac{1/2\times 7/5}{\frac{7}{5}-1}}{\frac{4}{\frac{5}{3}-1}+\frac{1/2}{\frac{7}{5}-1}}=1.62$$

2 **(a)**

Mean free path, $\lambda=\frac{1}{\sqrt{2}\pi d^2 n}$

Where, $n=$ Number of molecules per unit volume

$d=$ Diameter of the molecules

3 **(b)**

Speed of sound in gases in given by

$$v_{\text{sound}}=\sqrt{\frac{\gamma P}{\rho}}\Rightarrow\frac{v_1}{v_2}=\sqrt{\frac{\rho_2}{\rho_1}}=\sqrt{\frac{d_2}{d_1}}$$

4 **(c)**

$n_1C_{v1}\Delta T_1=n_2C_{v2}\Delta T_2$

$$\Rightarrow n_1\times\frac{3}{2}R\times 10=n_2\times\frac{5}{2}R\times 6\Rightarrow\frac{n_1}{n_2}=1$$

5 **(a)**

We treat water like a solid. For each atom average energy is $3k_BT$. Water molecule has three atoms, two hydrogen and one oxygen. The total energy of one mole of water is

$$U=3\times 3k_BT\times N_A=9RT\quad\left[\because k_B=\frac{R}{N_A}\right]$$

$\therefore$ Heat capacity per mole of water is

$$C = \frac{\Delta Q}{\Delta T} = \frac{\Delta U}{\Delta T} = 9R$$

6 **(a)**

K.E. is function of temperature. So $\frac{E_{H_2}}{E_{O_2}} = \frac{1}{1}$

7 **(c)**

According to kinetic theory of gases the temperature of a gas is a measure of the kinetic energies of the molecules of the gas.

8 **(c)**

At constant volume

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \Rightarrow T_2 = \left(\frac{P_2}{P_1}\right)T_1$$

$$\Rightarrow T_2 = \left(\frac{3P}{P}\right) \times (273 + 35) = 3 \times 308 = 924K = 651°\text{C}$$

9 **(d)**

$$\frac{3}{2}kT = 1\ eV \Rightarrow T = \frac{2}{3}\frac{eV}{k} = \frac{\frac{2}{3} \times 1.6 \times 10^{-19}}{1.38 \times 10^{-23}} = 7.7 \times 10^3 K$$

11 **(b)**

Vander Waal's gas equation for μ mole of real gas

$$\left(P + \frac{\mu^2 a}{V^2}\right)(V - \mu b) = \mu RT$$

$$P = \left(\frac{\mu RT}{V - \mu b} - \frac{\mu^2 a}{V^2}\right)$$

Given equation,

$$P = \left(\frac{RT}{2V - b} = \frac{a}{4b^2}\right)$$

On comparing the given equation with this standard equation, we get

$$\mu = \frac{1}{2}$$

Hence , $\mu = \frac{m}{M}$

$\Rightarrow$mass of gas, $m = \mu M = \frac{1}{2} \times 44 = 22g$

12 **(d)**

$$C_P = \left(\frac{f}{2} + 1\right)R = \left(\frac{5}{2} + 1\right)R = \frac{7}{2}R$$

13 **(c)**

$$\frac{R}{C_P} = \frac{R}{7/2R} = \frac{2}{7} \quad \left[\because C_P = \frac{7}{2}R\right]$$

14 **(c)**

As temperature decreases to half and volume made twice, hence pressure becomes $\frac{1}{4}$ times

15 **(d)**

$p = p_1 + p_2 + p_3$

$= \left(\frac{nRT}{V}\right)_{O2} + \left(\frac{nRT}{V}\right)_{N_2} + \left(\frac{nRT}{V}\right)_{CO2}$

$= \left(n_{O2} + n_{N2} + n_{CO2}\right)\frac{RT}{V}$

$= \frac{(0.25 + 0.5 + 0.5)(8.31) \times 300}{4 \times 10^{-3}}$

$= 7.79 \times 10^5$ Nm^{-2}

16 **(a)**

$$PV = \mu RT = \frac{m}{M}RT \Rightarrow V = \frac{mRT}{MP}$$

$$= \frac{2 \times 10^{-3} \times 8.3 \times 300}{32 \times 10^{-3} \times 10^5} = 1.53 \times 10^{-3} m^3 = 1.53\ litre$$

17 **(c)**

According to Boyle's law

$(P_1V_1)_{\text{At top of the lake}} = (P_2V_2)_{\text{At the bottom of the lake}}$

$$\Rightarrow P_1V_1 = (P_1 + h)V_2 \Rightarrow 10 \times \frac{4}{3}\pi\left(\frac{5r}{4}\right)^3$$

$$\Rightarrow (10 + h) \times \frac{4}{3}\pi r^3 \Rightarrow h = \frac{610}{64} = 9.53m$$

18 **(d)**

We have $\quad v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$; at $T = T_0$(NTP)

$$v_{\text{rms}} = \sqrt{\frac{3RT_0}{M}}$$

But at temperature T,

$$v_{\text{rms}} = 2 \times \sqrt{\frac{3RT_0}{M}}$$

$$\Rightarrow \quad \sqrt{\frac{3RT}{M}} = 2\sqrt{\frac{3RT_0}{M}}$$

$$\Rightarrow \quad \sqrt{T} = \sqrt{4T_0}$$

or $\quad T = 4T_0$

$$T = 4 \times 273\text{K} = 1092\text{K}$$

$\therefore \qquad T = 819°C$

19 **(b)**

$E = \frac{f}{2}RT; f = 5$ for diatomis gas $\Rightarrow E = \frac{5}{2}RT$

20 **(d)**

Average kinetic energy

$$E = \frac{3}{2}kT \Rightarrow \frac{E_1}{E_2} = \frac{T_1}{T_2} = \frac{(273 - 23)}{(273 + 227)} = \frac{250}{500} = \frac{1}{2}$$

$\Rightarrow E_2 = 2E_1 = 2 \times 5 \times 10^{-14} = 10 \times 10^{-14} erg$

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