DPP

DAILY PRACTICE PROBLEMS

CLASS : XIth
Date :

Solutions

SUBJECT : PHYSICS
DPP No. : 1

Topic :- KINETIC THEORY

1 **(d)**

$$v_{rms}=\sqrt{\frac{v_1^2+v_2^2+v_3^2+v_4^2+v_5^2}{5}}=4.24$$

2 **(a)**

Rate of cooling proportional to $(T^4 - T_0^4)$, as per Stefan's Law.

$$\therefore \quad \frac{R'}{R}=\frac{(900)^4-(300)^4}{(600)^4-(300)^4}$$

$$=\frac{9^4-3^4}{6^4-3^4}=\frac{3^4(3^4-1)}{3^4(2^4-1)}$$

$$=\frac{80}{15}=\frac{16}{3}$$

$$R'=\frac{16}{3}R$$

3 **(c)**

The temperature rises by the same amount in the two cases and the internal energy of an ideal gas depends only on it's temperature

Hence $\frac{U_1}{U_2}=\frac{1}{1}$

4 **(b)**

$$\frac{E_2}{E_1}=\left(\frac{T_2}{T_1}\right)^4$$

$$=\left(\frac{273+84}{273+27}\right)^4=\left(\frac{357}{300}\right)^4=2.0$$

5 **(a)**

Kinetic energy for m g gas $E=\frac{f}{2}mrT$

If only translational degree of freedom is considered

Then $f=3 \Rightarrow E_{\text{Trans}}=\frac{3}{2}mrT=\frac{3}{2}m\left(\frac{R}{M}\right)T$

$$=\frac{3}{2}\times 20\times\frac{8.3}{32}\times(273+47)=2490J$$

6 **(c)**

The number of moles of the system remains same,

$$\frac{P_1V_1}{RT_1}+\frac{P_2V_2}{RT_2}=\frac{P(V_1+V_2)}{RT}\Rightarrow T=\frac{P(V_1+V_2)T_1T_2}{(P_1V_1T_2+P_2V_2T_1)}$$

According to Boyle's law,

$$P_1V_1+P_2V_2=P(V_1+V_2)\ \therefore T=\frac{(P_1V_1+P_2V_2)T_1T_2}{(P_1V_1T_2+P_2V_2T_1)}$$

7 **(b)**

Saturated water vapour do not obey gas laws

8 **(c)**

$$v_{rms}=\sqrt{\frac{3RT}{M}}\Rightarrow T\propto M\quad [\because v_{rms}, R\rightarrow \text{constant}]$$

$$\Rightarrow\frac{T_{O_2}}{T_{N_2}}=\frac{M_{O_2}}{M_{N_2}}\Rightarrow\frac{T_{O_2}}{(273+0)}=\frac{32}{28}\Rightarrow T_{O_2}=312K=39℃$$

9 **(c)**

Boyle's and Charle's law follow kinetic theory of gases

10 **(b)**

$$F=\frac{3}{2}kT\Rightarrow E\propto T$$

12 **(a)**

In elastic collision kinetic energy is conserved

13 **(c)**

From the Mayer's formula

$$C_p - C_V = R \qquad ...(i)$$

and $\gamma=\frac{C_p}{C_V}$

$$\Rightarrow \gamma C_V = C_p \qquad ...(ii)$$

Substituting Eq. (ii) in Eq. (i) we get

$$\Rightarrow \gamma C_V - C_V = R$$

$$C_V(\gamma - 1) = R$$

$$C_V=\frac{R}{\gamma-1}$$

14 **(b)**

From Andrews curve

15 **(a)**

The rms velocity of an ideal gas is

$$v_{rms} = \sqrt{\frac{3RT}{M}}$$

Where T is the absolute temperature and M is the molar mass of an ideal gas

Since M remains the same

$\therefore v_{rms} \propto \sqrt{T}$

$$\frac{v'_{rms}}{v_{rms}} = \sqrt{\frac{T'}{T}} = \sqrt{\frac{3T}{T}}$$

$\Rightarrow v'rms = \sqrt{3} v_{rms}$

16 **(c)**

At constant temperature; $PV =$ constant

$\Rightarrow P \times \left(\frac{m}{D}\right) = \text{constant}$

$\Rightarrow \frac{P}{D} = \text{constant} = K.$ $[D = \text{ Density}]$

17 **(a)**

$$v_{rms} = \sqrt{\frac{3p}{\rho}} \Rightarrow \frac{v_1}{v_2} = \sqrt{\frac{\rho_2}{\rho_1}} = \sqrt{\frac{16}{1}} = \frac{4}{1}$$

18 **(a)**

The gases carbon monoxide (CO) and nitrogen (N_2) are diatomic, so both have equal kinetic energy $\frac{5}{2}kT$, $ie. E_1 = E_2$.

19 **(a)**

From ideal gas equation, we have

$$pV = nRT$$

$$\therefore \quad n = \frac{pV}{RT}$$

Given, $p = 22.4$ atm pressure

$= 22.4 \times 1.01 \times 10^5$ Nm^{-2},

$V = 2L = 2 \times 10^{-3}$ m^3,

$R = 8.31$ J mol^{-1} - K^{-1},

$T = 273$ K

$$\therefore \quad n = \frac{22.4 \times 1.01 \times 10^5 \times 2 \times 10^{-3}}{8.31 \times 273}$$

$$n = 1.99 \approx 2$$

Since, $n = \frac{\text{Mass}}{\text{Atomic weight}}$

We have,

mass $= n \times$ atomic weight $= 2 \times 14 = 28$ g

20 **(d)**

Average kinetic energy $E = \frac{3}{2}kT$

$\Rightarrow \quad E \propto T$

Thus, average kinetic energy of a gas molecule is directly proportional to the absolute temperature of gas.

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