DPP
DAILY PRACTICE PROBLEMS

CLASS : XIth
Date :

Solutions

SUBJECT : PHYSICS
DPP No. : 1

Topic :- KINETIC THEORY

1 **(a)**

The temperature at which protons in a proton gas would have enough energy to overcome Coulomb barrier between them is given by

$\frac{3}{2}k_B T = K_{av}$ ...(i)

Where k_{av} is the average kinetic energy of the proton, T is the temperature of the proton gas and k_B is the Boltzmann constant

From (i), we get $T = \frac{2K_{av}}{3K_B}$

Substituting the values, we get

$$T = \frac{2 \times 4.14 \times 10^{-14} J}{3 \times 1.38 \times 10^{-23} JK^{-1}} = 2 \times 10^9 K$$

2 **(b)**

The pressure exerted by the gas,

$$p = \frac{1}{3}\rho c^2$$

$$= \frac{1}{3}\frac{m}{V}\bar{c}^2$$

$$= \frac{2}{3}\left(\frac{1}{2}m\bar{c}^2\right)$$

$$(\because \frac{1}{2}m\bar{c}^2 = \frac{E}{V} = \text{energy per unit volume}, V = 1)$$

$$p = \frac{2}{3}E$$

3 **(d)**

Here, $\frac{D_1}{D_2} = \frac{1}{2}$

$$\frac{A_1}{A_2} = \frac{D_1^2}{D_2^2} = \frac{1}{4}$$

$$\frac{dx_1}{dx_2} = \frac{2}{1}$$

$$\frac{dQ_1}{dt} = KA_1\frac{dT}{dx_1} : \frac{dQ_2}{dt} = KA_2\frac{dT}{dx_2}$$

$\frac{dQ_1/dt}{dQ_2/dt} = \frac{A_1}{dx_1} \cdot \frac{dx_2}{A_2} = \frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$

4 **(d)**

Total pressure (P) of gas = Actual pressure of gas

$P_a +$ aqueous vapour pressure (P_V)

$\Rightarrow P_a = P - P_V = 735 - 23.8 = 711.2mm$

5 **(c)**

Let for mixture of gases, specific heat at constant volume be C_V

$$C_V = \frac{n_1(C_V)_1 + n_2(C_V)_2}{n_1 + n_2}$$

where for oxygen; $C_{V1} = \frac{5R}{2}, n_1 = 2$ mol

For helium; $C_{V2} = \frac{3R}{2}, n_2 = 8$ mol

Therefore, $C_V = \frac{\frac{2 \times 5R}{2} + 8 \times \frac{3R}{2}}{2 + 8} = \frac{17R}{10} = 1.7\ R$

6 **(a)**

For one g $mole$; average kinetic energy $= \frac{3}{2}RT$

7 **(d)**

As we know 1 mol of any ideal gas at STP occupies a volume of 22.4 $litres$.

Hence number of moles of gas $\mu = \frac{44.8}{22.4} = 2$

Since the volume of cylinder is fixed,

Hence $(\Delta Q)_V = \mu C_V\, \Delta T$

$= 2 \times \frac{3}{2} R \times 10 = 30R \left[\because (C_V)_{mono} = \frac{3}{2} R\right]$

8 **(b)**

The ideal gas law is the equation of state of an ideal gas. The state of an amount of gas is determined by its pressure, volume and temperature. The equation has the form

$$pV = nRT$$

where, p is pressure, V the volume, n the number of moles, R the gas constant and T the temperature.

$$\therefore \qquad \frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$$

Given, $p_1 = 200$ kPa, $V_1 = V$, $T_1 = 273 + 22 = 295$ K, $V_2 = V + 0.02\ V$

$T_2 = 273 + 42 = 315$ K

$$\frac{200 \times V}{295} = \frac{p_2 \times 1.02V}{315}$$

$$\Rightarrow \qquad p_2 = \frac{200 \times 315}{295 \times 1.02}$$

$$p_2 = 209 \text{ kPa}$$

9 **(c)**

$$PV = \mu RT \Rightarrow \mu = \frac{PV}{RT} = \frac{21 \times 10^4 \times 83 \times 10^{-3}}{8.3 \times 300} = 7$$

10 **(b)**

An ideal gas is a gas which satisfying the assumptions of the kinetic energy.

11 **(d)**

$$P = \frac{2}{3}E$$

12 **(b)**

$\gamma = 7/5$ for a diatomic gas

14 **(c)**

$$v_{rms} \propto \frac{1}{\sqrt{M}} \Rightarrow \frac{v_{O_2}}{v_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}} \Rightarrow \frac{C}{v_{H_2}} = \sqrt{\frac{2}{32}} = \frac{1}{4}$$

$$\Rightarrow v_{H_2} = 4C\ cm/s$$

15 **(a)**

$$P \propto T \Rightarrow \frac{P_1}{P_2} = \frac{T_1}{T_2} \Rightarrow \frac{P_2 - P_1}{P_1} = \frac{T_2 - T_1}{T_1}$$

$$\Rightarrow \left(\frac{\Delta P}{P}\right)\% = \left(\frac{251 - 250}{250}\right) \times 100 = 0.4\%$$

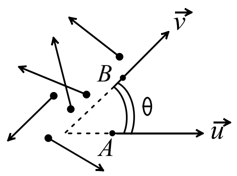
16 **(b)**

$$v_{rms} \propto \sqrt{T} \Rightarrow \frac{(v_{rms})_2}{(v_{rms})_1} = \sqrt{\frac{T_2}{T_1}}$$

$$\Rightarrow 2 = \sqrt{\frac{T_2}{300}} \Rightarrow T_2 = 1200K = 927°\text{C}$$

17 **(d)**

Figure shows the particles each moving with same speed v but in different directions. Consider any two particles having angle θ between directions of their velocities



Then, $\overrightarrow{v_{\text{rel}}} = \overrightarrow{v_B} - \overrightarrow{v_A}$

i.e., $v_{\text{rel}} = \sqrt{v^2 + v^2 - 2vv\cos\theta}$

$\Rightarrow v_{\text{rel}} = \sqrt{2v^2(1 - \cos\theta)} = 2v\sin(\theta/2)$

So averaging v_{rel} over all pairs

$$\overline{v}_{\text{rel}} = \frac{\int_0^{2\pi} v_{\text{rel}} d\theta}{\int_0^{2\pi} d\theta} = \frac{\int_0^{2\pi} 2v\sin(\theta/2)}{\int_0^{2\pi} d\theta} = \frac{2v \times 2[-\cos(\theta/2)]_0^{2\pi}}{2\pi}$$

$\Rightarrow \bar{v}_{\text{rel}} = (4v/\pi) > v \quad [\text{as } 4/\pi > 1]$

18 **(b)**

Since volume is constant,

Hence $\frac{P_1}{P_2} = \frac{T_1}{T_2} \Rightarrow \frac{1}{3} = \frac{(273+30)}{T_2}$

$\Rightarrow T_2 = 909K = 636°\text{C}$

19 **(d)**

The value of $\frac{pV}{T}$ for one mole of an ideal gas

= gas constant

= 2 cal mol^{-1}K^{-1}

20 **(d)**

Mean kinetic energy for μ mole gas $= \mu.\frac{f}{2}RT$

$\therefore E = \mu \frac{7}{2} RT = \left(\frac{m}{M}\right)\frac{7}{2} NkT = \frac{1}{44}\left(\frac{7}{2}\right)NkT$

$= \frac{7}{88} NkT$ [As $f = 7$ and $M = 44$ for CO_2]

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