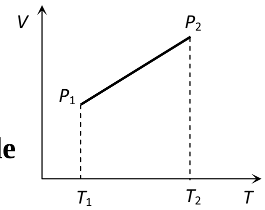
KINETIC THEORY OF GASES

1. **One mole of an ideal monatomic gas requires 210 J heat to raise the temperature by 10 K, when heated at constant temperature. If the same gas is heated at constant volume to raise the temperature by 10 K then heat required is**

(a) 238 J (b) 126 J (c) 210 J (d) 350 J

2. **From the following V-T diagram we can conclude**

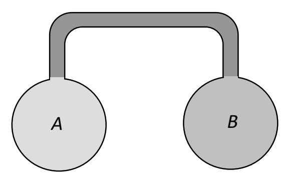


(a) $P_1 = P_2$ (b) $P_1 > P_2$ (c) $P_1 < P_2$ (d) None of these

3. **When the temperature of a gas is raised from 27°C to 90°C, the percentage increase in the r.m.s. velocity of the molecules will be**

(a) 10% (b) 15% (c) 20% (d) 17.5%

4. **Two spherical vessel of equal volume, are connected by a narrow tube. The apparatus contains an ideal gas at one atmosphere and 300K. Now if one vessel is immersed in a bath of constant temperature 600K and the other in a bath of constant temperature 300K. Then the common pressure will be**



(a) 1 atm

(b) $\frac{4}{5}$ atm

(c) $\frac{4}{3}$ atm

(d) $\frac{3}{4}$ atm

5. **At what temperature, the mean kinetic energy of O_2 will be the same for H_2 molecules at –73°C**

(a) 127°C (b) 527°C (c) – 73°C (d) – 173°C

6. **If the r.m.s. velocity of a gas at a given temperature (Kelvin scale) is 300 m/sec. What will be the r.m.s. velocity of a gas having twice the molecular weight and half the temperature on Kelvin scale =**

(a) 300 m/sec (b) 600 m/sec (c) 75 m/sec (d) 150 m/sec

7. **The energy of a gas/litre is 300 joules, then its pressure will be**

(a) $3 \times 10^5\ N/m^2$ (b) $6 \times 10^5\ N/m^2$ (c) $10^5\ N/m^2$ (d) $2 \times 10^5\ N/m^2$

8. **If pressure of CO_2 (real gas) in a container is given by $P = \frac{RT}{2V-b} - \frac{a}{4b^2}$ then mass of the gas in container is**

(a) 11 gm (b) 22 gm (c) 33 gm (d) 44 gm

9. **Four particles have speeds 2, 3, 4 and 5 cm/s respectively. Their rms speed is**

(a) 3.5 cm/sec (b) 27/2 cm/s (c) $\sqrt{54}$ cm/sec (d) $(\sqrt{54}/2)$ cm/s

10. **The root mean square speeds of molecules of ideal gases at the same temperature are**

(a) The same

(b) Inversely proportional to the square root of the molecular weight

(c) Directly proportional to the molecular weight

(d) Inversely proportional to the molecular weight.

11. **Which of the following gases possess maximum rms velocity, all being at the same temperature?**

(a) Oxygen (b) Air (c) carbon dioxide (d) Hydrogen

12. **At 0 K which of the following properties of a gas will be zero?**

(a) Kinetic energy (b) Potential energy (c) Vibrational energy (d) Density

13 **.Gases exert pressure on the walls of containing vessel because the gas molecules**

(a) Possess momentum (b) collide with each other

(c) have finite volume (d) obey gas laws

14. **The phenomenon of Brownian movement may be taken as evidence of**

(a) kinetic theory of matter (b) electromagnetic theory of radiation

(c) corpuscular theory of light (d) photoelectric phenomenon

15. **Absolute temperature can be calculated by**

(a) mean square velocity (b) motion of the molecule

(c) both (1) and (2) (d) none of these

KEY

1) **b**	2) **b**	3) **a**	4) **c**	5) **c**	6) **d**	7) **d**	8) **b**	9) **d**	10) **b**
11) **d**	12) **a**	13) **a**	14) **a**	15) **a**					

HINTS

1. $(\Delta Q)_P = \mu C_P \Delta T$ and $(\Delta Q)_V = \mu C_V \Delta T$

$$\Rightarrow \frac{(\Delta Q)_V}{(\Delta Q)_P} = \frac{C_V}{C_P} = \frac{\frac{3}{2}R}{\frac{5}{2}R} = \frac{3}{5} \quad \left[\because (C_V)_{mono} = \frac{3}{2}R, (C_P)_{mono} = \frac{5}{2}R\right]$$

$$\Rightarrow (\Delta Q)_V = \frac{3}{5} \times (\Delta Q)_P = \frac{3}{5} \times 210 = 126\ J$$

2. In case of given graph, V and T are related as V = aT – b, where a and b are constants.

From ideal gas equation, PV = μRT

We find $P = \frac{\mu RT}{aT - b} = \frac{\mu R}{a - b/T}$

Since $T_2 > T_1$, therefore $P_2 < P_1$.

3. $v_{rms} = \sqrt{\frac{3RT}{M}} \Rightarrow \frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{(273+90)}{(273+30)}} = 1.1$

% increase $= \left(\frac{v_2}{v_1} - 1\right) \times 100 = 0.1 \times 100 = 10\%$

4. $\mu = \mu_1 + \mu_2$

$$\frac{P(2V)}{RT_1} = \frac{P'v}{RT_1} + \frac{P'V}{RT_2} \Rightarrow \frac{2P}{RT_1} = \frac{P'}{R}\left[\frac{T_2 + T_1}{T_1 T_2}\right]$$

$$P' = \frac{2P\,T_2}{(T_1 + T_2)} = \frac{2 \times 1 \times 600}{(300 + 600)} = \frac{4}{3}atm$$

5. Mean kinetic energy of molecule depends upon temperature only. For O_2 it is same as that of H_2 at the same temperature of $-73°C$.

6. $v_{rms} = \sqrt{\frac{3RT}{M}} \Rightarrow v_{rms} \propto \sqrt{\frac{T}{M}}$

$\frac{v_2}{v_1} = \sqrt{\frac{M_1}{M_2} \times \frac{T_2}{T_1}} = \sqrt{\frac{1}{2} \times \frac{1}{2}} \Rightarrow v_2 = \frac{v_1}{2} = \frac{300}{2}$ =150m/sec

7. Energy $= 300\ J/litre = 300 \times 10^3\ J/m^3$

$$P = \frac{2}{3}E = \frac{2 \times 300 \times 10^3}{3} = 2 \times 10^5\ N/m^2$$

8. (b)Vander wall's gas equation for μ mole of real gas

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

on comparing the given equation with this standard equation we get $\mu = \frac{1}{2}$. Hence $\mu = \frac{m}{M} \Rightarrow$

mass of gas $m = \mu m = \frac{1}{2} \times 44 = 22\,gm.$