IMPORTANT QUESTIONS CLASS – 11 PHYSICS CHAPTER – 12 KINETICS ENERGY

Question 1.
Two identical cylinders contain helium at 2 atmospheres and argon at 1 atmosphere respectively. If both the gases are filled in one of the cylinders, then:
(a) What would be the pressure?

Answer:
(2 + 1) = 3 atmosphere.

(b) Will the average translational K.E. per molecule of both gases be equal?

Answer:
Yes, because the average translational K.E./molecule (32kT) depends only upon the temperature.

(c) Will the r.m.s. velocities are different?

Answer:
Yes, because of the r.m.s. velocity depends not only upon temperature but also upon the mass.

Question 2.
Why hydrogen escapes more rapidly than oxygen from the earth's surface?

Answer:
We know that $C_{rms} \propto 1\rho\surd$

Also $\rho_o = 16\ \rho_H$. So C_{rms} of hydrogen is four times that of oxygen at a given temperature. So the number of hydrogen molecules whose velocity exceeds the escape velocity from earth (11.2 km s^{-1}) is greater than the no. of oxygen molecules. Thus hydrogen escapes from the earth's surface more rapidly than oxygen.

Question 3.
Distinguish between the terms evaporation, boiling and vaporization.

Answer:
Evaporation: It is defined as the process of conversion of the liquid to a vapor state at all temperatures and occurs only at the surface of the liquid.

Boiling: It is the process of rapid conversion of the liquid to a vapour state at a definite temperature and occurs throughout the liquid.

Vaporization: It is the general term for the conversion of liquid to vapor state. It includes both evaporation and boiling.

Question 4 .
Estimate the total number of air molecules (inclusive of oxygen, nitrogen, water vapor and other constituents) in a room of capacity 125.0 m^3 at a temperature of 127°C and 2 atm pressure, $k = 1.38 \times 10^{-23}$ JK^{-1}.

Answer:
Here, T = 127°C + 273 = 400 K
$k = 1.38 \times 10^{-23}$ JK^{-1} P = 2 atmosphere
$= 2 \times 1.01 \times 10^5$ Nm^{-2}
$= 2.02 \times 10^5$ Nm^{-2}

V = volume of room = 125 m^3
N' = no. of molecules in the room =?
∴ $R = Nk = 6.023 \times 10^{23} \times 1.38 \times 10^{-23}$
= 8.31 JK^{-1} mol^{-1}

Let n = no. of moles of the air in the given volume.
∴ Using gas equation,
PV = nRT, we get
n = PVRT=2.02×105×1258.31×400
= 7.60 × 103 moles

∴ $N' = Nn = 6.023 \times 10^{23} \times 7.60 \times 10^3$
$= 45.77 \times 10^{26}$.

Question 5.
Calculate the temperature at which the oxygen molecules will have the same r.m.s. velocity as the hydrogen molecules at 150°C. The molecular weight of oxygen is 32 and that of hydrogen is 2.

Answer:
Here, Molecular weight of oxygen, M0 = 32
Molecular weight of hydrogen. MH = 2

Let T_o = temp. of oxygen = ?
T_H = temp. of hydrogen
= 150°C = 150 + 273 = 423 K
$C_o = C_H$

$$\text{or} \quad \sqrt{\frac{3RT_O}{M_O}} = \sqrt{\frac{3RT_H}{M_H}}$$

$$\text{or} \quad \frac{T_O}{M_O} = \frac{T_H}{M_H}$$

$$\text{or} \quad T_O = T_H \times \frac{M_O}{M_H}$$

$$= 423 \times \frac{32}{2} = 423 \times 16 = 6768 \text{ K}$$

$$= 6768 - 273 = 6495°\text{C}.$$

Question 6.
Calculate the r.m.s. the velocity of molecules of gas for which the specific heat at constant pressure is 6.84 cal per g mol per °C. The velocity of sound in the gas being 1300 ms^{-1}. R = 8.31 × 10^7 erg per g mol per °C. J = 4.2 × 10^7 erg cal^{-1}.

Answer:
Here, C_p = 6.84 cal/g mol/°C
R = 8.31 × 10 erg/g mol/°C
J = 4.2 × 10 erg/cal
v = velocity = 1300 ms^{-1}
= 1300 × 100 cm s^{-1}
C_{rms} =?

Using the relation,

$$C_P - C_v = \frac{R}{J}, \text{ we get}$$

$$C_v = C_P - \frac{R}{J} = 6.84 - \frac{8.31 \times 10^7}{4.2 \times 10^7}$$

$$= 6.84 - 1.98 = 4.86$$

$$\therefore \quad \gamma = \frac{C_P}{C_v} = \frac{6.84}{4.86} = 1.41$$

$$\therefore \quad C_{rms} = \sqrt{\frac{3P}{\rho}} \quad \text{.... (1)}$$

Now using the relation,

$$v = \sqrt{\frac{\gamma P}{\rho}}, \text{ we get}$$

$$\sqrt{\frac{P}{\rho}} = \frac{v}{\sqrt{\gamma}} = \frac{130000}{\sqrt{1.41}} \quad \text{.... (2)}$$

$\therefore$ from (1) and (2), we get

$$C_{rms} = \sqrt{3} \times \sqrt{\frac{P}{\rho}} = \sqrt{3} \times \frac{130000}{\sqrt{1.41}}$$

$$= \frac{1.732}{\sqrt{1.41}} \times 13 \times 10^4$$

$$= 18.98 \times 10^4 \text{ cms}^{-1}$$

$$= 1898 \text{ ms}^{-1}.$$

Question 7.
Calculate the molecular K.E. of I g of an oxygen molecule at 127°C. Given R = 8.31 JK^{-1} mol^{-1}. The molecular weight of oxygen = 32.

Answer:
Here, M = 32 g
T = 127 + 273 = 400 K

∴ Molecular K.E. of oxygen is given by
12 MC^2 = 32 RT
Now K.E. of 32 g of O_2 RT = 32RT

∴ K.E.of 1 g of O_2 = 32·RT32
or
E = 364 × 8.31 × 400 J
= 155.81 J.

Question 8.
Calculate the intermolecular B.E. in eV of water molecules from the following data:
$N = 6 \times 10^{23}$ per mole
1 eV= 1.6×10^{-19} J
L = latent heat of vaporization of water = 22.6×10^5 J/kg.

Answer:
Here, molecular weight of water, M = 2 + 16 = 18g
∴ No. of molecules in 1 kg of water = 6×102318 × 1000 = 10263

L = 22.6×10^5 J kg
∴ B.E .per molecule = 22.6×10^5 J = B.E of 6×102318 molecule

Thus B.E. per molecule

$$= \frac{22.6 \times 10^5}{10^{26}} \times 3$$
$$= 6.78 \times 10^{-20}\ J$$
$$= \frac{6.78 \times 10^{-20}}{1.6 \times 10^{-19}}\ eV$$
$$= 0.42\ eV.$$

Question 9.
Two perfect gases at absolute temperatures T_1 and T_2 are mixed. There is no loss of energy. Find the temperature of mixture if masses of molecules are m_1 and m_2 and the no. of molecules in the gases are n_1 and n_2 respectively.

Answer:
Let E_1 and E_2 be the K.E. of the two gases,
∴ $E_1 = 32\ kT_1 \times n_1$
and $E_2 = 32\ kT_2 \times n_2$

Let E be the total energy of the two gases before mixing
∴ $E = E_1 + E_2 = 32K(n_1T_1 + n_2T_2)$ ....(1)

After mixing the gases, let T be the temperature of the mixture of the two gases
∴ $E' = 32kT(n_1 + n_2)$ ...(2)

As there is no loss of energy,

$$\therefore \quad E = E'$$
$$\text{or} \quad \frac{3}{2}k(n_1T_1 + n_2T_2) = \frac{3}{2}kT(n_1 + n_2)$$
$$\text{or} \quad T = \frac{n_1T_1 + n_2T_2}{n_1 + n_2}.$$

Question 1.
Ram has to attend an interview. He was not well. He took the help of his friend Raman. On the way office, Ram felt giddy, He vomited on his dress. Raman washed his shirt. He made Ram drink enough amount of water. In spite of doing, a foul smell was coming from the shirt. Then Raman

purchased a scent bottle from the nearby cosmetics shop and applied to Ram. Ram attended the interview, Performed well. Finally, he was selected.
(a) What values do you find in Raman?

Answer:
He has the presence of mind, serves others in need.

(b) The velocity of air is nearly 500m/s. But the smell of scent spreads very slowly, Why?

Answer:
This is because the air molecules can travel only along a zig-zag path due to frequent collisions. Consequently, the displacement per unit time is considerably small.