# Speed Test-33

**1.** **(c)** Wt. of compound is 96 g. The compound exists as 50% monomer and 50% dimer.

Moles of monomer $= \frac{48}{48} = 1$,

Moles of dimer $= \frac{48}{96} = 0.5$

$$\therefore \quad P = \frac{1.5 \times 0.0821 \times (273 + 273)}{33.6} = 2.00 \text{ atm}$$

**2.** **(d)** $u_1 \propto \sqrt{\frac{1}{m_1}}$ and $u_2 \propto \sqrt{\frac{1}{m_2}}$

$$\therefore \frac{u_1^2}{u_2^2} = \frac{m_2}{m_1} \quad \therefore m_1 u_1^2 = m_2 u_2^2$$

**3.** **(c)** Gas equation is $PV = \frac{m}{M} RT$ ...(i)

Again $\frac{P}{2} V = \frac{m_1}{M} R . \frac{2}{3} T$ ...(ii)

Divide (i) by (ii)

$2 = \frac{m}{m_1} \times \frac{3}{2} \therefore m_1 = \frac{3}{4} m$. Gas escaped is then $= \frac{1}{4} m$

**4.** **(b)** $V_0 = \sqrt{\frac{2RT}{M}} = \sqrt{R(273 + t)}$

$$u_{rms} = \sqrt{\frac{3(2t + 273 + 273)R}{1}}$$

$$= \sqrt{6(t + 273)R} = \sqrt{6}\, V_0$$

**5.** **(d)** Average velocity $= \sqrt{\frac{8RT}{\pi M}}$

i.e., $v \propto \sqrt{T}$

$$\therefore \frac{v_2}{v_1} = \sqrt{\frac{2T}{T}} = 1.41$$

**6.** **(b)** $R = 0.0082$ litre atm $K^{-1} mol^{-1}$.

**7.** **(d)** From the ideal gas equation :

$PV = nRT$

or $n = \frac{PV}{RT} = \frac{3170 \times 10^{-3}}{8.314 \times 300} = 1.27 \times 10^{-3}$

**8.** **(c)** $\frac{x}{32} + \frac{x}{28} = \frac{60x}{32 \times 28}$,

PV = nRT;

$P_1 V = \frac{x}{32} RT$; $P_2 V = \frac{x}{28} RT$

$\therefore \quad 32 P_{O_2} = 28 P_{N_2}$

or, $\quad P_{O_2} = 0.875\, P_{N_2}$

**9.** **(a)** Since b = 4 × volume occupied by molecules of 1 mole of a gas

$$b = 4\ N_A \left(\frac{4}{3}\pi r^3\right)$$

$$\therefore r = \left(\frac{3b}{16 N_A \pi}\right)^{\frac{1}{3}} = \left[\frac{3 \times 24 cm^3 mol^{-1}}{16(6.023 \times 10^{23} mol^{-1} \times 3.14)}\right]^{\frac{1}{3}}$$

$$= 1.335 \times 10^{-8} \text{ cm} = 133.5 \text{ pm}$$

Molecular diameter, d = 2r = 267 pm.

**10.** **(d)** Let V be the original volume of bubble. The final volume will be 8 V. Let P be the atmospheric pressure and $P_1$ the pressure at the bottom

$\therefore \quad P \times 8\ V = P_1 \times V$;

$8p = P_1$

$P_1 =$ atmospheric pressure + pressure due to water lake

$= P + 7p$

The P = 10 m high, the 7p will be = 70 m high

So the depth = 70 m

**11.** **(a)** $d \propto P$, Boyle's law, $\left(d = \frac{MP}{RT}\right)$. At sea level pressure is more, hence density of air is more.

**12.** **(d)** $\frac{P}{T} =$ constant (Gay Lussac's law)

$$\Rightarrow \quad \frac{P_1}{T_1} = \frac{P_2}{T_2} \Rightarrow P_1 T_2 = P_2 T_1$$

PV = constant

$P_1 V_1 = P_2 V_2$ [Boyle's law]

**13.** **(a)** Given

$P_1 = 1.5$ bar $T_1 = 273 + 15 = 288$ K $V_1 = V$

$P_2 = 1.0$ bar $T_1 = 273 + 25 = 298$ K $V_2 = ?$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{1.5 \times V}{288} = \frac{1 \times V_2}{298}$$

$V_2 = 1.55$ V i.e., volume of bubble will be almost 1.6 time to initial volume of bubble.

**14.** **(a)** $r \propto \frac{P}{\sqrt{m}}$

$$\frac{r_A}{r_B} = \frac{P_A}{P_B}\sqrt{\frac{M_B}{M_A}}$$

**15.** **(a)** The mean free path, $\lambda = \frac{1}{\sqrt{2}\,\pi a^2 N}$

or $\lambda \propto \frac{1}{a^2}$, where $a$ = molecular diameter

∴ Smaller the molecular diameter, longer the mean free path. Hence $H_2$ is the answer.

**16.** **(d)** $u_{rms} = \sqrt{\frac{3RT}{M}}$ Using ideal gas equation,

$PV = nRT = \frac{w}{M}RT$; $\frac{RT}{M} = \frac{PV}{w} = \frac{P}{d}$ where d is the density of the gas

∴ $u_{rms} = \sqrt{\frac{3P}{d}}$ at constant pressure, $u_{rms} \propto \frac{1}{\sqrt{d}}$

**17.** **(c)** The correct order of viscosity of the given liquids is dimethyl ether < methyl alcohol < water < glycerol.

**18.** **(c)** The different type of molecular velocities possessed by gas molecules are

(i) Most probable velocity (α) $= \sqrt{\frac{2RT}{M}}$

(ii) Average velocity $\bar{v} = \sqrt{\frac{8RT}{\pi M}}$

(iii) Root mean square velocity in all three cases

$v = \sqrt{\frac{3RT}{M}}$

In all the above cases

Velocity $\propto \sqrt{T}$

**19.** **(c)** $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ at const. pressure

$\Rightarrow \frac{22.4}{273} = \frac{V_2}{373}$, $V_2 = 30.6$ litre

**20.** **(a)**

**21.** **(c)** $u_{rms} = \sqrt{\frac{3RT}{M}} \Rightarrow \sqrt{\frac{3RT_{H_2}}{2}} = \sqrt{7}\sqrt{\frac{3RT_{N_2}}{28}}$ ;

∴ $T_{N_2} = 2T_{H_2}$ or $T_{N_2} > T_{H_2}$

**22.** **(b)** Compressibility factor $(Z) = \frac{PV}{RT}$

(For one mole of real gas)

van der Waals equation

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

At low pressure, volume is very large and hence correction term b can be neglected in comparison to very large volume of V.

i.e. $V - b \approx V$

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

$$PV + \frac{a}{V} = RT$$

$$PV = RT - \frac{a}{V}$$

$$\frac{PV}{RT} = 1 - \frac{a}{VRT}$$

Hence, $\boxed{Z = 1 - \frac{a}{VRT}}$

**23.** **(b)** For gas A, $a = 0$, $Z = 1 + \frac{Pb}{RT}$ implies $Z$ varies linearly with pressure.

For gas B, $b = 0$, $Z = 1 - \frac{a}{VRT}$. Hence, $Z$ does not vary linearly with pressure.

Given the intersection data for gas C, it is possible to find the values of '$a$' and '$b$'. All van der Waal gases, like gas C, give positive slope at high pressures.

**24.** **(c)** According to Avogadro's law "At same temperature and pressure Volume ∝ no. of moles"

$n_{H_2} = \frac{w}{2}$; $n_{O_2} = \frac{w}{32}$; $n_{CH_4} = \frac{w}{16}$

$\because V_{H_2} : V_{O_2} : V_{CH_4} = n_{H_2} : n_{O_2} : n_{CH_4}$

$= \frac{w}{2} : \frac{w}{32} : \frac{w}{16} = 16 : 1 : 2$

**25.** **(c)** As temperature rises the most probable speed increases and the fraction of molecules possessing most probable speed decreases.

**26.** **(a)** $\frac{\text{K.E of neon at } 40°C}{\text{K.E of neon at } 20°C} = \frac{\frac{3}{2}K \times 313}{\frac{3}{2}K \times 293} = \frac{313}{293}$

**27.** **(c)** The expression of root mean square speed is

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

Hence,

$$\frac{u_{rms}(H_2)}{u_{rms}(O_2)} = \left[\frac{3R(50K)/(2\,g\,mol^{-1})}{3R(800K)/(32\,g\,mol^{-1})}\right]^{1/2} = 1$$

**28.** **(c)** For positive deviation: $PV = nRT + nPb$

$$\Rightarrow \frac{PV}{nRT} = 1 + \frac{Pb}{RT}$$

Thus, the factor nPb is responsible for increasing the PV value, above ideal value. b is actually the effective volume of molecule. So, it is the finite size of molecules that leads to the origin of 'b' and hence positive deviation at high pressure.

**29.** **(d)** Let the mass of methane and oxygen = m g

Mole fraction of $O_2$

$$= \frac{\text{Moles of } O_2}{\text{Moles of } O_2 + \text{Moles of } CH_4}$$

$$= \frac{m/32}{m/32 + m/16} = \frac{m/32}{3m/32} = \frac{1}{3}$$

Partial pressure of $O_2$ = Total pressure × mole fraction of $O_2$, $P_{O_2} = P \times \frac{1}{3} = \frac{1}{3}P$

**30.** **(d)** Rate $\propto \sqrt{\frac{1}{M}}$. The smaller the value of M the more is the rate of diffusion

**31.** **(d)** The given equation is cubic equation in the variable V and, therefore, for a single value of P and T, there should be three values of V, all of which may be real or one real and two imaginary.

At $T_c$ there values of V become identical.

**32.** **(d)** r.m.s. velocity $v_{rms} = \sqrt{\frac{3RT}{M}}$

i.e., $\frac{v_1}{v_2} = \sqrt{\frac{T_1}{T_2}}$

$$\frac{5 \times 10^4}{10 \times 10^4} = \frac{1}{2} = \sqrt{\frac{T_1}{T_2}}$$

$\therefore\ T_2 = 4T_1$

**33.** **(b)** $d = \frac{PM}{RT}$

It means density of gas is directly proportional to pressure and inversely proportional to temperature.

Density of neon will be maximum at highest pressure and lowest temperature.

**34.** **(d)** Above Boyle point, real gases show positive deviation from ideality and Z values are greater than one.

**35.** **(d)** Induced dipole moment depends upon the dipole moment present in the permanent dipole and the polarisability of the electrically neutral molecule. Molecules of large size can be easily polarized. High polarisability increases the strength of attractive interactions.

**36.** **(c)** More will be critical temperature easier is the liquification of the gas. Hence correct order will be

$He < H_2 < N_2 < O_2$

**37.** **(b)** The strength of H-bonding is in the order N....H< O....H < F....H

**38.** **(b)** Liquid drops assume spherical shape because a sphere has minimum surface area.

**39.** **(a)** $PV = \frac{1}{3}mnu^2 = \frac{1}{3}Mu^2$

$$= \frac{2}{3}.\frac{1}{2}Mu^2 = \frac{2}{3}E \text{ or } P = \frac{2}{3}E \text{ per unit vol.}$$

**40.** **(c)** Moles of A, $(n_A) = \frac{p_A v_A}{RT} = \frac{8 \times 12}{RT} = \frac{96}{RT}$

Moles of B, $(n_B) = \frac{p_B v_B}{RT} = \frac{8 \times 5}{RT} = \frac{40}{RT}$

Total pressure × total volume = $(n_A + n_B) \times RT$

$$P \times (12 + 8) = \frac{1}{RT}(96 + 40)RT$$

$$P = 6.8$$

Partial pressure of A = P × mole fraction of A

$$= 6.8\left(\frac{96}{RT}\Big/\frac{96 + 40}{RT}\right)$$

$$= 4.8 \text{ atm}$$

Partial pressure of B = 6.8 − 4.8 = 2 atm.

**41.** **(c)**

**42.** **(d)** These forces are important only at short distances (~ 500 pm)

**43.** **(a)** The gas molecules are tiny particles and not rigid in nature rather they are perfect elastic bodies.

**44.** **(a)** For statement (ii), $p_{real} = p_{ideal} - \frac{an^2}{V^2}$

For statement (iii), value of 'a' is independent of temperature and pressure.

**45.** **(a)** $P = \frac{n^2 a}{V^2}$; $a = \frac{PV^2}{n^2} = \text{atm dm}^6 \text{ mol}^{-2}$