61.(B) $\frac{r_{He}}{r_{CH_4}} = \sqrt{\frac{M_{CH_4}}{M_{He}}}$

62.(B) Option (B) is incorrect statement because at high pressure slope of the line will change from negative to positive.

63. $\mathbf{A \to p, s}$ **;** $\mathbf{B \to r}$ **;** $\mathbf{C \to p, q}$ **;** $\mathbf{D \to r}$

(A) At p = 200 atm, very high pressure, Z > 1. Also, at such a high pressure, the pressure correction factor $\left(\frac{n^2a}{V^2}\right)$ can be ignored in comparison to p.

(B) At $P \sim 0$, gas will behave like an ideal gas, $pV = nRT$.

(C) CO_2 (p = 1 atm, T = 273 K), Z < 1.

(D) At very large molar volume, real gas behaves like an ideal gas.

64.(ACD)

Option (A) is correct because in the limit of large volume, both intermolecular force and molecular volume becomes negligible in comparison to volume of gas.

Option (B) is wrong statement because in the limit of large pressure Z > 1.

Option (C) is correct statement. For a van der Waals' gas, van der Waal's constants and b are characteristic of a gas, independent of temperature.

Option (D) is wrong statement because Z can be either less or greater than unity, hence real pressure can be less or greater than ideal pressure.

65.(AB) Pv = nRT

66.(4) Given, $u_{rms} = u_{mp}$

$$\Rightarrow \quad \sqrt{\frac{3RT}{M(X)}} = \sqrt{\frac{2RT}{M(Y)}} \quad \Rightarrow \quad \frac{3R \times 400}{40} = \frac{2R \times 60}{M(Y)} \quad \Rightarrow \quad M(Y) = 4$$

67.(B) In the van der Waals' equation $\left(p + \frac{n^2a}{V^2}\right)(V - nb) = nRT$

The additional factor in pressure, i.e. $\frac{n^2a}{V^2}$ corrects for intermolecular force while b corrects for molecular volume.

68.(7) Since, the external pressure is 1.0 atm, the gas pressure is also 1.0 atm as piston is movable. Out of this 1.0 atm partial pressure due to unknown compound is 0.68 atm.

Therefore, partial pressure of $He = 1.00 - 0.68 = 0.32$ atm

$$\Rightarrow \quad \text{Volume} = \frac{n(He)RT}{p(He)} = \frac{0.1 \times 0.082 \times 273}{0.32} = 7\text{ L}$$

$\Rightarrow$ Volume of container = volume of He.

69.(ABCD)

Refer kinetic theory of gases

70.(C) The van der Waals' equation of state is $\left(p+\frac{n^2a}{V^2}\right)(V-nb)=nRT$

For one mole and when b = 0, the above equation condenses to $\left(p+\frac{a}{V^2}\right)V=RT$

$$\Rightarrow \quad pV = RT - \frac{a}{V} \qquad \ldots(i)$$

Eq. (i) is a straight equation between pV and $\frac{1}{V}$ whose slope is $-a'$. Equating with slope of the straight line given in the graph. $-a=\frac{20.1-21.6}{3-2}=-1.5 \quad \Rightarrow \quad a=1.5$

71.(C) **PLAN:** This problem can be solved by using the concept of Graham's law of diffusion according to which rate of diffusion of non-reactive gases under similar conditions of temperature and pressure are inversely proportional to square root of their density.

$$\text{Rate of diffusion} \propto \frac{1}{\sqrt{\text{molar weight of gas}}}$$

Let distance covered by X is d, then distance covered by Y is 24-d.

If r_x and r_y are the rate of diffusion of gases X and Y,

$$\frac{r_x}{r_y}=\frac{d}{24-d}=\sqrt{\frac{40}{10}}=2 \quad [\because \text{ Rate of diffusion} \propto \text{ distance travelled}]$$

$$d=48-2d \quad \Rightarrow \quad 3d-48 \quad \Rightarrow \quad d=16\text{ cm}$$

72.(BD) x is a lighter gas than y, hence x has greater molecular speed. Due to greater molecular speed of x, it will have smaller mean free path and greater collision frequency with the inert gas molecules. As a result, x will take more time to travel a given distance along a straight line. Hence x and y will meet at a distance smaller than one calculated from Graham's law.

73.(4) Universal gas constant, $R = kN_A$

Where, k = Boltzmann constant and N_A = Avogadro's number

$\therefore \quad R = 1.380\times10^{-23}\times6.023\times10^{23}\,J/Kmol = 8.31174 \cong 8.312\ J\,k^{-1}mol^{-1}$

Since, k and N_A both have four significant figures, so the value of R is also rounded off upto 4 significant figures.

[When number is rounded off, the number of significant figure is reduced, the last digit is increased by 1 if following digits ≥ 5 and is left as such that if following digits is ≤ 4]

Hence, correct integer is (4).

74.(C) As the given gas equation is $P(V-b)=RT$.

According to this equation inter particle forces is ignored/neglected.

Hence particles of gas can not get attracted so inter-atomic potential can not be negative.

Now, on further compression particles can't come closer than a certain distance.

So answer must be (C).

75.(4) Diffusion co-efficient $\propto \lambda.C_{mean}$

$$\lambda \propto \frac{T}{P}; \qquad C_{mean} \propto \sqrt{T}$$

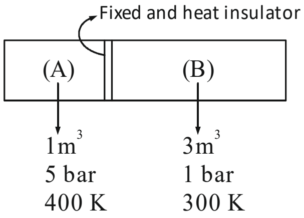
Diffusion co-efficient $\propto \frac{T}{P}\sqrt{T}$

Diffusion co-efficient $\propto \frac{T^{3/2}}{P}$

If T is increased four time and pressure is increased two times diffusion co-efficient should become 4 times.

76.(2.22)

After we changed the partition to movable and conducting, pressure and temperature on both sides will be equal.



Hence $\frac{n_A}{V_A} = \frac{n_B}{V_B}$ ....(A)

Let after sliding volume of chamber A = V

Then volume of chamber B = 4 – V

From initial conditions we can estimate n_A and n_B

$$n_A = \frac{P_A V_A}{RT_A} \qquad n_B = \frac{P_B V_B}{RT_B}$$

$$\frac{n_A}{n_B} = \frac{P_A}{P_B} \times \frac{V_A}{V_B} \times \frac{T_B}{T_A} = \frac{(5)}{(1)} \times \frac{(1)}{(3)} \times \frac{(300)}{(400)} = \frac{5}{4}$$

$$\frac{n_A}{n_B} = \frac{5}{4}$$

Using equation : $\frac{V_A}{V_B} = \frac{n_A}{n_B}$

$$\frac{V}{4-V} = \frac{5}{4} \Rightarrow V = \frac{20}{9} = 2.22\ m^3$$

77.(ABD) $\mu_{rms} = \sqrt{\frac{3RT}{M}} \Rightarrow \mu_{rms} \propto \frac{1}{\sqrt{M}}$

$\varepsilon_{av} = \frac{3}{2}kT \Rightarrow$ independent of molar mass

$\mu_{rms} \propto \sqrt{T}$

$\therefore$ μ_{rms} is doubled when temperature is increased four times