46.(123 g/ml)

Mass of liquid = $148 - 50 = 98$ g

$\Rightarrow$ Volume of liquid $= \dfrac{98}{0.98} = 100$ mL = volume of flask

Mass of gas = $50.5 - 50 = 0.50$ g

Now applying ideal gas equation : $pV = \left(\dfrac{w}{M}\right)RT$

$$\Rightarrow \quad M = \frac{wRT}{pV} = \frac{0.5 \times 0.082 \times 300}{1 \times 0.1} = 123 \text{ g mol}^{-1}$$

47.(A) A is the measure of intermolecular force of attraction. Greater the intermolecular force of attraction (H-bond in the present case) higher the value of a.

48.(6.46 atm L² mol⁻²)

The van der Waals' equation is $\left(p + \dfrac{n^2 a}{V^2}\right)(V - nb) = nRT$

$$\Rightarrow \quad a = \frac{V^2}{n^2}\left[\frac{nRT}{V - nb} - p\right] = \frac{(4)^2}{(2)^2}\left[\frac{2 \times 0.082 \times 300}{4 - 2(0.05)} - 11\right] = 6.46 \text{ atm L}^2 \text{ mol}^{-2}$$

49.(0.99 atm)

In case of negligible molecular volume, b = 0 and van der Waals' equation reduces to

$$\left(p + \frac{n^2 a}{V^2}\right)V = nRT \quad \Rightarrow \quad p = \frac{RT}{V} - \frac{a}{V^2} = \frac{0.082 \times 273}{22.4} - \frac{3.592}{(22.4)^2} = 0.99 \text{ atm}$$

50.(B) Compressibility factor (Z) = $\dfrac{V_{real}}{V_{ideal}} < 1$ (given)

$\Rightarrow \quad V = 22.4$ L $\quad \because \quad V_{id}$ (1 mol) = 22.4 L at STP

51.(C) $u_{rms} = \sqrt{\dfrac{3RT}{M}}$

$$\frac{u_{rms}(H_2)}{u_{rms}(N_2)} = \sqrt{7} = \sqrt{\frac{T_{(H_2)}}{2} \times \frac{28}{T_{(N_2)}}}$$

$$7 = \frac{14T_{(H_2)}}{T_{(N_2)}} \quad \Rightarrow \quad T_{(N_2)} = 2T_{(H_2)} \quad \Rightarrow \quad T_{(H_2)} < T_{(N_2)}$$

52.(D) Since constant volume is not given in statement I therefore it is false.

53.(D) $V_{rms} \propto \dfrac{1}{\sqrt{d}}$

54.(1.25 atm L² mol⁻²)

In case of negligible molecular volume, b = 0. For 1 mole of gas $\left(p + \dfrac{a}{V^2}\right)V = RT$

$$\Rightarrow \quad pV + \frac{a}{V} = RT \quad \Rightarrow \quad \frac{pV}{RT} + \frac{a}{VRT} = 1 \qquad \left[\because \frac{pV}{RT} = Z\right]$$

$$\Rightarrow \quad Z + \frac{a}{\left(\frac{ZRT}{p}\right)RT} = 1 \quad \Rightarrow \quad Z + \frac{a}{ZR^2T^2} = 1$$

$$\Rightarrow \quad a = \frac{ZR^2T^2(1-Z)}{p} = \frac{0.5(0.082 \times 273)^2(1-0.5)}{100}$$

$$a = 1.25 \text{ atm L}^2 \text{ mol}^{-2}$$

55.(ii) (2.07 × 10⁻² J)

(i) **(a)** 18 g mol^{-1} **(b)** 50 L mol^{-1} **(c)** 1.22 **(d)** Repulsive

(ii) 2.07×10^{-20} J

$$\frac{r_{gas}}{r_{O_2}} = 1.33 = \sqrt{\frac{32}{M_{gas}}}$$

(i) **(a)** $M_{gas} = 18 \text{ g mol}^{-1}$ **(b)** $V_m = \frac{18}{0.36} = 50 \text{ L mol}^{-1}$

(c) $Z = \frac{pV}{RT} = \frac{1 \times 50}{0.082 \times 500} = 1.22$ **(d)** $\because$ $Z > 1$, repulsive force is dominating.

(ii) $\overline{E}_k = \frac{3}{2}k_BT = \frac{3}{2} \times 1.38 \times 10^{-23} \times 1000 \text{ J} = 2.07 \times 10^{-20}$ J

56.(B) When the temperature is increased, surface tension of water decreases because cohesive forces decreases due to increased kinetic energy.

57.(C) PV = nRT $\Rightarrow \quad \frac{V}{T} = \frac{nR}{P} \Rightarrow \frac{V}{T} = \text{constant} \; \boxed{\frac{V_1}{T_1} = \frac{V_2}{T_2}}$

58.(434 ms)

$$\frac{u_{avg}}{u_{rms}} = \sqrt{\frac{8RT}{\pi M}} : \sqrt{\frac{3RT}{M}} = \sqrt{\frac{8}{3\pi}} \quad \Rightarrow \quad u_{rms} = \sqrt{\frac{3\pi}{8}}\, u_{avg} = \sqrt{\frac{3 \times 3.14}{8}} \times 400 = 434 \text{ ms}^{-1}$$

59.(A) Positive deviation corresponds to $Z > 1$ $\because$ $Z = \frac{pV}{nRT}$, for positive deviation, $\frac{pV}{nRT} > 1$

60.(434 ms)

$$V_{rms} = \sqrt{\frac{3RT}{M}} \qquad V_{avg} = \sqrt{\frac{8RT}{\pi M}}$$