

Homework.

u2b1 1

$$1.) \quad u_{rms} = \left(\frac{3RT}{M} \right)^{\frac{1}{2}}$$

$$\bar{u} = \left(\frac{8RT}{\pi M} \right)^{\frac{1}{2}}$$

$$u_{mp} = \left(\frac{2RT}{M} \right)^{\frac{1}{2}}$$

$$1.1) \quad u_{rms} = \left(\frac{3RT}{M} \right)^{\frac{1}{2}}$$

$$= \left[\frac{3 \times (8.314 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}) \times (373.15 \text{ K})}{(2 \text{ mol}) (28 \times 10^{-3} \text{ kg} \cdot \text{mol}^{-1})} \right]^{\frac{1}{2}}$$

$$= \left[\frac{3 \times 8.314 \times 373.15}{2 \times 28 \times 10^{-3}} \frac{\text{J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} \cdot \text{K}}{\text{kg} \cdot \text{mol}^{-1}} \right]^{\frac{1}{2}}$$

$$= (166198.34 \text{ m}^2 \cdot \text{s}^{-2})^{\frac{1}{2}}$$

$$= 407.67 \text{ m/s} \quad \underline{\underline{\text{Ans}}}$$

1.2)

$$\bar{u} = \left(\frac{8RT}{\pi M} \right)^{\frac{1}{2}}$$

$$\bar{u} = \left[\frac{8 \times (8.314 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}) (373.15 \text{ K})}{\pi \times (2 \text{ mol}) (28 \times 10^{-3} \text{ kg} \cdot \text{mol}^{-1})} \right]^{\frac{1}{2}}$$

$$= \left[\frac{8 \times 8.314 \times 373.15}{\pi \times 2 \times 28 \times 10^{-3}} \frac{\text{J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} \cdot \text{K}}{\text{kg} \cdot \text{mol}^{-1}} \right]^{\frac{1}{2}}$$

$$= \left[141073.54 \text{ m}^2 \cdot \text{s}^{-2} \right]^{\frac{1}{2}}$$

$$= 375.60 \text{ m/s} \quad \underline{\underline{\text{Ans}}}$$

1.3)

$$u_{mp} = \left(\frac{2RT}{M} \right)^{\frac{1}{2}}$$

$$u_{mp} = \left[\frac{2 (8.314 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}) (373.15 \text{ K})}{(2 \text{ mol}) (28 \times 10^{-3} \text{ kg} \cdot \text{mol}^{-1})} \right]^{\frac{1}{2}}$$

$$= \left[110798.90 \text{ m}^2 \cdot \text{s}^{-2} \right]^{\frac{1}{2}}$$

$$= 332.86 \text{ m/s} \quad \underline{\underline{\text{Ans}}}$$

1.4)

$$u_{mp} < \bar{u} < u_{rms}$$

$$332.86 < 375.60 < 407.67 \text{ m/s} \quad \underline{\underline{\text{Ans}}}$$

$$1 : 1.128 : 1.225$$

2.) Cl_2 10.0 g ; MW = 71.0 g/mol
 Volume = 2.00 dm³
 $T = 20 + 273.15 = 293.15 \text{ K}$

2.1) $PV = nRT$

$$P = \frac{nRT}{V}$$

$$P = \frac{\left(\frac{10.0 \text{ g}}{71.0 \text{ g}\cdot\text{mol}^{-1}}\right) \left(0.08206 \text{ L}\cdot\text{atm}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}\right) (293.15 \text{ K})}{2.00 \text{ dm}^3}$$

$$= \frac{\left(\frac{10.0}{71.0}\right) (0.08206) (293.15)}{(2.00)} \left(\frac{\text{mol}\cdot\text{L}\cdot\text{atm}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}\cdot\text{K}}{\text{dm}^3}\right)$$

$$= 1.694 \text{ atm} \quad \underline{\underline{\text{Ans}}}$$

$$2.2) \left[P + a \left(\frac{n}{V} \right)^2 \right] \cdot (V - nb) = nRT$$

$$P + a \left(\frac{n}{V} \right)^2 = \frac{nRT}{(V - nb)}$$

$$P = \frac{nRT}{(V - nb)} - a \left(\frac{n}{V} \right)^2$$

$$P = \left(\frac{10.0 \text{ g}}{71.0 \text{ g/mol}} \right) \left(0.08206 \text{ L} \cdot \text{atm} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} \right) (293.15 \text{ K})$$

$$\left(2.00 \text{ dm}^3 - \left(\frac{10.0 \text{ g}}{71.0 \text{ g/mol}} \right) \left(5.42 \times 10^{-2} \text{ L} \cdot \text{mol}^{-1} \right) \right)$$

$$- 6.343 \text{ atm} \cdot \text{L}^2 \cdot \text{mol}^{-2} \frac{\left(\frac{10.0 \text{ g}}{71.0 \text{ g/mol}} \right)^2}{(2.00 \text{ dm}^3)^2}$$

$$P = \frac{\left(\frac{10.0}{71.0} \right) (0.08206) (293.15)}{\left(2.00 - \frac{10.0}{71.0} \times 5.42 \times 10^{-2} \right)} \frac{\left(\frac{\text{g}}{\text{g/mol}} \right) (\text{L} \cdot \text{atm} \cdot \text{mol}^{-1}) (\text{K})}{\text{dm}^3 - \left(\frac{\text{g}}{\text{g/mol}} \right) \cdot \text{L} \cdot \text{mol}^{-1}}$$

$$- 6.343 \frac{\left(\frac{10.0}{71.0} \right)^2}{(2.00)^2} \frac{(\text{atm} \cdot \text{L}^2 \cdot \text{mol}^{-2}) \left(\frac{\text{g}}{\text{g} \cdot \text{mol}} \right)^2}{(\text{dm}^3)^2}$$

အမှတ် ၄.

$$P = \left(\frac{3.39}{1.99} \text{ atm} \right) - (0.0314 \text{ atm})$$

$$= 1.70 - 0.0314 \text{ atm}$$

$$= \underline{\underline{1.669 \text{ atm}}} \quad \underline{\underline{\text{Ans}}}$$

၇၂ ပုံစံတို့ကို အကန့်အသတ် နှစ် ၂.၁ နှင့် ၂.၂ နှစ်အတွက်ပါ။

ဒီပုံစံတို့ကို အကန့်အသတ် နှစ် Cl_2 ကို အကန့်အသတ် ideal gas

သို့ real gas

2025 b.

3)

$$M_2 = 28 \times 10^{-3} \text{ kg.mol}^{-1}$$

$$T = 27^\circ \text{C} = 273.15 + 27 = 300.15 \text{ K}$$

$$d = 3.70 \text{ \AA} = 3.70 \times 10^{-10} \text{ m}$$

$$P = 1.00 \text{ atm}$$

Soln

$$N = \frac{N_{\text{tot}}}{V}$$

$$= \frac{P \cdot N_0}{RT}$$

$$N = \frac{(1.00 \text{ atm}) (6.02 \times 10^{23} \text{ molecule.mol}^{-1}) (10^3 \text{ l.m}^{-3})}{(0.08206 \text{ l.atm.mol}^{-1}\text{K}^{-1}) (300.15 \text{ K})}$$

$$= \frac{(1.00) (6.02 \times 10^{23}) 10^3}{(0.08206) (300.15)} \frac{\text{atm. molecule.mol}^{-1} \cdot \text{l.m}^{-3}}{\text{l.atm.mol}^{-1}\text{K}^{-1} \cdot \text{K}}$$

$$= 2.44 \times 10^{25} \text{ molecule.m}^{-3} \quad \underline{\text{Ans}}$$

2057

$$\bar{c} = \left(\frac{8RT}{\pi M} \right)^{\frac{1}{2}}$$

$$\bar{c} = \left[\frac{8 \cdot (8.314 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}) (300.15 \text{ K})}{\pi (28 \times 10^{-3} \text{ kg} \cdot \text{mol}^{-1})} \right]^{\frac{1}{2}}$$

$$= \left(\frac{8 \times 8.314 \times 300.15}{\pi \times 28 \times 10^{-3}} \right)^{\frac{1}{2}} \left(\frac{\text{J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} \cdot \text{K}}{\text{kg} \cdot \text{mol}^{-1}} \right)^{\frac{1}{2}}$$

$$= (226950.14)^{\frac{1}{2}} \left(\frac{\text{m}^2}{\text{s}^2} \right)^{\frac{1}{2}}$$

$$= 476.39 \text{ m/s} \quad \underline{\underline{\text{Ans}}}$$

$$3.1) \quad z_1 = \sqrt{2} \pi \cdot d^2 \cdot \bar{c} \cdot N$$

$$z_1 = \sqrt{2} \cdot \pi (3.70 \times 10^{-10} \text{ m})^2 \cdot (476.39 \cdot \text{m/s}) (2.44 \times 10^{25} \text{ molecule} \cdot \text{m}^{-3})$$

$$= \sqrt{2} \cdot \pi (3.70 \times 10^{-10})^2 (476.39) (2.44 \times 10^{25}) \frac{\text{m}^2 \cdot \text{m}}{\text{s}} \frac{\text{molecule}}{\text{m}^3}$$

$$= 7.07 \times 10^9 \quad \text{molecule} \cdot \text{s}^{-1} \quad \underline{\underline{\text{Ans}}}$$

$$3.2) \quad z_{11} = \frac{\sqrt{2}}{2} \cdot \pi d^2 \cdot \bar{c} \cdot N^2$$

$$z_{11} = \frac{\sqrt{2}}{2} \cdot \pi (3.70 \times 10^{-10} \text{ m})^2 \cdot (476.39 \frac{\text{m}}{\text{s}}) (2.44 \times 10^{25} \frac{\text{molecule}}{\text{m}^3})^2$$

$$= \frac{\sqrt{2}}{2} \cdot \pi (3.70 \times 10^{-10})^2 (476.39) (2.44 \times 10^{25})^2 \frac{\text{m}^2 \cdot \text{m}}{\text{s}} \left(\frac{\text{molecule}}{\text{m}^3} \right)^2$$

$$= 8.62 \times 10^{34} \quad \text{molecule} \cdot \text{m}^{-3} \cdot \text{s}^{-1} \quad \underline{\underline{\text{Ans}}}$$

3.3) 0.26 mole ของแก๊สในภาชนะปิดที่อุณหภูมิ

$$= 8.62 \times 10^{34} \text{ molecule} \cdot \text{m}^{-3} \cdot \text{s}^{-1}$$

$$= \frac{8.62 \times 10^{34}}{6.02 \times 10^{23}} \frac{\text{molecule} \cdot \text{m}^{-3} \cdot \text{s}^{-1}}{\text{molecule} \cdot \text{mol}^{-1}}$$

$$= \frac{8.62 \times 10^{34} \times 10^{-3}}{6.02 \times 10^{23}} \frac{\text{molecule} \cdot \text{m}^{-3} \cdot \text{s}^{-1}}{\text{molecule} \cdot \text{mol}^{-1}} \cdot (\text{l}^{-1} \cdot \text{m}^3)$$

$$= 1.43 \times 10^8 \text{ mol} \cdot \text{l}^{-1} \cdot \text{s}^{-1} \quad \underline{\underline{\text{Ans}}}$$

3.4)

$$\lambda = \frac{1}{\sqrt{2} \cdot \pi N \cdot d^2}$$

$$= \frac{1}{\sqrt{2} \cdot \pi (2.44 \times 10^{25} \text{ molecule m}^{-3}) (3.70 \times 10^{-10} \text{ m})^2}$$

$$= 6.74 \times 10^{-8} \text{ m} \quad \underline{\underline{\text{Ans}}}$$

$$1 \text{ l} = 1000 \text{ cm}^3 = 10^3 \text{ cm}^3$$

$$1 \text{ m} = 10 \text{ dm} \quad 1 \text{ m}^3 = 10^3 \text{ dm}^3$$

$$1 \text{ m} = 100 \text{ cm} \quad 1 \text{ m}^3 = 10^6 \text{ cm}^3$$

$$10^6 \text{ cm}^3 = 10^3 \text{ dm}^3$$

$$1 \text{ l} = 10^3 \text{ cm}^3 = \frac{10^3 \times 10^3}{10^6} = 1 \text{ dm}^3$$

$$10^6 \text{ cm}^3 = 1 \text{ m}^3$$

$$1 \text{ l} = 10^3 \text{ cm}^3 = \frac{1 \times 10^3}{10^6} = 10^{-3} \text{ m}^3$$

$$1 \text{ l} = 10^{-3} \text{ m}^3$$