

Chapter 9 Problems

9.38, 39, 40, 48, 50, 51, 59, 64, 70, 79, 86, 90, 122

9.38 -

$$P = 480 \text{ mmHg} \times \frac{1.00 \text{ atm}}{760 \text{ mmHg}} = 0.632 \text{ atm}$$

$$P = 480 \text{ mmHg} \times \frac{101.325 \text{ kPa}}{760 \text{ mmHg}} = 6.40 \times 10^4 \text{ Pa} \text{ or } 64 \text{ kPa}$$

9.39 -

$$P = 352 \text{ torr} \times \frac{101.325 \text{ kPa}}{760 \text{ torr}} = 46.9 \text{ kPa}$$

$$P = 0.255 \text{ atm} \times \frac{760 \text{ mmHg}}{1 \text{ atm}} = 194 \text{ mmHg}$$

$$P = 0.0382 \text{ mmHg} \times \frac{101.325 \text{ kPa}}{760 \text{ mmHg}} = 5.09 \times 10^{-3} \text{ kPa}$$

9.40 -

$$P_{\text{flask}} = 754.3 \text{ mmHg}$$

$$P_{\text{flask}} = 754.3 \text{ mmHg} + 176 \text{ mmHg} = 930 \text{ mmHg}$$

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9.48 - They all contain the same number of gas molecules.

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9.50 -  $n$  &  $T$  are constant;  $nRT = P_1 V_1 = P_2 V_2$

$$V_2 = \frac{P_1 V_1}{P_2} = \frac{150 \text{ atm} \cdot 49.0 \text{ L}}{1.02 \text{ atm}} = 7210 \text{ L}$$

$n$  &  $P$  are constant; therefore  $\frac{nR}{P} = \frac{V_1}{T_1} = \frac{V_2}{T_2}$

$$V_2 = \frac{V_1 T_2}{T_1} = \frac{49.0 \text{ L} \cdot 308 \text{ K}}{293 \text{ K}} = 51.5 \text{ L}$$

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9.51  $T_1 = 20^\circ \text{C} = 293 \text{ K}$   $nR = \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{140 \text{ atm} \cdot 8.0 \text{ L} \cdot 273 \text{ K}}{293 \text{ K} \cdot 1.0 \text{ atm}} = 1.0 \times 10^3 \text{ L}$$

(3)

9.59 -

$$T = 85^{\circ}\text{C} \approx 358\text{K}$$

$$n_{\text{Ar}} = \frac{PV}{RT} = \frac{(1111\text{ mmHg} \times \frac{1.0\text{ atm}}{760\text{ mmHg}})(3.14\text{ L})}{(0.0821\text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K})(358\text{ K})} = \underline{0.156\text{ mol Ar}}$$

+ for  $\text{Cl}_2$  ( $70.91\text{ g mol}^{-1}$ )

$$n_{\text{Cl}_2} = 11.07\text{ g Cl}_2 \times \frac{1\text{ mol Cl}_2}{70.91\text{ g Cl}_2} = \underline{0.156\text{ mol Cl}_2}$$

The number of moles of gases are equal.

9.64

(a)  $\text{CH}_4$ , 16.04 amu

$$d = \frac{16.04\text{ g}}{22.4\text{ L}} = 0.716\text{ g/L}$$

(b)  $\text{CO}_2$ , 44.01 amu

$$d = \frac{44.01\text{ g}}{22.4\text{ L}} = 1.96\text{ g/L}$$

(c)  $\text{O}_2$ , 32.00 amu

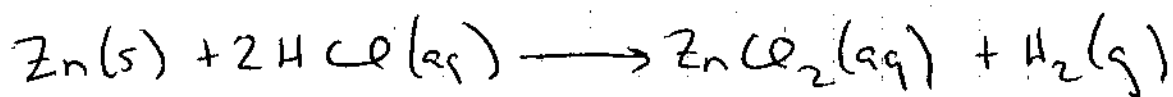
$$d = \frac{32.00\text{ g}}{22.4\text{ L}} = 1.43\text{ g/L}$$

(d)  $\text{UF}_6$ , 352.0 amu

$$d = \frac{352\text{ g}}{22.4\text{ L}} = 15.7\text{ g/L}$$

9.70-

(4)



$$\text{a) } 25.5\text{g Zn} \times \frac{1\text{mol Zn}}{65.39\text{g Zn}} \times \frac{1\text{mol H}_2}{1\text{mol Zn}} = 0.390\text{mol H}_2$$

$$V = \frac{nRT}{P} = \frac{(0.390\text{mol H}_2) \left(0.0821 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}\right) (288\text{K})}{\left(742\text{mmHg} \times \frac{1\text{atm}}{760\text{mmHg}}\right)} = \underline{9.44\text{L}}$$

$$\text{(b) } n = \frac{PV}{RT} = \frac{(0.461\text{atm}) \left(\overset{\uparrow}{350\text{mmHg}}\right) (5.0\text{L})}{\left(0.0821 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}\right) (303.15\text{K})} = 0.09256\text{mol H}_2$$

0.093mol H<sub>2</sub>

$$0.09256\text{mol H}_2 \times \frac{1\text{mol Zn}}{1\text{mol H}_2} \times \frac{65.39\text{g Zn}}{1\text{mol Zn}} = 6.05\text{g Zn}$$

9.79 -

5)

Let's Assume 1.0L sample of gas.

$$n = \frac{PV}{RT} = \frac{(1.0 \text{ atm})(1.0 \text{ L})}{\left(\frac{0.0821 \text{ L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}\right)(273.15 \text{ K})} = \frac{0.04461}{\text{mol}}$$

$$\text{The avg. molar mass} = \frac{1.413 \text{ g}}{0.04461 \text{ mol}} = 31.67 \text{ g/mol}$$

$$31.67 = x \cdot M_{\text{Ar}} + (1-x) \cdot M_{\text{N}_2}$$

$$31.67 = x(39.948) + (1-x)(28.013)$$

$$x = 0.3064, \quad 1-x = 0.6939$$

∴ The mixture is 30.64% Ar + 69.39% N<sub>2</sub>

if we assume 100 mol of gas total

$$X_{\text{Ar}} = \frac{30.64 \text{ mol}}{100 \text{ mol}} = 0.3064$$

$$X_{\text{N}_2} = \frac{69.36 \text{ mol}}{100 \text{ mol}} = 0.6939$$

9.84-

Heat is the energy transferred from one thing to another as the result of temperature differences between them.

Temperature is the measure of the kinetic energy of molecular motion

9.88-

$$\text{for } H_2, u = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3 \cdot (8.314 \text{ J mol}^{-1} \text{ K}^{-1}) (150 \text{ K})}{2.02 \times 10^{-3} \text{ kg/mol}}}$$

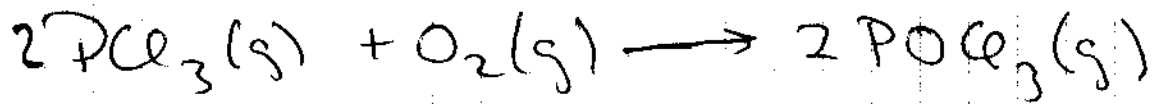
$$= 1360 \text{ m/s}$$

$$\text{for He, } u = \sqrt{\frac{3 \cdot (8.314 \text{ J mol}^{-1} \text{ K}^{-1}) (648 \text{ K})}{4.0 \times 10^{-3} \text{ kg/mol}}} = 2010 \text{ m/s}$$

He @ 375°C has the higher average speed.

9.112-

(7)



$$\text{mol PCl}_3 = 25.0\text{g} \times \frac{1\text{mol PCl}_3}{137.3\text{g PCl}_3} = \frac{0.182\text{mol PCl}_3}{2} =$$

$$\text{mol O}_2 = 3.00\text{g} \times \frac{1\text{mol O}_2}{32.0\text{g O}_2} = 0.0937\text{mol O}_2$$

The  $\text{PCl}_3$  is limiting } therefore  $0.182\text{mol PCl}_3$   
 $\downarrow$   
 $0.182\text{mol POCl}_3$   
 mol  $\text{O}_2$  left =

$$0.0937\text{mol} - 0.0910\text{mol O}_2 \text{ used} = 0.0027\text{mol O}_2 \text{ left over.}$$

$$P = \frac{nRT}{V} = \frac{(0.182\text{mol} + 0.0027\text{mol})(0.0821 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(473\text{K})}{5\text{L}}$$

$$= \underline{1.43\text{atm}}$$

9.86.

Heat is the energy transferred from one thing to another as the result of temperature differences between them.

Temperature is the measure of the kinetic energy of molecular motion.

9.90 —

$$\text{for } H_2, u = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3 \cdot (8.314 \text{ J mol}^{-1} \text{ K}^{-1}) (150 \text{ K})}{2.02 \times 10^{-3} \text{ kg/mol}}}$$

$$= 1360 \text{ m/s}$$

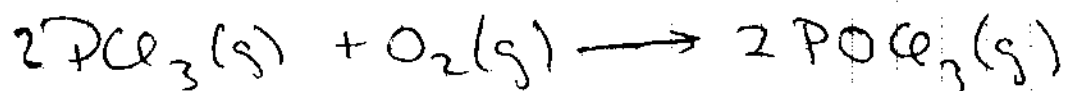
$$\text{for He, } u = \sqrt{\frac{3 \cdot (8.314 \text{ J mol}^{-1} \text{ K}^{-1}) (648 \text{ K})}{4.0 \times 10^{-3} \text{ kg/mol}}} = 2010 \text{ m/s}$$

He @ 375°C has the higher average speed.



9.122

(7)



$$\text{mol PCl}_3 = 25.0\text{g} \times \frac{1\text{mol PCl}_3}{137.3\text{g PCl}_3} = \frac{0.182\text{mol PCl}_3}{2}$$

$$\text{mol O}_2 = 3.00\text{g} \times \frac{1\text{mol O}_2}{32.0\text{g O}_2} = 0.0937\text{mol O}_2$$

The  $\text{PCl}_3$  is limiting } therefore  $0.182\text{mol PCl}_3$   
 $\downarrow$   
 $0.182\text{mol POCl}_3$

mol  $\text{O}_2$  left =

$$0.0937\text{mol} - 0.0910\text{mol O}_2 \text{ used} = 0.0027\text{mol O}_2 \text{ left over.}$$

$$P = \frac{nRT}{V} = \frac{(0.182\text{mol} + 0.0027\text{mol})(0.0821 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(473\text{K})}{5\text{L}}$$

$$= 1.43\text{atm.}$$