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 –

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

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

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

9.40 –

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

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

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

9.50 – n & T are constant; $nRT = P_1V_1 = P_2V_2$

$$V_2 = \frac{P_1V_1}{P_2} = \frac{150 \text{ atm} \cdot 49.0 \text{ L}}{1.02 \text{ atm}} = 7210 \text{ L}$$

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

$$V_2 = \frac{V_1T_2}{T_1} = \frac{49.0 \text{ L} \cdot 308 \text{ K}}{293 \text{ K}} = 51.5 \text{ L}$$

9.51 $T_1 = 20°\text{C} = 293 \text{ K}$ $nR = \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$$V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{140 \text{ atm} \cdot 8.0 \text{ L} \cdot 273 \text{ K}}{293 \text{ K} \cdot 1.0 \text{ atm}} = 1.0 \times 10^3 \text{ L}$$

9.59 –

$T = 85^\circ C$ or $358 K$

$$n_{Ar} = \frac{PV}{RT} = \frac{\left(1111\,\text{mmHg} \times \frac{1.0\,\text{atm}}{760\,\text{mmHg}}\right)(3.14\,L)}{(0.0821\,L.\text{atm}/\text{mol}K)(358K)} =$$

$\underline{0.156\,\text{mol Ar}}$

& for Cl_2 $(70.91\,g\,\text{mol}^{-1})$

$$n_{Cl_2} = 11.07\,g\,Cl_2 \times \frac{1\,\text{mol}\,Cl_2}{70.91\,g\,Cl_2} = \underline{0.156\,\text{mol}\,Cl_2}$$

The number of moles of gases are equal.

9.64

(a) CH_4, 16.04 amu $\quad d = \frac{16.04\,g}{22.4\,L} = 0.716\,g/L$

(b) CO_2, 44.01 amu $\quad d = \frac{44.01\,g}{22.4\,L} = 1.96\,g/L$

(c) O_2, 32.00 amu $\quad d = \frac{32.00\,g}{22.4\,L} = 1.43\,g/L$

(d) UF_6, 352.0 amu $\quad d = 352\,g/22.4\,L = 15.7\,g/L$

9.70 –

$$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$$

a) $25.5\,g\,Zn \times \frac{1\,mol\,Zn}{65.39\,g\,Zn} \times \frac{1\,mol\,H_2}{1\,mol\,Zn} = 0.390\,mol\,H_2$

$$V = \frac{nRT}{P} = \frac{(0.390\,mol\,H_2)\left(0.0821\,\frac{L\text{-}atm}{mol\,K}\right)(288\,K)}{\left(742\,mmHg \times 1\,atm / 760\,mmHg\right)} = \underline{9.44\,L}$$

(b) $$n = \frac{PV}{RT} = \frac{\left(\overset{0.461\,atm}{\uparrow}\cancel{350\,mmHg}\right)(5.0\,L)}{\left(0.0821\,\frac{L\text{-}atm}{mol\,K}\right)(303.15\,K)} = 0.09256\,mol\,H_2 \quad \underline{0.093\,mol\,H_2}$$

$0.09256\,mol\,H_2 \times \frac{1\,mol\,Zn}{1\,mol\,H_2} \times \frac{65.39\,g\,Zn}{1\,mol\,Zn} = 6.05\,g\,Z$

9.79 –

Let's Assume 1.0L sample of gas.

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

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

$$31.67 = x \cdot M_{Ar} + (1-x) \cdot M_{N_2}$$

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

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

∴ The mixture is 30.69% Ar + 69.39% N_2

if we assume 100mol of gas total

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

$$\chi_{N_2} = \frac{69.36\text{mol}}{100\text{mol}} = 0.6939$$

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-

for H_2, $u = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3\cdot(8.314\ \text{J mol}^{-1}\text{K}^{-1})(150\text{K})}{2.02\times10^{-3}\ \text{kg/mol}}}$

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

for He, $u = \sqrt{\frac{3\cdot(8.314\ \text{J mol}^{-1}\text{K}^{-1})(648\text{K})}{4.0\times10^{-3}\ \text{kg/mol}}} =$

$2010\ \text{m/s}$

He @ 375°C has the higher average speed.

9.112 —

$2PCl_3(g) + O_2(g) \longrightarrow 2POCl_3(g)$

$$\text{mol } PCl_3 = 25.0g \times \frac{1 \text{mol } PCl_3}{137.3g\, PCl_3} = \frac{0.182 \text{ mol } PCl_3}{2} =$$

$$\text{mol } O_2 = 3.00g \times \frac{1 \text{mol } O_2}{32.0g\, O_2} = 0.0937 \text{ mol } O_2$$

The PCl_3 is limiting } Therefore $0.182 \text{ mol } PCl_3 \downarrow 0.182 \text{ mol } POCl_3$

mol O_2 left =

0.0937 mol − 0.0910 mol O_2 used = 0.0027 mol O_2 left over.

$$P = \frac{nRT}{V} = \frac{(0.182\text{mol})(0.0027\text{mol})(0.0821 \frac{L\cdot atm}{mol\, K})(473.1}{5L}$$

= 1.43 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 —

for H_2, $u = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3\cdot(8.314\,J\,mol^{-1}K^{-1})(150K)}{2.02\times10^{-3}\,kg/mol}}$

$= 1360\ m/s$

for He, $u = \sqrt{\frac{3\cdot(8.314\,J\,mol^{-1}K^{-1})(648K)}{4.0\times10^{-3}\,kg/mol}} =$

2010 m/s

He @ 375°C has the higher average speed.

9.122 (7)

$$2PCl_3(g) + O_2(g) \longrightarrow 2POCl_3(g)$$

$$\text{mol } PCl_3 = 25.0\text{g} \times \frac{1 \text{ mol } PCl_3}{137.3\text{g } PCl_3} = \frac{0.182 \text{ mol } PCl_3}{2} =$$

$$\text{mol } O_2 = 3.00\text{g} \times \frac{1 \text{ mol } O_2}{32.0\text{g } O_2} = 0.0937 \text{ mol } O_2$$

The PCl_3 is limiting; therefore $\underset{0.182 \text{ mol } POCl_3}{\overset{0.182 \text{ mol } PCl_3}{\downarrow}}$

mol O_2 left =

0.0937 mol − 0.0910 mol O_2 used = 0.0027 mol O_2 left over.

$$P = \frac{nRT}{V} = \frac{(0.182 \text{ mol})(0.0027 \text{ mol})(0.0821 \frac{\text{L atm}}{\text{mol K}})(473.1}{5 \text{ L}}$$

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