Answers to Chapter 13 Study Questions

1. $P_1 = 722 \text{ mmHg} \times \frac{1\ atm}{760\ mmHg} = 0.950 \text{ atm}$; $T_1 = 22 + 273 = 295 \text{ K}$; $P_2 = 1.07 \text{ atm}$; $T_2 = ?$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}; \quad T_2 = T_1 \times \frac{P_2}{P_1} = 295 \text{ K} \times \frac{1.07\ atm}{0.950\ atm} = 332 \text{ K or } 59°C$$

2. a) STP: $P_T = 1 \text{ atm}$; $T = 273 \text{ K}$; $P_{O_2} = \left(\frac{n_{O_2}}{n_T}\right) P_T$; $n_T = 0.039 + 0.010 + 0.001 = 0.050 \text{ moles}$

$$P_{O_2} = \left(\frac{n_{O_2}}{n_T}\right) P_T; \quad P_{O_2} = \left(\frac{0.010}{0.050}\right)(1.00 \text{ atm}) = 0.20 \text{ atm}$$

b) V = ?; STP: $T = 273 \text{ K}$, $P_T = 1 \text{ atm}$; $n_T = 0.050 \text{ mol}$; $PV = nRT$

$$V = \frac{nRT}{P} = \frac{(0.050\ mol)(0.08206)(273\ K)}{1\ atm} = 1.1 \text{ L}$$

3. a) $P_T = P_{H_2} + P_{H_2O}$; Find P_{H_2O} in Table from lab report; at 19°C, $P_{H_2O} = 16 \text{ mmHg}$

$$P_{H_2} = P_T - P_{H_2O} = 756 - 16 = 740. \text{ mmHg}$$

b) $740 \text{ mmHg} \times \frac{1\ atm}{760\ mmHg} = 0.974 \text{ atm}$

4. $V_1 = 600. \text{ cm}^3$; $T_1 = 25°C = 298 \text{ K}$; $P_1 = 750. \text{ mmHg}$
$V_2 = 480. \text{ cm}^3$; $T_2 = 41°C = 314 \text{ K}$; $P_2 = ?$

$$P_2 = P_1 \times \frac{V_1}{V_2} \times \frac{T_2}{T_1} = 750\ mmHg \times \frac{600\ cm^3}{480\ cm^3} \times \frac{314\ K}{298\ K} = 988 \text{ mmHg}$$

5. $\text{density} = \frac{molar\ mass}{molar\ volume} = \frac{4.00\ g}{22.4\ L} = 0.178 \text{ g/L}$

6. a) $2\ C_4H_{10}(g) + 13\ O_2(g) \rightarrow 10\ H_2O(l) + 8\ CO_2(g)$

b) $2.0 \text{ L } CO_2 \times \frac{13\ L\ O_2}{8\ L\ CO_2} = 3.2 \text{ L } O_2$

c) $11.6 \text{ g } C_4H_{10} \times \frac{1\ mol\ C_4H_{10}}{58.0\ g\ C_4H_{10}} \times \frac{8\ mol\ CO_2}{2\ mol\ C_4H_{10}} \times \frac{22.4\ L\ CO_2}{1\ mol\ CO_2} = 17.9 \text{ L } CO_2$

d) 5.6 L $C_4H_{10} \times \frac{1\ mol\ C_4H_{10}}{22.4\ L} \times \frac{10\ mol\ H_2O}{2\ mol\ C_4H_{10}} \times \frac{6.02 \times 10^{23}\ molecules}{1\ mol\ H_2O}$ = 7.5 x 10^{23} molecules

7. $n_{Ar} = 0.25$ mol; $n_{He} = 0.75$ mol; $n_T = n_{Ar} + n_{He} = 0.25 + 0.75 = 1.00$ mol

$P_{He} = 0.60$ atm; $P_T = ?$; $\frac{P_{He}}{P_T} = \frac{n_{He}}{n_T}$; $P_T = P_{He} \times \frac{n_T}{n_{He}} = 0.60\ atm \times \frac{1.00\ mol}{0.75\ mol} = 0.80$ atm

8. $d = \frac{mm}{mV}$; $mV = \frac{nRT}{P} = \frac{(1\ mol)(0.08206)(546\ K)}{4.00\ atm} = 11.2\ L$; $d = \frac{44.0\ g}{11.2\ L} = 3.93$ g/L

9. methane = CH_4. To find grams, use $PV = nRT$ to calculate n. molar mass (CH_4) = 16.0 g/mol

$n = ?$; $V = 28.0$ L; $T = 68 + 273 = 341$ K; $P = 2.00$ atm.

$n = \frac{PV}{RT} = \frac{(2\ atm)(28.0\ L)}{(0.08206)(341\ K)} = 2.00$ mol; 2.00 mol $\times \frac{16.0\ g\ CH_4}{1\ mol\ CH_4} = 32.0$ g

10. Find molar volume at 710 mmHg and 36°C and then use conversion factors:

$T = 36 + 273 = 309$ K; $P = 710$ mmHg $\times \frac{1\ atm}{760\ mmHg} = 0.934$ atm

$V = \frac{nRT}{P} = \frac{(1\ mol)(0.08206)(309\ K)}{0.934\ atm} = 27.2$ L

6.52 g Cu S $\times \frac{1\ mol\ CuS}{95.6\ g\ CuS} \times \frac{2\ mol\ O_2}{1\ mol\ CuS} \times \frac{27.2\ L\ O_2}{1\ mol\ O_2} = 3.71$ L O_2

11. molar mass = $\frac{mass}{moles}$; so use $PV = nRT$ to calculate n; $T = 29 + 273 = 302$ K; $P = 1$ atm

$n = \frac{PV}{RT} = \frac{(1\ atm)(6.20\ L)}{(0.08206)(302\ K)} = 0.250$ moles; molar mass $= \frac{7.00\ g}{0.250\ mol} = 28.0$ g/mole

12. 15.0 g $CO_2 \times \frac{1\ mol\ CO_2}{44.0\ g\ CO_2} = 0.341$ mol CO_2; 12.0 g $CH_4 \times \frac{1\ mol\ CH_4}{16.0\ g\ CH_4} = 0.750$ mole CH_4;

At constant T and P, $\frac{V_1}{n_1} = \frac{V_2}{n_2}$; $V_2 = V_1 \times \frac{n_2}{n_1} = 7.16\ L \times \frac{0.750\ mol}{0.341\ mol} = 15.7$ L