Honors Chemistry

Answers to Chapter 5 Study Questions

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

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

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

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

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

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

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

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

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

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

5. 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) $5.6 \text{ L } C_4H_{10} \times \frac{1\ mol\ C_4H_{10}}{22.4\ L} \times \frac{10\ mol\ H_2O}{2\ mol\ C_4H_{10}} \times \frac{6.02 \times 10^{23}\ molecules}{1\ mol\ H_2O} = 7.5 \text{ x } 10^{23} \text{ molecules}$

6. $n = 1$ mole; $T = 68°C = 341$ K; $P = 2.00$ atm; $V = ?$

$$V = \frac{nRT}{P} = \frac{(1\ mol)(0.08206)(341\ K)}{2.00\ atm} = 14.0 \text{ L}$$

7. 8.00 g CH_4 $\times \frac{1\,mol\ CH_4}{16.0\ g\ CH_4} \times \frac{22.4\ L}{1\,mol}$ = 11.2 L

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. 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

$V = \frac{nRT}{P} = \frac{(1\,mol)(0.08206)(309\ K)}{0.934\ atm}$ = 27.1 L

6.52 g Cu S $\times \frac{1\,mol\ CuS}{95.6\ g\ CuS} \times \frac{2\,mol\ O_2}{1\,mol\ CuS} \times \frac{27.1\ L\ O_2}{1\,mol\ O_2}$ = 3.70 L O_2

10. 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

11. 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

12. $P_{H_2} = P_T - P_{H_2O}$; At 22°C, P_{H_2O} = 20 mm Hg; P_{H_2} = 750 mmHg - 20 mmHg = 730 mmHg

P_{H_2} = 730 mmHg $\times \frac{1\ atm}{760\ mmHg}$ = 0.960 atm; T = 22 + 273 = 295 K;

7.78 g Zn $\times \frac{1\,mol\ Zn}{65.4\ g\ Zn} \times \frac{1\,mol\ H_2}{1\,mol\ Zn}$ = 0.119 mol H_2 = n

$V = \frac{nRT}{P} = \frac{(0.119\ mol)(0.08206)(295\ K)}{0.960\ atm}$ = 3.00 L