Gas Stoichiometry - Practice Test

1. $CaCO_3 \rightarrow CO_2 + CaO$ (500L)

$PV = nRT$

$n = \frac{PV}{RT} = \frac{(750\,mmHg)(5.00\,L)}{(0.0821\,L\cdot atm)(298K)} \frac{mol\,K}{(760\,mmHg)(1\,atm)}$

$n = 15.1\ mol\ CO_2$

2. $15.1\ mol\ CO_2 \left| \frac{1\ mol\ CaO}{1\ mol\ CO_2} \right| \frac{(40.1+16)\,g}{1\ mol} = 847.11\ g\ CaO$

3. $F_2 = \frac{(19.0)^2\,g}{mol} = \frac{38\,g}{mol}$

$\frac{38\,g}{mol} \left| \frac{1\ mol}{22.4\,L} \right. = 1.696\ \frac{g}{L}$

4. $PV = xRT = \frac{mRT}{M}$ $\qquad m = \frac{PVM}{RT} = \frac{(670\,mmHg)(4\,L)(32\,g)}{mol\,K\,(0.0821\,L\cdot atm)(300K)\,760\,mmHg}$

$m = 4.58\ g\ O_2$

5. $2\,Al + 3H_2SO_4 \rightarrow 3\,H_2 + Al_2(SO_4)_3$ $\qquad PV = nRT$, $V = \frac{nRT}{P}$

(5g)

$V = \underbrace{\frac{5\,g\,Al}{27\,g} \left| \frac{mol}{2\ mol\ Al} \right. \frac{3\ mol\ H_2}{}}_{mol\ H_2\ (g)} \frac{(0.0821\,L\cdot atm)(293K)}{mol\,K} \frac{760\,mmHg}{745\,mmHg \cdot 1\,atm}$

$V = 6.64\ L\ H_2$

6. $Mg_{(s)} + 2HCl_{(g)} \rightarrow MgCl_2 + H_{2(g)}$

$PV = nRT$ $\qquad n = \frac{PV}{RT} = \frac{(3\,atm)(0.4\,L)\,mol\,K}{(0.0821\,L\cdot atm)\,293K} = 0.0499\ mol\ H_2$

$0.0499\ mol\ H_2 \left| \frac{1\ mol\ Mg}{1\ mol\ H_2} \right. = 0.0499\ mol\ Mg$

7. $2\,KClO_3 \rightarrow 2KCl + 3O_2$ $\qquad PV = nRT$ $\qquad V = \frac{nRT}{P}$

$\underbrace{\frac{1.5\,g\,KClO_3}{122.6\,g} \left| \frac{1\ mol}{2\ mol\ KClO_3} \right. \frac{3\ mol\ O_2}{}}_{mol\ O_2} \frac{(0.0821\,L\cdot atm)(296K)}{mol\,K} \frac{760\,mmHg}{(745-21.1)\,mmHg\ (1\,atm)} = 0.468\,L\,O_2$

8. $P_1V_1T_2 = P_2V_2T_1$

$$V_2 = \frac{P_1V_1T_2}{P_2T_1} = \frac{(745-21.1)\text{mmHg}(0.40\text{L})(273\text{K})\ 1\text{atm}}{(1\text{atm})(296\text{K})(760\text{mmHg})} = \underline{\underline{0.351\text{L } O_2 \text{ @ STP}}}$$

9. $O_2 + 2CO \rightarrow 2CO_2$

$$\frac{1.5\text{L CO} \,/\, 1\text{L } O_2}{2\text{L CO}} = \underline{\underline{0.75\text{L } O_2}}$$

10. $$\frac{\text{rate of Kr(g)}}{\text{rate of Ne(g)}} = \frac{\sqrt{M_{Ne}}}{\sqrt{M_{Kr}}} = \frac{\sqrt{20.2}}{\sqrt{83.8}} = 0.49$$

Kr is 0.49 Ne ∴ effusion time for Ne is $(0.49)(87.3\text{ sec}) = \underline{\underline{42.9\text{ sec}}}$

11. $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

mol H_2: $n = \frac{PV}{RT} = \frac{(750\text{mm Hg})(20.1\text{L})}{(0.0821\text{L·atm})(273)(760\text{mmHg})}\frac{\text{mol·K}}{1\text{atm}} = 0.885\text{ mol } H_2$

mol O_2: $n = \frac{PV}{RT} = \frac{(720\text{mm Hg})(11.2\text{L})}{(0.0821\text{L·atm})(300\text{K})760\text{mm Hg}}\frac{\text{mol·K}}{1\text{atm}} = 0.431\text{ mol } O_2$

need 0.862 mol H_2 to use all H_2 ∴ O_2 is limiting reactant

$$\frac{0.431\text{ mol } O_2 \,/\, 2\text{ mol } H_2O}{1\text{ mol } O_2} = \underline{\underline{0.862\text{ mol } H_2O}} \quad \text{or} \quad \frac{(0.862\text{mol})(18.0\text{g})}{\text{mol}} = \underline{\underline{15.5\text{g } H_2O}}$$

12. $$\frac{1.0\text{g } H_2 \,/\, 1\text{mol}}{2.016\text{g}} = 0.496\text{ mol } H_2 \qquad \frac{5\text{g He} \,/\, 1\text{mol}}{4\text{g}} = 1.25\text{ mol He}$$

$PV = nRT \qquad P = \frac{nRT}{V} = \frac{(0.496 + 1.25)\text{mol}\,(0.0821\text{L·atm})(293\text{K})}{\text{mol·K}\quad 5.0\text{K}} = \underline{\underline{8.4\text{ atm}}}$

E.C. $4C_3H_5(NO_3)_3 \rightarrow 12CO_2 + 6N_2 + O_2 + 10H_2O$

$PV = nRT$

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

$$\frac{385\text{g nitro} \,/\, 1\text{mol}}{227\text{g}} = 1.696\text{ mol nitro}$$

$$\frac{1.696\text{mol nitro} \,/\, 12\text{mol } CO_2}{4\text{mol nitro}}$$

$V = \frac{(5.1\text{mol})(0.0821\text{L·atm})(301\text{K})}{\text{mol·K}\,(301\text{K})\,0.889\text{atm}}$

$V = 141.4\text{ L } CO_2$

$$\frac{1.696\text{mol nitro} \,/\, 6\text{mol } N_2}{4\text{ mol nitro}}$$

$V = \frac{2.54\text{mol}(0.0821\text{L·atm})(301\text{K})}{\text{mol K}\,(0.889\text{ atm})}$

$V = 70.6\text{ L } N_2$

$$\frac{1.696\text{mol Nitro} \,/\, 1\text{mol } O_2}{4\text{mol nitro}}$$

$V = \frac{(0.424\text{mol})(0.0821\text{L·atm})(301\text{K})}{\text{mol·K}\,(0.889\text{ atm})}$

$V = 11.79\text{L } O_2$

$$\frac{1.696\text{mol Nitro} \,/\, 10\text{mol } H_2O}{4\text{mol nitro}}$$

$V = \frac{4.24\text{mol}(0.0821\text{L·atm})(301\text{K})}{\text{mol K}\,(0.889\text{ atm})}$

$V = 117.9\text{ L } H_2O$

$\Sigma_V = 341.7\text{ L gas}$