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AP Chem · Unit 1 Test Review

- 1) a)  $4\text{Fe(s)} + 3\text{O}_2\text{(g)} \rightarrow 2\text{Fe}_2\text{O}_3\text{(s)}$  synthesis/combination
- b)  $\text{C}_2\text{H}_4\text{(g)} + 3\text{O}_2\text{(g)} \rightarrow 2\text{CO}_2\text{(g)} + 2\text{H}_2\text{O(g)}$  combustion
- c)  $2\text{Al(s)} + 6\text{HCl(aq)} \rightarrow 2\text{AlCl}_3\text{(aq)} + 3\text{H}_2\text{(g)}$  single replacement

2) % N in  $\text{Ca}(\text{NO}_3)_2$  =  $\frac{\text{mass of 2 Nitrogens}}{\text{mass of } \text{Ca}(\text{NO}_3)_2} \times 100$

$$= \frac{28.02}{164.1} \times 100 = \boxed{17.07\% \text{ N}}$$

3)  $\frac{0.25 \text{ mol } \text{Ca}(\text{NO}_3)_2}{1 \text{ mol } \text{Ca}(\text{NO}_3)_2} \left| \begin{array}{c} 6 \text{ mol O} \\ 1 \text{ mol } \text{Ca}(\text{NO}_3)_2 \end{array} \right| \frac{6.02 \times 10^{23} \text{ atoms O}}{1 \text{ mol O}} = \boxed{9.0 \times 10^{23} \text{ atoms O}}$

4)  $\frac{1.50 \text{ g } \text{Na}_2\text{CO}_3}{105.99 \text{ g } \text{Na}_2\text{CO}_3} \left| \begin{array}{c} 1 \text{ mol Na}_2\text{CO}_3 \\ 1 \text{ mol Na}_2\text{CO}_3 \end{array} \right| \frac{3 \text{ mol O}}{1 \text{ mol Na}_2\text{CO}_3} \left| \begin{array}{c} 6.02 \times 10^{23} \text{ atoms O} \\ 1 \text{ mol O} \end{array} \right.$

$$= \boxed{2.56 \times 10^{22} \text{ atoms O}}$$

5)  $\frac{508 \text{ g } \text{NaHCO}_3}{84.01 \text{ g } \text{NaHCO}_3} = \boxed{6.05 \text{ mol NaHCO}_3}$

6)  $\frac{4.20 \text{ g HNO}_3}{63.02 \text{ g HNO}_3} \left| \begin{array}{c} 1 \text{ mol HNO}_3 \\ 1 \text{ mol HNO}_3 \end{array} \right| \frac{6.02 \times 10^{23} \text{ molecules HNO}_3}{1 \text{ mol HNO}_3}$

$$= \boxed{4.01 \times 10^{22} \text{ molecules HNO}_3}$$

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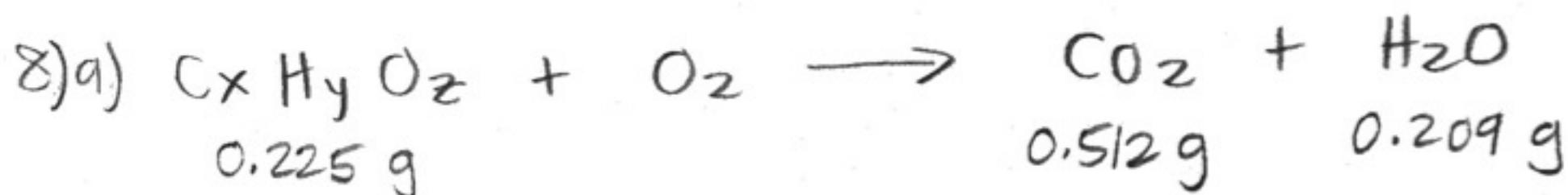
$$7) \text{a)} 37.51\% \text{ C} = \frac{37.51 \text{ g C}}{12.01 \text{ g C}} \left| \begin{array}{l} 1 \text{ mol C} \\ 12.01 \text{ g C} \end{array} \right. = \frac{3.123230641}{3.118811881} = 1 \text{ mol C}$$

$$3.15\% \text{ H} = \frac{3.15 \text{ g H}}{1.01 \text{ g H}} \left| \begin{array}{l} 1 \text{ mol H} \\ 1.01 \text{ g H} \end{array} \right. = \frac{3.118811881}{3.118811881} = 1 \text{ mol H}$$

$$59.34\% \text{ F} = \frac{59.34 \text{ g F}}{19 \text{ g F}} \left| \begin{array}{l} 1 \text{ mol F} \\ 19 \text{ g F} \end{array} \right. = \frac{3.123157895}{3.118811881} = 1 \text{ mol F}$$

Empirical Formula = CHF

b)  $\frac{\text{MM}_{\text{MF}}}{\text{MM}_{\text{EF}}} = \frac{96.052}{32.02} = 2.9997 = 3$  Molecular Formula = C<sub>3</sub>H<sub>3</sub>F<sub>3</sub>



$$\frac{0.512 \text{ g CO}_2}{44.01 \text{ g CO}_2} \left| \begin{array}{l} 1 \text{ mol CO}_2 \\ 1 \text{ mol CO}_2 \end{array} \right. \left| \begin{array}{l} 1 \text{ mol C} \\ 1 \text{ mol CO}_2 \end{array} \right. \left| \begin{array}{l} 12.01 \text{ g C} \\ 1 \text{ mol C} \end{array} \right. = .140 \text{ g C}$$

$$\frac{0.209 \text{ g H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \left| \begin{array}{l} 1 \text{ mol H}_2\text{O} \\ 1 \text{ mol H}_2\text{O} \end{array} \right. \left| \begin{array}{l} 2 \text{ mol H} \\ 1 \text{ mol H}_2\text{O} \end{array} \right. \left| \begin{array}{l} 1.01 \text{ g H} \\ 1 \text{ mol H} \end{array} \right. = .0234 \text{ g H}$$

mass of C<sub>x</sub>H<sub>y</sub>O<sub>z</sub> = mass C + mass H + mass O

$$0.225 \text{ g} = .140 \text{ g} + .0234 \text{ g} + \text{mass O}$$

$$\text{mass O} = .0616 \text{ g}$$

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8)a) continued

$$\frac{140 \text{ g C}}{12.01 \text{ g C}} \left| \begin{array}{l} | \text{mol C} \\ \hline | \end{array} \right. = \frac{0.016569525}{0.00385} = 3.027 = 3$$

Empirical  
formula

$$= \boxed{\text{C}_3\text{H}_6\text{O}}$$

$$\frac{0.0234 \text{ g H}}{1.01 \text{ g H}} \left| \begin{array}{l} | \text{mol H} \\ \hline | \end{array} \right. = \frac{0.0231683168}{0.00385} = 6.017 = 6$$

$$\frac{0.0616 \text{ g O}}{16 \text{ g O}} \left| \begin{array}{l} | \text{mol O} \\ \hline | \end{array} \right. = \frac{0.00385 \text{ g O}}{0.00385} = 1$$

b)  $\frac{MM_{MF}}{MM_{EF}} = \frac{116}{58.09} = 1.9969 = 2$

Molecular formula =  $\text{C}_6\text{H}_{12}\text{O}_2$



b) single replacement

c)  $\frac{5.00 \text{ g Zn}}{65.39 \text{ g Zn}} \left| \begin{array}{l} | \text{mol Zn} \\ \hline | \end{array} \right. \left| \begin{array}{l} | \text{mol H}_2 \\ \hline | \end{array} \right. \left| \begin{array}{l} | 2.02 \text{ g H}_2 \\ \hline | \end{array} \right. = 0.154 \text{ g H}_2$

$$\frac{5.00 \text{ g HCl}}{36.46 \text{ g HCl}} \left| \begin{array}{l} | \text{mol HCl} \\ \hline | \end{array} \right. \left| \begin{array}{l} | \text{mol H}_2 \\ \hline | \end{array} \right. \left| \begin{array}{l} | 2.02 \text{ g H}_2 \\ \hline | \end{array} \right. = \boxed{0.139 \text{ g H}_2}$$

i)  $\boxed{\text{limiting reactant} = \text{HCl}}$  theoretical yield

ii)  $\frac{5.00 \text{ g HCl}}{36.46 \text{ g HCl}} \left| \begin{array}{l} | \text{mol HCl} \\ \hline | \end{array} \right. \left| \begin{array}{l} | \text{mol Zn} \\ \hline | \end{array} \right. \left| \begin{array}{l} | 65.39 \text{ g Zn} \\ \hline | \end{array} \right. = 4.48 \text{ g Zn}$  used/consumed

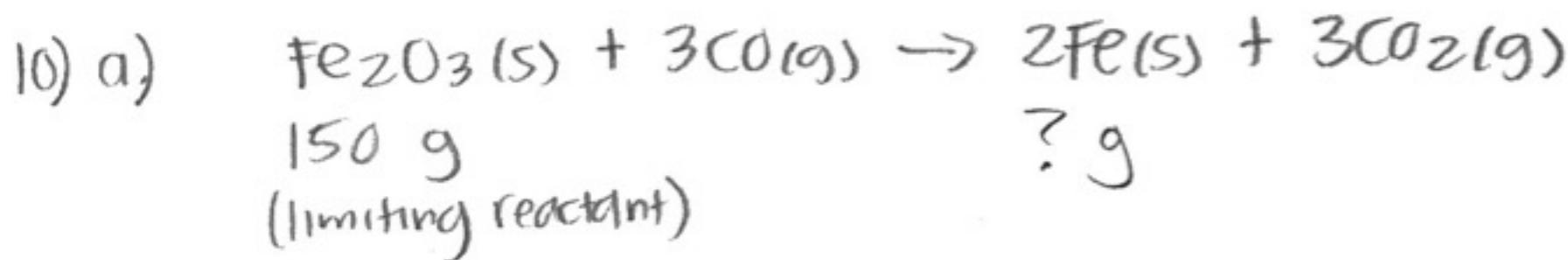
mass Zn remaining = mass Zn available - mass Zn used

$$= 5.00 \text{ g} - 4.48 \text{ g}$$

=  $\boxed{0.52 \text{ g Zn remains in excess}}$

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$$\frac{150 \text{ g Fe}_2\text{O}_3}{159.7 \text{ g Fe}_2\text{O}_3} \times \frac{1 \text{ mol Fe}_2\text{O}_3}{1 \text{ mol Fe}_2\text{O}_3} \times \frac{2 \text{ mol Fe}}{1 \text{ mol Fe}_2\text{O}_3} \times \frac{55.85 \text{ g Fe}}{1 \text{ mol Fe}} = 104.9$$

\*2 sig figs

$= 1.0 \times 10^2 \text{ g Fe}$

$$\text{b) \% \ yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

$$= \frac{87.9 \text{ g}}{1.0 \times 10^2 \text{ g}} \times 100 = 87.9\% = \boxed{88\% \text{ yield}}$$

$$\text{c) \% error} = 100 - \% \text{ yield}$$

$$= 100 - 88\% = \boxed{12\% \text{ error}}$$

$$\underline{\text{OR}} \quad \% \text{ error} = \left| \frac{\text{actual} - \text{theoretical}}{\text{theoretical}} \right| \times 100$$

$$= \left| \frac{87.9 \text{ g} - 1.0 \times 10^2 \text{ g}}{1.0 \times 10^2 \text{ g}} \right| \times 100 = \boxed{12\% \text{ error}}$$

$$11) \text{ a) mass hydrate before heating} = 17.580 \text{ g} - 15.013 \text{ g} = \boxed{2.567 \text{ g}}$$

$$\begin{aligned}
 b) \text{ mass water in hydrate} &= \text{mass hydrate} - \text{mass salt} \\
 &= 2.567 \text{ g} - 1.441 \text{ g} = 1.126 \text{ g} \\
 \text{mass salt} &= 16.454 \text{ g} - 15.013 \text{ g} = 1.441 \text{ g salt} \quad | \text{H}_2\text{O}
 \end{aligned}$$

$$c) \% \text{ H}_2\text{O} = \frac{\text{mass H}_2\text{O}}{\text{mass hydrate}} \times 100 = \frac{1.126 \text{ g}}{2.567 \text{ g}} \times 100 = 43.86\%$$

$$d) 43.86\% \text{ H}_2\text{O} = \frac{43.86 \text{ g H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \left| \begin{array}{l} 1 \text{ mol H}_2\text{O} \\ 18.02 \text{ g H}_2\text{O} \end{array} \right. = \frac{2.433962264}{0.3477237535} = 7 \text{ mol H}_2\text{O}$$

$$\text{Zinc} \quad \frac{56.14\% \text{ ZnSO}_4}{\therefore \text{ZnSO}_4 \cdot 7\text{H}_2\text{O}} = \frac{56.14 \text{ g ZnSO}_4}{161.45 \text{ g}} \left| \begin{array}{l} | \text{mol ZnSO}_4 \\ | \end{array} \right. = \frac{0.3477237535}{0.3477237535} = 1 \text{ mol ZnSO}_4$$