

## Objective 1

$$1. a. \cdot 275 \text{ mol HCl} \times \frac{324.93 \text{ g}}{1 \text{ mol}} = \boxed{89.4 \text{ g}}$$

$$b. 3.01 \times 10^{24} \text{ molecules} \times \frac{1 \text{ mol}}{6.02 \times 10^{23}} \times \frac{132 \text{ g}}{1 \text{ mol}} = \boxed{660. \text{ g}}$$

$$c. 4.5 \text{ mol} \times \frac{3 \text{ mol Li}}{1 \text{ mol Li}_3\text{P}} \times \frac{6.94 \text{ g}}{1 \text{ mol Li}} = \boxed{94 \text{ g}}$$

$$2. a. \frac{45.2 \text{ L N}_2}{1} \times \frac{1 \text{ mol N}_2}{22.4 \text{ L}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol N}_2} = \boxed{1.21 \times 10^{24} \text{ molecules}}$$

$$b. 65.3 \text{ g He} \times \frac{1 \text{ mol He}}{4 \text{ g}} \times \frac{22.4 \text{ L}}{1 \text{ mol He}} = \boxed{366 \text{ L}}$$

$$c. 450 \text{ L} \times 0.21 = 94.5 \text{ L O}_2$$

$$94.5 \text{ L O}_2 \times \frac{1 \text{ mol}}{22.4 \text{ L}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol O}_2} \times \frac{2 \text{ atoms O}}{1 \text{ molecule}} = \boxed{5.08 \times 10^{24} \text{ atoms O}}$$

3. a. C <sub>4</sub> H <sub>4</sub> O <sub>4</sub>	C	4 × 12 = 48	% C = $\frac{48}{116} \times 100 = 41.4\%$
	H	4 × 1 = 4	% H = $\frac{4}{116} \times 100 = 3.45\%$
	O	4 × 16 = 64	% O = $\frac{64}{116} \times 100 = 55.2\%$
		116 g/mol	

b. CHO

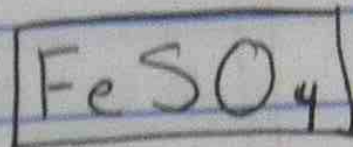
$$c. 13.5 \text{ g} \times 0.414 = \boxed{5.59 \text{ g of C}}$$

4. Assume 100g

$$36.763 \text{ g Fe} \times \frac{1 \text{ mol}}{55.845 \text{ g}} = \frac{.658 \text{ mol}}{.658 \text{ mol}} = 1$$

$$21.108 \text{ g S} \times \frac{1 \text{ mol}}{32 \text{ g}} = \frac{.659 \text{ mol}}{.658 \text{ mol}} = 1$$

$$42.128 \text{ g O} \times \frac{1 \text{ mol}}{16 \text{ g}} = \frac{2.63 \text{ mol}}{.658 \text{ mol}} = 4$$



5. Assume 100g

$$21.955 \text{ g S} \times \frac{1 \text{ mol}}{32 \text{ g}} = \frac{.686 \text{ mol}}{.686 \text{ mol}} = 1$$

$$78.045 \text{ g F} \times \frac{1 \text{ mol}}{19 \text{ g}} = \frac{4.108 \text{ mol}}{.686 \text{ mol}} = 6$$

$\boxed{\text{SF}_6}$  This is the empirical formula.

We would need the molecular mass to know the molecular formula.

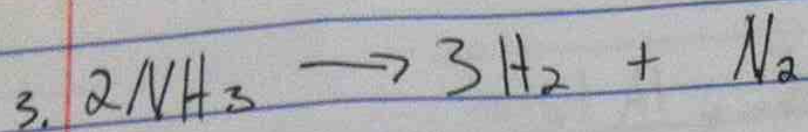
Objective 2:

$$1. 77 \text{ g HClO} \times \frac{1 \text{ mol HClO}}{52.45 \text{ g}} \times \frac{1 \text{ mol H}_2\text{SO}_4}{2 \text{ mol HClO}} \times \frac{98 \text{ g}}{1 \text{ mol H}_2\text{SO}_4} = \boxed{71.9 \text{ g H}_2\text{SO}_4}$$

72g w/ sig figs

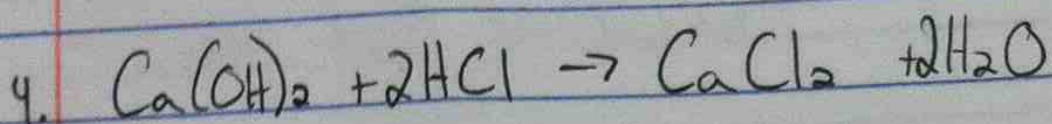
$$2. 45 \text{ g C}_3\text{H}_6 \times \frac{1 \text{ mol C}_3\text{H}_6}{42 \text{ g}} \times \frac{6 \text{ mol CO}_2}{2 \text{ mol C}_3\text{H}_6} \times \frac{44 \text{ g CO}_2}{1 \text{ mol CO}_2} = \boxed{141 \text{ g CO}_2}$$

140g w/ sig figs



$$.145 \text{ mol NH}_3 \times \frac{1 \text{ mol N}_2}{2 \text{ mol NH}_3} = \boxed{.0725 \text{ mol N}_2}$$

$$.145 \text{ mol NH}_3 \times \frac{3 \text{ mol H}_2}{2 \text{ mol NH}_3} = .2175 \text{ mol} \rightarrow \boxed{.218 \text{ mol H}_2}$$



$$5.00 \text{ g Ca(OH)}_2 \times \frac{1 \text{ mol Ca(OH)}_2}{74 \text{ g}} \times \frac{2 \text{ mol HCl}}{1 \text{ mol Ca(OH)}_2} \times \frac{1 \text{ L}}{100 \text{ mol}} = \boxed{1.35 \text{ L}}$$

$$5. \quad 150.5 \text{ g CrO}_5 \times \frac{1 \text{ mol CrO}_5}{149 \text{ g}} \times \frac{5 \text{ mol O}_2}{4 \text{ mol CrO}_5} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = \boxed{333.7 \text{ L O}_2}$$

$$150.5 \text{ g CrO}_5 \times \frac{1 \text{ mol CrO}_5}{149 \text{ g}} \times \frac{4 \text{ mol NO}_2}{4 \text{ mol CrO}_5} \times \frac{46 \text{ g NO}_2}{1 \text{ mol NO}_2} = \boxed{46.46 \text{ g NO}_2}$$

$$6. \quad 75 \text{ g Fe}_2\text{O}_3 \times \frac{1 \text{ mol Fe}_2\text{O}_3}{159.69 \text{ g}} \times \frac{1 \text{ mol Al}_2\text{O}_3}{1 \text{ mol Fe}_2\text{O}_3} \times \frac{6.02 \times 10^{23} \text{ formula units}}{1 \text{ mol Al}_2\text{O}_3} = \boxed{2.8 \times 10^{23} \text{ formula units}}$$

$$7. \quad 5.0 \text{ g Fe} \times \frac{1 \text{ mol Fe}}{55.845 \text{ g}} \times \frac{3 \text{ mol Ag}}{1 \text{ mol Fe}} = \boxed{.27 \text{ mol Ag}}$$

$$8. \quad 25\text{g Al} \times \frac{1\text{mol Al}}{27\text{g Al}} \times \frac{3\text{mol H}_2}{2\text{mol Al}} \times \frac{2\text{g H}_2}{1\text{mol}} = 2.8\text{g H}_2$$

$$90\text{g HCl} \times \frac{1\text{mol HCl}}{36.45\text{g}} \times \frac{3\text{mol H}_2}{6\text{mol HCl}} \times \frac{2\text{g H}_2}{1\text{mol}} = 2.5\text{g H}_2$$

HCl is the limiting reagent; therefore  
will be produced.

**2.5g of H<sub>2</sub>**

$$9. \quad 20\text{g N}_2 \times \frac{1\text{mol N}_2}{28\text{g}} \times \frac{2\text{mol NH}_3}{1\text{mol N}_2} = 1.4\text{mol NH}_3$$

$$5.0\text{g H}_2 \times \frac{1\text{mol H}_2}{2\text{g}} \times \frac{2\text{mol NH}_3}{3\text{mol H}_2} = 1.7\text{mol NH}_3$$

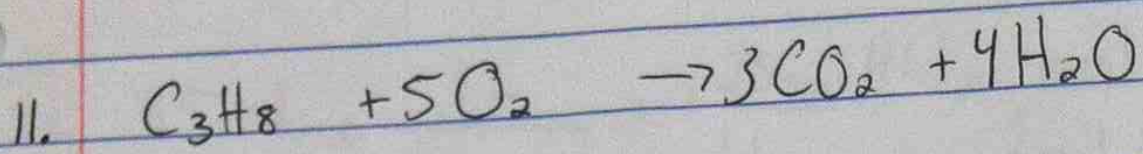
N<sub>2</sub> is the limiting reagent.

$$10. \quad 10.0\text{g Al} \times \frac{1\text{mol Al}}{27\text{g}} \times \frac{2\text{mol Al}_2\text{O}_3}{4\text{mol Al}} \times \frac{102\text{g}}{1\text{mol Al}_2\text{O}_3} = 18.9\text{g Al}_2\text{O}_3$$

$$20.0\text{g O}_2 \times \frac{1\text{mol O}_2}{32\text{g O}_2} \times \frac{2\text{mol Al}_2\text{O}_3}{3\text{mol O}_2} \times \frac{102\text{g}}{1\text{mol Al}_2\text{O}_3} = 42.5\text{g Al}_2\text{O}_3$$

Al is the limiting reagent; therefore  
is produced

**18.9g Al<sub>2</sub>O<sub>3</sub>**

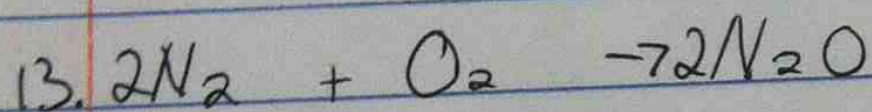


$$15.0\text{g C}_3\text{H}_8 \times \frac{1\text{mol C}_3\text{H}_8}{44\text{g}} \times \frac{3\text{mol CO}_2}{1\text{mol C}_3\text{H}_8} = 1.02\text{ mol CO}_2$$

$$60.0\text{g O}_2 \times \frac{1\text{mol O}_2}{32\text{g}} \times \frac{3\text{mol CO}_2}{5\text{mol O}_2} = 1.125\text{ mol CO}_2$$

$\text{C}_3\text{H}_8$  is the limiting reagent; therefore 1.02 mol  $\text{CO}_2$  will be produced.

12. Limiting reagent questions will tell amounts of both reactants. Basic stoich problems will only give you the one amount and the other will be in excess.



$$17.3\text{L} \times \frac{1\text{mol O}_2}{22.4\text{L}} \times \frac{2\text{mol N}_2\text{O}}{1\text{mol O}_2} \times \frac{44\text{g}}{1\text{mol N}_2\text{O}} = 68.0\text{g N}_2\text{O}$$

$$45.3\text{g} \times \frac{1\text{mol N}_2}{28\text{g}} \times \frac{2\text{mol N}_2\text{O}}{2\text{mol N}_2} \times \frac{44\text{g N}_2\text{O}}{1\text{mol N}_2\text{O}} = 71.2\text{g N}_2\text{O}$$

a.  $\text{O}_2$  is the limiting reactant

$$b. \frac{5\text{g}}{68.0\text{g}} \times 100 = \boxed{7\%}$$

$$c. 45.3\text{g}$$

$$- 43.25\text{g}$$

$$c. 17.3\text{L} \times \frac{1\text{mol O}_2}{22.4\text{L}} \times \frac{2\text{mol N}_2}{1\text{mol O}_2} \times \frac{28\text{g N}_2}{1\text{mol N}_2} = 43.25\text{g N}_2$$

2.05g  $\text{N}_2$   
in excess

$$14. \quad 85 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{0.25 \text{ mol HCl}}{1 \text{ L}} \times \frac{1 \text{ mol CO}_2}{2 \text{ mol HCl}} = 0.0106 \text{ mol CO}_2$$

$$0.84 \text{ g} \times \frac{1 \text{ mol}}{74 \text{ g}} \times \frac{1 \text{ mol CO}_2}{1 \text{ mol Li}_2\text{CO}_3} = 0.0114 \text{ mol CO}_2$$

a. HCl is the limiting reactant

$$b. \quad 85 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{0.25 \text{ mol HCl}}{1 \text{ L}} \times \frac{1 \text{ mol Li}_2\text{CO}_3}{2 \text{ mol HCl}} \times \frac{74 \text{ g}}{1 \text{ mol}} = 0.78 \text{ g}$$

$$0.84 \text{ g} - 0.78 \text{ g} = \boxed{0.06 \text{ g Li}_2\text{CO}_3 \text{ in excess}}$$

$$c. \quad 0.0106 \text{ mol CO}_2 \times \frac{22.4 \text{ L}}{1 \text{ mol}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = \boxed{237 \text{ mL CO}_2}$$

$$d. \quad \frac{150 \text{ mL}}{237 \text{ mL}} \times 100 = \boxed{63\%}$$