

Name: \_\_\_\_\_

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## Limiting Reactant

Practice Sheet #

1. Copper (II) sulfate is reacted with zinc to produce copper and zinc sulfate.

a. Write a balanced chemical equation for this reaction.



- b. If 2.00 moles of copper (II) sulfate are combined with 3.00 mol of zinc, which reactant is limiting and which is excess?

$$2.00 \text{ moles CuSO}_4 \times \frac{1 \text{ mol Cu}}{1 \text{ mol CuSO}_4} = 2.00 \text{ L.R.}$$

$$3.00 \text{ moles Zn} \times \frac{1 \text{ mol Cu}}{1 \text{ mol Zn}} = 3.00$$

- c. What is the mass of each of the products?

$$2.00 \text{ mol CuSO}_4 \times \frac{1 \text{ mol Cu}}{1 \text{ mol CuSO}_4} \times \frac{63.55 \text{ g Cu}}{1 \text{ mol Cu}} = 127 \text{ g Cu}$$

$$\text{'' ''} \times \frac{1 \text{ mol ZnSO}_4}{1 \text{ mol CuSO}_4} \times \frac{161.44 \text{ g ZnSO}_4}{1 \text{ mol ZnSO}_4} = 323 \text{ g ZnSO}_4$$

2. Calcium hydroxide reacts with phosphoric acid to produce water and calcium phosphate.

a. Write a balanced chemical equation for this reaction.



- b. If 4.20 mol of calcium hydroxide are reacted with 2.20 mol of phosphoric acid, which reactant is limiting and which is excess.

$$4.20 \text{ mol Ca(OH)}_2 \times \frac{6 \text{ mol H}_2\text{O}}{3 \text{ mol Ca(OH)}_2} = 8.4 \text{ mol H}_2\text{O}$$

$$2.20 \text{ mol H}_3\text{PO}_4 \times \frac{6 \text{ mol H}_2\text{O}}{2 \text{ mol H}_3\text{PO}_4} = 6.6 \text{ mol H}_2\text{O}$$

H<sub>3</sub>PO<sub>4</sub> is L.R.

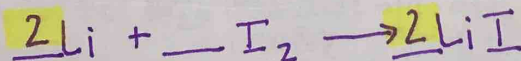
- c. What is the mass of each of the products?

$$2.20 \text{ mol H}_3\text{PO}_4 \times \frac{6 \text{ mol H}_2\text{O}}{2 \text{ mol H}_3\text{PO}_4} \times \frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 119 \text{ g H}_2\text{O}$$

$$\text{''} \times \frac{1 \text{ mol Ca}_3(\text{PO}_4)_2}{2 \text{ mol H}_3\text{PO}_4} \times \frac{310.18 \text{ g}}{1 \text{ mol Ca}_3(\text{PO}_4)_2} = 341 \text{ g Ca}_3(\text{PO}_4)_2$$

3. Lithium is reacted with iodine.

a. Write a balanced chemical equation for this reaction.



- b. If 15.10 grams of lithium are combined with 200.4 g of iodine, which reactant is limiting and which is excess? c. What is the mass of the product?

$$15.10 \text{ g Li} \times \frac{1 \text{ mol Li}}{6.939 \text{ g Li}} \times \frac{2 \text{ mol LiI}}{2 \text{ mol Li}} \times \frac{133.8 \text{ g LiI}}{1 \text{ mol LiI}} = 291.2 \text{ g LiI} \quad \text{Li = excess}$$

$$200.4 \text{ g I}_2 \times \frac{1 \text{ mol I}_2}{253.8 \text{ g I}_2} \times \frac{2 \text{ mol LiI}}{1 \text{ mol I}_2} \times \frac{133.8 \text{ g LiI}}{1 \text{ mol LiI}} = 211.3 \text{ g LiI} \quad \text{I}_2 = \text{limiting}$$

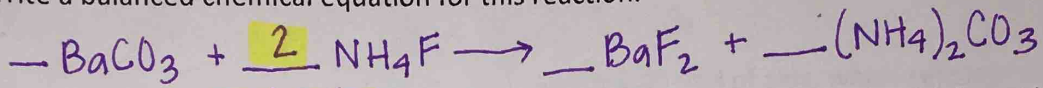
d. What mass of the excess reactant is used in the reaction, and what mass of the excess reactant remains after the reaction?

$$200.4 \text{ g I}_2 \times \frac{1 \text{ mol I}_2}{253.8 \text{ g I}_2} \times \frac{2 \text{ mol Li}}{1 \text{ mol I}_2} \times \frac{6.94 \text{ g Li}}{1 \text{ mol Li}} = 10.96 \text{ g Li used in reaction}$$

$$15.10 \text{ g Li} - 10.96 \text{ g} = 4.142 \text{ g Li in excess}$$

4. Barium carbonate is reacted with ammonium fluoride.

a. Write a balanced chemical equation for this reaction.



b. If 240 g of barium carbonate and 95.0 g ammonium fluoride are combined, which reactant is limiting and which is excess? c. What is the mass of the products.

L.R

$$240 \text{ g BaCO}_3 \times \frac{1 \text{ mol BaCO}_3}{197.31 \text{ g BaCO}_3} \times \frac{1 \text{ mol BaF}_2}{1 \text{ mol BaCO}_3} \times \frac{175.3 \text{ g BaF}_2}{1 \text{ mol BaF}_2} = 213 \rightarrow 210 \text{ g BaF}_2$$

$$95 \text{ g NH}_4\text{F} \times \frac{1 \text{ mol NH}_4\text{F}}{37.04 \text{ g NH}_4\text{F}} \times \frac{1 \text{ mol BaF}_2}{2 \text{ mol NH}_4\text{F}} \times \frac{175.3 \text{ g BaF}_2}{1 \text{ mol BaF}_2} = 224 \rightarrow 220 \text{ g BaF}_2$$

EXCESS

$$95 \text{ g NH}_4\text{F} \times \frac{1 \text{ mol NH}_4\text{F}}{37.04 \text{ g NH}_4\text{F}} \times \frac{1 \text{ mol (NH}_4)_2\text{CO}_3}{2 \text{ mol NH}_4\text{F}} \times \frac{96.09 \text{ g}}{1 \text{ mol (NH}_4)_2\text{CO}_3} = 123 \rightarrow 120 \text{ g (NH}_4)_2\text{CO}_3$$

d. mass of BaF<sub>2</sub> actually obtained:

$$100 \text{ g (NH}_4)_2\text{CO}_3 \times \frac{1 \text{ mol}}{96.09 \text{ g (NH}_4)_2\text{CO}_3} \times \frac{1 \text{ mol BaF}_2}{1 \text{ mol (NH}_4)_2\text{CO}_3} \times \frac{175.3 \text{ g BaF}_2}{1 \text{ mol BaF}_2} = 182 \text{ BaF}_2 \text{ } \frac{\% \text{ yield}}{88.5}$$

e. What mass of the excess reactant is used in the reaction, and what mass of the excess reactant remains after the reaction?

$$240 \text{ g BaCO}_3 \times \frac{1 \text{ mol}}{197.31 \text{ g BaCO}_3} \times \frac{2 \text{ mol NH}_4\text{F}}{1 \text{ mol BaCO}_3} \times \frac{37.04 \text{ g NH}_4\text{F}}{1 \text{ mol NH}_4\text{F}} = 90.1 \rightarrow 90 \text{ g used}$$

$$95.0 - 90 = 5.0 \text{ grams excess.}$$

5. Aluminum bromide is reacted with chlorine.

a. Write a balanced chemical equation for this reaction.



b. If 135 g of aluminum bromide and 50.0 g of chloride are combined, which reactant is limiting and which is excess?

EXCESS

$$135 \text{ g AlBr}_3 \times \frac{1 \text{ mol AlBr}_3}{266.71 \text{ g AlBr}_3} \times \frac{3 \text{ mol Br}_2}{2 \text{ mol AlBr}_3} = 0.759 \text{ mol Br}_2$$

$$50.0 \text{ g Cl}_2 \times \frac{1 \text{ mol Cl}_2}{70.90 \text{ g Cl}_2} \times \frac{3 \text{ mol Br}_2}{3 \text{ mol Cl}_2} = 0.705 \text{ mol Br}_2$$

L.R

c. What is the mass of each of the products?

$$0.705 \text{ mol Br}_2 \times \frac{159.82 \text{ g Br}_2}{1 \text{ mol Br}_2} = 113 \text{ g Br}_2$$

$$50.0 \text{ g Cl}_2 \times \frac{1 \text{ mol Cl}_2}{70.9 \text{ g Cl}_2} \times \frac{2 \text{ mol AlCl}_3}{3 \text{ mol Cl}_2} \times \frac{133.33 \text{ g}}{1 \text{ mol AlCl}_3} = 62.7 \text{ g AlCl}_3$$

d. If the reaction yields 104 g of bromine, determine the percent yield. What mass of aluminum chloride would actually be obtained?

$$\frac{104 \text{ g}}{113 \text{ g}} \times 100 = 92\% \text{ Yield}$$

$$104 \text{ g Br}_2 \times \frac{1 \text{ mol Br}_2}{159.82 \text{ g Br}_2} \times \frac{2 \text{ mol AlCl}_3}{3 \text{ mol Br}_2} \times \frac{133.33 \text{ g AlCl}_3}{1 \text{ mol AlCl}_3} = 57.8 \text{ g AlCl}_3$$

e. What mass of the excess reactant is used in the reaction, and what mass of the excess reactant remains after the reaction?

$$50.0 \text{ g Cl}_2 \times \frac{1 \text{ mol Cl}_2}{70.90 \text{ g Cl}_2} \times \frac{2 \text{ mol AlBr}_3}{3 \text{ mol Cl}_2} \times \frac{266.71 \text{ g}}{1 \text{ mol}} = 125 \text{ g AlBr}_3 \text{ used}$$

$$135 \text{ g} - 125 \text{ g} = 10 \text{ g excess}$$