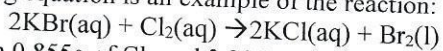


EXTRA PRACTICE: Limiting Reactant and Percent Yield Worksheet

1. Chlorine can replace bromine in bromide compounds forming a chloride compound and elemental bromine. The following equation is an example of the reaction:



(a) When 0.855g of Cl_2 and 3.205g of KBr are mixed in solution, which is the limiting reactant?

0.855 g Cl_2	1 mol Cl_2	2 mol KCl	74.6 g KCl	= 1.80 g KCl
71 g Cl_2	1 mol Cl_2	2 mol KCl	74.6 g KCl	

(LR) ←

3.205 g KBr	1 mol KBr	2 mol KCl	74.6 g KCl	= 2.01 g KCl
119 g KBr	2 mol KBr	1 mol KCl	74.6 g KCl	

(ER) ←

Limiting Reactant = Cl_2

(b) How many grams of each product are formed?

(Use Limiting Reactant now that we know it is Cl_2)

0.855 g Cl_2	1 mol Cl_2	1 mol Br_2	159.8 g Br_2	= 1.92 g Br_2
71 g Cl_2	1 mol Cl_2	1 mol Br_2	159.8 g Br_2	

(LR) ←

Excess Reactant = KBr

Masses of each product based on the limiting reactant: 1.80 g KCl & 1.92 g Br_2

(c) How many grams of the excess reactant remain after the reaction is complete?

g LR used → g ER used

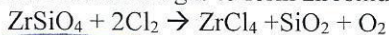
0.855 g Cl_2	1 mol Cl_2	2 mol KBr	119 g KBr
71 g Cl_2	1 mol Cl_2	2 mol KBr	119 g KBr

= 2.87 g KBr used

HAD - USED:

3.205 g - 2.87 g = 0.335 g KBr left over

2. A process by which zirconium metal can be produced from the mineral zirconium (IV) orthosilicate, ZrSiO_4 , starts by reacting it with chlorine gas to form zirconium (IV) chloride.



What mass of ZrCl_4 can be produced if 862g of ZrSiO_4 and 950.g of Cl_2 are available? (You must first determine limiting reactant).

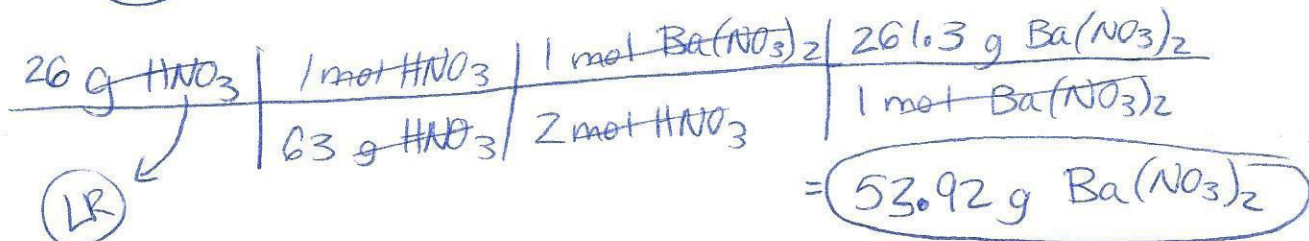
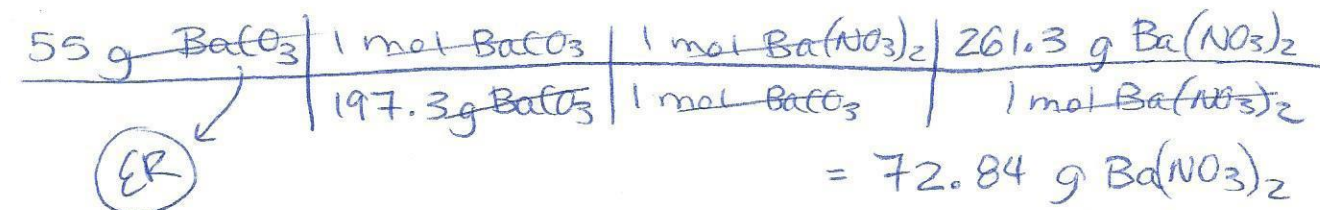
862 g ZrSiO_4	1 mol ZrSiO_4	1 mol ZrCl_4	233.2 g ZrCl_4	= 1096.67 g ZrCl_4
183.3 g ZrSiO_4	1 mol ZrSiO_4	1 mol ZrCl_4	233.2 g ZrCl_4	

(LR) ←

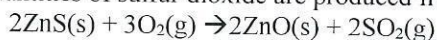
950 g Cl_2	1 mol Cl_2	1 mol ZrCl_4	233.2 g ZrCl_4	= 1560.14 g ZrCl_4
71 g Cl_2	2 mol Cl_2	1 mol ZrCl_4	233.2 g ZrCl_4	

(ER) ←

3. In the reaction $\text{BaCO}_3 + 2\text{HNO}_3 \rightarrow \text{Ba}(\text{NO}_3)_2 + \text{CO}_2 + \text{H}_2\text{O}$, what mass of $\text{Ba}(\text{NO}_3)_2$ can be formed by combining 55g BaCO_3 and 26g HNO_3 ?

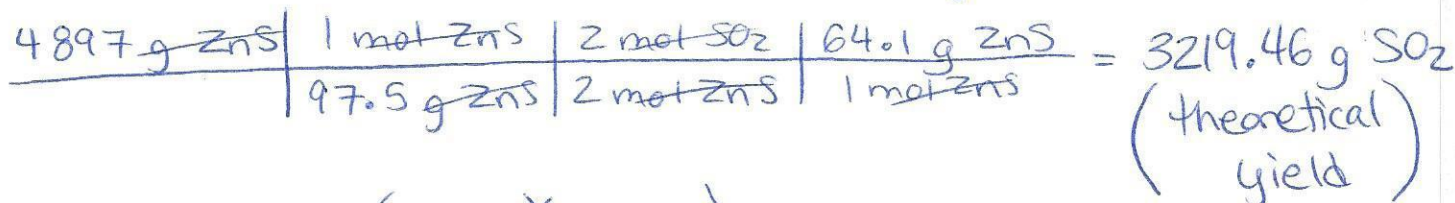


4. Huge quantities of sulfur dioxide are produced from zinc sulfide by means of the following reaction.



If the typical yield is 86.78%, how much SO_2 should be expected if 4897g of ZnS are used?

↳ solve for actual yield = x

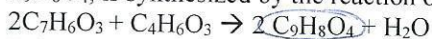


$$86.78\% = \left(\frac{x}{3219.46 \text{ g } \text{SO}_2} \right) \times 100$$

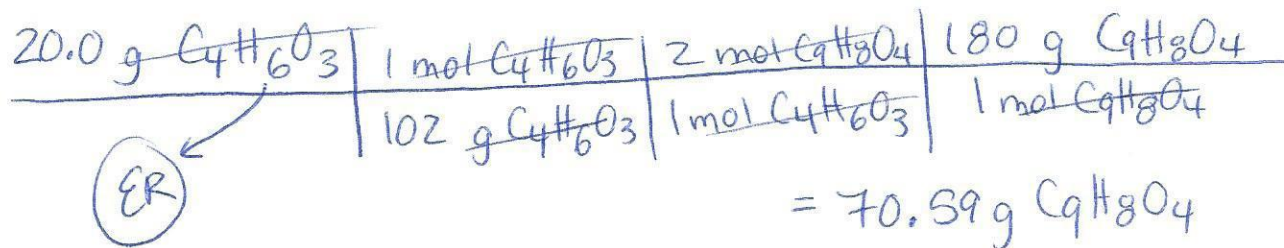
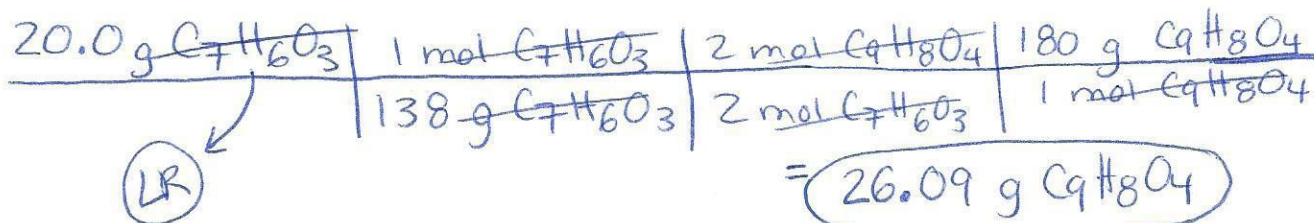
$$(0.8678)(3219.46 \text{ g } \text{SO}_2) = x$$

$$2793.85 \text{ g } \text{SO}_2 = x = \text{actual yield.}$$

5. Aspirin, $\text{C}_9\text{H}_8\text{O}_4$, is synthesized by the reaction of salicylic acid, $\text{C}_7\text{H}_6\text{O}_3$, with acetic anhydride, $\text{C}_4\text{H}_6\text{O}_3$.

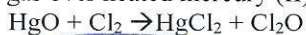


- a. When 20.0 g of $\text{C}_7\text{H}_6\text{O}_3$ and 20.0g of $\text{C}_4\text{H}_6\text{O}_3$ react, What mass, in grams, of aspirin are formed, and which is the limiting reagent?



Limiting Reactant = $\text{C}_7\text{H}_6\text{O}_3$

6. Dichlorine monoxide, Cl_2O is sometimes used as a powerful chlorinating agent in research. It can be produced by passing chlorine gas over heated mercury (II) oxide according to the following equation:



What is the percent yield, if the quantity of the reactants is sufficient to produce 0.86g of Cl_2O but only 0.71 g is obtained?

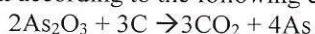
theoretical yield ←

→ actual yield

$$\% \text{ yield} = \left(\frac{0.71 \text{ g } \text{Cl}_2\text{O}}{0.86 \text{ g } \text{Cl}_2\text{O}} \right) \times 100$$

$$= 82.56\%$$

7. In the commercial production of the element arsenic, arsenic(III) oxide is heated with carbon, which reduces the oxide to the metal according to the following equation:



- a. If 8.87g of As_2O_3 is used in the reaction and 5.33 g of As is produced, what is the percent yield?

→ actual yield

$$\frac{8.87 \text{ g } \text{As}_2\text{O}_3}{197.8 \text{ g } \text{As}_2\text{O}_3} \times \frac{1 \text{ mol } \text{As}_2\text{O}_3}{2 \text{ mol } \text{As}_2\text{O}_3} \times \frac{4 \text{ mol As}}{1 \text{ mol As}} \times 74.9 \text{ g As} = 6.72 \text{ g As}$$

(theoretical yield)

$$\% \text{ yield} = \left(\frac{5.33 \text{ g As}}{6.72 \text{ g As}} \right) \times 100$$

$$= 79.31\%$$

- b. If 67 g of carbon is used up in a different reaction and 425g of As is produced, calculate the percent yield of this reaction.

$$\frac{67 \text{ g C}}{12 \text{ g C}} \times \frac{1 \text{ mol C}}{3 \text{ mol C}} \times \frac{4 \text{ mol As}}{1 \text{ mol As}} \times 74.9 \text{ g As} = 557.59 \text{ g As}$$

(theoretical yield)

$$\% \text{ yield} = \left(\frac{425 \text{ g As}}{557.59 \text{ g As}} \right) \times 100$$

$$= 76.22\%$$

8. Assume that the following hypothetical reaction takes place.
 $2A + 7B \rightarrow 4C + 3D$

Calculate the percent yield in each of the following cases:

- a. The reaction of 0.0251 mol of A produces 0.0349 mol of C.

$$\frac{0.0251 \text{ mol } A}{2 \text{ mol } A} \left| \frac{4 \text{ mol } C}{2 \text{ mol } A} \right. = 0.0502 \text{ mol } C$$

(theoretical yield)

$$\% \text{ yield} = \left(\frac{0.0349 \text{ mol}}{0.0502 \text{ mol}} \right) \times 100$$

$$= 69.52\%$$

- b. The reaction of 1.19 mol of A produces 1.41 mol of D.

$$\frac{1.19 \text{ mol } A}{2 \text{ mol } A} \left| \frac{3 \text{ mol } D}{2 \text{ mol } A} \right. = 1.785 \text{ mol } D$$

(theoretical yield)

$$\% \text{ yield} = \left(\frac{1.41 \text{ mol } D}{1.785 \text{ mol } D} \right) \times 100$$

$$= 78.99\%$$

- c. The reaction of 189 mol of B produces 39 mol of D.

$$\frac{189 \text{ mol } B}{7 \text{ mol } B} \left| \frac{3 \text{ mol } D}{7 \text{ mol } B} \right. = 81 \text{ mol } D$$

(theoretical yield)

$$\% \text{ yield} = \left(\frac{39 \text{ mol } D}{81 \text{ mol } D} \right) \times 100$$

$$= 48.15\%$$

- d. The reaction of 3500 mol of B produces 1700 mol of C.

$$\frac{3500 \text{ mol } B}{7 \text{ mol } B} \left| \frac{4 \text{ mol } C}{7 \text{ mol } B} \right. = 2000 \text{ mol } C$$

(theoretical yield)

$$\% \text{ yield} = \left(\frac{1700 \text{ mol } C}{2000 \text{ mol } C} \right) \times 100$$

$$= 85\%$$