

CW: Limiting & Excess Reactants

Define -

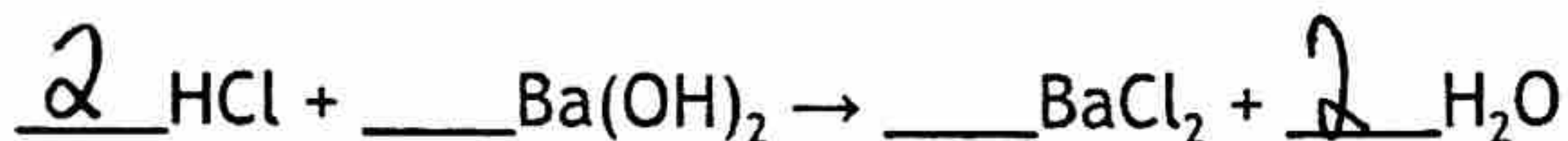
Limiting reactant -

find these in video notes

Excess reactant -

Question 1)

Balance:



If 2.0 mol of HCl reacts with 2.5 mol of Ba(OH)₂

1. How many moles of each product can be made?

BaCl₂ = _____ H₂O = _____

	2 HCl	+ Ba(OH) ₂	→	BaCl ₂	+ H ₂ O
	2.0 mol	2.5 mol		0	0
	-2x	-x		+x	+2x
2.0 - 2x = 0 x = 1.0 mol	0 mol	1.5 mol		1.0 mol	2.0 mol
2.5 - x = 0 x = 2.5					

2. Which is the limiting reactant?

HCl

3. Which is the excess reactant?

Ba(OH)₂

4. Which reactant do you use to determine the amount of product? LR

5. How many grams of water are ACTUALLY produced?

$$2.0 \text{ mol H}_2\text{O} \left| \frac{18.016 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} \right. = 36.032 \text{ g H}_2\text{O}$$

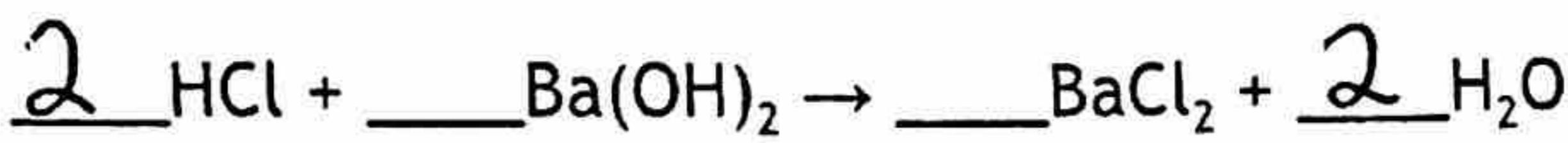
= 36g H₂O

6. How many grams of BaCl₂ are ACTUALLY produced?

$$1.0 \text{ mol BaCl}_2 \left| \frac{208.28 \text{ g BaCl}_2}{1 \text{ mol BaCl}_2} \right. = 208.28 \text{ g BaCl}_2$$

= 210g BaCl₂

Question #2)



If 4.0 mol of HCl reacts with 4.5 mol of Ba(OH)₂

1. Which is the limiting reactant?

	2HCl	$+ \text{Ba(OH)}_2$	\rightarrow	BaCl_2	$+ 2 \text{H}_2\text{O}$
I	4.0 mol	4.5 mol		0	0
C	$+2x$	$-x$		$+x$	$+2x$
E	0 mol	2.5 mol		2.0 mol	4.0 mol

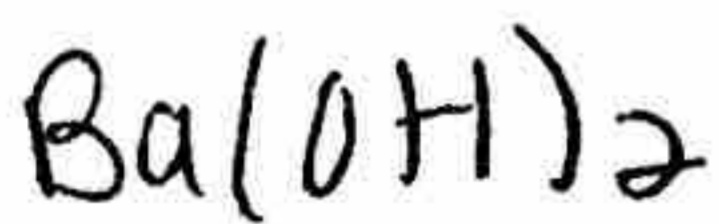
$$4.0 - 2x = 0$$

$$x = 2.0$$

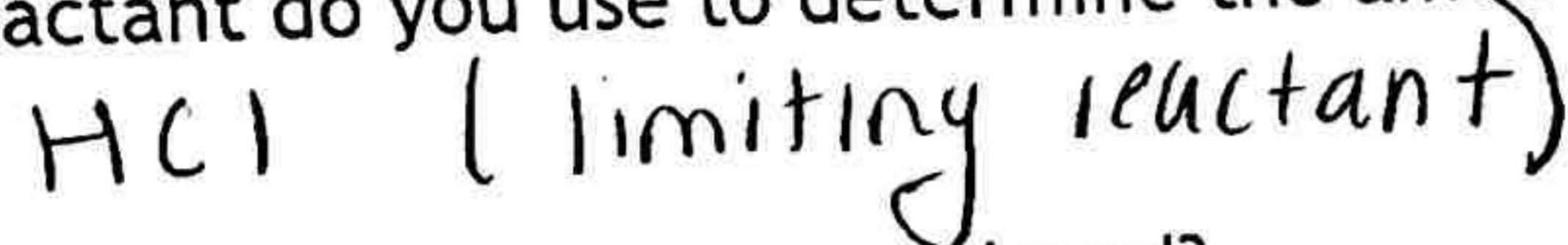
$$4.5 - x = 0$$

$$x = 4.5$$

2. Which is the excess reactant?



3. Which reactant do you use to determine the amount of product?



4. How many grams of water are produced?

$$4.0 \text{ mol H}_2\text{O} \left| \frac{18.016 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} \right. = 72 \text{ g H}_2\text{O}$$

5. How many grams of BaCl₂ are produced?

$$2.0 \text{ mol BaCl}_2 \left| \frac{208.28 \text{ g BaCl}_2}{1 \text{ mol BaCl}_2} \right. = 416.56 \rightarrow 420 \text{ g BaCl}_2$$

Question 3)

Given: $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ If 1.00 g Mg reacts with 0.500 L O₂ at STP, how many g MgO will be produced? (Remember to identify the limiting reactant.)

LR $\rightarrow 2 \text{Mg} + \text{O}_2 \rightarrow 2 \text{MgO}$

I	0.0411 mol	0.0223 mol	0
C	$-2x$	$-x$	$+2x$
E	0 mol	0.0017 mol	0.0412 mol

$$1.00 \text{ g Mg} \left| \frac{1 \text{ mol}}{24.31 \text{ g}} \right. = 0.0411 \text{ mol}$$

$$0.500 \text{ L O}_2 \left| \frac{1 \text{ mol O}_2}{22.4 \text{ L O}_2} \right. = 0.0223 \text{ mol}$$

$$0.0411 - 2x = 0$$

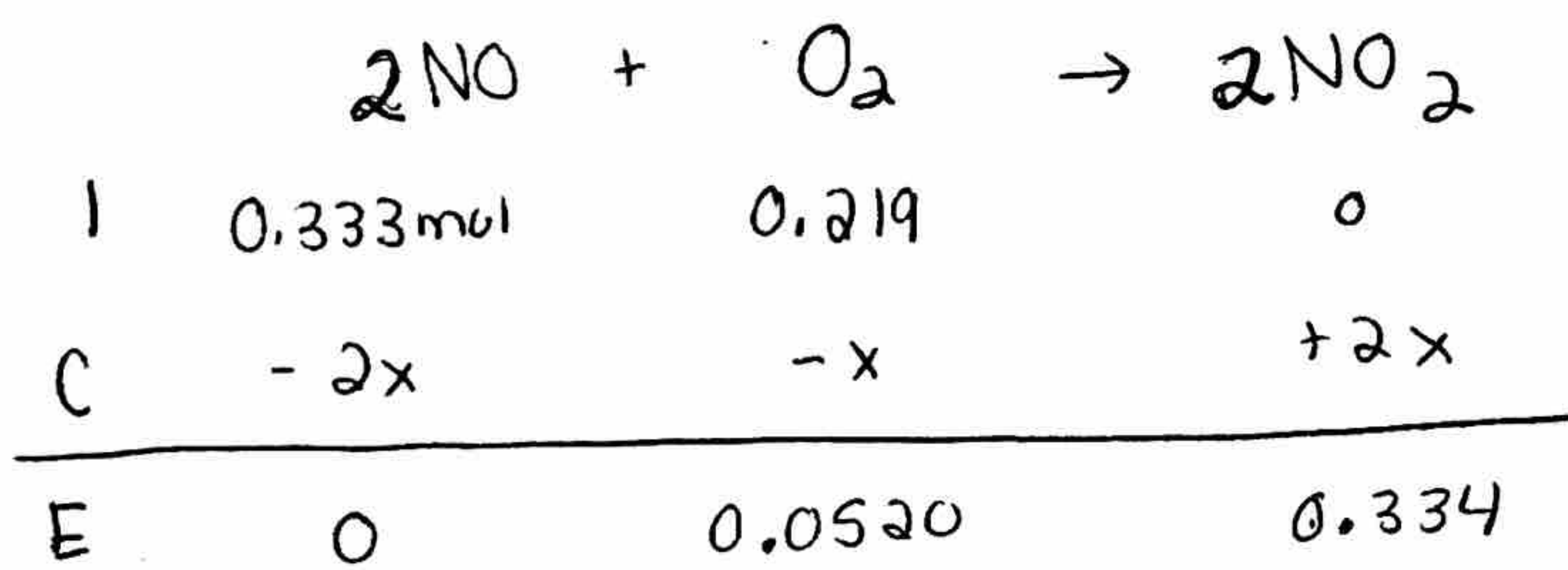
$$x = 0.0206$$

$$0.0223 - x = 0$$

$$x = 0.0223$$

$$0.0412 \text{ mol MgO} \left| \frac{40.31 \text{ g MgO}}{1 \text{ mol MgO}} \right. = 1.66 \text{ g MgO}$$

Question 4) If 10.0 g NO reacts with 7.0 g O₂ how many g NO₂ are produced? (Write a balanced equation & Identify your limiting reactant!!)



$$0.334 \text{ mol NO}_2 \left| \frac{46.01 \text{ g}}{1 \text{ mol}} \right. = 15.4 \text{ g NO}_2$$

$$\frac{10.0 \text{ g NO}}{30.01 \text{ g NO}} \left| \frac{1 \text{ mol NO}}{1} \right. = 0.333 \text{ mol NO}$$

$$\frac{7.0 \text{ g O}_2}{32.00 \text{ g O}_2} \left| \frac{1 \text{ mol O}_2}{1} \right. = 0.219 \text{ mol O}_2$$

$$0.333 - 2x = 0$$

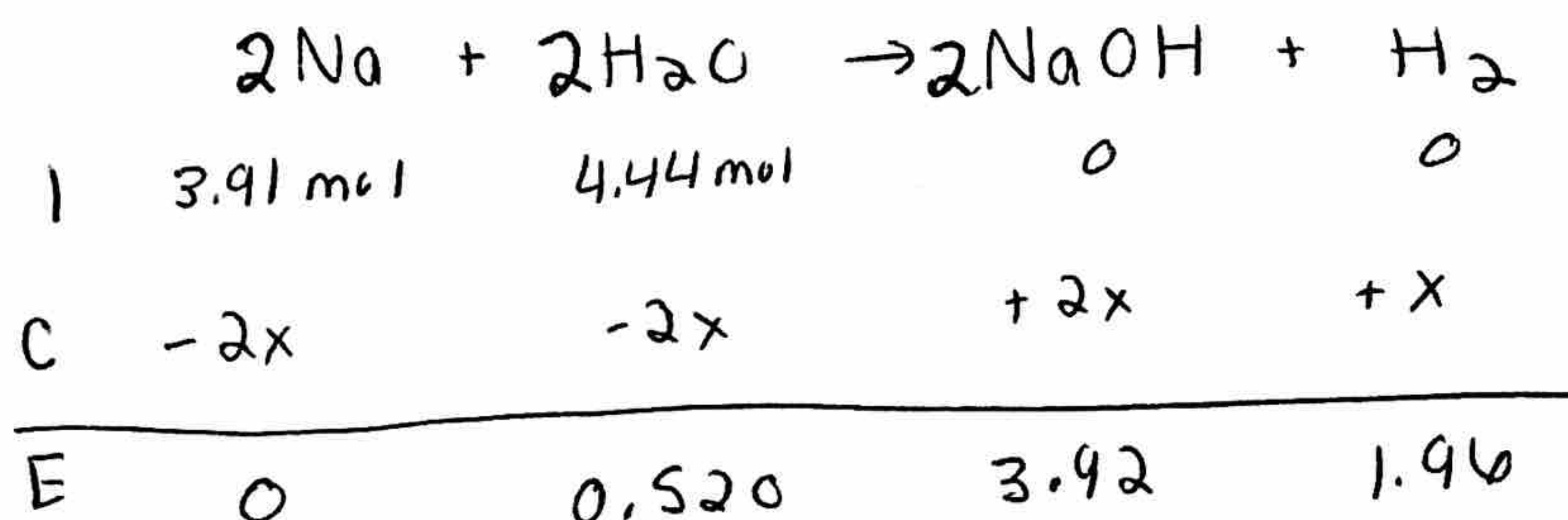
$$x = 0.167$$

$$0.219 - x = 0$$

$$x = 0.219$$

Question 5) Given: Sodium reacts with water to produce sodium hydroxide and hydrogen gas.

a) If 90.0 grams Na is dropped into 80.0 g H₂O, how many liters of H₂(g) will be produced at STP by the given reaction?



$$1.96 \text{ mol H}_2 \left| \frac{22.4 \text{ L H}_2}{1 \text{ mol H}_2} \right. = 43.9 \text{ L H}_2$$

$$\frac{90.0 \text{ g Na}}{22.99 \text{ g Na}} \left| \frac{1 \text{ mol Na}}{1} \right. = 3.91 \text{ mol Na}$$

$$\frac{80.0 \text{ g H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} \left| \frac{1 \text{ mol H}_2\text{O}}{1} \right. = 4.44 \text{ mol H}_2\text{O}$$

$$3.91 - 2x = 0$$

$$x = 1.96$$

$$4.44 - 2x = 0$$

$$x = 2.22$$

b) How much of the excess reactant is left over?

$$0.520 \text{ mol H}_2\text{O}$$

Percent, Actual, and Theoretical Yield

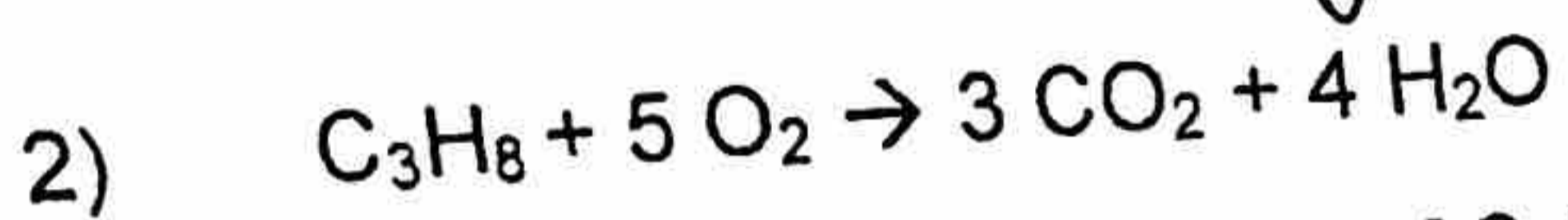


a) I began this reaction with 20 grams of lithium hydroxide. What is my theoretical yield of lithium chloride?

$$\frac{20 \text{ g LiOH}}{23.949 \text{ g LiOH}} \times \frac{1 \text{ mol LiOH}}{1 \text{ mol LiOH}} \times \frac{1 \text{ mol LiCl}}{1 \text{ mol LiOH}} \times \frac{42.391 \text{ g LiCl}}{1 \text{ mol LiCl}} = 40 \text{ g LiCl}$$

b) I actually produced 6 grams of lithium chloride. What is my percent yield?

$$\frac{6 \text{ g}}{40 \text{ g}} \times 100 = 15\% \rightarrow \text{20\%}$$



a) If I start with 5 grams of C_3H_8 , what is my theoretical yield of water?

$$\frac{5 \text{ g C}_3\text{H}_8}{44.094 \text{ g C}_3\text{H}_8} \times \frac{1 \text{ mol C}_3\text{H}_8}{1 \text{ mol C}_3\text{H}_8} \times \frac{4 \text{ mol H}_2\text{O}}{1 \text{ mol C}_3\text{H}_8} \times \frac{18.016 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 8 \text{ g H}_2\text{O}$$

b) I got a percent yield of 75%. How many grams of water did I make?

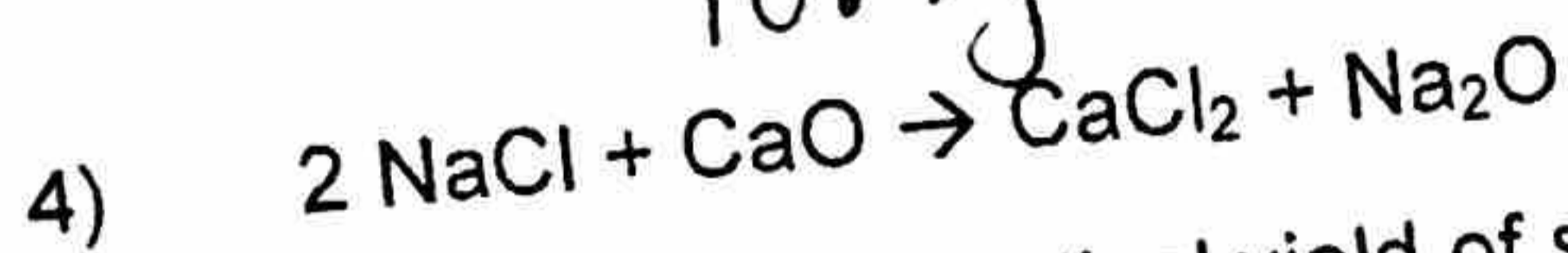
$$75\% = 100 \times \frac{x}{8} \rightarrow 8 \times 0.75 = \frac{x}{8} \times 8$$

$$6 \text{ g} = x$$



My theoretical yield of beryllium chloride was 10.7 grams. If my actual yield was 4.5 grams, what was my percent yield?

$$\frac{4.5 \text{ g}}{10.7 \text{ g}} \times 100 = 42\%$$



What is my theoretical yield of sodium oxide if I start with 20 grams of calcium oxide?

$$\frac{20 \text{ g CaO}}{56.08 \text{ g CaO}} \times \frac{1 \text{ mol CaO}}{1 \text{ mol CaO}} \times \frac{1 \text{ mol Na}_2\text{O}}{1 \text{ mol CaO}} \times \frac{61.98 \text{ g Na}_2\text{O}}{1 \text{ mol Na}_2\text{O}} = 22 \text{ g Na}_2\text{O} \rightarrow 20 \text{ g Na}_2\text{O}$$



a) What is my theoretical yield of iron (II) chloride if I start with 34 grams of iron (II) bromide?

$$\frac{34 \text{ g FeBr}_2}{215.65 \text{ g FeBr}_2} \times \frac{1 \text{ mol FeBr}_2}{1 \text{ mol FeBr}_2} \times \frac{1 \text{ mol FeCl}_2}{1 \text{ mol FeBr}_2} \times \frac{126.75 \text{ g FeCl}_2}{1 \text{ mol FeCl}_2}$$

= 20 g FeCl₂

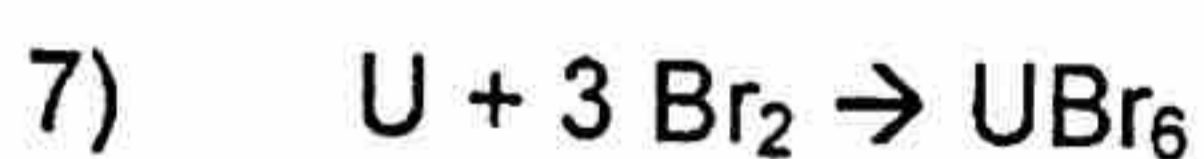
b) What is my percent yield of iron (II) chloride if my actual yield is 4 grams?

$$\frac{4 \text{ g}}{20 \text{ g}} \times 100 = 20\%$$



What is my percent yield of titanium (II) oxide if I start with 20 grams of titanium (II) sulfide and my actual yield of titanium (II) oxide is ~~22~~ ¹² grams?

$$\frac{20 \text{ g TiS}}{79.95 \text{ g TiS}} \times \frac{1 \text{ mol TiS}}{1 \text{ mol TiS}} \times \frac{1 \text{ mol TiO}}{1 \text{ mol TiS}} \times \frac{63.88 \text{ g TiO}}{1 \text{ mol TiO}} = 15.9 \rightarrow 20 \text{ g}$$

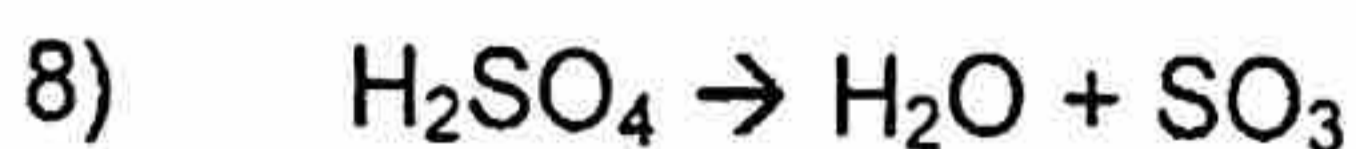


$$\frac{12}{20} \times 100 = 60\%$$

What is my actual yield of uranium hexabromide if I start with 100 grams of uranium and get a percent yield of 83%?

$$\frac{100 \text{ g U}}{238.04 \text{ g U}} \times \frac{1 \text{ mol U}}{1 \text{ mol U}} \times \frac{1 \text{ mol UBr}_3}{1 \text{ mol U}} \times \frac{477.74 \text{ g UBr}_3}{1 \text{ mol UBr}_3} = 200 \text{ g UBr}_3$$

$$83\% = 100 \times \frac{x}{200}$$



$$x = 166 \text{ g}$$

If I start with 89 grams of sulfuric acid and produce 7.1 grams of water, what is my percent yield?

$$\frac{89 \text{ g H}_2\text{SO}_4}{98.086 \text{ g H}_2\text{SO}_4} \times \frac{1 \text{ mol H}_2\text{SO}_4}{1 \text{ mol H}_2\text{SO}_4} \times \frac{1 \text{ mol H}_2\text{O}}{1 \text{ mol H}_2\text{SO}_4} \times \frac{18.016 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}}$$

$$\frac{7.1}{16} \times 100 = 44\% = 16 \text{ g H}_2\text{O}$$