INTRODUCTION TO LIMITING REACTANT

TARGET: TODAY I WILL BE ABLE TO DEFINE LIMITING REACTANT AND THEORETICAL YIELD. PG. 131

POST - ACTIVITY QUESTIONS:

① HOW MANY SHEEP WERE YOU ABLE TO MAKE?

    ↳ ONE. THIS IS AN EXAMPLE OF THEORETICAL YIELD. GIVEN ONLY A CERTAIN AMOUNT OF REACTANTS, THEORETICAL YIELD IS HOW MUCH OF A DESIRED PRODUCT IT IS POSSIBLE TO MAKE.

        (NOTE: IT IS THEORETICAL ONLY BECAUSE ACTUAL LABORATORY ERROR MAY RESULT IN A DIFFERENT AMOUNT, NOT BECAUSE IT IS INCORRECT).

② WHAT INGREDIENT WAS USED UP FIRST?

    ↳ THE PRETZELS, THERE WERE NOT ENOUGH TO MAKE A SECOND OR THIRD SHEEP. THIS IS AN EXAMPLE OF THE LIMITING REACTANT. THE LIMITING REACTANT IS THE REACTANT THAT IS USED UP FIRST IN A CHEMICAL REACTION. NOTE THAT IT IS NOT NECESSARILY THE REACTANT THAT IS IN THE SMALLEST AMOUNT.

        (NOTE: IT IS IMPOSSIBLE TO TELL IN A REAL CHEMICAL RXN WHICH REACTANT IS THE LIMITING REACTANT. STOICHIOMETRIC CALCULATIONS MUST BE PERFORMED).

③ WHAT INGREDIENTS DID YOU HAVE EXTRA OF?

    ↳ THE LARGE AND SMALL MARSHMALLOWS. ANY REACTANTS THAT ARE NOT ENTIRELY USED UP IN A CHEMICAL REACTION ARE CALLED "EXCESS REAGENTS" AND ARE SAID TO BE "IN EXCESS".
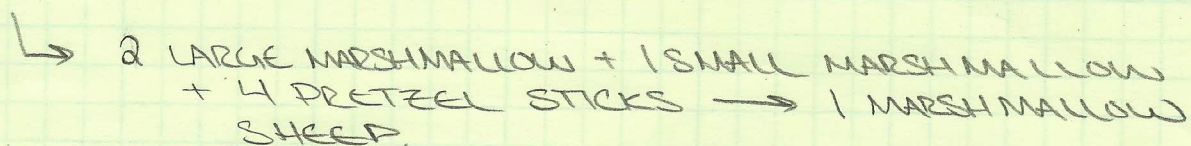
④ HOW MUCH EXTRA OF EACH INGREDIENT WOULD YOU NEED TO MAKE THREE SHEEP?

    ↳ 3 MORE LARGE MARSHMALLOW
       8 MORE PRETZELS
       0 MORE SMALL MARSHMALLOWS.

WHAT ARE SOME EXAMPLES OF LIMITING REACTANT IN REAL LIFE?

(STUDENT RESPONSES)

WRITE A BALANCED CHEMICAL EQUATION FOR THE REACTION THAT PRODUCED ONE MARSHMALLOW SHEEP.

↳ 2 LARGE MARSHMALLOW + 1 SMALL MARSHMALLOW + 4 PRETZEL STICKS ⟶ 1 MARSHMALLOW SHEEP.

USE UNIT ANALYSIS TO DETERMINE THE LIMITING REACTANT IN THE REACTION, GIVEN 3 LARGE MARSHMALLOWS, 3 SMALL MARSHMALLOWS AND 4 PRETZEL STICKS.

GIVEN	FIND	PROCEDURE
3 LARGE MARSH.	LIMITING	① WRITE GIVEN AND FIND
3 SMALL MARSH.	REACTANT	
4 PRETZEL		
2 LARGE MARSH : 1 SHEEP		② IDENTIFY MOLAR RATIO
1 SMALL MARSH : 1 SHEEP		OF EACH REACTANT TO
4 PRETZEL : 1 SHEEP		THE DESIRED PRODUCT

$$\frac{3 \, \cancel{LARGE \, MARSH}}{1} \left(\frac{1 \, SHEEP}{2 \, \cancel{LARGE \, MARSH}} \right) = 3/2 \, SHEEP$$

③ SET UP A PICKET FENCE FOR EACH GIVEN AMOUNT THAT SOLVES FOR THE PRODUCT.

$$\frac{3 \, \cancel{SMALL \, MARSH}}{1} \left(\frac{1 \, SHEEP}{1 \, \cancel{SMALL \, MARSH}} \right) = 3 \, SHEEP$$

* $$\frac{4 \, \cancel{PRETZEL}}{1} \left(\frac{1 \, SHEEP}{4 \, \cancel{PRETZEL}} \right) = \boxed{1 \, SHEEP}$$

④ CIRCLE THE SMALLEST PRODUCT PRODUCED

⟨ LIMITING REACTANT = PRETZELS ⟩

⑤ LOOK BACK TO THE REACTANT; THAT IS YOUR LIMITING REACTANT.

THEORETICAL YIELD

2.

FOR THE FOLLOWING EQUATION:

$$8Zn + S_8 \longrightarrow 8ZnS$$

IF 2.00 mol Zn REACT w/ 1.00 mol S_8:
WHAT IS THE THEORETICAL YIELD OF ZnS IN mol?
WHAT IS THE LIMITING REACTANT?

GIVEN
2.00 mol Zn
1.00 mol S_8
8 mol Zn = 8 mol ZnS
1 mol S_8 = 8 mol ZnS

FIND
___ mol ZnS
LIMITING REACTANT

$$\frac{2.00 \text{ mol Zn}}{1} \left(\frac{8 \text{ mol ZnS}}{8 \text{ mol Zn}} \right) = \boxed{2.00 \text{ mol ZnS}} \quad \text{THEORETICAL YIELD}$$

$$\frac{1.00 \text{ mol } S_8}{1} \left(\frac{8 \text{ mol ZnS}}{1 \text{ mol } S_8} \right) = 8.00 \text{ mol ZnS}$$

LIMITING REACTANT IS Zn

(IF EXTRA TIME)

FOR THE FOLLOWING REACTION: $HCl + NaOH \rightarrow NaCl$

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

IF 2.0 mol HCl REACTS WITH 2.5 mol NaOH, WHAT
IS THE THEORETICAL YIELD OF NaCl IN MOL?
WHAT IS THE LIMITING REACTANT?

GIVEN
2.0 mol HCl
2.5 mol NaOH
1 mol HCl = 1 mol NaCl
1 mol NaOH = 1 mol NaCl

FIND
___ mol NaCl
LIMITING REACTANT

$$\frac{2.0 \text{ mol HCl}}{1} \left(\frac{1 \text{ mol NaCl}}{1 \text{ mol HCl}} \right) = \boxed{2.0 \text{ mol NaCl}} \quad \text{THEORETICAL YIELD}$$

$$\frac{2.5 \text{ mol NaOH}}{1} \left(\frac{1 \text{ mol NaCl}}{1 \text{ mol NaOH}} \right) = 2.5 \text{ mol NaCl}$$

∴ HCl IS THE LIMITING REACTANT