Throw-Back Thursday #1

Topics for today:

1.) Limiting reactants
2.) Law of definite proportions
3.) Thermal decomposition lab
4.) Stoichiometry
5.) Law of multiple proportions

KEY

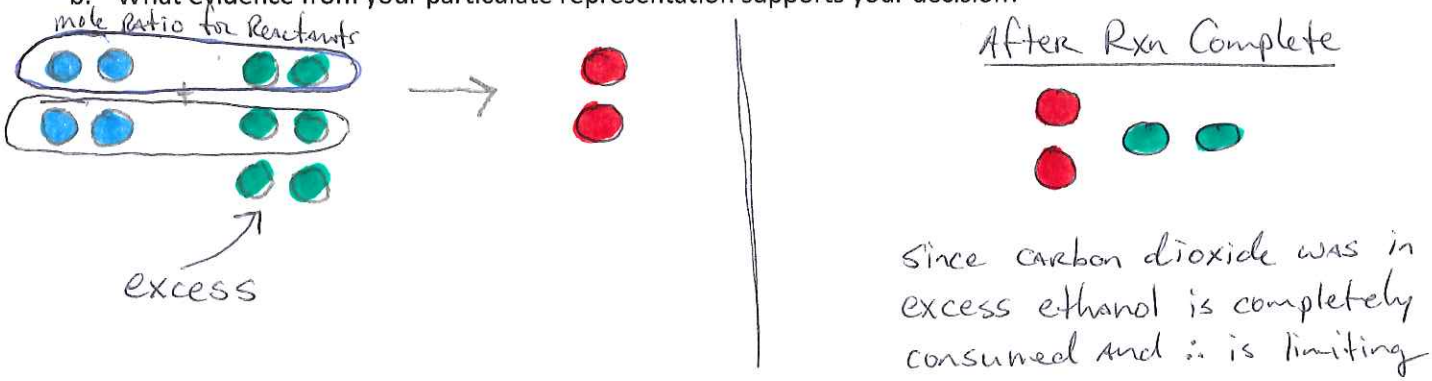
Limiting reactants:

$2\ C_2H_5OH_{(aq)} + 2\ CO_{2(g)} \rightarrow C_6H_{12}O_{6(aq)}$

Use the blue chips to represent ethanol (C_2H_5OH), green chips to represent carbon dioxide, and red chips to represent the carbohydrate ($C_6H_{12}O_6$).

1. 4 moles of ethanol and 6 moles of carbon dioxide were mixed together and the reaction proceeded until complete. Use the chips to create a representation of the initial and final molar abundances. You should transfer the particulate representation to your CHILL
   a. Was there a limiting reactant? If so, please identify it. Yes, ethanol was limiting

   b. What evidence from your particulate representation supports your decision?

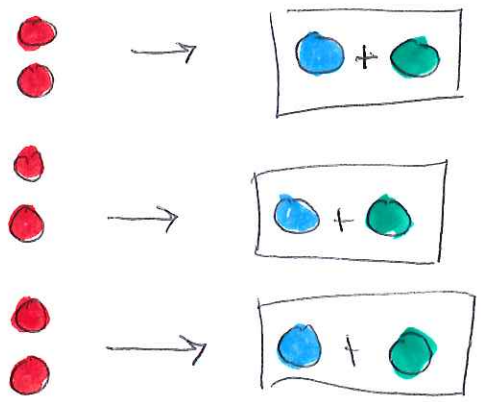


since carbon dioxide was in excess ethanol is completely consumed and ∴ is limiting

Thermal decomposition of natron lab:

$2\ NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + H_2O_{(g)} + CO_{2(g)}$

1. We thermally decomposed sodium bicarbonate and were able to measure the mass lost to be 1.657 grams. In the lab we just added together the formula mass of the water and carbon dioxide to convert the 1.657 g to moles and attributed it to the fact that it was because they were equimolar. Technically, this is not a law of definite proportions calculation but it is similar. Using blue chips to represent water and green chips to represent carbon dioxide explain why. You should transfer the particulate representation to your CHILL



For every 2 moles of $NaHCO_3$ that decompose 1 mole of CO_2 and 1 mole of H_2O are produced. Water cannot be produced without producing CO_2 ∴ CO_2 and H_2O therefore represent a constant composition of the mass loss, even though it is not definite proportions (they are different molecules and definite proportions describes the constant composition of a single compound)

note: we are ignoring Na_2CO_3 for simplicity

2. How many moles of water would you have using the information from question 1?

$\frac{1.657\ g\ \text{~~mass~~ lost } (CO_2 + H_2O)}{62.026\ g/mol\ (CO_2 + H_2O)} = 0.0267\ mol$

since $CO_2 : H_2O$ is 1:1

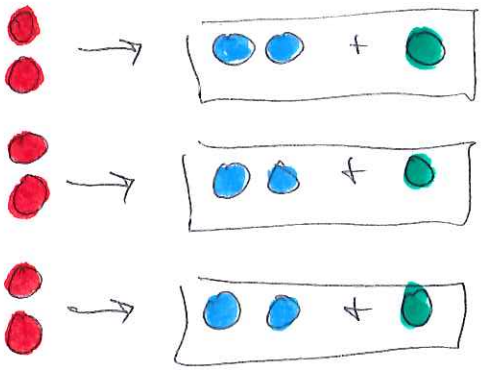
↳ 0.0267 mole CO_2 = 0.0267 mole H_2O

3. How many grams of sodium bicarbonate decomposed according to the information in question 1?

$0.0267\ mole\ H_2O \times \frac{2\ mole\ NaHCO_3}{1\ mole\ H_2O} = 0.0534\ mole\ NaHCO_3 \times 84.008\ g/mol = \boxed{4.49\ g\ NaHCO_3}$

4. How would the calculation be different if the molar ratio was 2 moles of water : 1 mole of carbon dioxide? Use the blue and green chips to represent water and carbon dioxide again and show how the calculation would differ from above. You should transfer the particulate representation to your CHILL

* Assuming ~~that~~ 2 moles of $NaHCO_3$ decompose, even though this does not represent a balanced equation *



since now there are 2 moles of water per mole of CO_2 produced new mass for $2H_2O + CO_2$ = 80.042 to account for additional H_2O

$\frac{g\ \text{Mass Lost}}{80.042\ g/mol} = \text{moles}$ → H_2O → Moles × 2 = moles H_2O

→ CO_2 → moles × 1 = moles CO_2

5. How many moles of water would you have if 1.657 grams of gas were lost given the mole ratios from question #4?

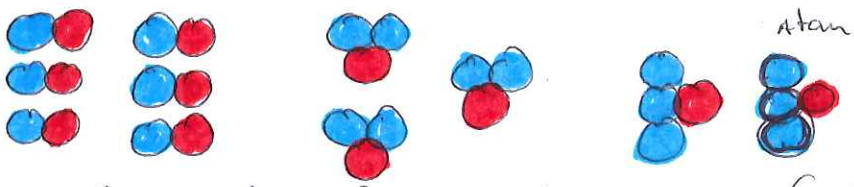
$\frac{1.657\ g\ \text{lost } (2H_2O + CO_2)}{80.042\ g/mol\ (2H_2O + CO_2)} = 0.0207\ mole$

H_2O → $0.0207\ mol \times 2 = 0.0414\ mole\ H_2O$

CO_2 → $0.0207\ mole \times 1 = 0.0207\ mol\ CO_2$

Law of Multiple Proportions

1.) Using the colored chips make a series of three molecules that would follow the law of multiple proportions and explain why they do. Be sure to transfer the particulate representations as particulate diagrams to your CHILL. The first molecule must contain 1 blue, the second 2 blue, and the third 3 blue. Predict what your mass ratios would be per gram of blue based on the molecules you created. Note: For Simplicity I assumed only 1 other atom bonded with blue in all cases



6 : 3 : 2 (ratio)

* the goal would be to get # of Blue present constant (total # present equal) between the 3 different molecules and then reds present represent ratios of combining masses