Hello everyone! Good job, y’all made it through another week!!

I’ll be posting weekly resources on the topics that will be covered in class the following week. Reach out to me if you need help with anything. Also do let me know if there are any specific resources you find helpful in the discussion board. If you cannot make it to Group Tutoring, remember these resources are available to you on the tutoring center website.

**Our Group Tutoring sessions will be every Wednesday from 5:15-6:15 PM. We will go over important topics that you will be covering in class and we will practice problems that you will need to be familiar with. You can reserve a spot at https://baylor.edu/tutoring. I hope to see you there!**

**Topics I’ll be covering:** limiting and excess reactants, theoretical yield, actual yield, percent yield, polar solvent (water), hydration definitions (solute, solvent, electric conductivity: strong electrolytes, weak electrolytes, non-electrolytes)

**Keywords:** Limiting Reactant, Percent Yield, Hydration, Reaction Types, Redox Reactions

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### TOPIC OF THE WEEK

#### Limiting and Excess Reactants

- One reactant can **limit** the amount of product that can form
- This limiting reactant will be **completely** used up in the reaction
- The reactant that is not the limiting reactant is in **excess** and will be **left over**

\[
\begin{align*}
90.0 \text{ g FeCl}_3 & \times \frac{1 \text{ mol FeCl}_3}{162 \text{ g FeCl}_3} \times \frac{6 \text{ mol HCl}}{2 \text{ mol FeCl}_3} \times \frac{36.5 \text{ g HCl}}{1 \text{ mol HCl}} = 60.8 \text{ g HCl} \\
52.0 \text{ g H}_2\text{S} & \times \frac{1 \text{ mol H}_2\text{S}}{34.1 \text{ g H}_2\text{S}} \times \frac{6 \text{ mol HCl}}{3 \text{ mol H}_2\text{S}} \times \frac{36.5 \text{ g HCl}}{1 \text{ mol HCl}} = 111 \text{ g HCl} \\
\text{Limiting Reactant} & = \text{FeCl}_3 \\
90.0 \text{ g FeCl}_3 & \times \frac{1 \text{ mol FeCl}_3}{162 \text{ g FeCl}_3} = \frac{6 \text{ mol H}_2\text{S}}{2 \text{ mol FeCl}_3} \times \frac{34.1 \text{ g H}_2\text{S}}{1 \text{ mol H}_2\text{S}} = 28.4 \text{ g H}_2\text{S reacted} \\
52.0 \text{ g H}_2\text{S} - 27.4 \text{ g H}_2\text{S} & = 23.6 \text{ g H}_2\text{S excess}
\end{align*}
\]

In the image on the left, 90 g of FeCl$_3$ produces 60.8 g of HCl which is smaller as compared to 111g of HCl produced by 52 g of H$_2$S. Therefore, FeCl$_3$ is the **limiting reactant** and H$_2$S is in **excess**.

https://www.chem.tamu.edu/class/141/notes/tutorialfiles/stoichiometryproblems.htm
In order to carry out limiting and excess reactant problems, it is very essential to know how to balance an equation.

To practice balancing equations and stoichiometry, I found these practice worksheets online that y’all can do. It might be helpful!

- [https://www.saddleback.edu/faculty/jzoval/worksheets_tutorials/ch6_worksheets/balancing_equations_worksheet_and_key_7_23_09.pdf](https://www.saddleback.edu/faculty/jzoval/worksheets_tutorials/ch6_worksheets/balancing_equations_worksheet_and_key_7_23_09.pdf)
- [http://www.chemistry.wustl.edu/~coursedev/Online%20tutorials/Plink/Stoichiometry/stoichset.htm](http://www.chemistry.wustl.edu/~coursedev/Online%20tutorials/Plink/Stoichiometry/stoichset.htm)

**HIGHLIGHT #1: Theoretical yield, Actual Yield, and Percent Yield**

**Theoretical Yield:** the amount of product that can be produced in a chemical reaction based on the amount of limiting reactant

**Actual Yield:** the amount of product that is actually produced; reported from experimental data (always smaller than theoretical yield)

**Percent Yield:**

The image on the left illustrates a practice problem for solving percent yield. Percent yield can be calculated by dividing Actual Yield with Theoretical Yield and multiplying the ratio by 100 to get a percent value.

In the problem on the left, 13.1 g is the actual yield and the theoretical yield is the expected mass that you solve for.

Steps to solving Percent Yield Problems:

1. Write a balanced equation
2. Identify the given mass of the reactant and identify the actual yield
3. Solve for the expected mass (theoretical yield) of product using the given mass of the reactant
4. Calculate the percent yield
HIGHLIGHT #2: Hydration reactions

Water (a polar solvent):
- Interaction between water molecules and ions of a salt might cause dissolution of salt
- Salts are broken up into individual cations and anions
- Called **hydration** when water molecules surround ions in solution

[Image of hydration reaction]


**Hydration of ammonium nitrate**

![Image of ammonium nitrate hydration]

https://letstalkscience.ca/educational-resources/stem-in-context/cold-pack-a-chilly-example-endothermic-reaction

HIGHLIGHT #3: Strong Electrolytes and Weak Electrolytes

**Solute:** substance dissolved  
**Solvent:** liquid water  
**Electrical conductivity:** the ability of a solution to conduct electricity  
i) Solutions with **high** electrical conductivity are **strong electrolytes**  
ii) Solutions with **low** electrical conductivity are called **weak electrolytes**  
iii) Non-electrolytes **do not** conduct electricity

<table>
<thead>
<tr>
<th>Strong Electrolytes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strong Acids</strong></td>
</tr>
<tr>
<td><strong>Strong Bases</strong></td>
</tr>
<tr>
<td><strong>Salts</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weak Electrolytes</th>
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<tbody>
<tr>
<td><strong>Weak Acids</strong></td>
</tr>
<tr>
<td><strong>Weak Bases</strong></td>
</tr>
</tbody>
</table>

The image on the left illustrates that strong electrolytes consist of strong acids, strong bases and salts. On the other hand, weak electrolytes consist of weak acids and weak bases. It is imperative to memorize the list of strong acids and bases to be able to identify if they will conduct electricity or not.
HIGHLIGHT #4: Types of Reactions:

1. **Precipitation reactions:** When two aqueous solutions are mixed, an insoluble product is formed (precipitate), which separated from the solution

<table>
<thead>
<tr>
<th>Compounds That Are Generally Soluble in Water</th>
<th>Compounds That Are Generally Insoluble in Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compounds containing the following ions are generally soluble</td>
<td>Exceptions (when combined with ions on the left, the compound will be <strong>INSOLUBLE</strong>)</td>
</tr>
<tr>
<td>Li⁺, Na⁺, K⁺, NH₄⁺</td>
<td>None</td>
</tr>
<tr>
<td>NO₃⁻, C₂H₂O₂⁻ (or CH₃COO⁻)</td>
<td>None</td>
</tr>
<tr>
<td>Cl⁻, Br⁻, I⁻</td>
<td>Ag⁺, Hg₂⁺, Pb₂⁺</td>
</tr>
<tr>
<td>SO₄²⁻</td>
<td>Ag⁺, Ca²⁺, Sr²⁺, Ba²⁺, Pb²⁺</td>
</tr>
</tbody>
</table>

2. **Acid-Base Reactions**
   - Acid is a proton donor (H⁺ in solutions)
   - Base is a proton acceptor
   - **Neutralization reaction:** Acid and Base Reacts to form Salt and Water

3. **Oxidation-Reduction Reactions**
   - Involves the transfer of electrons from one atom to another
   - Redox: reduction + oxidation
   - Oxidation: To lose electrons (OIL)
   - Reduction: To gain electrons (RIG)

CHECK YOUR LEARNING

1. What is the percent yield if a student makes 5.2 grams of carbon dioxide by decomposing 9.5 grams of aluminum bicarbonate?
   \[ \text{Al(HCO}_3\text{)}_3 \rightarrow \text{Al}_2\text{O}_3 + \text{CO}_2 + \text{H}_2\text{O} \]

2. Identify the oxidizing and reducing agents in the following equation:
   \[ \text{Al (s)} + 3\text{Ag}^+ (aq) \rightarrow \text{Al}^{3+} (aq) + 3 \text{Ag (s)} \]
THINGS YOU MAY STRUGGLE WITH

- Not balancing equations before identifying the limiting reagent. Balancing the reaction is so crucial and it is the very first step in the solving process.
- Not being able to identify the actual yield value when calculating the percent yield. The actual yield is always going to be mentioned in the question. Theoretical yield is a value we generally solve for.
- If the product has a solid formed, then it is a precipitation reaction. It is important to memorize which ions are soluble or insoluble. Memorize the two tables mentioned in the resource under the topic: Precipitation reactions.

Thank you!! Hope y’all have a great time learning chemistry! Please reach out if you have any questions and don’t forget to visit the Tutoring Center website for further information at www.baylor.edu/tutoring.

Answer key:

1. 86.6%

2. Al changes from 0 to +3, so Al is oxidized and Al(s) is the reducing agent
   
   Ag changes from +1 to 0, so Ag is reduced and Ag+ (aq) is the oxidizing agent