Labware

Equipment without exact measurements

- Erlenmeyer Flask

Beaker

- These normally have graduations (marks labeling volume), however they have a lot of error in them. Most beakers are even labeled ± 5% (the accuracy of measure).

Lesser accuracy

- Lesser accuracy is NOT always bad!!
- We do most of our reactions in beakers.
- If the value will be necessary for a mathematical calculation, you need to be accurate (when adding a specific moles of analyte).
- If it will not be needed for a calculation, or it is added in excess you don't need to be accurate (when adding enough water to cover the pH probe).

Stirring

- This can be a major cause of error in a lab.
- Solutions and reaction vessels can stratify, form layers of different concentrations.
- If you measure a point that that is not properly mixed your readings can be way off.
- If you use the top of a solution and it is not properly mixed it can mess up and entire lab.

Graduated Cylinders

- Significantly more accurate than a beaker, but less accurate than anything volumetric.
- Larger graduated cylinders tend to be less accurate.
- They are always necessary for measuring unknown amounts or what is produced.

Volumetric Flask

- Most accurate.
- Only good for making starting reactant solutions.
- **Difficult to clean**
- You should never attempt to "dry" them with a paper towel. If you are filling the flask with water, it won't matter if it is not dry!
- For almost all solutions add a certain amount of a chemical and fill with distilled water to the line.
- https://www.youtube.com/watch?v=R4nCkc0IF3Y&feature=youtu.be

Drying & Rinsing

- It is important to "rinse" burettes and pipettes with the solution they will be dispensing
- This should flush out any excess water.
- This is important because these dispense certain volumes of a liquid of known concentration.
- If extra water were present, it would introduce error into our reading.

Volumetric pipette

- Requires some device to cause suction. Either a pipette bulb or a filler may be used.
- **They are also very difficult to clean.**
- They normally need to be "**rinsed**" with the solution they will dispense before use.
- Instead of drying, you "rinse" by taking a small amount of solution into the beaker then throwing it into the waste container.
- https://www.youtube.com/watch?v=te_WOyaUqME&feature=youtu.be

Burette

- Used for titrations or adding specific amounts of one solution into something else.
- The solution in the burette is called the titrant, it is normally the known solution.
- The solution in the beaker is the analyte, it is normally the unknown.
- https://www.youtube.com/watch?v=Pty9TCZ8z5w&feature=youtu.be

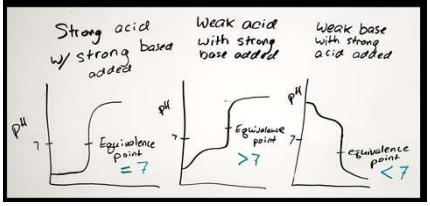
Indicators

- Indicators change color in the presence of whatever it is they happen to indicate.
- We have used a variety of acid/base indicators such as litmus, phenolphthalein, and indigo carmine. This have different colored products and reactants. As the concentrations change from products to reactants we see a color change.
- The permanganate, hydrogen peroxide redox reaction is naturally indicated. It goes from purple to clear during the reaction.
- We technically didn't need the probe.

Titrations without probes

- When titrations are done with indicators you look for the **end point**, the point where the color changes.
- You need a conceptual understanding the reaction to ensure the **color change** will happen during the **equivalence point**, where moles of titrant equal moles of analyte, to make is so it is very near the **end point**.
- An acid base indicator is a separate equilibrium that is stressed by the reaction.
- An indicator with a pKa near the pH of the equivalence point in needed!

Titration curves

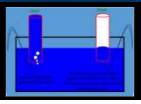


Mass

- You get mass with a scale.
- To get the mass of a liquid or some messy solid you weigh a weighting tray or a beaker, then add the substance to the tray or beaker and weigh again. You then subtract.
- This is similar to the water displacement method to get the volume of a solid.
- The expensive scale is called a quantitative balance.

Gas collection over water

- Gases can be difficult to collect. It is normally done over water.
- A container is filled with water then flipped upside down in water. The water will be suspended by atmospheric pressure.
- A gas is then bubbled into the water and collected.
- You do have to subtract the partial pressure of water vapor with this method! However, that is a constant that would be given. http://www.wiredchemist.com/chemistry/data/vapor-pressure



Common Calculations

- Density = mass / volume
- Molar Mass = mass / moles
- Mass percent = (mass of part / mass of whole)x100
- Percent error = (| observed – actual | / actual) x100
- Always read what is given carefully. If a sample contains something, that doesn't mean it is pure. A 3.4 g sample containing iron (III) chloride is not 3.4 g of $FeCl_3$