Friday quiz 8-9, 1-2 or 4-5; take it in Chem100 or Chem111 lab
- Know solubility rules
- 20-30 minutes
- Bring a calculator (needs to have sci. notation)

In lab, this week's determination is designed to introduce you to measurements.

Next week, determination of KHP
graded on % KHP value; % KHP = \( \frac{g \text{ KHP}}{g \text{ sample}} \) \times 100
sample

Dry sample, weigh it to get value

- Use chemistry

KHP \xrightarrow{\text{water}} K^+ + HPO_4^{2-}

100% conversion

(Titration)

Controlled major run.

Carry out run: HPO_4^{2-} + \text{OH}^- \rightarrow \text{H}_2\text{O} + \text{P}_2\text{O}_7^{2-}

- How many HPO_4^{2-}'s do you have?

This run will go until one reactant gets used up

- If known # HPO_4^{2-}, know # KHP; know mmoles KHP; get g KHP

Control" means want to achieve condition where both reactants are limiting reagents
it can get that condition, can determine amount analyte

The condition where both reactants are limiting reagents is called the equivalence point.

How are we going to do this?
When throw in one \text{OH}^-, get run w/ one HPO_4^{2-}
Sooner or later, have one last HPO_4^{2-} in solution
Need signal when last HPO_4^{2-} reacts w/ \text{OH}^-

A titration (any chem run) takes place particle by particle

How do we do this in lab? When we can't work particle by particle
- the "scoreboard" is critical
- we need some way to scale up the process to the human scale (bulk level)
- the unit that allows you to scale up is the mole
  \[ \text{molecules per mole} \]
- in lab, easiest to work with clumps of particles of \(6.02 \times 10^{23}\) mmoles, moles, mL, liters
- keep track of # of mmoles of titrant, will know # of mmol of analyzed present

\* how do you actually get the # of mmoles?

\[ \text{Titration} \]

Measure a volume (use a buret that allows you to measure \(\ldots\) mL)

\[ \text{vol mL} \times \frac{\text{conc mmol}}{\text{ML}} = \text{mmoles} \]

you get # mmoles indirectly

\* how do we know when to stop adding \(\text{OH}^-\)?
- need an indicator, something that changes color abruptly
- since an A/B rxn, use A/B terms
  \[ \text{acid} + \text{base} \rightarrow \text{water} + \text{salt} \]
  \[ \text{HP}^- + \text{OH}^- \rightarrow \text{H}_2\text{O} + \text{P}^2^- \] (classic neutralization rxn)
- if we hit the equivalence pt., what is the pH? not 7 b/c of something called minor reactions. (at equiv. pt., pH can be 7, depending on the actual case)

A hierarchy:
- bulk material in water \(\rightarrow\) major change or not?
  \(\text{KHP} \rightarrow \text{K}^+ + \text{HP}^-\), material breaks up
- carry out major rxn, rxn controlled by a limiting reagent
  \(\text{HP}^- + \text{OH}^- \rightarrow \text{H}_2\text{O} + \text{P}^2^-\)
- look around for any minor rxns
  (we'll develop this characterization)
Overall titration template:

\[
\frac{\text{titrant}}{\text{analyte}} \quad \text{(Vol \ ML \ OH^-)} \quad \text{(Conc \ MMol \ OH^-)} \quad \left( \frac{1 \ \text{HPO}_4^-}{1 \ \text{OH}^-} \right) \quad \text{(KHP \ wt. \ mg)} \quad \left( \frac{100\%}{\text{wt. sample \ mg}} \right) = \% \text{ KHP}
\]

- don't titrate KHP, titrate HPO_4^-, but know conversion relationship

Quality of measurements

Where are the measurements in this titration?

Vol OH^- & weight sample are raw measurements
Conc. OH^- is a processed measurement, was calculated

Standardization step exists to generate a concentration value to the needed level of quality

? how know what level of quality needed? how gd. does answer have to be?

for this det'n, \% KHP

↑ Value out to 100ths place

This result is a consequence of several steps, linked together in practical terms, any of measurements you have need to be to at least this level of quality

(use sig figs for time being to evaluate quality, 4 figures)

Can always get a nice to high enough level of quality for your work

\[1 \ \text{HPO}_4^- / 1 \ \text{OH}^- \text{ has no sig fig limitations}\]