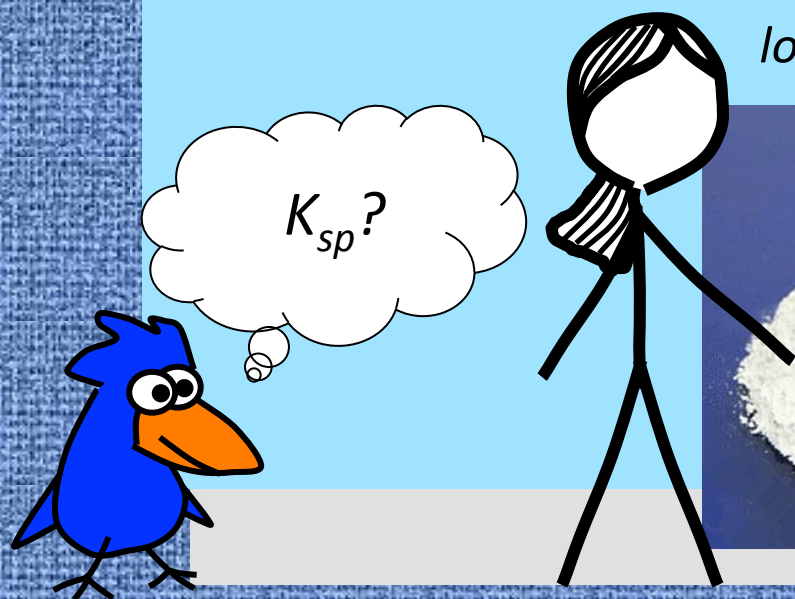


Determination of K_{sp} for Calcium Hydroxide

20 February 2020

This is what calcium hydroxide looks like... It costs \$160/ton.



Hmmm. So if we all chip in \$4...



*Photo credit:
Alibaba.com*

Objectives: To determine a useful value: an equilibrium constant.

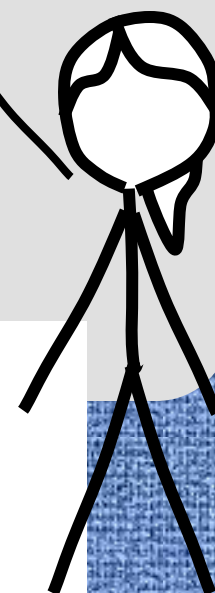


Today we will perform a colorful titration on our way to estimating a value of an equilibrium constant for a sparingly soluble salt.

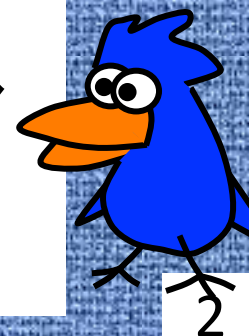
Overview:

1. The equilibrium constant of a sparingly soluble ionic solid.
2. Overview of the experiment and calculations.
3. The titration
4. Procedure: What we do today
5. Your lab report

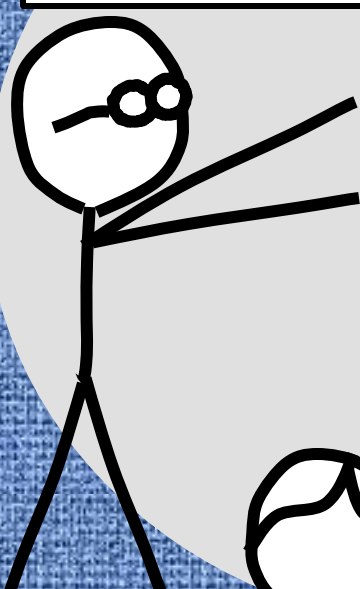
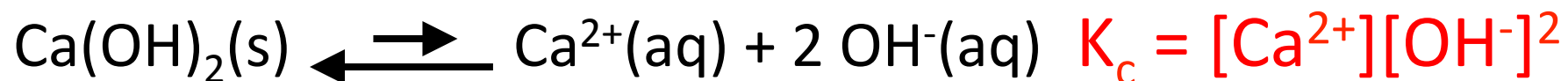
The salt we will study is $\text{Ca}(\text{OH})_2$ which is only a little soluble.




I use the word sparingly sparingly.



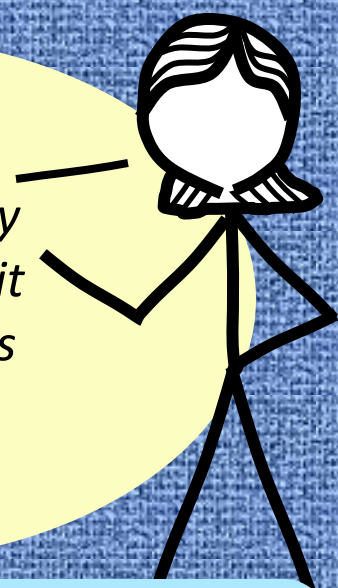
1. The equilibrium constant of a sparingly soluble ionic solid.



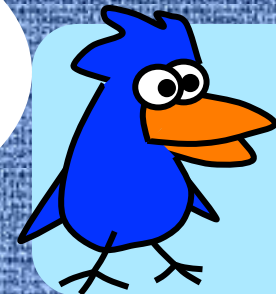
This is the equilibrium we will study. We know K_c is stuff on the right divided by stuff on the left and we ignore solids.



Arrows going both ways means we have an equilibrium.



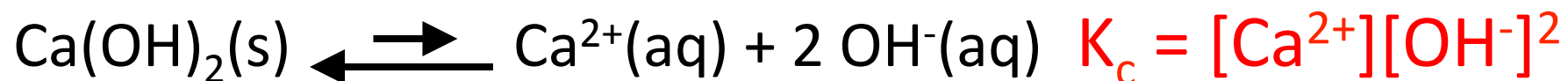
Calcium hydroxide does not dissolve very much, but the little bit that does, dissociates 100% into ions...



...because all ionic substances that dissolve dissociate 100% into ions. Even sparingly soluble ionics do this.

Info for
Introduction

2. Overview of the experiment and calculations

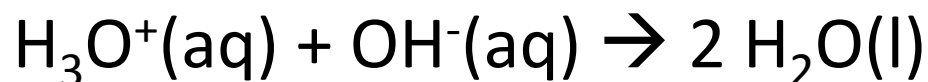


If we titrate the OH^{-} with a known concentration of $\text{HCl}(\text{aq})$, we can figure out moles of HCl used by using

$$n_{\text{acid}} = M_{\text{acid}} V_{\text{acid}}$$

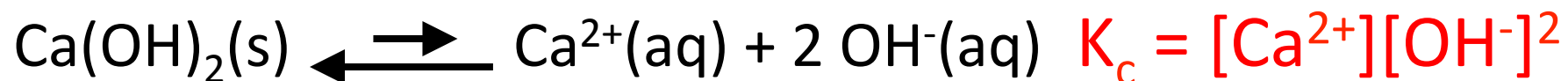
$$n = MV$$

And from there we can figure out the moles of OH^{-} that were present from the 1:1 stoichiometry of the acid-base titration. The moles of OH^{-} equals the moles of H_3O^{+} , $n_{\text{base}} = n_{\text{acid}}$.




Info for
Introduction

2. Overview of the experiment and calculations



Here's our "road map". From moles of OH^{-} , we get the molarity of OH^{-} . That gives us $[\text{Ca}^{2+}]$ from the 2:1 stoichiometry. With $[\text{OH}^{-}]$ and $[\text{Ca}^{2+}]$ we calculate K_c ! Easy peasy.


$$n_{\text{OH}^{-}} = n_{\text{H}_3\text{O}^{+}}$$

$$[\text{OH}^{-}] = \frac{n_{\text{OH}^{-}}}{V_{\text{original Ca(OH)}_2 \text{ Sol'n}}}$$

$$[\text{Ca}^{2+}] = \frac{[\text{OH}^{-}]}{2}$$

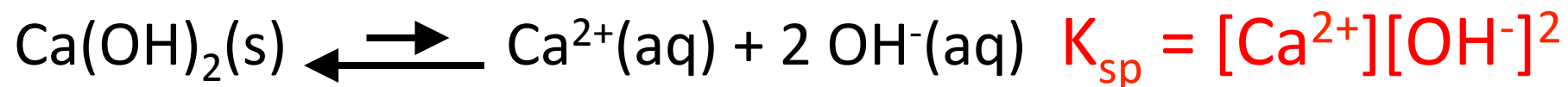
$$K_c = [\text{Ca}^{2+}][\text{OH}^{-}]^2$$

Psssst. 5.00 mL.
You're welcome.



Info for
Introduction

2. Overview of the experiment and calculations



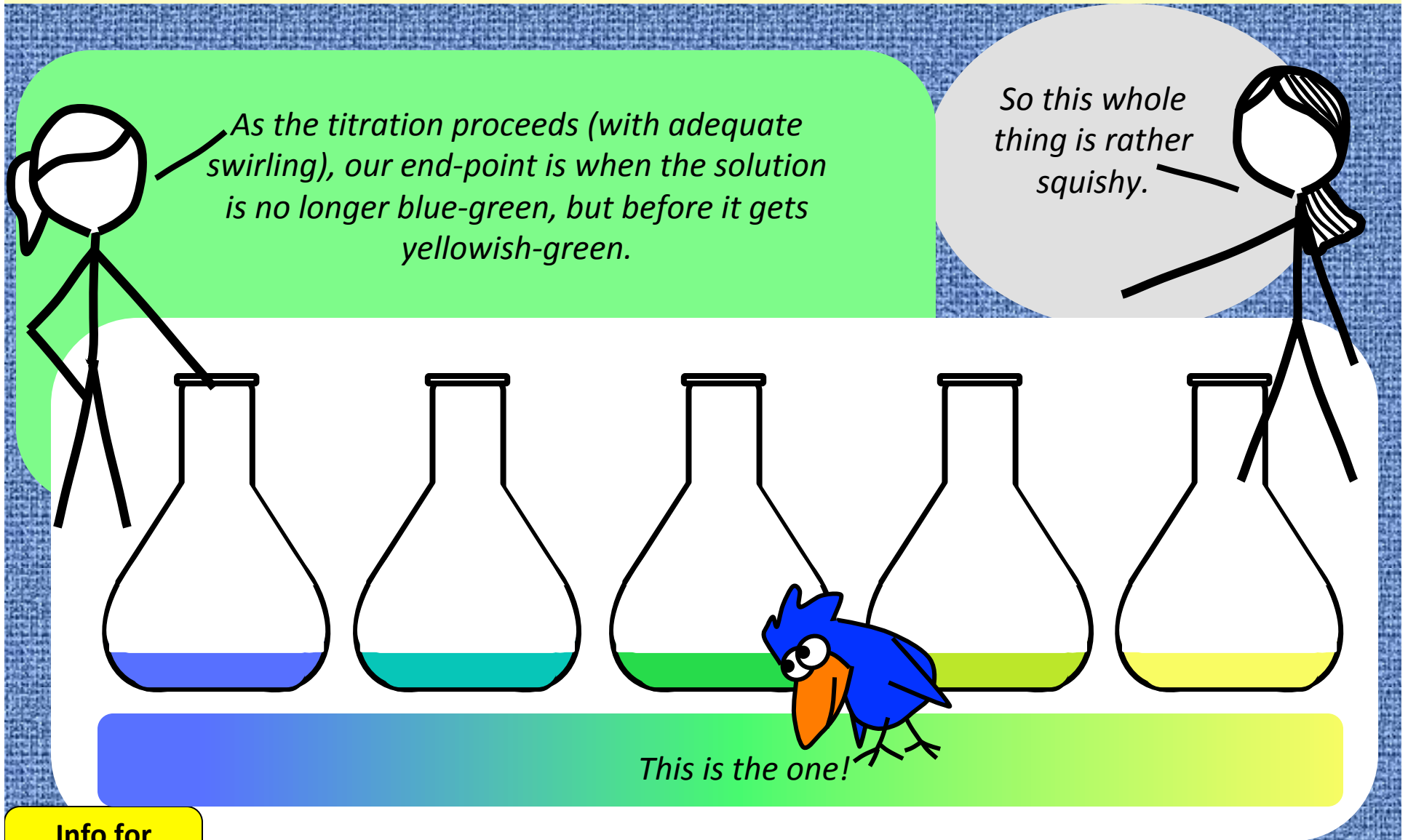
$$K_c = [\text{Ca}^{2+}][\text{OH}^{-}]^2 \quad \text{or} \quad K_{\text{sp}} = [\text{Ca}^{2+}][\text{OH}^{-}]^2$$

Here is the simplest slide ever! K_c is given a new name, K_{sp} – just to remind readers that the equilibrium constant has something to do with solubility.

... it also means super parrot. Just sayin'

*The **sp** in K_{sp} stands for solubility product.*

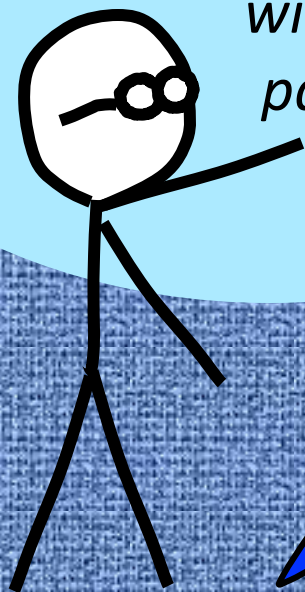
3. The titration



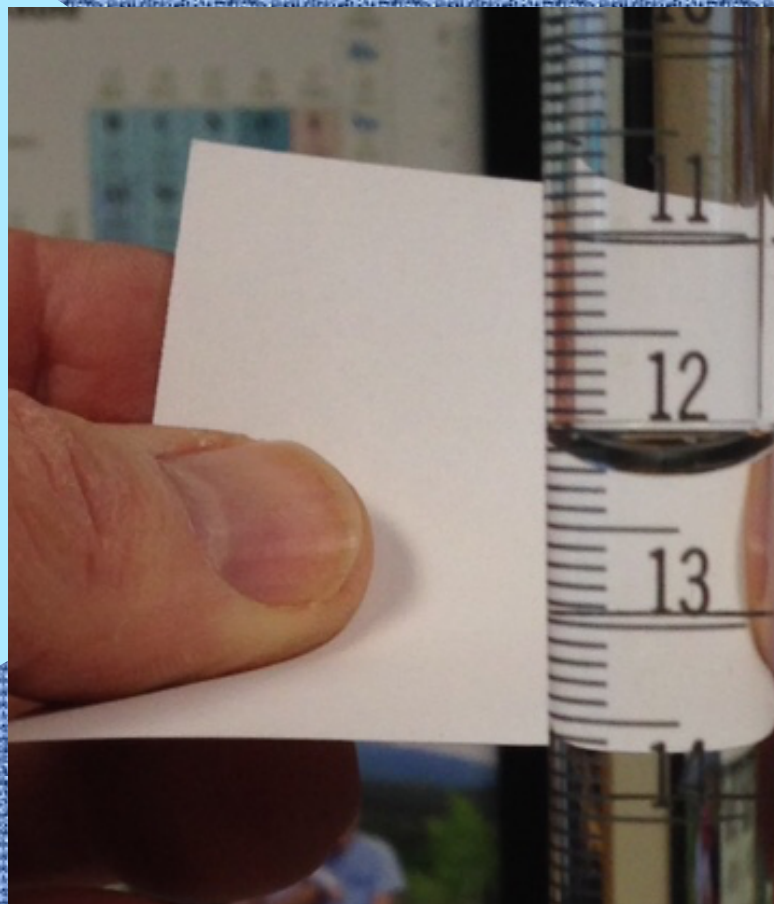
3. The titration

Use a 3 x 5 notecard as a light scoop...

... and compare what you get with your partner.



This is how to prevent buret reading errors.

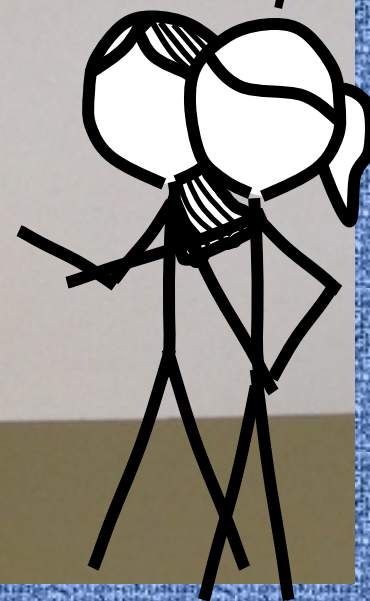


What did you get?

12.22. You?

The same

Good!

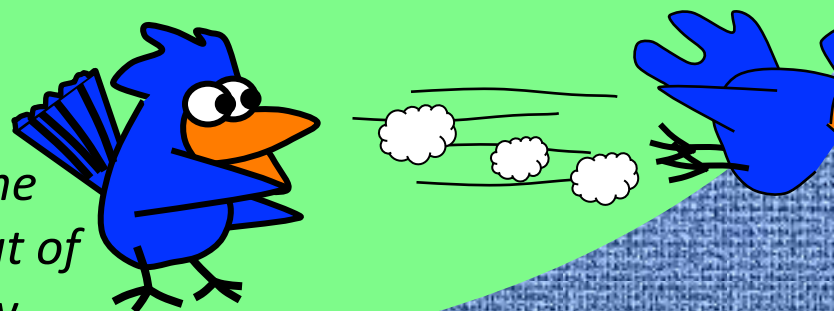


3. The titration

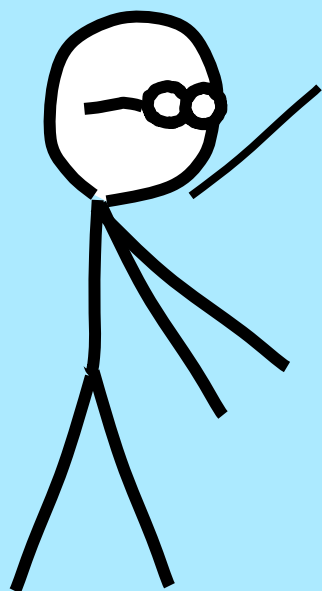
We can speed titrate! The volume of acid used in the first trial will be similar to the volumes needed in the next trials. That lets us “speed titrate”. Suppose the first titration took 15.05 mL? That means the other titrations will take about the same – so we can jet in the first 12 or 13 mL and then slow down for the perfect middle-green.

If you “think” maybe you should add one more drop, write down the buret volume before you do – just in case it was a bad idea.

This is me getting out of lab early.



4. Procedure: What we do today

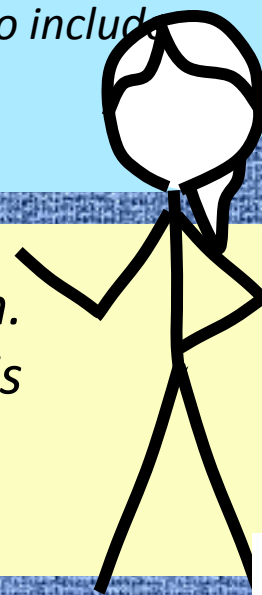


- ① *Take time writing an introduction in your own words before lab.*
- ② *Record observations and details as carefully as possible. Show your calculations with formulas, units, and significant figures!*
- ③ *After the first titration is done, the subsequent titrations will take about the same volume of HCl(aq).*
- ④ *Compare your K_{sp} with the literature value (from our textbook or the internet). Cite your reference.*
- ⑤ *The cover sheet summarizes everything that you need to include with your report.*



Only this one way will work!

*You'll be entering data into a Google form. Exponential numbers are entered as in this example: 8.00×10^{-6} would be entered as **8.00E-6** – note there are no spaces!*



5. Your lab report

- ① First, the cover page with TA initials.
- ② Next, the trimmed copy pages from your lab notebook stapled together. Staple all together.
- ③ **On-line results** due at the end of class today. **Late submissions are not graded – see the syllabus.**
- ④ No attached pages today.
- ⑤ Turn in lab report today or ***before*** the start of class tomorrow. **Late labs may not be graded – see the syllabus.**

