

N50 – Titrations

Our last lecture of the year!

TARGET:

I can use the technique of titrations and stoichiometry in order to determine the concentrations of unknown acid/base solutions.

What is titration?

A way to determine the concentration of an unknown substance.

- Uses the fact that acids and bases react with each other in “neutralization reactions”
- At the point where the neutralization reaction is finished
 $\# \text{ moles Acid} = \# \text{ moles Base}$

What is titration?

Titrand

The unknown solution you are interested in

Titrant

The solution with the known concentration

End Point or Equivalence Point

The point at which all the titrand has reacted with the titrant.

Moles Acid = # Moles Base

Question #1: What is our
titrand? What is our titrant?

Titrand = HCl









Titrant = NaOH

How do you know you reached the end point?









Use an **INDICATOR**

Turns colors based on pH – can show you visually when you have reached the end point.

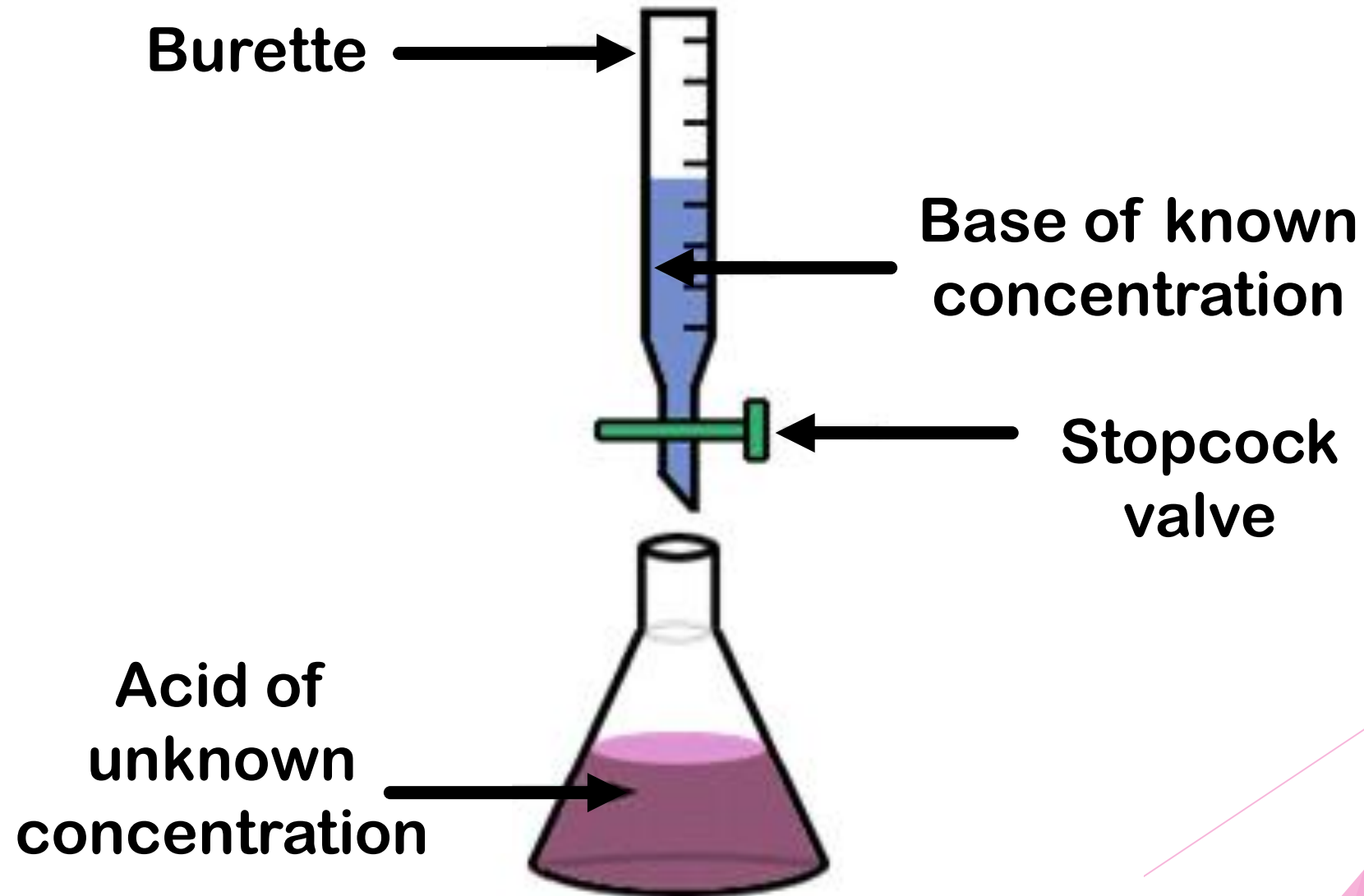
Pick the right indicator!

	pH range for color change								
	0	2	4	6	8	10	12	14	
Methyl violet	Yellow			Violet					
Thymol blue	Red			Yellow		Yellow			Blue
Methyl orange		Red			Yellow				
Methyl red			Red			Yellow			
Bromthymol blue				Yellow			Blue		
Phenolphthalein					Colorless			Pink	
Alizarin yellow R						Yellow			Red

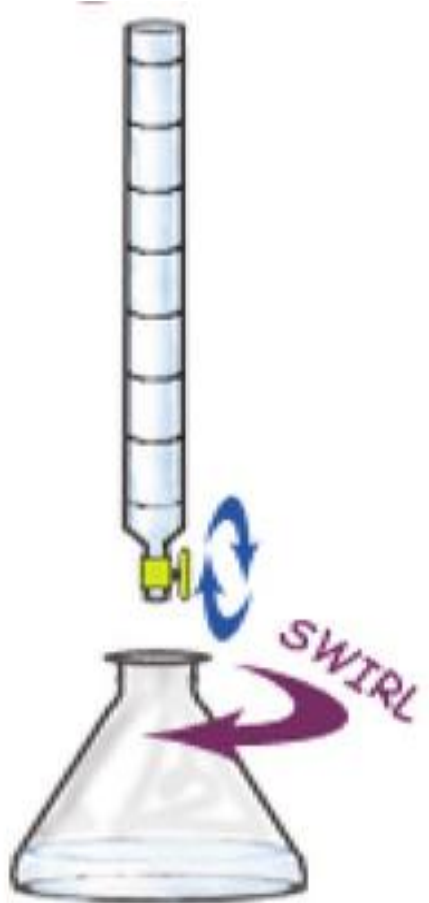
Question: Which indicator should we pick? Our unknown will be in the 8-10 range.

	pH range for color change									
	0	2	4	6	8	10	12	14		
Methyl violet	Yellow			Violet						
Thymol blue		Red			Yellow		Yellow			Blue
Methyl orange			Red			Yellow				
Methyl red				Red			Yellow			
Bromthymol blue				Yellow			Blue			
Phenolphthalein					Colorless			Pink		
Alizarin yellow R						Yellow			Red	

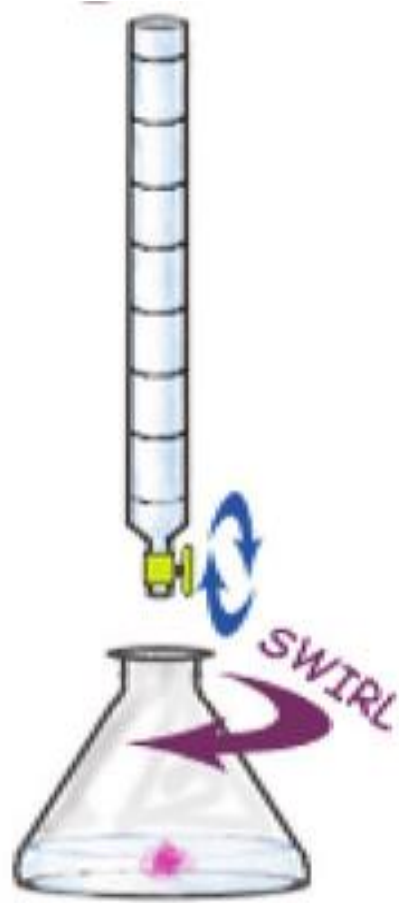
Lab Set Up



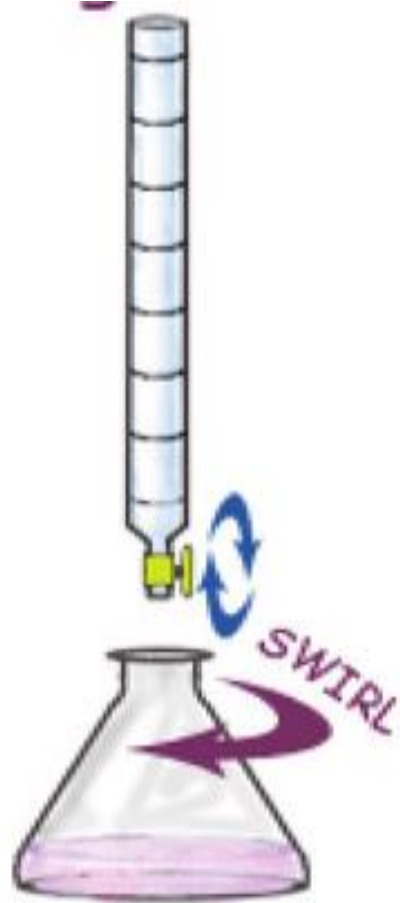
Careful! Don't go too fast!



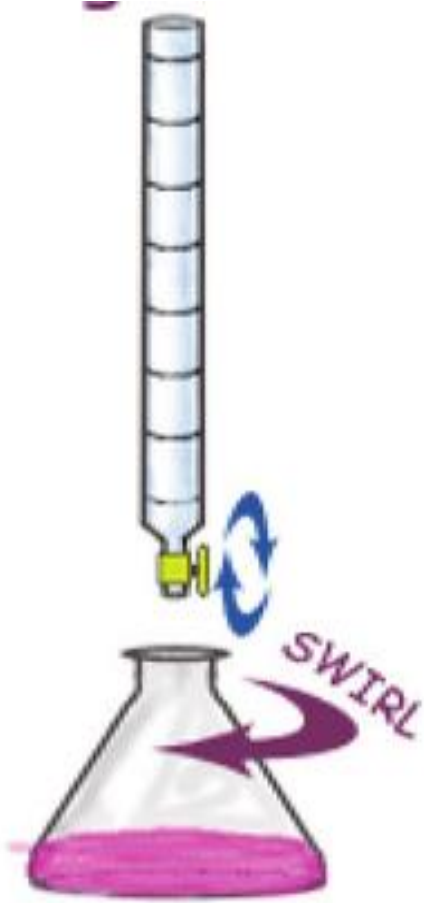
Startpoint



Slow Down



Endpoint



Too Far

Lab Set Up

- 1) Make sure everything is rinsed with distilled water
- 2) Clamp burette into burette clamp onto a ring stand
- 3) Fill burette with NaOH with a known concentration
- 4) Put a beaker under burette and slowly open valve, letting some NaOH out until bottom of meniscus is reading at an easy to read value. Careful! Make sure that the entire tip of the burette is filled with NaOH.

Lab Set Up continued...

- 5) Using a graduated cylinder, put a known volume of your titrand (unknown concentration) into an Erlenmeyer flask.
- 6) Add a small amount of appropriate indicator to the flask.

Set up your lab station

**Burette's are already clamped
in for you, and filled with NaOH**

– not super safe to fill them, so I did it for you.

How many trials to do?

Do **FOUR** trials (typically)

1st Trial – Rough trial – “Quick and dirty”
Just a rough estimate so you have an idea of when you need to start slowing down

2nd – 4th Trials – Real ones – Be careful!

Set up your Data Table

Titration of Unknown HCl Solution with Phenolphthalein				
[] of Titrant:			Volume of Titrand Used:	
	Rough Trial	Trial #1	Trial #2	Trial #3
Burette Starting Volume (mL)				
Burette Ending Volume (mL)				
Volume of Titrant Used (mL)				

Every group needs to do one rough trial, and each person will do a trial. Four people in a group = Four trials. Make the right number of columns in your table!

Set up your Data Table

Titration of Unknown HCl Solution with Phenolphthalein				
[] of Titrant:		Volume of Titrand Used:		
	Rough Trial	Trial #1	Trial #2	Trial #3
Burette Starting Volume (mL)				
Burette Ending Volume (mL)				
Volume of Titrant Used (mL)				

Perform Rough Trial

Titration of Unknown HCl Solution with Phenolphthalein				
[] of Titrant:			Volume of Titrand Used:	
	Rough Trial	Trial #1	Trial #2	Trial #3
Burette Starting Volume (mL)				
Burette Ending Volume (mL)				
Volume of Titrant Used (mL)				

Each person does their trial

Titration of Unknown HCl Solution with Phenolphthalein				
[] of Titrant:		Volume of Titrand Used:		
	Rough Trial	Trial #1	Trial #2	Trial #3
Burette Starting Volume (mL)				
Burette Ending Volume (mL)				
Volume of Titrant Used (mL)				

Calculate how many moles of NaOH you used

Moles used = Volume x Concentration

Moles = L x mol

$$\text{Moles NaOH} = \frac{\text{L}}{\text{L}} \times \frac{\text{mol}}{\text{L}}$$

$x \text{ mL}$	1 L	$Y \text{ mol}$
	1000 mL	1 L

Calculate the unknown concentration of the acid

At End Point \rightarrow Moles NaOH = Moles HCl

Moles used = Volume x Concentration

Moles NaOH used = L Acid x $\frac{\text{mol Acid}}{\text{L}}$
(same as mol acid!)

Come check what your unknown concentration of Acid was!

Calculate the % error for each person's acid – let's see which person had the most accurate titration per group!

Average your group member's answers together – report % error of averaged data on the whiteboard – let's see which group had the best titration skills!