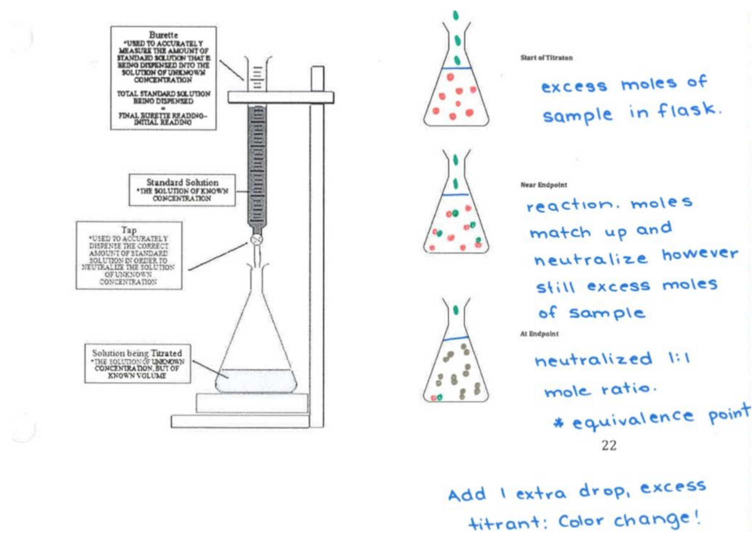
Science 30	Unit B: Chemistry
Lesson 5 - Quantifying Acidity	84 mins

Qualitative vs Quantitative

Observations of the senses: - Colour, Bubbles, Heat, etc.	Observations of Instruments - Numbers, Temp., pH, Concentration, etc

Titration

- A technique used to determine the concentration of an unknown solution by reacting it with a completely known solution.



Calculating Concentration

Concentration of A $\longrightarrow$ Moles of A $\longrightarrow$ Moles of B $\longrightarrow$ Concentration of B

$\frac{mol}{L} \times L$ Mole Ratio! $\frac{WANTED}{GET\ RID\ OF}$ $mol \times \frac{1}{L}$

Concentration to moles: multiply by litres

To change moles to another type of moles: use the mole ratio

Turn moles to concentration: divide by litres!

Examples

Consider the reaction

$$H_3PO_4 + 2KOH \rightarrow K_2HPO_4 + 2H_2O$$

If 19.8 mL of H_3PO_4 with an unknown molarity reacts with 25.0 mL of 0.500 mol/L KOH, What is the molarity of the H_3PO_4?

$$[H_3PO_4] = \frac{0.500mol}{1L} KOH \times 0.0025L \times \frac{1H_3PO_4}{2KOH} \times \frac{1}{0.0198L}$$
$$[H_3PO_4] = 0.316\ mol/L$$

Consider the reaction

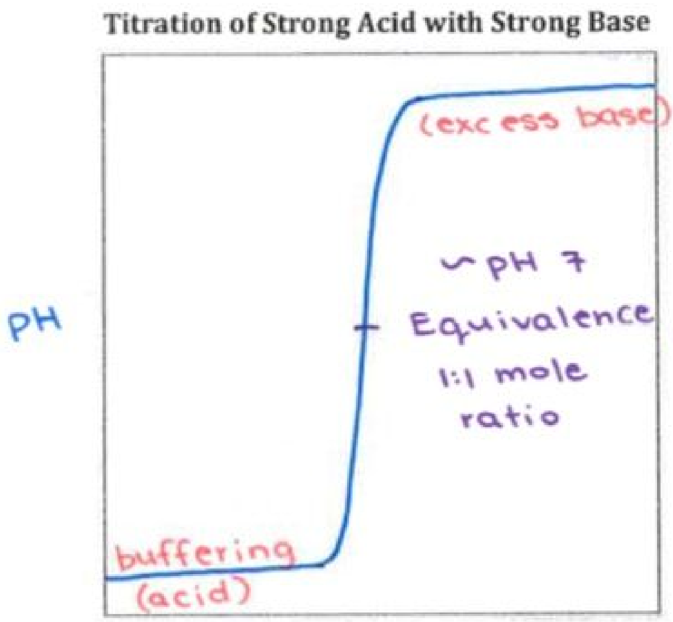
$$2CH_3COOH + Ca(OH)_2 \rightarrow Ca(CH_3COO)_2 + 2H_2O$$

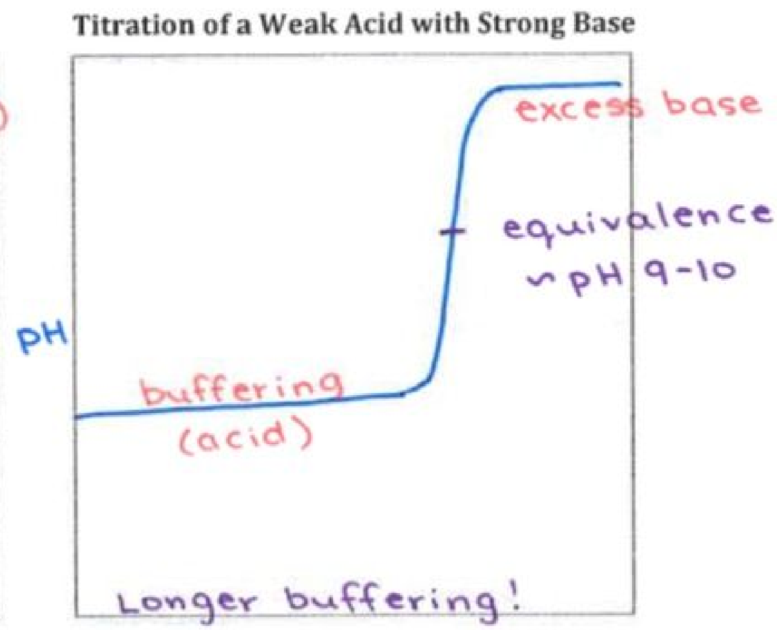
What volume of 0.200M $Ca(OH)_2$ is required to react with 125 mL of 0.250M acetic acid?

$$L\ Ca(OH)_2 = \frac{0.250mol}{L} \times 0.125L \times \frac{1}{2} \times \frac{1L}{0.200mol}$$

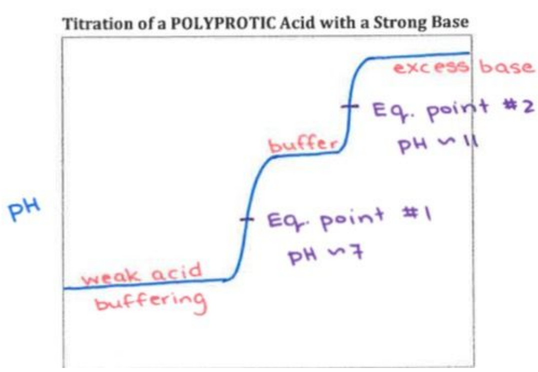
$$L\ Ca(OH)_2 = 0.0781L\ or\ 78.1mL$$

Tratation Graphs

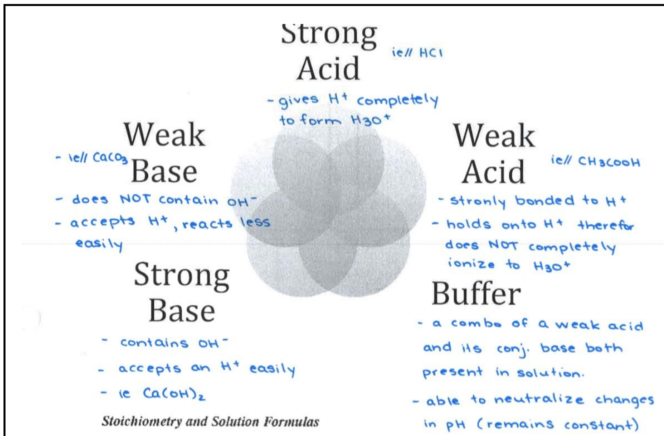


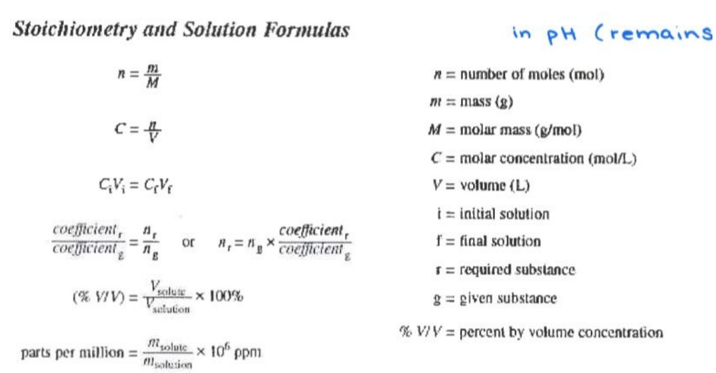


Buffering is where the acid is neutralizing the base. As soon as the acid is used up the pH changes quickly! Buffering zones PROCEED n equivalence point on a graph. There is one Equivalence point for every H^+ transfer	Weak acids have greater buffering because they hold on to their H^+ stronger… don't fully dissociate.



Indicators are chosen for their transition point is within the equivalence point!





Stoichiometry and Solution Formulas

in pH (remains

$n = \frac{m}{M}$ — n = number of moles (mol), m = mass (g), M = molar mass (g/mol)

$C = \frac{n}{V}$ — C = molar concentration (mol/L), V = volume (L)

$C_iV_i = C_fV_f$ — i = initial solution, f = final solution

$\frac{coefficient_r}{coefficient_g} = \frac{n_r}{n_g}$ or $n_r = n_g \times \frac{coefficient_r}{coefficient_g}$ — r = required substance, g = given substance

$(\%\ V/V) = \frac{V_{solute}}{V_{solution}} \times 100\%$ — % V/V = percent by volume concentration

parts per million $= \frac{m_{solute}}{m_{solution}} \times 10^6$ ppm

Science 30 - Lesson 19 - Quantifying Acidity

Name: ________________________________

Practice Problems

1) If it takes 54 mL for 0.1 M NaOH to neutralize 125 mL of an HCl solution, what is the concentration of the HCl?

2) If it takes 25 mL of 0.05 M HCl to neutralize 345 mL of NaOH solution, what is the concentration of the NaOH?

3) If it takes 50 mL of 0.5 M KOH solution to completely neutralize 125 mL of sulfuric acid solution (H_2SO_4), what is the concentration of the H_2SO_4 solution?

4) Can I titrate a solution of unknown concentration with another solution of unknown concentration and still get a meaningful answer? Explain your answer in a few sentences.

5) Explain the difference between an endpoint and equivalence point in a titration.

6) A beaker contains 0.0250 mL of H_2SO_4. A graduated tube (burette) is used to slowly add NaOH solution. At the instant that 15.6 mL of the 3.2M solution of NaOH has been added, that is, the equivalence point has been reached, the titration process is stopped. What is the concentration of sulphuric acid?

7) The Following table represents the results of a titration of 25.0 mL of a 0.500M solution of KOH with an unknown concentration of phosphoric acid

	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**
Initial Buret Reading (mL)	0.00	21.2	0.15	19.85
Final Buret Reading (mL)	21.2	41.1	19.85	39.6
Volume of NaOH used (v_f-v_i)				
Colour at Endpoint	Bright Yellow	Dark Yellow	Dark Yellow	Dark Yellow
Average volume of NaOH (mL)				

a) Complete the above chart
b) Calculate the concentration of Phosphoric acid.