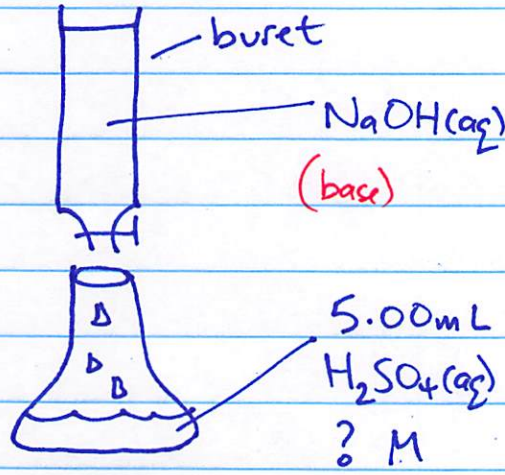
• 10/7/2019 **Titrations**

- used to measure [ ] (molarity) of unknown acid/base sample,
  - we will do in lab.



- add base (NaOH) until H_2SO_4 is fully neutralized
- use an acid-base indicator ... changes color when neutralized!

ex: if it takes 28.42mL of 0.100M NaOH to fully neutralize the H_2SO_4 ... $[H_2SO_4]$ = ?

Know: $[H_2SO_4] = \frac{\#mol\ H_2SO_4}{\#L\ H_2SO_4}$ ← ? * need to find out!

↑ 5.00mL H_2SO_4

$M_1V_1 = M_2V_2$ DILUTIONS

$5.00mL \times \frac{1L}{1000mL} = 0.00500\ L$

(3 s.f.) (exact) (3 s.f.)

$$H_2SO_4(aq) + 2NaOH(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O(l)$$

$H^+\ SO_4^{2-}$ $Na^+\ OH^-$ $Na^+\ SO_4^{2-}$ $H^+\ OH^-$

H^+ [? mol H_2SO_4] ② coeff. {? mol NaOH} ① molar conc NaOH {28.42mL NaOH} START

END

2 1 HOH

$H_2SO_4(aq) + 2NaOH(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O(l)$

? mol H_2SO_4 ← ② coeff. ← ? mol NaOH ← ① 0.100M NaOH

28.42mL NaOH

$[H_2SO_4] = \frac{\#\text{mol } H_2SO_4}{\#\text{L } H_2SO_4}$ ②

0.00500L

0.100M means...

$28.42\text{mL} \times \frac{1\text{L}}{1000\text{mL}} \times \frac{0.100\text{mol NaOH}}{1\text{L}} \times \frac{1\text{ mol } H_2SO_4}{2\text{ mol NaOH}} = 0.0142\text{ mol } H_2SO_4$

① ②

$[H_2SO_4] = \frac{\#\text{mol } H_2SO_4}{\#\text{L } H_2SO_4} = \frac{0.0142\text{mol}}{0.00500\text{L}} = 2.84\text{M } H_2SO_4$

0.284M H_2SO_4.

Q: What's [NaOH] if a 15.00mL sample takes 17.82mL of 2.84M $H_3PO_4(aq)$ to neutralize?

chem eq: $H_3PO_4(aq) + 3NaOH(aq) \rightarrow Na_3PO_4(aq) + 3H_2O(l)$.

$[NaOH] = \frac{\#\text{mol NaOH}}{\#\text{L NaOH}}$ ← ?

└ 15.00mL

0.01500L

$17.82\text{mL} \times \frac{1\text{L}}{1000\text{mL}} \times \frac{2.84\text{ mol } H_3PO_4}{1\text{L}} \times \frac{3\text{ mol NaOH}}{1\text{ mol } H_3PO_4} = 0.15182\text{mol NaOH}$

0.15182mol NaOH

$[NaOH] = \frac{0.15182\text{mol NaOH}}{0.01500\text{L}} = 10.1\text{M NaOH}$

Gas Evolution rxns

... main one to know is formation of $CO_2(g)$

$$H_2CO_3(aq) \xrightarrow{\sim 1\,ms} H_2O(l) + CO_2(g)\uparrow$$

UNSTABLE (carbonic acid) @ atmospheric pressure.
(stable @ high p)

ex: $2HCl(aq) + Na_2CO_3(aq) \longrightarrow 2NaCl(aq)$ ~~H_2CO_3~~ $H_2O(l) + (O_2(g))\uparrow$

$H^+ \; Cl^-$ $\quad$ $Na^+ \; CO_3^{2-}$ $\quad$ $Na^+ \; Cl^-$ $\quad$ $H^+ \; CO_3^{2-}$

Na^+

2 1