CHEMISTRY – UNIT 5A TEST

When is it happening?	Friday April 17th
How long will it take?	45 minutes
What is the format?	35 points total including exit ticket: 6 multiple choice questions (7 points total) open response questions (19 points total) You may use any resources you wish to
What is it worth?	20% of your Q3 grade
What will it cover?	See below
What resources will be useful?	This study guide Homework 5.1 and 5.2 Labs 5.1 – 5.5 Class Worksheets 5.1 – 5.5

ACIDS

HCl (hydrochloric acid) - contains H^+ and Cl^- (chloride) ions
H_2SO_4 (sulfuric acid) - contains H^+ and SO_4^{2-} (sulfate) ions
HNO_3 (nitric acid) - contains H^+ and NO_3^- (nitrate) ions

acid – substance which produces H^+ ions when dissolved in water (eg HNO_3)
base – substance which can react with an acid to make a salt (eg CuO)
alkali – substance which produces OH^- ions when dissolved in water (an alkali is a soluble base) (eg NaOH)
salt – substance made when the H^+ ion in an acid is replaced with a metal ion (eg NaCl)
neutralization – the reaction between an acid and a base to make a salt

BASES and SALTS

Hydroxides (OH^-) react with acids to make a salt + water
Eg nitric acid + sodium hydroxide → sodium nitrate + water ($HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$)

Oxides (O^{2-}) react with acids to make a salt + water
Eg sulfuric acid + copper oxide → copper sulfate + water ($H_2SO_4 + CuO \rightarrow CuSO_4 + H_2O$)

Carbonates (CO_3^{2-}) react with acids to make a salt + carbon dioxide + water
Eg hydrochloric acid + calcium carbonate → calcium chloride + carbon dioxide + water
($2HCl + CaCO_3 \rightarrow CaCl_2 + CO_2 + H_2O$)

$H_2O \rightleftharpoons H^+ + OH^-$

Water breaks up naturally into H^+ and OH^- ions, so all aqueous solutions contain both H^+ and OH^- ions

Neutral solutions contain equal numbers of H^+ + OH^- ions: $H^+ = OH^-$

Acidic solutions contain more H^+ than OH^- ions: $H^+ > OH^-$

Alkaline solutions contain more OH^- than H^+ ions: $H^+ < OH^-$

THE PH SCALE

The pH scale is a measure of how much H^+ is present:

- **If pH = 7,** $H^+ = OH^-$ and the solution is neutral
- **If pH < 7,** $H^+ > OH^-$ and the solution is acidic – the more acidic the solution, the lower the pH
- **If pH > 7,** $H^+ < OH^-$ and the solution is alkaline – the more alkaline the solution, the higher the pH

pH	-1	1	3	5	7	9	11	13	15
Acidity	highly acidic		slightly acidic		neutral	slightly alkaline		strongly alkaline	
H^+ level	very high		quite high		normal	quite low		very low	
OH^- level	very low		quite low		normal	quite high		very high	
example	stomach acid		orange juice		water	baking soda		bleach	

HNO_3, HCl and H_2SO_4 are **strong acids** – they completely break up in water to produce H^+ ions

Eg $HCl \rightarrow H^+ + Cl^-$

Acetic acid ($HC_2H_3O_2$) and citric acid are **weak acids** – they only slightly break up in water to produce H^+ ions

Eg $HC_2H_3O_2 \rightleftharpoons H^+ + C_2H_3O_2^-$

Strong acids contain more H^+ than weak acids so:

- they have a lower pH than weak acids
- they react with bases faster than weak acids
- their neutralization reactions are more exothermic than weak acids

Strong acids and weak acids need the **SAME** amount of base to neutralize them - as the H^+ ions get neutralized, the weak acid molecules break up more and produce more H^+ ions, until the acid has completely broken up

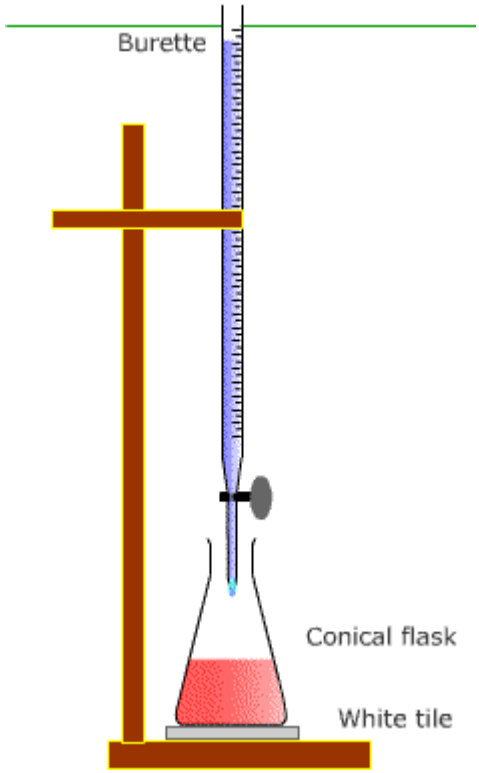
ACID-BASE **INDICATORS** are substances which turn one color in acid and a different color in alkali

- methyl orange is red in acid and yellow in alkali
- bromothymol blue is yellow in acid and blue in alkali
- phenolphthalein is colorless in acid and purple in alkali

Universal indicator is a mixture of these indicators

A **titration** is an experiment designed to find out what volume of an acid is needed to react with a fixed volume of a base

- use a pipette to transfer a fixed volume of alkali into a conical flask
- add a drop of indicator to the conical flask
- record the initial volume of acid
- add the acid slowly to the alkali until the indicator changes color
- record the final volume of acid
- calculate the volume of acid used
- repeat until you get two similar results



Titration are used to determine

- the molarity of a base by titrating against an acid of known molarity
- the molarity of an acid by titrating against a base of known molarity
- use the equations:

$C_A = \frac{C_B V_B}{C_A}$ or $C_B = \frac{C_A V_A}{C_B}$

Worked example: 18.4 mL of HCl was required to neutralise 25 mL of 0.1 mol/L NaOH. Deduce the molarity of the HCl.

$C_A = \frac{C_B V_B}{C_A} = \frac{0.1 \text{ x } 25}{18.4} = 0.136$ mol/L