## ZNOTES // IGCSE SERIES

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## Updated to 2016-18 Syllabus

OE IVGOECHEMISTRY OKIO

ALTERNATIVE TO PRACTICAL NOTES (PAPER 6)


Top pan balance


Gauze




Stop watch




- Reducing Copper(III) Oxide to Copper



## EXPERIMENTS

- Showing that oxygen and water is needed for rusting iron

air and water

water
no air

air
no water
calcium
chloride

- Showing that air is 21\% Oxygen



## RATES OF REACTION

- Testing factors affecting rate of reaction
- Different temperature acid
- Different size of particle/reactant
- Concentration of acid



## RATES OF REACTION

- Time how long it takes for the cross to disappear from view
- You can change the temperature and concentration of acid used
$20 \mathrm{~cm}^{3}$ of dilute nitic acid
- Keep constant:
- Diameter of beaker
- The Cross
- Volume

initial view through conical flask from above

sôdium thiosulffate and dilute hydrochloric acid

- Find the amount of energy given when an alcohol is burnt:
- You need to know:
- Mass of water
- Change in mass of burner containing alcohol
- Specific heat capacity of water
- Temperature change of water

- The molecular mass of the alcohol
- $\frac{\text { Change in mass }}{\text { Molecular mass }}=$ Number of moles burnt

- Change in temperature $\times$ mass of water $\times$ SHC of water $=$ Energy
- $\frac{\text { Energy }}{\text { Moles burnt }}=$ amount of energy per mole $(\mathrm{J} / \mathrm{mol})$


## Finding CONCENTRATION

- Acid and base titration to find the concentration of a solution:
- Measure volume of acid then pour into conical flask
- Record initial volume of base in burette
- Slowly add base from burette, stirring each time
- When indicator neutral, record final volume of base
- Find amount of bas used: Final - Initial
- Find moles of base used by volumexconcentration
- Use balanced equation to find how many moles of acid are needed to neutralize the base
- $\frac{\text { Number of moles of Acid Needed }}{\text { Volume of Acid Used }}=$ Concentration of Acid



## Flame Tests

- $\quad$ Lithium $=$ Red
- Sodium = Yellow
- Potassium = Lilac
- Iron = Gold
- Magnesium = Bright White
- Source of errors for flame tests:
- The test cannot detect low concentrations of most ions.
- Brightness of the flames varies from one sample to another.
- Impurities or contaminants affect the test results.
- The test cannot differentiate between all elements or compounds


## ChROMATOGRAPHY

- Principle: Difference in solubility separates different pigments
- Drop substance to center of filter paper and allow it to dry
- Drop water on substance, one drop at a time
- Paper + rings $=$ chromatogram.
- Stationary phase: material on which the separation takes place
- Mobile phase: mixture you want to separate, dissolved in a solvent.
- Interpreting simple chromatograms:
- Number of rings/dots = number of substances
- If two dots travel the same distance up the paper they are the same substance.


## Chromatography

- You can calculate the Rf value to identify a substance, given by the formula:

$$
R f \text { Value }=\frac{\text { Distance moved by solute }}{\text { Distance moved by solvent }}
$$

- To make colorless substances visible
- Dry chromatogram in an oven
- Spray it with a locating agent
- Heat it for 10 minutes in the oven

Different colored inks


## Separation Methods

- Filtration
- Mixture goes in a funnel with filter paper, into a flask.
- Residue is insoluble and filtrate goes through
- Crystallization
- Some water in the solution is evaporated so solution becomes



## Separation Methods

- Simple distillation:
- Impure liquid is heated
- It boils, and steam rises into the condenser
- Impurities are left behind
- Condenser is cold so steam condenses to the pure liquid and it drops into the beaker

- Fractional distillation:
- Removes a liquid from a mixture of liquids, because liquids have different b.p.s
- Mixture is heated to evaporate substance with lowest b.p.
- some of the other liquid(s) will evaporate too.
- Beads are heated to boiling point of lowest substance, so that substance being removed cannot condense on beads.
- Other substances continue to condense and will drip back
 into the flask
- The beaker can be changed after every fraction.


## SEPARATION METHODS

- Separating mixture of two solids:
- Can be done by dissolving one in an appropriate solvent
- Then filter one and extract other from solution by evaporation
- If one solid is magnetic, can use a magnet e.g. sand and iron

| Solvent | It dissolves... |
| :--- | :--- |
| Water | Some salts, sugar |
| White spirit | Gloss paint |
| Propanone | Grease, nail polish |
| Ethanol | Glues, printing inks, scented substances, chlorophyll |

- Choosing a suitable method:

| Method of separation | Used to separate |
| :--- | :--- |
| Filtration | A solid from a liquid |
| Evaporation | A solid from a solution |
| Crystallization | A solid from a solution |
| Simple Distillation | A solvent from a solution |
| Fractional Distillation | Liquids from each other |
| Chromatography | Different substances from a solution |

## MAKING SALTS



- When bubbling (hydrogen) stops the reaction is done
- Filter off excess metal
- Starting with an insoluble base:
- Add insoluble base to acid and heat gently, it will dissolve
- Keep adding until no more dissolves (reaction is done)
- Filter out the insoluble (excess) base


## MAKING SALTS

- Titration:
- Put a certain amount alkali in a flask and add phenolphthalein
- Add acid from a burette, stirring, until it goes colorless
- Find out how much acid you used and repeat, to be more accurate
- Evaporate water from neutral solution
- Precipitation:
- Mix the two soluble salts, so they react together
- Filter the mixture to separate the products produced (soluble and insoluble salt produced)
- Wash the insoluble salt on the filter paper
- Dry the insoluble salt in a warm oven


## SALTS AND INDICATORS

- Solubility of salts:

| Soluble Salts | Insoluble Salts |
| :---: | :---: |
| All sodium, potassium and <br> ammonium salts | The rest |
| All nitrates | N/A |
| Chlorides | Except silver and lead |
| Sulphates | Except barium, lead and calcium |
| Potassium, sodium and <br> ammonium carbonates | All other carbonates |

- Indicators:

| Indicator | Color in acid | Color in alkaline |
| :--- | :---: | :---: |
| Phenolphthalein | Colorless | Pink |
| Methyl orange | Pink | Yellow |
| Methyl red | Red | Yellow |
| Red litmus | Red | Blue |
| Blue litmus | Red | Blue |

- pH Scale:


| Cation | Sodium <br> Hydroxide | Ammonia |
| :--- | :--- | :--- |
| Aluminum ( $\left.\mathbf{A l}^{3+}\right)$ | Soluble white <br> ppt. | White ppt. |
| Ammonium <br> $\left(\mathbf{N H}_{4}{ }^{+}\right)$ | Ammonium gas - <br> damp red litmus <br> turns blue | N/A |
| Calcium (Ca2+) | White ppt. | No ppt. |
| Copper ( $\left.\mathbf{C u}^{2+}\right)$ | Light blue ppt. | Light blue soluble <br> ppt. |
| Iron(II) $\left(\mathrm{Fe}^{2+}\right)$ | Green ppt. | Green ppt. |
| Iron(III) $\left(\mathrm{Fe}^{3+}\right)$ | Red-brown ppt. | Red-brown ppt. |
| Zinc $\left(\mathrm{Zn}^{2+}\right)$ | White soluble <br> ppt. | White soluble <br> ppt. |


| Anion | Test | Test result |
| :---: | :---: | :---: |
| Carbonate $\left(\mathrm{CO}_{3}{ }^{2-}\right)$ | Add dilute nitric acid | Limewater goes cloudy |
| Chloride ( $\mathrm{Cl}^{-}$) | Add nitric acid, then aqueous silver nitrate | White ppt. |
| Bromide ( $\mathrm{Br}^{-}$) |  | Cream ppt. |
| Iodide ( ${ }^{-}$) |  | Yellow ppt. |
| Nitrate ( $\mathrm{NO}_{3}{ }^{-}$) | Add aqueous sodium hydroxide then add aluminum | Gas produced turns damp red litmus paper blue |
| Sulphate ( $\mathrm{SO}_{4}{ }^{2-}$ ) | Add nitric acid, then add aqueous barium nitrate | White ppt. |


| Gas | Test and test result |
| :--- | :--- |
| Ammonia $\left(\mathrm{NH}_{3}\right)$ | Damp red litmus <br> paper turns blue |
| Carbon dioxide $\left(\mathrm{CO}_{2}\right)$ | Bubble gas through <br> limewater - from <br> colorless to cloudy |
| Chlorine $\left(\mathrm{Cl}_{2}\right)$ | Bleaches red/blue <br> litmus paper |
| Hydrogen $\left(\mathrm{H}_{2}\right)$ | Place lighted splint, <br> squeaky pop |
| Oxygen $\left(\mathrm{O}_{2}\right)$ | Place glowing splint, <br> splint relights |


| Substance | Test and test result |
| :--- | :--- |
| Water | White anhydrous copper (II) <br> sulphate crystals turns blue |
|  | Blue cobalt chloride paper <br> turns pink |
|  | Add to bromine water; from <br> orange to colourless |
| Alkane | Add to bromine water; <br> remains orange |
|  | Blue litmus paper turns redAdd a metal carbonate; <br> bubbles of $\mathrm{CO}_{2}$ |
| Base | Red litmus paper turns blue |

## Preparing Gases in the Lab

| To make.... | Place in flask: | Add.... | Reaction |
| :---: | :---: | :---: | :---: |
| $\mathbf{C O}_{\mathbf{2}}$ | $\mathrm{CaCO}_{3}$ (marble chips) | Dilute HCl | $\mathrm{CaCO}_{3}(\mathrm{~s})+\mathrm{HCl}(\mathrm{aq}) \rightarrow \mathrm{CaCl}_{2}(\mathrm{aq})+\mathrm{H}_{2} \mathrm{O}(\mathrm{I})+$ <br> $\mathrm{CO}_{2}(\mathrm{~g})$ |
| $\mathrm{Cl}_{\mathbf{2}}$ | Manganese (IV) oxide <br> (as an oxidising agent) | Conc. HCl | $2 \mathrm{HCL}(\mathrm{aq})+[\mathrm{O}] \rightarrow \mathrm{H}_{2} \mathrm{O}(\mathrm{I})+\mathrm{Cl}_{2}(\mathrm{~g})$ |
| $\mathbf{H}_{\mathbf{2}}$ | Pieces of zinc | Dilute HCl | $\mathrm{Zn}(\mathrm{s})+\mathrm{HCL}(\mathrm{aq}) \rightarrow \mathrm{ZnCl}_{2}(\mathrm{aq})+\mathrm{H}_{2}(\mathrm{~g})$ |
| $\mathbf{O}_{\mathbf{2}}$ | Manganese (IV) oxide <br> (as a catalyst) | Hydrogen <br> peroxide | $2 \mathrm{H}_{2} \mathrm{O}_{2}(\mathrm{aq}) \rightarrow 2 \mathrm{H}_{2} \mathrm{O}(\mathrm{I})+\mathrm{O}_{2}(\mathrm{~g})$ |


| Method | Downward <br> displacement of <br> air | Upward <br> displacement of <br> air | Over water |
| :---: | :---: | :---: | :---: | :---: |$\quad$ Gas syringe

