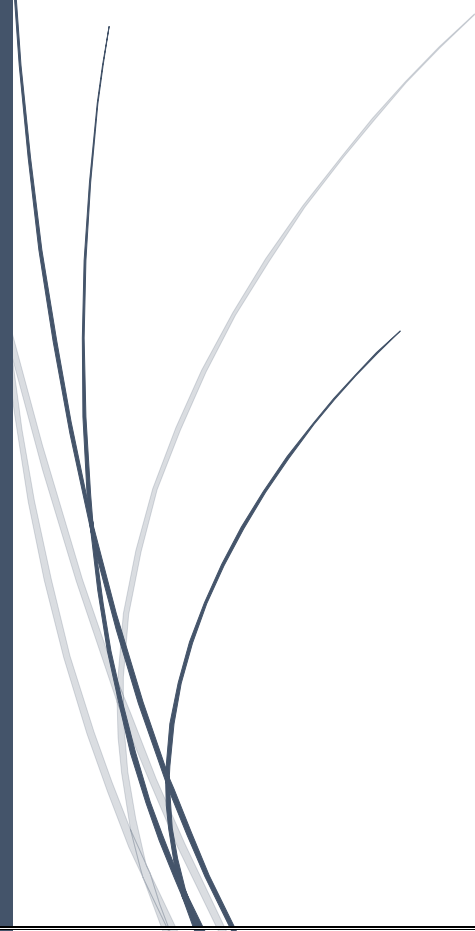


OCR B A-level Chemistry

A-level Chemistry Core practical Guide



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Core practical 1: Making up standard solutions and diluting solutions using volumetric apparatus.

Specification points:

- the techniques and procedures used in experiments to measure volumes of solutions; the techniques and procedures used in experiments to prepare a standard solution from a solid or more concentrated solution and in acid-base titrations.

Key definitions:

- Acid = H⁺ donator
- Base = H⁺ acceptor
- Concentrated = contains more solute than solvent
- Dilute = contains more solvent than solute

For example:

You are asked to make 250 cm³ of a standard solution of potassium carbonate. You will need to weigh out 2.5 g of solid.

You will need:

- 250 cm³ Conical flask
- Beaker
- 2.5g of solid (Potassium carbonate)
- Distilled water
- Balance
- Funnel
- Glass rod
- Dropping Pipette

Method:

1. Weight out 2.5g of Potassium carbonate using a balance.
2. Dissolve the solid in 100cm³ of distilled water in a beaker
3. Stir with a glass rod until all the solid has dissolved.
4. When completely dissolved, use a funnel to transfer the solution to a 250cm³ volumetric flask
5. Wash out the beaker several times with distilled water and add the washings to the flask.
6. Add distilled water close to the mark, then use a dropping pipette to add the last drops of water so the bottom of the meniscus is on the line.
7. Place the lid on then invert the flask to mix.

Core practical 2: Acid-Base Titrations

Specification points:

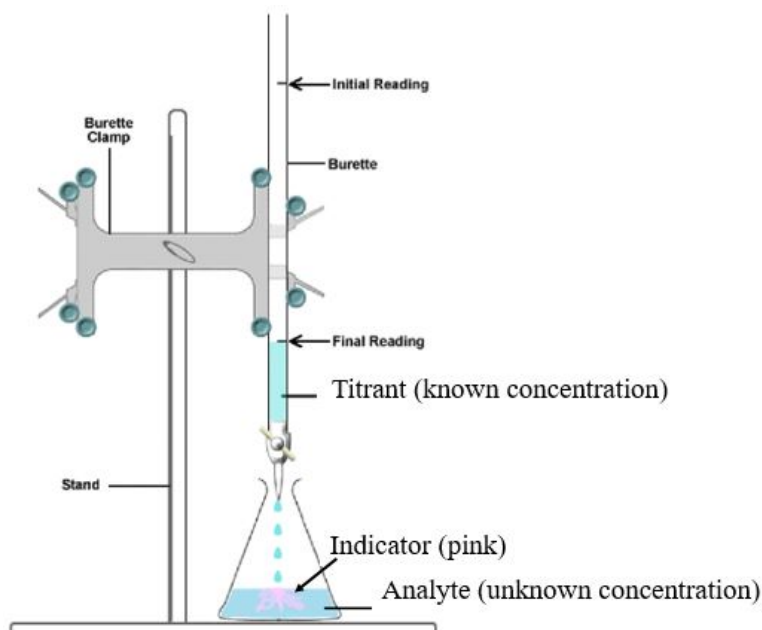
-the techniques and procedures used in experiments to measure volumes of unknown solutions.

You will need:

- Standard solution prepared.
- Burette
- Conical flask
- White tile
- Methyl Orange/ Phenolphthalein indicator

Method:

1. Before starting the experiment, rinse the burette with
2. In your burette, fill the known concentration of your acid to the 0-line mark using a funnel.
3. Then using a volumetric pipette, measure out 25cm^3 of your NaOH and place into your conical flask.
4. Add 2-3 drops of Phenolphthalein indicator into the conical flask. Solution will initially turn pink.
5. The turn on the tap of the burette and continue to add the acid until solution turns from dark pink to light pink. This will be a rough titre.
6. Swirl gently throughout the practical.
7. Repeat steps 1-4 again but this time when you reach close the 1st reading, turn the tap halfway to get a precise reading and concordant results with 0.01cm^3 of each other
8. Calculate the mean of your concordant results to get an average volume.



Core practical 3: Making salts:

Specification points:

-techniques and procedures for making soluble salts by reacting acids and bases and insoluble salts by precipitation reactions

Aims:

To investigate the preparation of pure, dry hydrated copper sulphate crystals starting from copper oxide

You will need:

- Measuring cylinder
- Beaker
- Filter paper
- Bunsen burner
- Bunsen burner stand
- Forceps
- Evaporating Basin
- Glass rod
- Copper oxide powder

Method:

1. Pour 25cm³ of sulfuric acid in a beaker and then on place this on top of the Bunsen burner.
2. Add a spatula of copper oxide powder to the acid and stir with a glass rod
3. Continue adding copper oxide powder until it is in excess
4. Filter the mixture to remove the excess copper oxide
5. Pour the filtrate (the copper sulphate solution) into an evaporating basin
6. Heat the copper sulphate solution to evaporate half of the water
7. Pour the solution into a watch glass and leave to allow all of the water to evaporate.
8. Leave the crystals to dry for 24hrs.

Core practical 4: Enthalpy change of Combustion

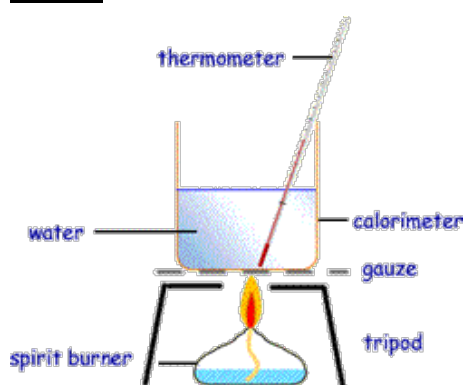
Specification points:

- techniques and procedures for measuring the energy transferred when reactions occur in solution (or solids reacting with solutions) or when flammable liquids burn, the calculation of enthalpy changes from experimental results.

You will need:

- Calorimeter
- Thermometer
- Fuel – Spirit burner
- Water
- Windshield

Set up:



Method:

NB: A calorimeter is used to work out the enthalpy change of combustion.

1. Measure the temperature of the water at the start with a thermometer and its initial mass.
2. Measure the mass of the fuel you would use with a balance.
3. You would then heat the water till the temperature doesn't rise anymore.
4. Record the reading of the temperature of water at the end.
5. Record the mass of the fuel left at the end.

How to measure the energy released from this practical: Using $Q=mc\Delta T$ and $-Q/n = \Delta H$

NB: Q = energy transferred to the water
 M = mass of the water
 C = specific heat energy.
 T = Temperature change of the water

Why data book value is not the same as our value?

- Incomplete combustion, not done under standard conditions, heat loss etc...

Core practical 5: Enthalpy change of Neutralisation

Specification:

-techniques and procedures for measuring the energy transferred when reactions occur in solution (or solids reacting with solutions) or when flammable liquids burn, the calculation of enthalpy changes from experimental results.

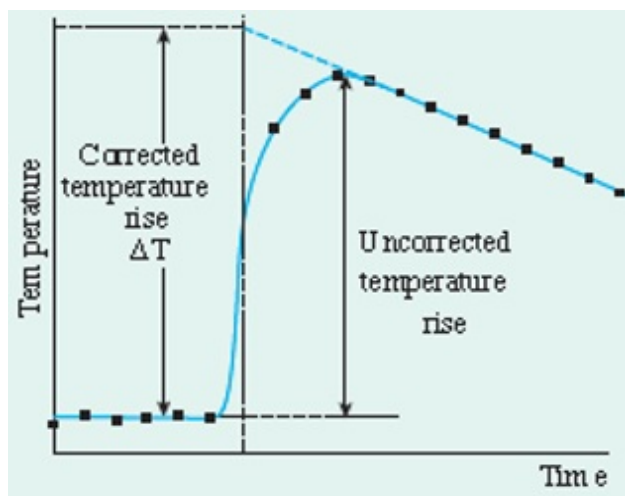
You will need:

- Stopwatch
- 25cm³ of solution
- 5g of solid.
- Polystyrene cup

Method:

1. Add the acid in the polystyrene cup.
2. Measure the temperature with a thermometer every 1min up to 3mins
3. Then you would add the alkali or the solid and stir the mix.
4. Measure the temperature change every min after that for 15mins max.
5. Plot this information onto the graph.
6. To find your temperature change, you need to extrapolate backwards to find the maximum temperature.

Exploration of Data from a graph:



Core practical 6: Cracking a hydrocarbon vapour over a heated catalyst and testing the product

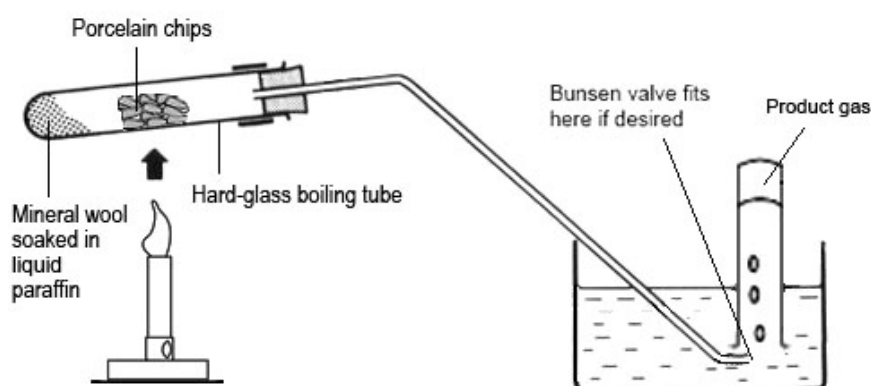
Specification:

-the term *cracking*; the use of catalysts in cracking processes; techniques and procedures for cracking a hydrocarbon vapour over a heated catalyst.

You will need:

- Cotton wool soaked in the hydrocarbon
- Catalyst
- Delivery tube
- Bung
- Test tube
- Water Bath
- Bromine water

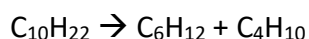
Set up of practical:



Method:

1. Set up the experiment as shown above.
2. Turn on the Bunsen burner and heat gently using the blue flame over the mineral wool and the catalyst giving them equal heat.
3. This allows the fuel to evaporate and condense down into the delivery tube.
4. The products of this, is collected in the other test tube in the water bath as a liquid.
5. The long hydrocarbon will be broken down alkene and alkanes.

For example:



How to test the products of the cracking process?

- ➔ Add bromine water...
- ➔ If colour changes from orange to colourless then an alkene is present
- ➔ If colour remains orange = Alkane functional group is present.

Core practical 7: Electrolysis

Specification:

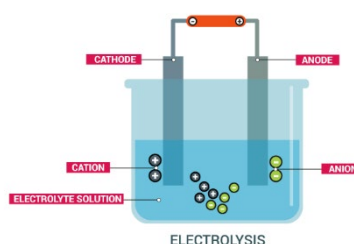
- techniques and procedures in the electrolysis of aqueous solutions; half-equations for the processes occurring at electrodes in electrolysis of molten salts and aqueous solutions:

What is electrolysis?

Electrolysis when there is electricity that passes through a molten or aqueous ionic compound. This will break down compounds into different elements at the different electrodes. Because the charged ions are free to move, and this is because molten ionic compounds dissociate letting the ions to move to the oppositely charged electrodes this creates a complete circuit.

You will need:

- 2 electrodes made of either graphite or platinum
- Solvent
- Wire
- Current



Theory:

Study tip: Cations migrate to the cathode and the anions to the anode.

- Ionic compound can only conduct electricity when molten.
- Cathode = -ve but Cations are +ve.
- Anode = +ve but anions are -ve

Rules: In solution

Rules for the cathode:

- If + ions (metals) are group 1,2, aluminium, or acids then hydrogen will be produced.
- If +ions (metals) are less reactive than hydrogen, the metal will be produced.

Rules for the anode:

- If -ions are halogens like Cl⁻, Br⁻ or I⁻ then the halogens will be produced. If -ions are not a halogen like SO₄²⁻, NO₃⁻ then oxygen will be produced.

Rules: When molten

- The product at the cathode will be a metal and the product at the anode will be a non-metal apart from hydrogen.

Core practical 8: techniques and procedures in iodine–thiosulfate titrations (Redox titrations)

Specification:

-techniques and procedures in iodine– thiosulfate titrations

You will need:

- 0.003 moldm³ of sodium thiosulfate
- 1 moldm³ of HCl
- 0.6 moldm³ of KI solution
- 0.5% starch indicator
- 250cm³ volumetric flask
- 2 x 10cm³ measuring cylinder
- 50cm³ pipette
- Distilled water
- Stirring rod

Method:

Stage 1: Preparation of standard solution

1. Measure known mass of solid sodium thiosulfate using a balance in a weighing boat.
2. Dissolve solid in 100cm³ of distilled water in a beaker
3. Transfer to 250cm³ volumetric flask using a funnel
4. Rinse the breaker with distilled water and transfer washings to volumetric flask.
5. Use a dropping pipette to fill the volumetric flask to the calibration line.
6. Invert the solution several times to mix.

Stage 2: Preparation of the ‘brine’ standard solution

1. Use the 25cm³ pipette to transfer 50cm³ of brine solution to the volumetric flask
2. Add distilled water to the volumetric flask until it reaches the calibration line.
3. Invert the flask several times to mix.

Stage 3: Titration

1. Fill burette with sodium thiosulfate solution
2. Use volumetric pipette to transfer 50cm³ of your standard ‘brine’ solution to a 250cm³ conical flask.
3. Add 5cm³ of HCl and 5cm³ of KI solution to same conical flask using measuring cylinder = solution turns yellow/brown colour
4. Turn the burette on and titrate until solution turns very pale-yellow colour. + Record volume of sodium thiosulphate used.
5. Add 1cm³ of starch indicator to the flask = turns dark blue/black colour
6. Continue titration until colour becomes colourless.
7. Repeat the titration until concordant results are obtained.

Core Practical 9: Preparation of Halogens:

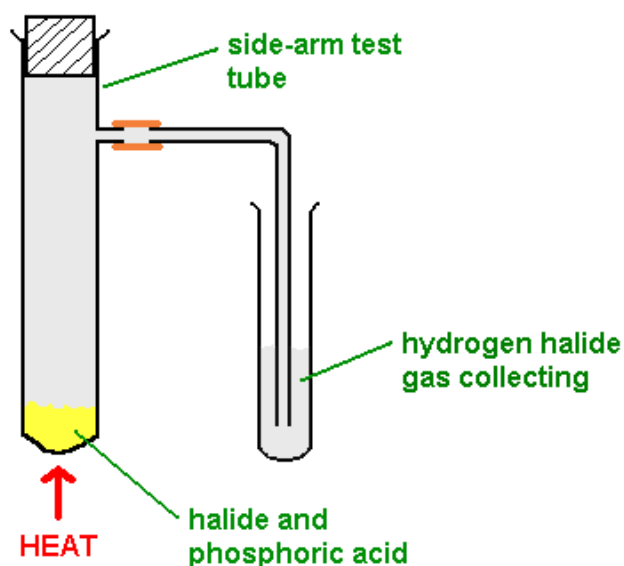
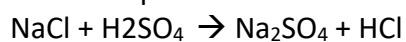
Specification Points:

-The preparation of HCl; the preparation of HBr and HI by using the halide and phosphoric acid. the action of sulfuric acid on chlorides, bromides, and iodides

Method: Making hydrogen chloride

- 1.You can add concentrated sulphuric acid to a solid chloride like sodium chloride in the cold.
- 2.The concentrated sulphuric acid donates a hydrogen ion to a chloride ion to make hydrogen chloride.
- 3.Because this is a gas, it immediately escapes from the system.

The full equation for the reaction is:



Core practical 10: Measuring the rate of reaction

Specification:

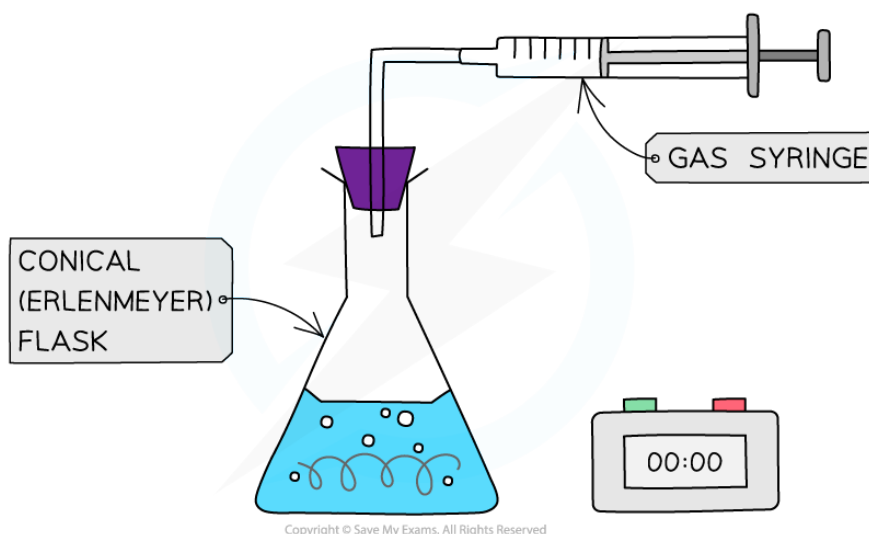
- techniques and procedures for experiments in reaction kinetics including plotting graphs to follow the course of a reaction.

Ways of measuring the rate of reactions: (Dependant variable)

- (a) measuring the volume of gas given off by a reaction over time
- (b) measuring the loss of mass of a reaction over time when a gas is produced
- (c) measuring the amount of light that passes through a reaction mixture over time – this can be done by inspection or using a light sensor and data logger

Method:

1. Add 25cm³ of the solution you are testing to the conical flask.
2. Place a white piece of paper with a clearly drawn cross on the bottom of the flask.
3. Add 5g of the metal you are testing.
4. Place a bung on top of the conical flask that is connected to the volumetric syringe. It should look like this below:



5. Record the volume of O₂ gas produced every 30sec until cross is no longer visible and solution has turned cloudy.
6. Repeat steps 1-5 for the other variable.
7. Draw a volume vs time graph + plot the points.
8. Calculate rate by drawing tangent or volume / time (cm³/s) or (g/cm³)

Core practical 11: Purification of Organic Compounds

Specification points:

-techniques and procedures for preparing and purifying a liquid organic product including the use of a separating funnel and of Quick fit or reduced scale apparatus for distillation and heating under reflux

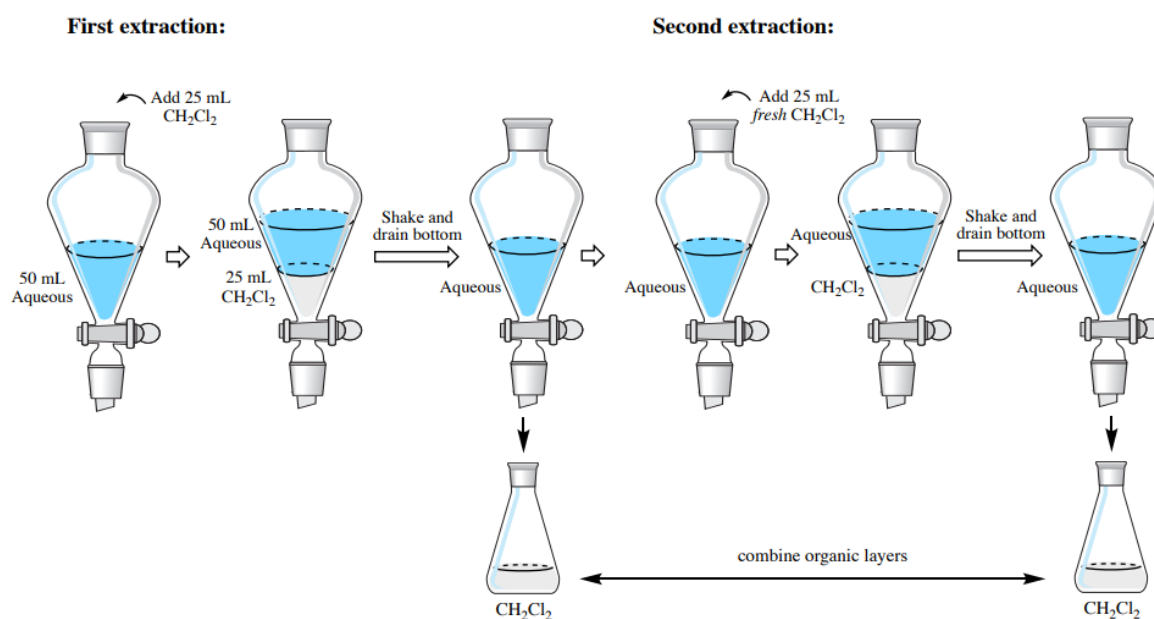
For example: **Describe how the student can obtain a dry, pure sample of 1-bromobutane from the reaction mixture.**

Equipment:

- Separating funnel
- Distilled water
- Beaker
- Anhydrous Magnesium sulphate (drying agent)
- Sodium carbonate = used to remove any unreacted acid

Method:

1. Add the reaction mixture to the separating funnel.
2. Add 2g of Sodium Carbonate to remove any unreacted acid
3. Add distilled water to allow the layers to separate. = aqueous layer forms on top as the density of the organic layer is greater than the density of water.
4. Allow the organic layer to run out and collect in a separate conical flask/beaker.
5. Add small quantities of Anhydrous Magnesium sulphate to the organic layer to absorb the water content.
6. Filter the organic layer to remove the anhydrous agent.
7. Evaporate away the excess water and leave to dry.



Core practical 12: Esterification of Aspirin

Specification:

- techniques and procedures for making a solid organic product

You will need:

- Balance
- Crushed ice
- Cold distilled water
- Conical flask (100cm³)
- 2 measuring cylinders
- Stirring rod
- 250cm³ large beaker for the ice bath
- Vacuum filtration apparatus
- Watch glass
- Ethanoic anhydride ~ 4cm³
- Concentrated sulfuric acid ~ 5 drops
- Concentrated cold glacial ethanoic acid

Method:

1. 1.Measure the mass with a balance of your sample tube and record the mass.
2. Use 2g of your hydroxybenzoic acid that you have made in the part 1 into a sample tube.
3. Measure with the balance the mass of the sample tube with the sample to know how much you have of 2-hydroxybenzoic acid.
4. Record the mass. If you don't have enough sample, you can add more of the "authentic" 2-hydroxybenzoic acid to make the mass to be 2g.
5. Transfer you sample into a conical flask.
6. You would add 4cm³ of ethanoic acid into a 10 cm³ dry measuring cylinder which you will after pour into the conical flask.
7. Once you have added 5 drops of sulphuric acid to the flask and shake gently for 10 mins , place your conical flask in a large beaker containing crushed ice.
8. Leave the conical flask in the ice bath for 5-10 mins to complete the process of crystallisation.
9. Using a clean measuring cylinder, measure 4cm³ of cold glacial ethanoic acid then pour it into the conical flask containing the reactants.
10. Then set up the vacuum filtration apparatus as shown on the diagram on this slide with filter paper in the funnel.
11. Pour ice-cold distilled water into the white funnel containing the filter paper to wash
12. Filter off the solid product by vacuum filtration.
13. Measure the initial mass of the watch glass then transfer your product onto the watch glass to leave to dry for 48hrs

Core practical 13: Recrystallisation

Specification:

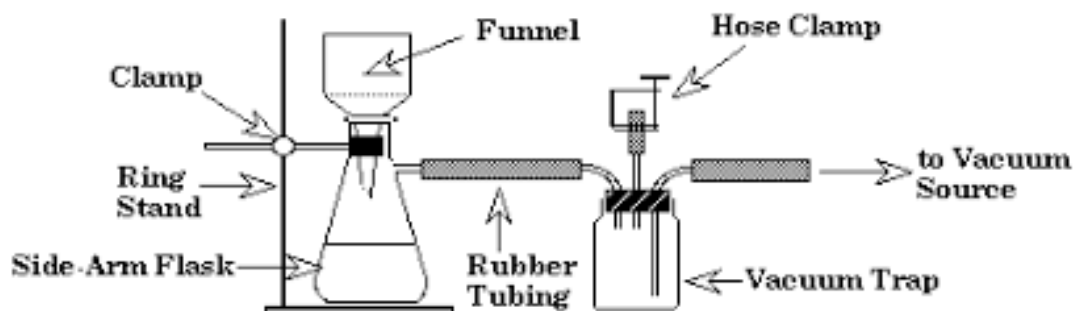
-techniques and procedures for making a solid organic product and for purifying it using filtration under reduced pressure and recrystallisation (including choice of solvent and how impurities are removed);

You will need:

- suitable solvent that is fully soluble in solute when hot but insoluble when cold. (E.g., ethanol.)
- hot plate
- Ice bath
- Conical flask
- Vacuum filtration apparatus
- Filter paper

General Method:

1. Dissolve solute in minimum volume of hot water / solvent.
2. Filter the (hot solution) using filter paper into small beaker= **removing insoluble impurities**
3. Place the small beaker containing filtered solution in ice bath =allow to crystallise = **only soluble impurities are left.**
4. Then you need to carry out Vacuum filtration. Set up the apparatus below:



5. Place filter paper in the funnel. Wash with cold solvent + allow crystals to dry = **soluble impurities are washed away**

Core practical 14: Determining the melting point of unknown compounds

Specification:

-techniques and procedures for melting point determination and thin layer chromatography

You will need:

- Capillary tube/melting point tubes
- Melting point apparatus
- Spatula
- Watch glass

Method:

- Using a spatula, break the crystals into a fine powder on the watch glass.
- Then using a capillary tube, place the crystals into the tube gently.
- Then set up your apparatuses as shown in the photo on this slide.
- Turn on the equipment and place the capillary tube with the product into the machine.
- On the machine, set the setting to 133 °C
- Allow the machine to calibrate and heat up the product.
- Wait for the machine to reach 133°C.
- Read off the melting point of your crystals after 1-2 mins.
- Record this value in a suitable place and compare to the actual melting point of Aspirin.



Core practical 15: Paper Chromatography Core practical:

Aim: To be able to understand and know the application of paper Chromatography to test for substances.

Equipment:

- TLC paper
- Pencil
- Ruler
- Chromatography solvent
- Beaker
- Capillary tubes
- Solutions that are being tested.
- Ethanol (if required)
- UV lamp
- Spotting tile

Method:

1. First, using your samples, dissolve them in a known concentration of ethanol on a spotting tile.
2. Then, using your pencil, draw a horizontal line 1cm above the TLC paper
3. Then mark on the TLC at equal distances crosses marking the position of the samples.
4. After this, using the capillary tubes, carefully place each other solution along the crosses you previously made in step 3. (Ensure that all the samples are the same size and use a different capillary tube for each sample.)
5. Then, carefully place your chromatography paper in the beaker containing 100cm³ of chromatography solvent.
6. Allow the solvent to rise.
7. Once the solvent reaches the top, remove the paper and mark on the solvent front.
8. Dry this completely under the fume hood.
9. Once your TLC has dried, place your paper into a UV light box.
10. Mark in the middle of each sample and sketch the general outline.
11. Remove this and calculate the R_f value of each solvent.

Analysis of results:

To calculate the R_f, you apply this formula:

$$R_f = \text{distance travelled by the solute} / \text{distance travelled by solvent}$$

Tip: the R_f value must be between 0.0 - 1.0

- The higher the distance travelled by the solute, the greater the solubility.
- Solubility is determined by the height of the sample in a set period of time.
- We say that more soluble samples have a higher 'infinity'.
- Less soluble substances have a lower 'infinity'.

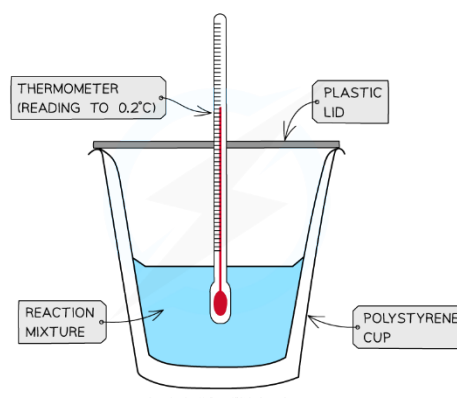
Core practical 16: Measuring enthalpy change of solution

Specification

-techniques and procedures for measuring the energy transferred in experiments involving enthalpy changes in solution

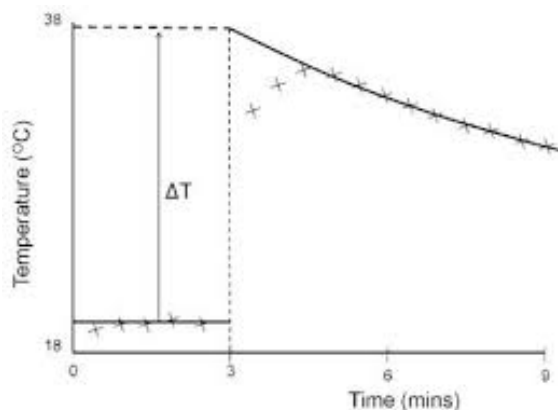
You will need:

- 25cm³ of copper sulphate solution
- 5g of Zinc metal
- Weighing boat
- Thermometer
- Volumetric pipette
- Graph paper



Method:

1. Using a volumetric pipette, measure 25cm³ of the copper sulphate solution and place into the polystyrene cup.
2. Measure out 5g of Zinc metal into the weighing boat.
3. Start the stopwatch
4. Measure the temperature of the solution every 30secs until 3mins.
5. Then add the 5g of Zinc previously measured.
6. Record the temperature every 30 secs until 10 mins are complete in total.
7. Plot this data onto a line graph of time vs temperature.
8. Then extrapolate backwards to find the greatest temperature change like this.



9. Once ΔT has been calculated from the graph, we can then use this information to calculate the energy transferred to the water using $Q = mc\Delta T$.
10. Then we can find no.of moles of the solution and apply this to the formula to find enthalpy change :

$$\Delta H = - Q / n$$

Core practical 17: Setting up electrochemical cells

Specification:

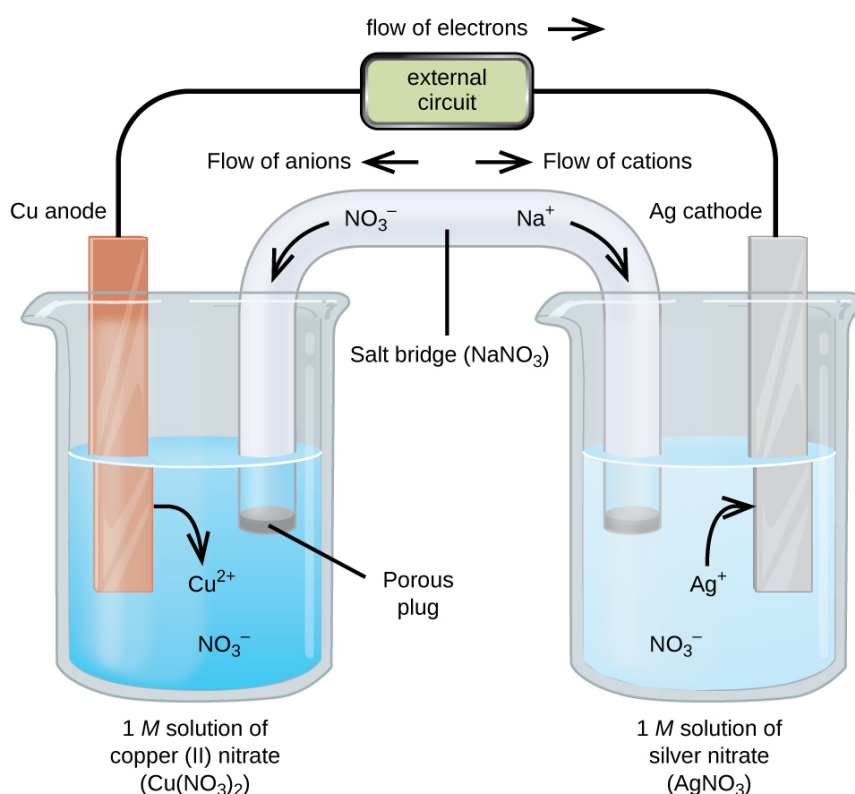
- techniques and procedures for measuring the energy transferred in experiments involving enthalpy changes in solution.

You will need:

- 2 electrodes/ metals
- 2 solutions
- 1 high resistance voltmeter
- Salt bridge soaked in potassium nitrate.
- 2 beakers

Method:

1. Pour 50cm³ of each of the given solutions into each beaker.
2. Place in each metal/electrode into the corresponding solutions.
3. Connect the clips onto each metal to form a circuit.
4. Read and record the voltage measured.



Core practical 18: Colourimetry to determine concentration of unknown solutions

Specification:

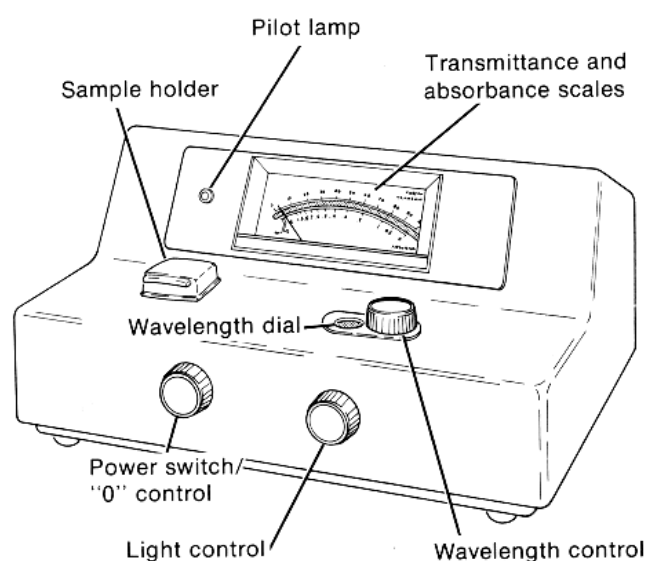
- techniques and procedures to measure concentrations of solutions using a colorimeter or visible spectrophotometer.

Equipment:

- Colourimeter
- Curvette
- Distilled water
- Coloured filter
- Known concentrations of the dilute solution.
- Graph paper

Method:

1. Prepare a range of dilutions of a standard solution. Ensure you know the concentration of each solution prepared before starting your experiment.
2. Place a red filter into the colourimeter and Calibrate by placing a small tube containing distilled water.
3. Once colourimeter has been calibrated, place in each of the solutions one at a time and record the % absorbency.
4. Plot your results on a concentration vs % absorbency graph. (This will be the calibration curve used to determine the unknown solutions concentration).
5. Draw a line of best fit on the graph.
6. Place the unknown solutions into the colourimeter and record % absorbency.
7. Read concentration based on your calibration curve for the standard solution to determine the solutions concentration.



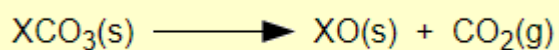
Core practical 19: Measuring the Thermal stability of Group 2 Carbonates

Specification:

- test-tube or reduced scale reactions involving the elements of Group 2 and their compounds

Theory:

Group 2 metals are affected by heat which causes thermal decomposition to occur which causes the Group 2 metal to break down into a metal oxide and CO₂. This is represented by this equation:



As you go down Group 2, the thermal stability increases. This is because the Group 2 ion has lower charge density, and thus distorts the carbonate ion less. The less distorted the carbonate ion is, the more stable it is, and so a higher temperature is required to decompose the carbonate.

(NB: Charge density decreases down the group)

You will need:

- 5g of Group 2 Metal carbonate
- 50 cm³ of Limewater
- Delivery tube with bung attached
- 2 test tubes
- Bunsen burner
- Clamp stand

Method:

1. Set up the apparatus as shown as above.
2. Gently heat the metal carbonate.
3. After a couple of mins, a white ppt will form in the test tube.
4. The quicker the white ppt is formed, the less thermally stable the compound is.

