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EXPERIMENTAL TECHNIQUES

Measurement

Measurement of time

- A stop-clock is used to measure time.
- Electronic stop-clocks often read seconds to two decimal places.

Measurement of temperature

- Temperature is measured in Celsius, $^{\circ}\text{C}$.
- Thermometers give a reading, accurate to one-tenth of a degree, but the reading to the nearest degree is acceptable.

Measurement of mass

- A top balance, accurate to two decimal places, is used to measure mass.
- The unit of mass is kilograms (kg).

Measurement of volume

- $1\text{dm}^3 = 1000\text{cm}^3$
- Volumetric pipettes range from 10cm^3 to 25cm^3 .
- Burettes accurately deliver up to 50cm^3 of liquid.
- A burette or volumetric pipette is far more accurate than a measuring cylinder.
- A volumetric pipette is used to measure a single fixed volume very accurately.
- A burette is used in titrations and in getting more accurate measurements than by using a measuring cylinder.
- Measuring cylinders are used when accuracy is not important.
- Volumetric flasks range from 5cm^3 to 1dm^3 .

Calculating volume of a solid

- A volumetric flask has a liquid. The reading is taken.
- The solid is added to the liquid. The new reading is taken.
- For the volume of the solid, the new reading - the liquid's reading.

is calculated.

Volumes of gases

- Gas volumes can be measured using either a gas syringe or an upturned measuring cylinder.
- In an upturned measuring cylinder, the gas pushes the water down. The gas displaces the water.
- A burette can be used for greater accuracy.

Accuracy

- Repeat your measurements in the same way.
- Use apparatus with small scale divisions
- Use apparatus carefully.

Criteria of Purity

- Chromatography is a method of separating and purifying coloured compounds

Colours separate if:

- pigments have different solubilities in the solvent.
 - pigments have different degrees of attraction for the filter paper.
- These two factors determine how fast the pigments move across the filter paper.
- If the mixture of pigments is not soluble in water, other solvents such as ethanol and propanone can be used.
 - The type of solvent affects how far the pigment moves.

Uses of chromatography

- Identifying substances in a mixture
- Separating out substances in a mixture and thereby purifying them.

More about chromatography

- Chromatography can also be used to identify colourless substances.
- Locating agents are used to make colourless compounds visible on a chromatogram.
- The colour is usually developed by warming the paper in an oven.
- These substances can be identified by comparing how far the spots have moved from the base line with the solvent front. This is known as the R_f value.

R_f value = $\frac{\text{distance from base line to the centre of the spot}}{\text{distance of solvent front from the base line}}$

Importance of purity

- When a substance is called 'pure', it means there is only one substance in it.
- If a substance has a small amount of substance mixed with it, it becomes impure. The unwanted substance is called an impurity.

For example:

- Chemical companies make medical drugs and food additives.
- Computer industry need pure silicon to make computer chips.

Melting and Boiling points

- Pure substances have a sharp melting and boiling point.
- Impure substances melt and boil over a range of temperatures.
- The more impurities, the wider the range of temperatures.
- The boiling point is increased by impurities.
- The melting point is decreased by impurities.

Methods of Purification

Filtration

- A solution contains a solid dissolved in a solvent.
- The solute is the dissolved solid.
- The solvent is the liquid that dissolves the solid.
- An undissolved solid can be separated from a solution by passing it through a piece of filter paper in a filter funnel. This is called filtration.
- The filtrate is the solution through which passes through the filter paper.
- The residue is the solid that stays on the filter paper.
- The solid should be washed with distilled water to remove any solution between the solid particles.
- The solid is then dried in an oven.

Decanting

- Decanting is pouring off the solution.
- It is suitable for solids that have very heavy particles.

Centrifugation

- A centrifuge is a machine which spins test tubes round and round at very high speeds.
- The spinning pulls the solid to the bottom of the tube.
- The liquid can be decanted from the solid.
- The solution can be broken, washed, and centrifuged.

Crystallisation

- Crystallisation is used to obtain a crystalline solid from a solution.
- The solution is gently heated in an evaporating basin to

concentrate it.

- The solvent is evaporated until the crystallisation point is reached.
- This can be checked by pouring the solution on a cold tile. If crystals form, the crystallisation point is reached.
- The concentrated solution is left to cool.
- Eventually, crystals form at the bottom of the evaporating basin, and are filtered off and dried between filter paper.

Solvent Extraction

- Solvent extraction is used to separate two solutes dissolved in a solvent, using another solvent, which is immiscible to the first solvent.

Distillation

- Distillation is used to obtain a solvent from a solution.
- Distillation is a combination of two processes, evaporation and condensation.

Fractional Crystallisation

- Fractional crystallisation is used to separate two dissolved substances having different solubilities at different temperature.

Fractional Distillation

- Fractional distillation is used to separate miscible liquids with different boiling points.
- There is continuous evaporation and condensation throughout the tall columns.
- It is used to separate more volatile liquids from less volatile liquids.