Rewarding Learning

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Chemistry

Unit A21: Practical Manual

Teacher / Technician Notes

Practical 1.1

Investigating the effect of changing concentration on the rate of a chemical reaction (spec ref 4.3.7)

Teacher / Technician Notes

Each pupil/group will need:

- safety goggles
- stop clock
- 100 cm^3 conical flask
- 2 × plastic dropping pipettes
- 3 × 10 cm^3 measuring cylinder
- card marked with an X
- approximately 50 cm^3 hydrochloric acid (1.0 mol dm^{-3})
- approximately 100 cm^3 sodium thiosulfate solution (0.1 mol dm^{-3})
- Bottle of deionised water

A graph of rate of reaction against concentration of sodium thiosulfate should be a straight line graph through the origin, indicating that the reaction is first order with respect to sodium thiosulfate.

Centres are responsible for their own hazard analysis and risk assessment before beginning this practical work with pupils.

Practical 1.2

Investigating the effect of changing concentration on the rate of a chemical reaction (spec ref 4.3.7)

Teacher / Technician Notes

Each pupil/group will need:

- approximately 50 cm^3 of 1.0 mol dm^{-3} propanone solution
- approximately 50 cm^3 of 1.0 mol dm^{-3} sulfuric acid
- approximately 50 cm^3 of 0.02 mol dm^{-3} iodine solution
- approximately 150 cm^3 0.01 mol dm^{-3} sodium thiosulfate solution
- approximately 20 cm^3 of 1% starch solution
- sodium hydrogen carbonate
- 2 × 25 cm^3 measuring cylinders
- 50 cm^3 measuring cylinder
- 250 cm^3 beaker
- 5 × 250 cm^3 conical flasks
- 10 cm^3 graduated pipette
- pipette filler
- spatula
- stop clock
- safety goggles

A graph of concentration of iodine against time should be a straight line graph, indicating that the reaction is zero order with respect to iodine.

Centres are responsible for their own hazard analysis and risk assessment before beginning this practical work with pupils.

Practical 1.3

Investigating the effect of changing concentration on the rate of a chemical reaction (spec ref 4.3.7)

Teacher / Technician Notes

Each pupil/group will need:

- 5 × boiling tubes
- 5 × plastic dropping pipettes
- 20 cm^3 of 1.0 mol dm^{-3} potassium iodide solution
- 15 cm^3 of 0.04 mol dm^{-3} potassium peroxodisulfate(VI) solution
- 15 cm^3 of 0.01 mol dm^{-3} sodium thiosulfate solution
- 15 cm^3 of deionised water
- 10 cm^3 of 1% starch solution
- stop clock

A graph of rate against concentration of iodide ions against should be a straight line graph through the origin, indicating that the reaction is first order with respect to iodide ions.

Centres are responsible for their own hazard analysis and risk assessment before beginning this practical work with pupils.

Practical 2.1

Making buffer solutions and investigating their pH values (spec ref 4.5.5)

Teacher / Technician Notes

Each pupil/group will need:

- 5 × 100 cm^3 beakers
- 2 × 25 cm^3 measuring cylinders
- 10 cm^3 measuring cylinder
- 25 cm^3 of 0.5 mol dm^{-3} ethanoic acid
- 25 cm^3 of 0.5 mol dm^{-3} potassium ethanoate solution
- 25 cm^3 of 0.5 mol dm^{-3} methanoic acid
- 25 cm^3 of 0.5 mol dm^{-3} potassium methanoate solution
- 25 cm^3 of 0.5 mol dm^{-3} ammonia solution
- 25 cm^3 of 0.5 mol dm^{-3} ammonium chloride solution
- 10 cm^3 of 0.5 mol dm^{-3} hydrochloric acid
- 10cm^3 of 0.5 mol dm^{-3} sodium hydroxide solution
- pH meter/Universal indicator paper (1–14)
- glass rod
- deionised water

Pupils could be asked to calculate the required mass of each salt to produce the corresponding 0.5 mol dm^{-3} solution and make the salt solutions up.

Centres are responsible for their own hazard analysis and risk assessment before beginning this practical work with pupils.

Practical 2.2

Determining the shape of a titration curve (spec ref: 4.5.6)

Teacher / Technician Notes

Each pupil/group will need:

- approximately 25 cm^3 of 0.1 mol dm^{-3} hydrochloric acid
- approximately 40 cm^3 of 0.1 mol dm^{-3} sodium hydroxide solution
- pH meter/Universal indicator solution
- 50.0 cm^3 burette
- 25.0 cm^3 pipette
- pipette filler
- 250 cm^3 conical flask
- bottle of deionised water

Centres are responsible for their own hazard analysis and risk assessment before beginning this practical work with pupils.

Practical 2.3

Determining the pH of salts (spec ref: 4.5.8)

Teacher / Technician Notes

Each pupil/group will need:

- sodium chloride
- sodium ethanoate
- ammonium chloride
- ammonium ethanoate
- pH meter
- 250 cm^3 deionised water
- 50 cm^3 measuring cylinder
- 4 × 100 cm^3 beakers
- 4 × weighing boats
- glass rod
- access to a mass balance (2 d.p)

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Practical 3.1

Preparation of 2,4-dinitrophenylhydrazones (spec ref: 4.7.8)

Teacher / Technician Notes

Each pupil/group will need:

- 2 × 100 cm^3 beakers
- 250 cm^3 beaker
- glass rod
- 2 × plastic dropping pipettes
- approximately 5 cm^3 of 2,4-dinitrophenylhydrazine solution
- approximately 2 cm^3 of an aldehyde or ketone labelled X
- Büchner funnel and flask
- filter funnel
- 100 cm^3 conical flask
- spatula
- ethanol
- filter paper
- access to a drying oven
- a capillary tube sealed at one end
- access to melting point apparatus

There are a number of aldehydes/ketones that can be used. The melting points of some hydrazone derivatives are given below.

Aldehyde/Ketone	Melting point of hydrazone (°C)
Ethanal	164
Propanal	156
Propanone	128
Butanone	115

Centres are responsible for their own hazard analysis and risk assessment before beginning this practical work with pupils.

Practical 3.2

Using Fehling's solution and Tollens' reagent to distinguish between aldehydes and ketones (spec ref 4.7.9)

Teacher / Technician Notes

Each pupil/group will need:

- 4 × test tubes (these should be very clean)
- 250 cm^3 beaker
- 4 × plastic dropping pipettes
- approximately 5 cm^3 of Fehling's solution 1
- approximately 5 cm^3 of Fehling's solution 2
- approximately 5 cm^3 of 0.1 mol dm^{-3} silver nitrate solution
- approximately 5 cm^3 of 1 mol dm^{-3} ammonia solution
- approximately 2 cm^3 of ethanal
- approximately 2 cm^3 propanone
- safety goggles

Centres are responsible for their own hazard analysis and risk assessment before beginning this practical work with pupils.

Practical 4.1

Preparing a carboxylic acid from an alcohol (spec ref 4.8.3)

Teacher / Technician Notes

Each pupil/group will need:

- safety goggles
- gloves
- 10 cm^3 measuring cylinder
- spatula
- plastic dropping pipette
- funnel
- pear-shaped flask, still head, condenser with rubber tubing attached, receiver adapter with vent
- 100 cm^3 conical flask
- 2 × retort stands, bosses and clamps
- Bunsen burner, tripod, gauze, heatproof mat
- weighing boat
- thermometer (0–200 °C) and adapter
- anti-bumping granules
- approximately 10 cm^3 sulfuric acid (1 mol dm^{-3})
- approximately 2 cm^3 concentrated sulfuric acid
- approximately 5 g sodium dichromate(VI)
- approximately 1 cm^3 ethanol
- access to a mass balance (1 d.p)
- Universal indicator paper (1–14)
- approximately 0.5 g sodium carbonate

Centres are responsible for their own hazard analysis and risk assessment before beginning this practical work with pupils.

Practical 4.2

Carrying out test tube reactions of a carboxylic acid with sodium carbonate, sodium hydroxide and aqueous ammonia and measuring pH changes (spec ref 4.8.5)

Teacher / Technician Notes

Each pupil/group will need:

- safety goggles
- 3 × plastic dropping pipettes
- 4 × test tubes
- test tube rack
- spatula
- approximately 1 cm^3 ethanoic acid (1 mol dm^{-3})
- approximately 0.5 g sodium carbonate
- approximately 1 cm^3 sodium hydroxide solution (1 mol dm^{-3})
- approximately 1 cm^3 ammonia solution (1 mol dm^{-3})
- Universal indicator paper (1–14)
- thermometer (0–100 °C)
- delivery tube with bung
- limewater

Centres are responsible for their own hazard analysis and risk assessment before beginning this practical work with pupils.

Practical 5.1

Preparing a liquid ester from a carboxylic acid and an alcohol (spec ref 4.9.5)

Teacher / Technician Notes

Each pupil/group will need:

- safety glasses
- 50 cm^3 pear-shaped flask, still head, condenser with rubber tubing attached, receiver adapter, conical flask to collect distillate
- tripod, heat mat, wire gauze, Bunsen burner
- 10 cm^3 measuring cylinder
- 25 cm^3 measuring cylinder
- spatula
- plastic dropping pipette
- 2 × retort stands, bosses & clamps
- 250 cm^3 beaker
- separating funnel & stopper
- 4 × 100 cm^3 conical flasks
- thermometer (0–100 °C) and adapter
- anti-bumping granules
- approximately 10 cm^3 ethanol
- approximately 12 cm^3 glacial ethanoic acid
- approximately 1 cm^3 concentrated sulfuric acid
- approximately 20 cm^3 sodium carbonate solution (1 mol dm^{-3})
- anhydrous sodium sulfate

Centres are responsible for their own hazard analysis and risk assessment before beginning this practical work with pupils.

Practical 6.1

Preparation of methyl 3-nitrobenzoate (spec ref 4.10.5)

Teacher / Technician Notes

Each pupil/group will need:

- safety glasses & protective gloves
- 2 × 100 cm^3 conical flasks
- 3 × 10 cm^3 measuring cylinders
- test tube
- plastic dropping pipette
- thermometer (-10 – 100 °C)
- 250 cm^3 beaker
- glass rod
- Büchner funnel and flask
- filter paper
- watch glass
- access to a drying oven
- access to a mass balance (2 d.p)
- melting point apparatus
- capillary tube sealed at one end
- approximately 12 cm^3 concentrated sulfuric acid
- approximately 4 cm^3 methyl benzoate
- approximately 3 cm^3 concentrated nitric acid
- approximately 20 cm^3 of ethanol
- ice
- deionised water wash bottle

The melting point of methyl 3-nitrobenzoate is 78–80 °C.

Centres are responsible for their own hazard analysis and risk assessment before beginning this practical work with pupils.