

SALTERS ADVANCED CHEMISTRY

AS

TECHNICIANS MANUAL

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We also thank *CLEAPSS* for the excellent safety information, which has been used in the production of both the Technicians' and Students' Safety Sheets.

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*Chris Peel
Tracy Lambert*

Quantities in Requirements

The quantities given in the requirements are per student or group of students.

The bulk quantities given for preparing solutions may need to be adjusted to the needs of individual establishments, depending on the number of students or groups of students per experiment

Suppliers

Some information on suppliers for particular items is given in the Advance Warning and Technicians Sheets. This information however may go out of date. Updated information on suppliers can be found on the Salters website at, www.york.ac.uk/org/seg/salters/chemistry or, www.salterschem.org.uk.

Also on this site is a direct link to a discussion forum for Salters technicians, with simple instructions on how to register.

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Technician and Student Safety Sheets

The technician and student safety sheets, have been compiled using the current *CLEAPSS* safety information. They include details of the hazard classification and specific risks associated with each chemical. They also deal with practical safety issues relating to the activity. Some *CLEAPSS Hazcard* references are given, particularly in the Students Safety Sheets. Some immediate first aid measures for eye and skin contact are included, but further information on first aid is available on the *CLEAPSS Hazcards*.

The safety sheets are not risk assessments in themselves, but they provide a guide towards a risk assessment for the specific activity. The degree of risk posed by any hazard depends on local procedures and conditions, for example laboratory size, number of students etc., and must incorporate local safety rules, guidelines and any updated safety information.

Whilst every effort has been made to ensure the information contained in this manual is correct, the authors cannot be held responsible for errors and omissions or held liable for any loss or damage, however arising. The final assessment of risk therefore, is the responsibility of individual schools and colleges.

Further information on safety matters can be obtained from the following sources.

- *CLEAPSS*. School Science Service, Brunel University, Uxbridge. As well as *Hazcards*, *CLEAPSS* provide information and advice on all aspects of science in schools and colleges. The benefits of membership far outweigh any costs.
- *Topics in Safety*, 3rd edition. Association for Science Education
- *Safeguards in the School Laboratory*, 10th edition. ASE, 1996
- *Safety Reprints*. ASE, 1996
- *Safety in Science Education*. DfEE, HMSO, 1996
- *Hazardous Chemicals: A Manual for Science Education*. SSERC Ltd, 1997
- Chemical suppliers' catalogues and Safety Data Sheets

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THE ELEMENTS OF LIFE

Advance warning

The following items needed for activities in this unit may not be already in your school or college and might take a little time to obtain.

Activity	Item(s)	Quantities per expt.	Essential or Optional	
EL3.1	Barium	Small piece	E	Buy granules. Available from Aldrich Chemical Co. The Old Brickyard, New Rd., Gillingham, Dorset, SP8 4XT Tel. 0800 717181

Notes

Chemicals required for EL

Chemical	Concs.	Quantities per group
Barium		Few small pieces
Barium carbonate		Few grams
Barium nitrate	0.1M	10 cm ³
Calcium		Few small pieces
Calcium carbonate		Few grams
Calcium nitrate	0.1M	10 cm ³
Copper foil		Piece 15 cm ² x 1 cm ²
Hydrated iron(II) ammonium sulphate		5 g
Hydrochloric acid	Conc.	Few cm ³
Iodine crystals		0.3 g
Lime water (calcium hydroxide)		15 cm ³
Magnesium		Few small pieces
Magnesium carbonate		Few grams
Magnesium nitrate	0.1M	10 cm ³
Potassium manganate(VII)	0.010M	150 cm ³
Solid chlorides of; barium, calcium, potassium, sodium & strontium		Few crystals
Sodium carbonate	1M	10 cm ³
Sodium hydroxide	1M	10 cm ³
Strontium carbonate		Few grams
Strontium nitrate	0.1M	10 cm ³
Sulphuric acid	2M	25 cm ³
	1M	300 cm ³

Notes





EL1 HOW DO WE KNOW THE FORMULA OF A COMPOUND?

Requirements

Copper foil strip	Approximately 15 cm x 1 cm
Emery paper	
Dry filter paper	
Iodine crystals	0.3 g
Boiling tube with a mineral wool plug	
250 cm ³ beaker	To stand boiling tube in when weighing
Spatula	
Access to a balance	

Notes

EL1 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing iodine crystals	 Harmful  Harmful to environment	Harmful if breathed in or by contact with skin. Causes burns to skin if left for some time. The vapour is particularly dangerous to eyes.	 Safety goggles should be worn.  Gloves should be worn. Dispense in a fume cupboard

Notes









EL2.1 HOW MUCH IRON IS IN A SAMPLE OF AN IRON COMPOUND?

Requirements

Hydrated iron(II) ammonium sulphate	5g
Sulphuric acid 1M	250 cm ³ - Add 56 cm ³ of the conc. acid slowly with stirring to 600 cm ³ dist. water. Make up to 1 dm ³ with dist. water
Potassium manganate(VII) 0.010M (accurate for titration)	100 cm ³ - Dissolve 1.58 g of the salt in dist. Water. Make up to 1 dm ³ with dist. water
Weighing bottle	
Conical flask	
250 cm ³ volumetric flask and stopper	
Burette and funnel	
100 cm ³ beaker	3
25 cm ³ pipette	
Safety pipette filler	
Small funnel	
10 cm ³ measuring cylinder	
Dropping pipette	
White tile	
Glass rod	
Spatula	
Access to balance	

Notes

EL2.1 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dilution of concentrated sulphuric to 1M	<p>Conc. Sulphuric acid</p>  <p>Corrosive</p> <p>1M sulphuric acid</p>  <p>Irritant</p>	<p>The concentrated acid causes severe burns and has an affinity for water. Hence it is extremely dangerous to eyes, and can cause blindness if entering the eye.</p> <p>The act of diluting produces much heat and if control measures are not taken the mixture can boil causing dangerous splashes.</p>	 A full face shield should be worn.  Gloves should be worn. <p>The conc. acid should be added very slowly to the distilled water, with constant stirring, cooling the beaker in a large vessel of cold water. Never add water to conc. acid</p>
Preparing potassium manganate(VII) solution 0.010M	<p>Solid</p>  <p>Oxidiser</p>  <p>Harmful</p>	<p>Contact with combustible material can cause fire.</p> <p>Harmful if entering the eyes and if swallowed</p> <p>The solution at this concentration is not harmful but contact with eyes should be avoided, and if in contact with skin will stain it brown.</p>	 Wear eye protection  Wear protective gloves when handling the solid.




























Notes

EL3.1 THE CHEMISTRY OF GROUP 1 AND GROUP 2 ELEMENTS

Requirements

Test tubes and bungs	12
100 cm ³ beaker	3
Universal indicator solution & charts	
Tweezers	
Filter paper	
Small pieces of;- magnesium, calcium and barium	Purchase granules NOT rods of barium as they are extremely difficult to cut. Store barium under oil after opening. (Do not use strontium)
Spatula	3
Dropping pipette	
Magnesium carbonate	A few grams
Calcium carbonate	A few grams
Strontium carbonate	A few grams
Barium carbonate	A few grams
Magnesium nitrate solution 0.1M	10 cm ³ - Dissolve 2.56 g of the salt in dist. water, make up to 100 cm ³ with dist. water
Calcium nitrate solution 0.1M	10 cm ³ - Dissolve 2.36 g of the salt in dist. water, make up to 100 cm ³ with dist. water
Strontium nitrate solution 0.1M	10 cm ³ - Dissolve 2.12 g of the salt in dist. water, make up to 100 cm ³ with dist. water
Barium nitrate solution 0.1M	10 cm ³ - Dissolve 2.61 g of the salt in dist. water, make up to 100 cm ³ with dist. water
Sodium hydroxide solution 1M	10 cm ³ - Dissolve 4 g of the solid in dist. water, make up to 100 cm ³ with dist. water
Sodium carbonate solution 1M	10 cm ³ - Dissolve 10.6 g of the anhydrous salt in dist. water, make up to 100 cm ³ with dist. water
Lime water	15 cm ³ - Make a stock solution by placing excess calcium hydroxide in a winchester topped up with dist. water. Shake to saturate. Allow to settle, carefully decant or filter if necessary
Delivery tube	Angled with bung to fit test tube

EL3.1 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing barium	 Harmful	Harmful by ingestion and inhalation of dust. Hydrogen is produced when the metal comes into contact with water	 Wear eye protection.  Wear protective gloves. Keep the metal dry
Dispensing calcium	 Highly flammable	Contact with moisture forms calcium oxide and hydroxide which are irritants to eyes and skin. Hydrogen is produced when the metal comes into contact with water	 Wear eye protection  Wear protective gloves. Keep metal dry
Dispensing magnesium	 Highly flammable	The metal is difficult to ignite but burns vigorously and is difficult to extinguish	 Wear eye protection Keep away from naked flames
Dispensing barium carbonate	 Harmful	Harmful by ingestion and inhalation of dust. May be irritating to eyes and skin.	 Wear eye protection  Wear protective gloves. Avoid inhaling dust
Preparation of 0.1M barium nitrate	Solid  Oxidiser Solid & 0.1M soln.  Harmful	The solid is harmful by ingestion and inhalation of dust. It severely irritates the eyes, skin and respiratory system. Contact with combustible material may cause fire. The solution is harmful by ingestion.	 Wear eye protection  Wear protective gloves. Avoid inhaling dust. Keep solid away from combustible materials
Preparation of 0.1M magnesium strontium and calcium nitrate	Solids  Oxidiser	Contact with combustible material may cause fire.	 Wear eye protection  Wear protective gloves. Keep solid away from combustible materials
Preparation of 1M sodium hydroxide	Solid & 1M soln.  Corrosive	Solid and solution cause severe burns and are particularly dangerous to eyes. The solid gets hot when added to water	 Wear safety goggles  Wear protective gloves. Add solid slowly to water with constant stirring.
Preparation of 1M sodium carbonate	 Irritant	Irritating to eyes skin and respiratory system.	 Wear eye protection  Wear protective gloves. Avoid inhaling dust
Preparation of lime water	Solid calcium hydroxide  Irritant	May irritate eyes, skin and respiratory system	 Wear eye protection  Wear protective gloves. Avoid inhaling dust










EL4.3 INVESTIGATING A SPECTROSCOPIC TECHNIQUE

Requirements

Direct vision spectroscope	
Concentrated hydrochloric acid	A few cm ³
Solid chlorides of:- barium calcium potassium sodium strontium	A few grams of each. Analytical grade chemicals give better results than reagent grade
Nichrome wire with a cork holder	Platinum wire fixed in a glass holder is a much better alternative.- The wires can be cleaned by repeatedly holding them in a hot bunsen flame and dipping into concentrated hydrochloric acid, in a well ventilated laboratory or prep. room, until no further colour appears in the flame
100 cm ³ beaker	
Watch glass	1 per sample

Notes

EL4.3 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing concentrated hydrochloric acid	 Corrosive	Causes burns. The vapour is very irritating to the respiratory system	 Wear safety goggles  Wear protective gloves. Dispense in a fume cupboard.
Dispensing barium chloride	 Toxic	Harmful by ingestion and inhalation of dust. May be irritating to eyes and skin.	 Wear eye protection.  Wear protective gloves. Avoid inhaling dust
Dispensing calcium and strontium chlorides	 Irritant	Irritating to eyes, skin and respiratory system. Dangerous with water. The anhydrous salts can cause water to boil.	 Wear eye protection  Wear protective gloves. Keep anhydrous salts dry.

Notes

Notes on “Elements of Life”

DEVELOPING FUELS

Advance warning

The following items needed for activities in this unit may not be already in your school or college and might take a little time to obtain.

Activity	Item(s)	Quantities per expt.	Essential or Optional	
DF1.2	Hexane	100 cm ³	E	
	Spirit burners	2	E	
DF3.2	Summer blend petrol (unleaded)	20 cm ³	E	Or alternatives as in the technicians notes on page 30
	Winter blend Petrol (unleaded)	20 cm ³	E	
DF3.3	Pentane	1 cm ³	E	
	2-Methylbutane	1 cm ³	E	

Notes

Chemicals required for DF

Chemicals	Concs.	Quantities per group
2-Methylbutane		Few drops
Bromine water		Few cm ³
Butan-1-ol		Enough for spirit burners used
Ethanol		Enough for spirit burners used
Hexane		Enough for spirit burners used
Methanol		Enough for spirit burners used
Pentane		Few drops
Petroleum jelly or liquid alkane mixture		Few grams
Propan-1-ol		Enough for spirit burners used
Propan-2-ol		Enough for spirit burners used
Winter and summer petrols or different boiling ranges of petroleum ethers		5 cm ³ of each

Notes










DF1.2 MEASURING THE ENTHALPY CHANGES OF COMBUSTION OF FUELS

Requirements

0-110 °C thermometer	Or 0-50 °C thermometer
100 cm ³ measuring cylinder	
Spirit burner containing hexane	
Spirit burner containing methanol	
Draught shielding for spirit burners	Bench protection mats can be used
Copper calorimeter	Base about 10 cm diameter
Access to balance	

Notes

DF1.2 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Pouring hexane into spirit burners	 Highly flammable  Harmful  Harmful to environment	Hexane is harmful to health by prolonged exposure. Risk of fire	 Wear eye protection  Wear protective gloves. Use in a fume cupboard and away from any sources of ignition
Pouring methanol into spirit burners	 Highly flammable  Toxic	Methanol is toxic by inhalation, if swallowed and by skin absorption. Risk of fire.	 Wear eye protection  Wear protective gloves. Avoid inhaling fumes. Use in a fume cupboard and away from sources of ignition.

Notes















DF1.3 COMPARING ENTHALPY CHANGES OF COMBUSTION OF ALCOHOLS

Requirements

Spirit burner containing propan-1-ol	
Spirit burners containing;- ethanol propan-2-ol methanol butan-1-ol	These can be shared and passed around the class
Small can	Or copper calorimeter
0-110 °C thermometer	
100 cm ³ measuring cylinder	
Access to balance	

Notes

DF1.3 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Pouring methanol into spirit burners	 Highly flammable  Toxic	Methanol is toxic by inhalation, if swallowed and by skin absorption. Risk of fire.	 Wear eye protection  Wear protective gloves. Avoid inhaling fumes. Use in a fume cupboard and away from sources of ignition.
Pouring ethanol into spirit burners	 Highly flammable	Breathing the vapour has a narcotic effect. Risk of fire.	 Wear eye protection Avoid inhaling fumes. Use in a fume cupboard and away from sources of ignition.
Pouring butan-1-ol into spirit burners	 Flammable  Harmful	The vapour is harmful by inhalation and may cause headaches and dizziness and can irritate the eyes and skin. Risk of fire	 Wear eye protection  Wear protective gloves. Avoid inhaling fumes. Use in a fume cupboard and away from sources of ignition.
Pouring propan-1-ol & propan-2-ol into spirit burners	 Highly flammable  Harmful & irritant	Serious risk of damage to eyes. Vapours may cause drowsiness or dizziness. Risk of fire.	 Wear eye protection  Wear protective gloves. Avoid inhaling vapour. Use away from sources of ignition.

Notes

DF3.2 COMPARING WINTER AND SUMMER PETROL BLENDS















Requirements

Test tubes	2 the same size
Balloons	2 identical.
Simulated summer petrol	5 cm ³ - make up freshly in order to prevent the loss of volatile compounds
Simulated winter petrol	5 cm ³ - make up freshly in order to prevent the loss of volatile compounds
Supply of hot water	At about 60 °C from a hot tap or kettle
250 cm ³ beaker	

Notes

DF3.2 Technicians Safety Sheet

N.B. Unleaded petrol generally contains 4-5 % benzene which is a carcinogen. Winter and summer petrols can be simulated using petroleum ether fractions. For example, winter petrol; 50:50 mixture of 40/60 and 60/80 petroleum ethers, summer petrol; 50:50 mixture of 60/80 and 80/100 petroleum ethers. Or use 40/60 for winter petrol and either 60/80 or 80/100 for summer petrol.

Operation	Hazard	Risks	Control measures
Dispensing petrol	 Highly flammable  Harmful  Harmful to environment	The vapour is harmful as petroleum ethers contain a certain amount of benzene.	 Wear eye protection  Wear protective gloves. Avoid inhaling vapour. Use in a fume cupboard and away from sources of ignition.
Mixing petroleum ethers to simulate petrols	 Highly flammable  Harmful  Harmful to environment	The vapour is harmful as petroleum ethers contain a certain amount of hexane. Risk of fire.	 Wear eye protection Avoid inhaling vapour. Use in a fume cupboard and away from sources of ignition.
Addition of pentane or hexane to petrol	Pentane & Hexane  Highly flammable  Harmful to environment Hexane  Harmful	Risk of fire Hexane is harmful to health by prolonged exposure.	 Wear eye protection  Wear protective gloves. Avoid inhaling vapour. Use in a fume cupboard and away from sources of ignition.





DF 3.3 AUTO- IGNITION IN A TEST TUBE

Requirements

Hard glass boiling tubes	2
Dropping pipette with large teat and long tube	2
Bunsen burners	2
Pentane	In a stoppered bottle containing a few drops only
2-Methylbutane	In a stoppered bottle containing a few drops only

Notes

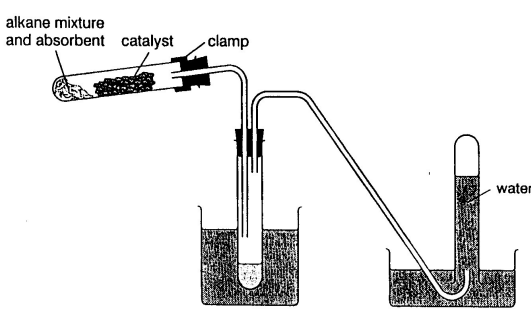
DF3.3 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing pentane & 2-methybutane	 Highly flammable  Harmful  Harmful to environment	Risk of fire. Vapour/air mixtures are explosive	 Wear eye protection. Avoid inhaling vapours. Dispense in a fume cupboard. Do not dispense in the same room where there is any source of ignition.

Notes

DF4.4B CRACKING ALKANES








Requirements

Test tubes with bungs and delivery tubes as in the diagram	
Test tubes and bungs	4
Crystallising dish	Or plastic trough
Inert absorbent	Mineral wool or vermiculite
Catalyst	Broken unglazed porcelain, aluminium oxide granules or pumice or zeolite
250 cm ³ beaker	
Combustion spoon	Or glass rod
Bromine water	Dissolve liquid bromine in dist. water (in a fume cupboard) until saturated. Store in dark bottles
Solid alkane mixture	Vaseline, petroleum jelly
Spatula	

Notes

DF4.4b Technicians Safety Sheet

N.B. Make sure that there is space above the catalyst in the tubes so that the gases can freely pass over it

Operation	Hazard	Risks	Control measures
Preparation of bromine water	<p>Bromine</p>  <p>Corrosive</p>  <p>Very toxic</p>  <p>Harmful to environment</p> <p>Bromine water</p>  <p>Corrosive</p>  <p>Very toxic</p>	<p>The liquid causes severe burns to eyes and skin. The vapour is very toxic if breathed in.</p> <p>Saturated bromine solution causes severe burns to eyes and skin. The vapour is very toxic if breathed in.</p>	 <p>Wear protective goggles</p>  <p>Wear RUBBER gloves. Use and make solution in a fume cupboard. Do not breathe vapour.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>WHEREVER BROMINE IS USED, HAVE A 500cm³ BOTTLE OF 1M (25%) SODIUM THIOSULPHATE TO HAND TO TREAT SPILLAGES</p> </div>

Notes

Notes on “Developing Fuels”

FROM MINERALS TO ELEMENTS

Advance warning

The following items needed for activities in this unit may not be already in your school or college and might take a little time to obtain

Activity	Item(s)	Quantities per expt.	Essential or Optional	
M2.1	Samples of minerals	1 per class	O	Available from, Offa Rocks, The Vicarage, Ford, Shrewsbury, SY5 9LZ.
	Copper ore (unroasted)	2 g	E	Available from, The Project Secretary, The Salters Advanced Chemistry Project, Dept. of Chemistry, University of York, Heslington, York, YO10 5DD
M2.2 & M2.3	Copper ore (roasted)	110 g	E	Available in 3 kg packs from address above
M2.2 & M2.3	Domestic food warming tray	1 per class	E	Available from large department stores
M2.3	Ammonium ethanoate	10 g	O	

Notes

Chemicals required for Minerals to Elements

Chemical	Concs.	Quantities per group
Ammonia solution	4M	100 cm ³
Ammonium carbonate		20 g
Ammonium ethanoate		10 g
Bromine water	Saturated	5 cm ³
Chlorine water	Saturated	5 cm ³
Copper ore	Roasted Unroasted	2 g 56 g
Copper(II) carbonate		Few g
Copper(II) sulphate	1M	6 cm ³
Cyclohexane		30 cm ³
Hydrochloric acid	50% 1M	10 cm ³ 3 cm ³
Iodine solution	0.04M	5 cm ³
Lead nitrate(V)	1M	3 cm ³
Potassium bromide	Solid 0.1M	7 g 10 cm ³
Potassium chloride	Solid 0.1M	2 g 10 cm ³
Potassium iodide	1M	1 cm ³
Potassium iodide	Solid 0.1M	2 g 10 cm ³
Propanone		20 cm ³
Silver nitrate	0.025M	1 cm ³
Sodium carbonate	1M	2 cm ³
Sodium chloride	1M	Few cm ³
Sodium hydroxide	2M 1M 0.01M	Few cm ³ 2 cm ³ 100 cm ³
Sodium thiosulphate	0.1M	50 cm ³
Sodium(V) nitrate	1M	10 cm ³
Starch solution	1%	5 cm ³
Sulphuric acid	4M 1M 0.005M	15 cm ³ 2 cm ³ 50 cm ³
Zinc dust		4 g
Phenolphthalein indicator		Few drops

Notes



























M1.1 SOLUTIONS OF IONS

Requirements

Test-tubes	12
Dropping pipettes	2
10 cm ³ measuring cylinder	
Copper(II) carbonate	1 spatula measure
Copper(II) sulphate 1M	6 cm ³ - Dissolve 25 g of the hydrated solid in dist. water. Make up to 100 cm ³ with dist. water.
Sodium nitrate(V) 1M	10 cm ³ - Dissolve 8.5 g of the solid in dist. water. Make up to 100 cm ³ with dist. water.
Sodium carbonate 1M	2 cm ³ - Dissolve 10.6 g of the anhydrous solid in dist. water. Make up to 100 cm ³ with dist. water.
Lead nitrate(V) 1M	3 cm ³ - Dissolve 33.1 g of the solid in dist. water. Make up to 100 cm ³ with dist. water.
Potassium iodide 1M	1cm ³ - Dissolve 16.6 g of the solid in dist. water. Make up to 100 cm ³ with dist. water.
Hydrochloric acid 1M	3 cm ³ - Add 8.4 cm ³ of the concentrated acid (36%) to dist. water. Make up to 100 cm ³ with dist. water.
Sodium hydroxide 1M	2 cm ³ - Dissolve 4 g of the solid in dist. water. Make up to 100 cm ³ with dist. water.
Sulphuric acid 1M	2 cm ³ - Slowly add 5.4 cm ³ of the concentrated acid to dist. water, with constant stirring. Cool, make up to 100 cm ³ with dist. water.
Sodium chloride 1M	Few cm ³ - Dissolve 5.8 g of the solid in dist. water. Make up to 100 cm ³ with dist. water.
Spatula	

Notes

M1.1 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing solid copper(II) carbonate	 Harmful	Harmful if swallowed. Dust irritates the lungs	 Wear eye protection Avoid inhaling dust.
Preparing 1M copper(II) sulphate	Solid & IM soln.  Harmful  Harmful to environment	Harmful if swallowed. The solid may be irritating to eyes and skin and has been known to sensitise the skin.	 Wear eye protection  Wear protective gloves.
Preparing 1M sodium(V) nitrate solution	Solid  Oxidiser	Contact with combustible material may cause fire	 Wear eye protection Keep away from combustible material including organic substances.
Preparing 1M sodium carbonate solution	Solid  Irritant	Irritating to eyes, skin and respiratory system	 Wear eye protection  Wear protective gloves. Avoid inhaling dust
Preparing 1M lead(V) nitrate solution	Solid & soln.  Toxic  Harmful to environment Solid  Oxidiser	Harmful by ingestion and inhalation of dust. Danger of cumulative effects. May cause damage to unborn child.	 Wear eye protection.  Wear protective gloves. Use solid in a fume cupboard. Avoid inhaling dust.
Diluting concentrated hydrochloric acid to make 1M acid	Conc. acid  Corrosive	Causes burns. The vapour is very irritating to the respiratory system	 Wear safety goggles  Wear protective gloves. Prepare in a fume cupboard
Preparing 1M sodium hydroxide solution	Solid & 1M soln  Corrosive	Solid and solution cause severe burns and are particularly dangerous to eyes. The solid gets hot when added to water	 Wear safety goggles  Wear protective gloves. Add solid slowly to water with constant stirring.
Diluting concentrated sulphuric acid to make 1M acid	Conc. acid  Corrosive 1M sulphuric acid  Irritant	The concentrated acid causes severe burns and has an affinity for water. Hence it is extremely dangerous to eyes, and can cause blindness if entering the eye. The act of diluting produces much heat and if control measures are not taken the mixture can boil causing dangerous splashes.	 A full face shield should be worn.  Gloves should be worn. The conc. acid should be added very slowly to the distilled water, with constant stirring, cooling the beaker in a large vessel of cold water. Never add water to conc. acid

M1.3 HALOGENS AND THEIR COMPOUNDS





















Requirements

Chlorine solution in water	5 cm ³ - Prepare fresh. Using a gas generator drop conc. hydrochloric acid onto solid potassium permanganate (in a fume cupboard). Bubble chlorine gas into dist. water until saturated. Store in dark bottles.- Old solutions may still smell of chlorine, but may have very little in solution. Or see hazard 81 for alternative methods.
Bromine solution in water	5 cm ³ - Add a few cm ³ of liquid bromine to dist. water (in a fume cupboard). Stir until saturated. Store in dark bottles
Iodine solution in water	5 cm ³ - Dissolve 4 g of potassium iodide in 150 cm ³ dist. water, add 2.5 g of iodine, dissolve, make up to 200 cm ³ with dist. water
Potassium chloride solution 0.1M	10 cm ³ - Dissolve 7.46 g of the salt in dist. water, make up to 1 dm ³ with dist. water
Potassium bromide solution 0.1M	10 cm ³ - Dissolve 11.9 g of the salt in dist. water, make up to 1 dm ³ with dist. water
Potassium iodide solution 0.1M	10 cm ³ - Dissolve 16.6 g of the salt in dist. water, make up to 1 dm ³ with dist. water
Cyclohexane	30 cm ³
Potassium chloride	2 g
Potassium bromide	2 g
Potassium iodide	2 g
Silver nitrate solution 0.025M	1 cm ³ - Dissolve 0.42 g of the salt in dist. water, make up to 100 cm ³ with dist. water. Store in dark bottles
Test tubes & bungs	15
Spatula	
Dropping pipettes	6




Optional Gas jar of chlorine Gas jar of bromine Round bottom flask containing iodine crystals with a cotton wool plug	Demo for class to look at Ditto Ditto
--	---

Notes

M1.3 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Preparation of chlorine water.	Chlorine gas  Toxic  Irritant  Harmful to environment Chlorine water  Harmful	Chlorine gas is toxic if breathed in, causing severe lung damage. It irritates the eyes, skin and respiratory system, and may trigger an asthma attack. Gas escapes easily from solution if more than 0.4M. (A saturated solution is about 1M)	 Wear eye protection  Wear protective gloves. Always prepare in a fume cupboard. <div> CHECK HAZARDS AND CONTROL MEASURES NEEDED, DEPENDING ON PREFERRED METHOD OF CHLORINE PREPARATION. (E.G CONCENTRATED HYDROCHLORIC ACID- HAZCARD 47 & SOLID POTASSIUM MANGANATE(VII)- HAZCARD 81.) SEE HAZCARD 81 FOR ALTERNATIVE METHODS OF PREPARATION </div>
Preparation of bromine water	 Corrosive  Very toxic  Harmful to environment Bromine water  Corrosive Very toxic	The liquid causes severe burns to eyes and skin. The vapour is very toxic if breathed in. Saturated bromine solution causes severe burns to eyes and skin. The vapour is very toxic if breathed in.	 Wear protective goggles  Wear RUBBER gloves. Use and make solution in a fume cupboard. Do not breathe vapour. <div> WHEREVER BROMINE IS USED, HAVE A 500 cm³ BOTTLE OF 1M (25%) SODIUM THIOSULPHATE TO HAND TO TREAT SPILLAGES </div>
Preparation of iodine solution	 Harmful  Harmful to environment	Harmful if breathed in or by contact with skin. Causes burns to skin if left for some time. The vapour is particularly dangerous to eyes.	 Safety goggles should be worn.  Gloves should be worn. Dispense in a fume cupboard
Preparation of 0.025M silver nitrate solution	Solid  Corrosive  Harmful to environment	Causes burns. Solid and solution is dangerous to eyes and will blacken the skin. If ingested can cause severe internal damage	 Wear eye protection  Wear protective gloves.

Cont...

Operation	Hazard	Risks	Control measures
Dispensing cyclohexane	 Highly flammable  Harmful to environment	Risk of fire.	 Wear eye protection Keep away from sources of ignition.

Do not put cyclohexane residues down sinks. Put into waste halogenated residues container for future disposal. Put silver residues in a residue container for future recovery

Notes


M2.1 MINERAL SPOTTING

Requirements

Unroasted sample of copper ore	2 g
Boiling tube and bung	
Spatula	
Microscope slide	
Microscope with lamp to illuminate from above	
Samples of :- chalcopyrite galena shalenite quartz fluorite calcite sphalerite malachite	

Notes

M2.1 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing copper ore	Low hazard	Solid particles entering the eye.	 Wear eye protection

Notes











M2.2 GETTING AT THE MINERALS

Requirements

100 cm ³ beakers	2
Cling film or watch glasses	2
10 cm ³ measuring cylinder	
Sample of roasted copper ore	6 g- Now supplied roasted, but if sample is not already roasted, roast in the following way. Spread out "ore for roasting" on metal trays. Heat strongly over a bunsen turning from time to time. The roasting is complete when there is no further change and the ore is a uniform colour.- (500 g takes about 30 mins.) Alternatively it can be heated in an oven at 600 °C. Do not overheat
Hydrochloric acid 50%	10 cm ³
Ammonia leach solution	10 cm ³ - Dissolve 192 g ammonium carbonate in 1 dm ³ 4M ammonia solution. To make 4M ammonia, dissolve 230 cm ³ conc. ammonia in dist. water, make up to 1 dm ³ with dist. water. These preparations should be carried out in a fume cupboard
Domestic food warming tray	To allow slow evaporation without spitting

Notes

M2.2 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Roasting copper ore	Very hot	The ore can "spit" when heated very strongly and may stay hot for a long time after heating	 Wear safety goggles  Wear heat proof protective gloves when turning the mixture
Preparing the ammonia leach solution	Concentrated ammonia  Corrosive 4M ammonia & leach soln.  Irritant  Harmful	The concentrated ammonia causes burns in contact with skin and is dangerous to eyes. The vapour is irritating to eyes. Pressure can build up in sealed containers The 4M solution and the leach solution are irritating to eyes and skin and the vapour can cause distress	 Goggles must be worn  Wear protective gloves to avoid skin contact Dispense, carry out all dilutions, and dissolve the ammonium carbonate in a fume cupboard. Open containers of the concentrated ammonia with care particularly on hot days, using a safety screen or face shield.
Dilution of concentrated hydrochloric acid to make 50% hydrochloric acid	Concentrated & 50% acid  Corrosive	Causes burns. The vapour is very irritating to the respiratory system	 Wear safety goggles  Wear protective gloves. Dilute adding the acid slowly to water in a fume cupboard.

Notes

M2.3 EXTRACTING COPPER

Requirements





















Roasted copper ore	50 g- If the ore is not already roasted, roast as in expt. M2.2
250 cm ³ conical flask	
Cotton wool	To stopper conical flask
Ammonia leach solution	100 cm ³ - Prepare as in expt. M2.2
Domestic food warming tray	To allow slow evaporation without spitting
Test tubes	2
Apparatus for vacuum filtration	i.e. Büchner flask, funnel, filter paper and pump
400 cm ³ beaker	
100 cm ³ measuring cylinder	
250 cm ³ beaker	
Sulphuric acid 4M	100 cm ³ - Slowly add 224 cm ³ of the conc. acid to 600 cm ³ dist. water with constant stirring, make up to 1 dm ³ with dist. water
Sodium hydroxide 2M	A few cm ³ - Dissolve 8 g of the solid in dist. water, make up to 100 cm ³ with dist. water
pH paper and chart	
Zinc dust	4 g
Propanone	20 cm ³
Watch glass	
Glass rod	
Filter paper and funnel	
Access to balance	

Additional requirements (optional)

250 cm ³ volumetric flask	
Burette	
Ammonium ethanoate	10 g
Potassium iodide	5 g
Sodium thiosulphate 0.100 M	50 cm ³ - Dissolve 24.82 g of the solid in distilled water. Make up to 1 dm ³ with distilled water.
Starch solution	5 cm ³ - Freshly prepared. Mix 1 g of the solid with a little distilled water to form a thin paste. Boil 80 cm ³ of dist. water and pour onto the paste. Stir and cool. Make up to 100 cm ³ with dist. water.

Notes

M2.3 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Roasting copper ore	Very hot	The ore can "spit" when heated very strongly and may stay hot for a long time after heating	 Wear safety goggles  Wear heat proof protective gloves when turning the mixture
Preparing the ammonia leach solution	Concentrated ammonia  Corrosive 4M ammonia & leach soln.  Irritant  Harmful	<p>The concentrated ammonia causes burns in contact with skin and is dangerous to eyes. The vapour is irritating to eyes. Pressure can build up in sealed containers</p> <p>The 4M solution and the leach solution are irritating to eyes and skin and the vapour can cause distress</p>	 Goggles must be worn  Wear protective gloves to avoid skin contact Dispense, carry out all dilutions, and dissolve the ammonium carbonate in a fume cupboard. Open containers of the concentrated ammonia with care particularly on hot days, using a safety screen or face shield.
Preparing 4M sulphuric acid	Concentrated sulphuric acid  Corrosive 4M sulphuric acid  Corrosive	<p>Causes severe burns. The concentrated acid has an affinity for water. Hence it is extremely dangerous to eyes, and can cause blindness if entering the eye. The act of diluting produces much heat, and if control measures are not taken the mixture can boil causing dangerous splashes.</p>	 Wear a full-face shield.  Gloves should be worn. The conc. acid should be added very slowly to the distilled water, with constant stirring, cooling the beaker in a large vessel of cold water. Never add water to the conc. acid
Preparation of 2M sodium hydroxide	Solid sodium hydroxide  Corrosive Corrosive 2M sodium hydroxide  Corrosive	<p>The solid causes severe burns and is particularly dangerous to eyes Gets very hot when added to water.</p> <p>Causes burns and particularly dangerous to eyes</p>	 Wear goggles or face-shield  Wear protective gloves Add the solid to the water slowly with constant stirring to dissipate the heat produced
Dispensing zinc powder	 flammable	Risk of fire. Contact with water liberates hydrogen	 Wear eye protection Keep dry and away from sources of ignition
Dispensing propanone	 Highly flammable	Serious risk of liquid and vapour catching fire. Can cause severe eye damage. The liquid will degrease skin. The vapour can be harmful with prolonged exposure	 Wear eye protection  Wear protective gloves. Use and dispense well away from naked flames in a well ventilated area or fume cupboard

Notes









M2.4 FINDING HOW MUCH ACID THERE IS IN A SOLUTION

Requirements

Solution of 'acid rain'	50 cm ³ - 0.005M sulphuric acid. Make 0.1M acid by slowly adding 5.5 cm ³ of the conc. acid to 600 cm ³ dist. water. Make up to 1 dm ³ with dist. water. Mix thoroughly then take 50 cm ³ of the 0.1M solution and dilute to 1 dm ³ with dist. water
Sodium hydroxide solution 0.01M (Accurate for titration)	100 cm ³ - Dissolve 4 g of the base in dist. water, make up to 1 dm ³ with dist. water. Mix thoroughly then take 100 cm ³ of the 0.1M solution and make up to 1 dm ³ with dist. water
100 cm ³ conical flask	2
10 cm ³ pipette and filler	
Burette and funnel	
White tile	
Phenolphthalein indicator	A few drops

Notes

M2.4 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dilution of concentrated sulphuric acid to make "acid rain"	Conc. Sulphuric acid  Corrosive	The concentrated acid causes severe burns and has an affinity for water. Hence it is extremely dangerous to eyes, and can cause blindness if entering the eye. The act of diluting produces much heat, and if control measures are not taken the mixture can boil causing dangerous splashes.	 A full face shield should be worn.  Gloves should be worn. The conc. acid should be added very slowly to the distilled water, with constant stirring, cooling the beaker in a large vessel of cold water. Never add water to conc. acid
Preparation of 0.01M sodium hydroxide solution	Solid  Corrosive	Solid causes severe burns and is particularly dangerous to eyes. The solid gets hot when added to water	 Wear safety goggles  Wear protective gloves. Add solid slowly to water with constant stirring.
Preparation of phenol phthalein indicator solution	Ethanol  Highly flammable	Breathing the vapour has a narcotic effect. Risk of fire.	 Wear eye protection Avoid inhaling fumes. Use in a fume cupboard and away from sources of ignition.

Notes

Notes on “Minerals to Elements”

THE ATMOSPHERE

Advance warning

The following items needed for activities in this unit may not be already in your school or college and might take some time to obtain

Activity	Item(s)	Quantities per expt.	Essential or Optional	
A2.2	Ultra-violet light source	1 per class	E	Supplying 280-400 nm range (ie mid-near UV or UV A+B) Available from Aldrich Chemical Co. The Old Brickyard, New Road, Gillingham, Dorset, SP8 4XT (Tel 01202 712222)
	Sunscreen with different screening factors	Small amount of each	E	Buy locally. The screening ability deteriorates with age
	UV sensitive labels	1 cut into small pieces		Available from, Aldrich chemical Co., The Old Brickyard, New Road, Gillingham, Dorset, SP8 4XT (Tel 01202 712222) Cat no., Z30,037-3
A3.2	Hexane	6 cm ³	E	
A3.3	Hexane	35 cm ³	E	

Notes

Chemicals required for A

Chemical	Concs.	Quantities per group
1-bromobutane		Few drops
1-chlorobutane		Few drops
1-iodobutane		Few drops
2-Methylpropan-2-ol (<i>tert</i> -butyl alcohol)		7.5 cm ³
Ammonia	Conc.	Few drops
Ammonium chloride		1 spatula full
Anhydrous sodium sulphate		Few g
Bromine		2 cm ³
Ethanol		3 cm ³
Hexane		45 cm ³
Hydrochloric acid	Conc.	20 cm ³
Iron(III) chloride	0.5M	2 drops
Phenolphthalein indicator		Few drops
Potassium (or ammonium) thiocyanate	0.5M	2 drops
Potassium chromate(VI)	0.1M	2 cm ³
Silver nitrate	0.01M	3 cm ³
Sodium hydrogen carbonate	5%	0.5 g 10 cm ³
Sodium hydroxide	2M 0.200M	2 cm ³ 100 cm ³
Sodium thiosulphate	25%	1 bottle for bromine spills
Sulphuric acid	1M	2 cm ³

Notes



A2.2 INVESTIGATING SUNSCREENS

Requirements

A light source to provide radiation of the same frequency as the UV light that causes sunburn	E.g. UV lamp: sunlamp: UV exposure unit for photo-etch board as used by Electronics depts.; any other UV source supplying 280-400 nm range (i.e mid-near UV or UV A+B)
UV sensitive paper	UV sensitive labels or any other method of detecting UV light
A means of supporting the sunscreen so that light can be directed at it	
Cling film	
A piece of recently washed white cloth	
Bottle of tonic water	
Piece of photocopying paper	
Variety of sunscreens with different screening factors	

Notes

A2.2 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Checking ultra-violet light	 Ultra-violet radiation	Ultra-violet light can damage the eyes	 Wear the correct eye protection. Do not look directly into the ultra-violet light.

Notes

A3.2 THE PHOTODISSOCIATION OF BROMINE













Optional teacher demonstration

Requirements

Hexane	6 cm ³ – The cyclohexane suggested in the <i>Activities Book</i> is slow to react and has therefore been replaced with hexane
Bromine	3 drops
Test tubes	3
Aluminium foil	To cover 2 of the test tubes
Concentrated ammonia solution	A few drops
Light source	Sunlight is best, but a strong lamp such as a fluorescent tube or microscope lamp is OK. It works well on an OHP
Sodium thiosulphate 25%	A 500 cm ³ reagent bottle near the bromine to treat any spillages
Dropping pipette	
Glass rod	
pH paper and chart	
Protective gloves	

Notes

A3.2 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing hexane	 Highly flammable  Harmful  Harmful to environment	Risk of fire.	 Wear eye protection Keep away from sources of ignition.
Dispensing bromine	Bromine  Corrosive  Very toxic  Harmful to environment	The liquid causes severe burns to eyes and skin. The vapour is very toxic if breathed in.	 Wear protective goggles  Wear RUBBER gloves. Use and make solution in a fume cupboard. Do not breathe vapour. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> WHEREVER BROMINE IS USED, HAVE A 500cm³ BOTTLE OF 1M (25%) SODIUM THIOSULPHATE TO HAND TO TREAT SPILLAGES </div>
Dispensing concentrated ammonia solution	Concentrated ammonia  Corrosive	The concentrated ammonia causes burns in contact with skin and is dangerous to eyes. The vapour is irritating to eyes. Pressure can build up in sealed containers	 Goggles must be worn  Wear protective gloves to avoid skin contact Dispense in a fume cupboard. Open containers of the concentrated ammonia with care particularly on hot days, using a safety screen or face shield.

The hexane residues must be placed into the halogenated organic residues container for disposal and NOT flushed down the sink

Notes
















A3.3 INVESTIGATING THE REACTION BETWEEN BROMINE AND HEXANE

Requirements

Reagent bottle with a good fitting stopper	250 cm ³ capacity
Hexane	35 cm ³ – The cyclohexane suggested in the <i>Activities Book</i> is slow to react and has therefore been replaced with hexane
Bromine	1 g
Marked pipette for adding bromine	Marked at 1 g of bromine
Sodium hydroxide 0.200M (accurate)	100 cm ³ - Dissolve 8 g of the solid in dist. water. Make up to 1 dm ³ with dist. water
Phenolphthalein indicator	A few drops
Burette and funnel	
White tile	
50 cm ³ measuring cylinder	
Light source	Sunlight, strong lamp or OHP (as A 3.2)
25% sodium thiosulphate	500 cm ³ reagent bottle near bromine to treat any spills
Access to balance	
Protective gloves	

Notes

A3.3 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing hexane	 Highly flammable  Harmful  Harmful to environment	Risk of fire.	 Wear eye protection Keep away from sources of ignition.
Dispensing bromine	 Corrosive  Very toxic  Harmful to environment	The liquid causes severe burns to eyes and skin. The vapour is very toxic if breathed in.	 Wear protective goggles  Wear RUBBER gloves. Use and make solution in a fume cupboard. Do not breathe vapour. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> WHEREVER BROMINE IS USED, HAVE A 500 cm³ BOTTLE OF 1M (25%) SODIUM THIOSULPHATE TO HAND TO TREAT SPILLAGES </div>
Preparation of 0.200 sodium hydroxide	Solid  Corrosive 0.200M soln  Irritant	Solid causes severe burns and is particularly dangerous to eyes. The solid gets hot when added to water The solution is irritating to eyes and skin	 Wear safety goggles  Wear protective gloves. Add solid slowly to water with constant stirring.
Preparation of phenol phthalein indicator solution	Ethanol  Highly flammable	Breathing the vapour has a narcotic effect. Risk of fire.	 Wear eye protection Avoid inhaling fumes. Use in a fume cupboard and away from sources of ignition.

Care when clearing and washing-up

The products of the reaction are flammable. The vapours are harmful and irritate the eyes. Avoid breathing the vapours

The reaction mixture must be emptied into the halogenated organic residues container for future disposal and NOT flushed down the sink











A4.1B HOW DO HALOGENOALKANES DIFFER IN REACTIVITY ?

Requirements

Test tubes	6
Ethanol	3 cm ³
Silver nitrate solution 0.01M	3 cm ³ - Dissolve 1.7 g of the salt in dist. water. Make up to 1 dm ³ with dist. water
0-110 °C thermometer	
250 cm ³ beaker	
Hot water	At 50 °C
1-Chlorobutane	A few drops
1-Bromobutane	A few drops
1-Iodobutane	A few drops
Stopclock	
Dropping pipettes	3

Notes

A4.1b Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing ethanol	 Highly flammable	Breathing the vapour has a narcotic effect. Risk of fire.	 Wear eye protection Avoid inhaling fumes. Use in a fume cupboard and away from sources of ignition.
Dissolving solid silver nitrate to make 0.01M solution	Solid  Corrosive  Harmful to environment	Causes burns. Solid and solution are dangerous to eyes and will blacken the skin. If ingested can cause severe internal damage	 Wear eye protection  Wear protective gloves.
Dispensing 1-chlorobutane 1-bromobutane 1-iodobutane	 Highly flammable  Harmful	Risk of fire, especially with 1-chlorobutane. All are harmful by inhalation, ingestion and contact with the skin. They are narcotic in high concentration and may be irritating to the eyes and skin.	 Wear eye protection  Wear protective gloves. Dispense in a fume cupboard. Avoid breathing vapours. Keep away from sources of ignition

Notes








A4.2 MAKING A HALOGENOALKANE

Requirements

Small bunsen burner or heating mantle	
100 cm ³ conical flask	2
50 cm ³ beaker	3
10 cm ³ measuring cylinder	2
50 cm ³ measuring cylinder	
50 cm ³ pear-shaped flask	
50 cm ³ separating funnel and stopper	
Condenser	
Distillation head	
Anti-bump granules	
Spatula	
Specimen tube	
0-110 °C thermometer	
2-Methylpropan-2-ol (<i>tert</i> - butyl alcohol)	6.5 cm ³ -It has a melting point of 25.5 °C so if it is stored in the cold it will need time to thaw
Concentrated hydrochloric acid	20 cm ³
Sodium hydrogen carbonate solution 5%	10 cm ³
Anhydrous sodium sulphate	A few grams
Access to balance	

Notes

A4.2 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing 2-methylpropan-2-ol	 Highly flammable  Harmful	Can catch fire very easily. Harmful by inhalation. The vapour may cause dizziness and headaches and can irritate the eyes and skin.	 Wear eye protection.  Wear protective gloves. Dispense in a fume cupboard. Avoid inhaling vapour. Keep away from any sources of ignition.
Dispensing concentrated hydrochloric acid	 Corrosive	Causes burns. The vapour is very irritating to the respiratory system	 Wear safety goggles  Wear protective gloves. Use in a fume cupboard.

Care when clearing up.

Avoid inhaling vapours as they can be harmful. Rinse or wash used apparatus in a fume cupboard. Empty products of the experiments into waste halogenated organic residues container. They must not be discarded down sinks

Notes





















A8.1 EFFECT OF CONCENTRATION CHANGES ON CHEMICAL EQUILIBRIA

Requirements

Test tubes	8
Potassium chromate(VI) solution 0.1M	2 cm ³ - Dissolve 1.9 g of the salt in dist. water, make up to 100 cm ³ with dist. water
Sulphuric acid 1M	2 cm ³ - Slowly add 5.6 cm ³ of the conc. acid to dist. water with stirring, make up to 100 cm ³ with dist. water
Sodium hydroxide solution 2M	2 cm ³ - Dissolve 8 g of the base in dist. water, make up to 100 cm ³ with dist. water
Dropping pipettes	3
Potassium (or ammonium) thiocyanate solution 0.5M	2 drops- Dissolve 5.0 g of the potassium salt (3.8 g of the ammonium salt) in dist. water, make up to 100 cm ³ with dist. water
Iron(III) chloride 0.5M	2 drops- Dissolve 13.5 g of the hydrated solid in dist. water, make up to 100 cm ³ with dist. water
Ammonium chloride	1 spatula full
Stirring rod	
Spatula	

Notes

A8.1 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dissolving solid potassium chromate(VI) to make 0.1M solution	Solid & soln  Toxic  Irritant  Harmful to environment	Chromates are suspected carcinogens. Irritating to eyes, respiratory system and skin.	 Wear eye protection.  Wear protective gloves. Avoid all skin contact. Any spillages should be washed off at once
Dilution of concentrated sulphuric to 1M	Conc. Sulphuric acid  Corrosive 1M sulphuric acid  Irritant	The concentrated acid causes severe burns and has an affinity for water. Hence it is extremely dangerous to eyes, and can cause blindness if entering the eye. The act of diluting produces much heat, and if control measures are not taken the mixture can boil causing dangerous splashes.	 A full face shield should be worn.  Gloves should be worn. The conc. acid should be added very slowly to the distilled water, with constant stirring, cooling the beaker in a large vessel of cold water. Never add water to conc. acid
Preparation of 2M sodium hydroxide	Solid & 2M soln.  Corrosive	Solid and solution cause severe burns and are particularly dangerous to eyes. The solid gets hot when added to water	 Wear safety goggles  Wear protective gloves. Add solid slowly to water with constant stirring.
Preparation of 0.5M potassium or ammonium thiocyanate	 Harmful	Harmful by inhalation, if swallowed and in contact with skin. Contact with acids produces a very toxic gas	 Wear eye protection  Wear protective gloves. Avoid skin contact and breathing dust. Keep away from all acids
Preparation of 0.5M iron(III) chloride	Solid  Irritant	Irritating to eyes and skin.	 Wear eye protection  Wear protective gloves. Avoid skin contact
Dispensing solid ammonium chloride	 Harmful	Harmful if swallowed. Irritating to eyes.	 Wear eye protection

Notes

Notes on the “Atmosphere”

THE POLYMER REVOLUTION

Advance warning

The following items needed for activities in this unit may not be already in your school or college and might take a little time to obtain

Activity	Item(s)	Quantities per expt.	Essential or Optional	
PR2	Phenylethene (styrene)	10 cm ³	O	Remove the inhibitor before use as in techs instructions page 99
	Di(dodecanol)peroxide (lauryl peroxide)	0.2 g	O	
PR5.3	Poly(ethenol) film (hot water soluble)	50 cm ²	E	Available from, Aldrich <u>Cat. No. Z30,038-1</u>
PR5.4	Poly(ethenol) (polyvinyl alcohol)	2 g	E	Buy M_r 65 x 10 ³ to 115 x 10 ³ ; 96-98% hydrolysed. Available from, Aldrich Chemical Co., The Old Brickyard, New Road, Gillingham, Dorset, SP8 4XT Tel, 01202 71222 <u>Cat. No. 36,311-1</u>
PR6	Pyrrole	0.7 g	E	Available from, Aldrich <u>Cat. No. 13,170-9</u> Available from, Aldrich <u>Cat. No. 1,5253-6</u>
	Sodium 4-methylbenzenesulphonate (p-toluenesulphonic acid sodium salt)	4 g	E	

Notes

Chemicals required for PR

Chemical	Concs.	Quantities per group
Bromine water	Sat. solution	2 cm ³
Copper foil	1 cm wide strip	
Cyclohexane		50 cm ³
Di(dodecanoyl) peroxide		0.2 g
Ethanol		50 cm ³
Methylbenzene		55 cm ³
Phenylethene (styrene)		10 cm ³
Poly(ethenol) film		Few small pieces
Poly(ethenol) solution	4%	50 cm ³
Propan-1-ol		Test tube full
Propane-1,2,3-triol (glycerol)		Test tube full
Propane-1,2-diol		Test tube full
Propanone		70 cm ³
Pyrrole		0.7 g
Sodium 4-methylbenzene sulphonate	0.1M	200 cm ³
Sodium borate	4%	10 cm ³

Notes

PR2 MAKING POLY(PHENYLETHENE)




















Optional activity

Requirements

Phenylethene (styrene)	10 cm ³ - The polymerisation inhibitor must be removed by washing with 1M sodium hydroxide, then dist. water in a separating funnel. Dry with anhydrous sodium sulphate for 10 minutes
10 cm ³ measuring cylinder	
Di(dodecanoyl) peroxide	0.2 g
Boiling tube	
Test tubes	2
250 cm ³ beaker	
Cotton wool	To plug the test tubes
Methylbenzene	5 cm ³
Bromine water	2 cm ³ - Stir bromine with dist. water in a fume cupboard until saturated. Store in dark bottles
Spatula	
Dropping pipette	
Access to balance	

Notes

PR2 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing phenylethene	 Flammable  Harmful	Harmful by inhalation. May be irritating to eyes and skin. Vapour can catch fire.	 Wear eye protection  Wear protective gloves. Dispense in a fume cupboard away from sources of ignition. Avoid inhaling vapour
Dispensing di(dodecanoyl) peroxide	 Oxidiser  Irritant	Has flammable properties even when not in contact with other combustible materials. Burns fiercely when ignited. Irritating to eyes, respiratory system and skin.	 Wear eye protection  Wear protective gloves. Avoid breathing fumes. Keep away from any combustible material.
Dispensing methylbenzene	 Highly flammable  Harmful	Vapour/air mixtures are explosive. Harmful by inhalation which may cause dizziness and headaches. Vapour is irritating to eyes and mucous membranes	 Wear eye protection  Wear protective gloves. Dispense in a fume cupboard. Keep away from sources of ignition. Avoid inhaling vapour.
Preparing and dispensing bromine water	Bromine  Corrosive Very toxic  Harmful to environment Bromine water  Corrosive  Very toxic  Harmful to environment	The liquid causes severe burns to eyes and skin. The vapour is very toxic if breathed in. Saturated bromine solution causes severe burns to eyes and skin. The vapour is very toxic if breathed in.	 Wear protective goggles  Wear RUBBER gloves. Use and make solution in a fume cupboard. Do not breathe vapour. <div style="border: 1px solid black; padding: 5px;"> WHEREVER BROMINE IS USED, HAVE A 500cm³ BOTTLE OF 1M (25%) SODIUM THIOSULPHATE TO HAND TO TREAT SPILLAGES </div>

PR3 USING SPAGHETTI TO MODEL POLYMER STRUCTURE

Requirements

Spaghetti	About 250 g
Saucepan or a 2 litre beaker	
Container with a flat base and straight sides	Plastic ice-cream container or sandwich box is suitable
Sieve or strainer	

Notes

PR3 Technicians Safety Sheet

**DO NOT EAT ANY OF THE SPAGHETTI THAT HAS BEEN USED IN THE
LABORATORY**

Notes













PR5.1 DEFLECTING JETS

Requirements

Propanone	50 cm ³ to fill each burette
Ethanol	50 cm ³ to fill each burette
Cyclohexane	50 cm ³ to fill each burette
Methylbenzene	50 cm ³ to fill each burette
Water	50 cm ³ to fill each burette
Burettes & funnels	1 for each liquid.- A few sets can be shared around the class
250 cm ³ beakers	1 to go with each burette
Plastic rulers	Or electrostatic rod
Cloth	

Notes

PR5.1 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing propanone	 Highly flammable	Serious risk of liquid and vapour catching fire. Can cause severe eye damage. The liquid will degrease skin. The vapour can be harmful with prolonged exposure	 Wear eye protection  Wear protective gloves. Use and dispense well away from naked flames in a well ventilated area or fume cupboard
Dispensing ethanol	 Highly flammable	Breathing the vapour has a narcotic effect. Risk of fire.	 Wear eye protection Avoid inhaling fumes. Use in a fume cupboard and away from sources of ignition.
Dispensing cyclohexane	 Highly flammable  Harmful to environment	Risk of fire.	 Wear eye protection Keep away from sources of ignition.
Dispensing methylbenzene	 Highly flammable  Harmful	Vapour/air mixtures are explosive. Harmful by inhalation which may cause dizziness and headaches. Vapour is irritating to eyes and mucous membranes	 Wear eye protection  Wear protective gloves. Dispense in a fume cupboard. Keep away from sources of ignition. Avoid inhaling vapour.

Do not put the used organic liquids down sinks. They can be re-used if uncontaminated, or put into the correct organic residues containers for future disposal

Notes







PR5.2 VISCOSITY IN ALCOHOLS

Requirements

Test tubes and bungs	3- Use long test tubes
Propan-1-ol	Enough to fill test tube
Propane-1,2-diol	Enough to fill test tube
Propane-1,2,3-triol (glycerol)	Enough to fill test tube
Stop watch	

Notes

PR5.2 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing Propan-1-ol	 Highly flammable  Harmful	Vapours may be unpleasant. Risk of fire.	 Wear eye protection  Wear protective gloves. Avoid inhaling vapour. Use away from sources of ignition.
Dispensing propane-1,2-diol	 Harmful	Harmful if swallowed	 Wear eye protection

Notes




PR5.3 NOW YOU SEE IT

Requirements

Poly(ethenol) film	Several small pieces of the hot water soluble variety
250 cm ³ beaker	
Washing powder	
Glass rod	
Spatula	
Other apparatus as requested, may include;- stop watch thermometer scissors 100 cm ³ measuring cylinder balance	

Notes

PR5.3 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dispensing washing powder	 Irritant	May irritate the skin, eyes and respiratory system	 Wear eye protection  Wear protective gloves. Avoid inhaling dust.

Notes



PR 5.4 MAKING 'SLIME'

Requirements

Plastic drinking cup	
Wooden stick for stirring	Flat sided ones such as tongue depressors
Sodium borate solution (sodium tetraborate) 4%	10 cm ³ - Dissolve 4 g of the salt in dist. water, make up to 100 cm ³ with dist. water
Poly(ethenol) solution (Polyvinyl alcohol) 4%	50 cm ³ - Heat 400 cm ³ dist. water to 85 °C, remove from heat, add 20 g of poly(ethenol) with a high M_r (M_r =65x10 ³ to 115x10 ³ ; 96-98% hydrolysed work well) slowly with constant stirring on a magnetic stirrer until the solution is clear, make up to 500 cm ³ with dist. water. DO NOT BOIL
50 cm ³ measuring cylinder	
10 cm ³ measuring cylinder	
Disposable gloves	
Food colouring or fluorescent dye	Optional

Notes

PR5.4 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Dissolving sodium borate	Minimal hazard	Dust may be irritating to eyes. Solution may irritate the skin	 Wear eye protection
Making the poly(ethanol) solution	Minimal hazard	Low risk	 Wear eye protection

'Slime' spoils carpets and can remove paint













Notes

PR6 POLY(PYRROLE) - A CONDUCTING POLYMER

Requirements

Pyrrole	0.68 g
Copper foil	1 cm wide strip
Nickel spatula	Needs to be a flat one
Wire wool	Or emery cloth
Metal polish	
Small pieces of cloth	2
Paper towels	2
Sodium 4-methylbenzenesulphonate (p-toluenesulphonic acid sodium salt) solution 0.1M	200 cm ³ - Dissolve 19.4 g of the salt in dist. water, make up to 1 dm ³ with dist. water
250 cm ³ beaker	
250 cm ³ conical flask	
0-4.7K Ω variable resistor	
12 volt DC supply	In 2 volt steps
Multimeter	To measure resistance
Ammeter	To read to 30 mA
Razor blade	
Dropping pipette	
Propanone	20 cm ³
Croc-clips	2
Connecting leads	4
Microscope slide	
1.5 volt light bulb in holder	Alternatively multimeter can be used to measure current
Access to balance	

PR6 Technicians Safety Sheet

Operation	Hazard	Risks	Control measures
Preparing 0.1M solution of Sodium 4-methylbenzene sulphonate	Solid & soln  Irritant	Irritating to eyes, skin and respiratory system.	 Wear eye protection.  Wear protective gloves. Avoid inhaling dust from the solid.
Dispensing pyrrole	 Flammable  Harmful  Irritant	Harmful by inhalation, in contact with skin and if swallowed. Irritation to eyes and respiratory system. Risk of fire.	 Wear eye protection.  Wear protective gloves to avoid skin contact. Use only in a fume cupboard. Avoid inhaling vapour. Keep away from sources of ignition.
Dispensing propanone	 Highly flammable  Irritant	Serious risk of liquid and vapour catching fire. Can cause severe eye damage. The liquid will degrease skin. The vapour can be harmful with prolonged exposure	 Wear eye protection  Wear protective gloves. Use and dispense well away from naked flames in a well ventilated area or fume cupboard

Notes

Notes on “Polymer Revolution”