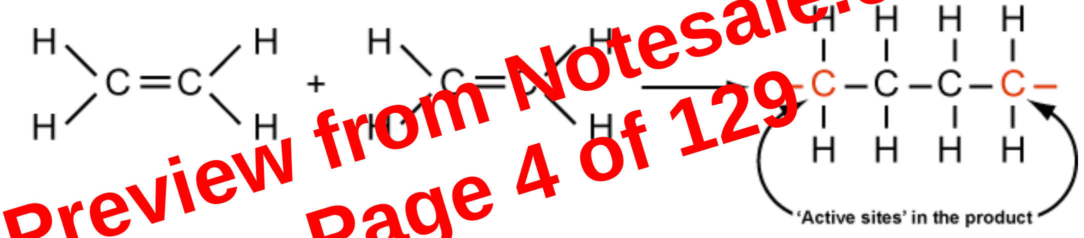
- ***identify that ethylene serves as a monomer from which polymers are made***

  A *monomer* is a small molecule, many of which can be joined together to form a long chain molecule called a *polymer*. *Ethylene* is one such monomer, the double bond can be broken which allows atoms or compounds to be added to the open carbon atoms, thus creating a longer chain molecule (polymer). This process is called polymerisation.

- ***identify polyethylene as an addition polymer and explain the meaning of this term***

  An *addition polymer* is one that is produced from the addition reaction/polymerisation of monomers. *Polyethylene* is an example on an addition polymer as it is formed from the addition reaction of ethylene monomers. When the double bond is broken, it allows the carbon atoms to be added to by atoms or molecules, lengthening the chain. By the addition of more ethylene molecules to the open carbon atoms, a polymer known as polyethylene is formed.



- ***outline the steps in the production of polyethylene as an example of a commercially and industrially important polymer***

  There are two types of polyethylene produced commercially using ethylene as the raw material, these are LDPE (low density polyethylene) and HDPE (high density polyethylene). LDPE uses temperatures between 80º and 300º and very high pressures with oxygen or an organic peroxide initiating the reaction. HDPE uses temperatures above 300º in the presence of certain metal oxide catalysts. LDPE is a branched polymer as branched molecules cannot be packed together tightly, so they tend to be less dense than HDPE. HDPE is a linear polymer, and therefore can pack together more densely. The stages in the *production of polyethylene* (LDPE and HDPE) are:

  1. *Initiation* – a chemical called an initiator starts the reaction (LDPE: oxygen or organic peroxide, HDPE: certain metal oxides) by opening a double bind of an ethylene monomer, forming an ethylene free radical.

RESULTS:
- one test tube became discoloured and one remained the yellow/brownish colour of the bromine water

- ***analyses information from secondary sources such as computer simulations, molecular model kits or multimedia resources to model the polymerisation process***

- ***assess the potential of ethanol as an alternative fuel and discuss the advantages and disadvantages of its use***

Advantages of ethanol	Disadvantages of ethanol
• a renewable resource • can be produced from agricultural wastes • reduction of greenhouse gases • reduction of carbon monoxide (combustion of ethanol is complete) • reduction of high-octane additives (used to replace tetraethyl lead in petrol) • spills are easily biodegraded or dilutes to non-toxic concentrations • burns more cleanly (complete combustion)	• large areas of land required for production of raw materials • high cost of distillation • high cost of removing water from fuel (to prevent problems with the carburettor, fuel injection systems and corrosion of fuel lines) • engines need to be modified to take high percentages of ethanol • during combustion other volatile organic compounds are produced that must be removed by catalytic converters in the exhaust system of a vehicle • spills are difficult to contain and recover as they blend with water • lower energy value than petrol (lower fuel economy)

Currently, ethanol being used as a fuel is not a viable solution for petrol. It has big potential to completely replace petrol in the future, but at the moment, it is only used as a mix with petrol in E10 and E85. There are many issues currently surrounding the production costs, energy required for production, and compatibility in cars, but as these solutions are found, ethanol would be a very appropriate replacement for petrol.

- ***present information from secondary sources by writing a balanced equation for the fermentation of glucose to ethanol***

glucose or fructose → ethanol + carbon dioxide

$C_6H_{12}O_6(aq) \rightarrow ..... C_2H_5OH(aq) + ... CO_2(g)$

- ***identify data sources, choose resources and perform a first-hand investigation to determine and compare heats of combustion of at least three liquid alkanols per gram and per mole***

EXPERIMENT: Heat of Combustion

AIM: to compare the heat of combustion of 3 alkanols

EQUIPMENT:
- aluminium can
- water
- spirit burner
- scales
- thermometer

METHOD:
1. Set up the equipment as shown in the diagram
2. Measure out 200mL of water and place in the can
3. Find the temperature of the can
4. Weigh the spirit burner
5. Light the burner and leave until the temperature of the water has gone up by 20°C
6. Put the cap on the spirit burner
7. Note the maximum temperature reached by the water

RESULTS:

Alkanol	***Methanol***
Mass of water (g)	200
Initial water temperature (°C)	22
Final water temperature (°C)	42
Initial mass of burner (g)	246.25
Final mass of burner (g)	236.03

Students:

- ~~***perform a first-hand investigation to identify the conditions under which a galvanic cell is produced***~~

- ***perform a first-hand investigation and gather first-hand information to measure the difference in potential of different combinations of metals in an electrolyte solution***

- ***solve problems and analyse information to calculate the potential requirement of named electrochemical processes using tables of standard potentials and half-equations***

E.g. magnesium and copper
Magnesium:
$Mg^{2+} + 2e^- \rightarrow Mg_{(s)}$ -2.36 V
$Mg_{(s)} \rightarrow Mg^{2+} + 2e^-$ 2.36 V * magnesium is the more reactive metal it will be the oxidation reaction , needs to be reversed *

Copper:
$Cu^{2+} + 2e^- \rightarrow Cu_{(s)}$ 0.35 V

Overall:
$Mg_{(s)} + Cu^{2+} \rightarrow Mg^{2+} + Cu_{(s)}$ 2.71 V

E.g. Aluminium and Nickel
Aluminium:
$Al^{3+} + 3e^- \rightarrow Al_{(s)}$ -1.66 V
$Al_{(s)} \rightarrow Al^{3+} + 3e^-$ 1.66 V

Nickel:
$Ni^{2+} + 2e^- \rightarrow Ni_{(s)}$ -0.23 V

* electrons don't balance *

$2Al \rightarrow 2Al^{3+} + 6e^-$ 1.66 V
$2Ni^{2+} + 6e^- \rightarrow 3Ni_{(s)}$ -0.23 V

Overall:
$3Ni^{2+} + 2Al_{(s)} \rightarrow 3Ni_{(s)} + 2Al^{3+}$ 1.43 V

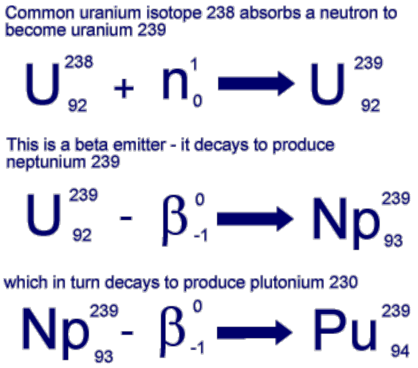
E.g. Zinc and Silver
Oxidation: $Zn_{(s)} \rightarrow Zn^{2+} + 2e^-$ 0.76 V
Reduction: $Ag^+ + e^- \rightarrow Ag_{(s)}$ 0.80 V

$Zn_{(s)} + 2Ag^+ \rightarrow Zn^{2+} + 2Ag_{(s)}$ 1.56 V

$Zn \mid Zn^{2+} \parallel Ag^+ \mid Ag$

- ***describe how transuranic elements are produced***

Transuranic elements are those that have a larger atomic number than uranium (Z > 92), they do not exist naturally in nature. All are radioactive, and many have very little practical application rather than for nuclear research. When a neutron bombards uranium-238 it forms a new element (neptunium). It will eventually decay by beta emission to plutonium.



Common uranium isotope 238 absorbs a neutron to become uranium 239

$$U^{238}_{92} + n^{1}_{0} \longrightarrow U^{239}_{92}$$

This is a beta emitter - it decays to produce neptunium 239

$$U^{239}_{92} - \beta^{0}_{-1} \longrightarrow Np^{239}_{93}$$

which in turn decays to produce plutonium 230

$$Np^{239}_{93} - \beta^{0}_{-1} \longrightarrow Pu^{239}_{94}$$

Scientists have been able to produce two dozen transuranic elements this way. Transuranic elements are also made by accelerating nuclei of atoms using linear accelerators and cyclotrons and bombarding them into heavy nuclei.

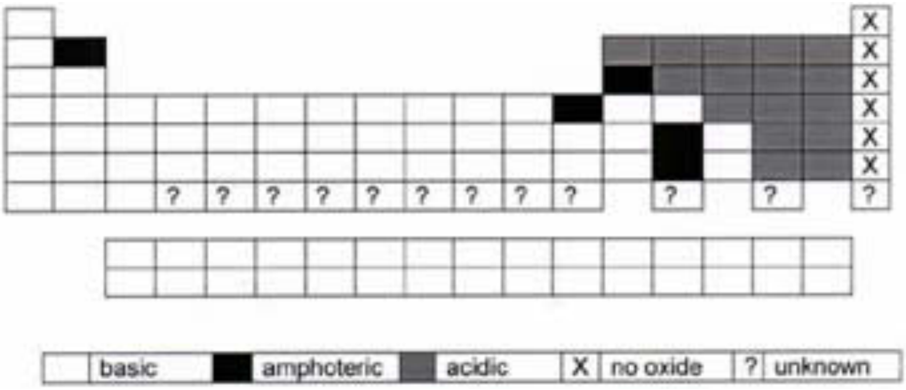
- ***describe how commercial radioisotopes are produced***

There are around 50 naturally occurring radioisotopes, and scientists have produced another several thousands. About twenty have uses in industry and medicine. Some of them are naturally occurring but it is uneconomic to extract them from their ores where they are found in small quantities.

Nuclear Reactor:
A nuclear reactor contains sufficient fissionable material arranged so that a controlled chain reaction can be started and maintained. All types of reactors produce neutrons, fissionable materials and heat. Because nuclear reactors are neutron-rich, they can be used to make radioisotopes by neutron bombardment.

Cyclotrons:
Radioisotopes can be produced by cyclotrons, an electromagnetic device that contains no uranium-bearing fuel elements and produces no highly radioactive waste products. Positive particles are accelerated by passing them through alternating positive and negative fields. The magnetic field keeps the particles moving in a spiral path, and when very high speeds are achieved the positive particles collide with atoms of the target substance. Major hospitals have cyclotrons to produce short-lived isotopes used in medical diagnosis, prediction and treatment.

- ***analyse the position of these non-metals in the Periodic Table and outline the relationship between position of elements in the Periodic Table and acidity/basicity of oxides***



Looking across a period of the periodic table, metals give way to non-metals. Similarly three is a trend from basic oxides through a few amphoteric oxides, to acidic oxides. Noble gases do not form oxides.

- ***define Le Chatelier's principle***

Le Chatelier wrote in 188, that if a change occurs in one of the conditions of an equilibrium system, the system would adjust, tending to nullify the change and return to equilibrium. The main features of a system at equilibrium are:

- no matter or energy enters or leaves the system
- macroscopic properties (colour, temperature, pressure, state of matter) do not change
- reactant and product concentrations remain the same
- microscopic changes occur
- the rate of forward reaction equals rate of reverse reaction
- there will always be some reactant and product

- ***identify factors which can affect the equilibrium in a reversible reaction***

The factors that can affect the equilibrium in a reversible reaction are:

- *change in concentration* – increasing the concentration of a reactant will drive the reaction in the forward direction, increasing the concentration of the product will drive the reaction in the reverse direction. E.g. A + B → C + D, adding A drives the reaction in the forward direction, producing more C and D, in the process, reducing concentrations of A and B

- *change in temperature* – changing the temperature can alter the equilibrium, it shifts to minimise the effect of the change. If A + B →

Students:

- ***identify data, plan and perform a first-hand investigation to decarbonate soft drink and gather data to measure the mass changes involved and calculate the volume of gas released at 25°C and 100kPa***

  The gas can be removed from the soft drink by letting the contents go flat. The difference in mass before opening the bottle and the flat soft drink will indicate the quantity of carbon dioxide released. This will allow you to calculate the volume of gas released.

- ***analyse information from secondary sources to summarise the industrial origins of sulfur dioxide and oxides of nitrogen and evaluate reasons for concern about their release into the environment***

- ***describe the relationship between an acid and its conjugate base and a base and its conjugate acid***

When an acid donates a proton, it forms its conjugate base:

$$\underset{\text{acid}}{HCl + H_2O} \rightarrow \underset{\text{conjugate base}}{Cl^-} + H_3O^+$$

When a base accepts a proton, it forms its conjugate acid:

$$HCl + \underset{\text{base}}{H_2O} \rightarrow Cl^- + \underset{\text{conjugate acid}}{H_3O^+}$$

- a strong acid has a weak conjugate base
- a weak acid has a strong conjugate base
- a strong base has a weak conjugate acid
- a weak base has a strong conjugate acid

- ***identify a range of salts which form acidic, basic or neutral solutions and explain their acidic, neutral or basic nature***

A salt is formed when an acid is neutralised by a base. Salts may be acidic, basic or neutral.

- A salt formed from a weak acid and a strong base will produce a solution, pH > 7 in water

- A salt formed from a strong acid and a weak base will produce a solution,
pH < 7 in water

- a salt formed from a strong acid and a strong base will produce a neutral, or approximately neutral solution, pH = 7 in water

- a salt formed from a weak acid and a weak base will produce a neutral, or approximately neutral solution, pH = 7 water

- ***identify conjugate acid/base pairs***

Whenever an acid and a base react, they form their conjugates:

$$\underset{\text{acid}_1}{HCl} + \underset{\text{base}_2}{H_2O} \rightarrow \underset{\text{conjugate base}_1}{Cl^-} + \underset{\text{conjugate acid}_2}{H_3O^+}$$

- hydrochloric acid and chloride ion are a conjugate acid-base pair
- water and hydronium ion are another conjugate acid-base pair

4. Titrate flask until the first permanent pink colour is reached, record results and repeat with flasks B and C

RESULTS:

	A	B	C
Initial reading (mL)	0.00	17	9.1
Final reading (mL)	17	34.2	24.9
Volume NaOH	17	17.1	15.8

CALCULATIONS:
Average volume = 0.0172 L
N = V x C
= 0.0172 x 0.1
= 0.00172 mol
$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$
[acetic acid] = 0.00172/ 0.025
= 0.0688 mol L^{-1}
$n_1 = n_2$
$C_1V_1 = C_2V_2$
C x 0.01 = 0.0688 x 0.1
= 0.69 mol L^{-1}

- ***perform a first-hand investigation to determine the concentration of a domestic acidic substance using computer-based technologies***

Scientists increasingly use computer-based technologies in their work. They can be far more accurate, time saving and efficient. While the technologies are standard equipment in laboratories, they are seldom found in schools due to their cost and specialised nature

- ***analyse information from secondary sources to assess the use of neutralisation reactions as a safety measure or to minimise damage in accidents or chemical spills***

- in laboratories, acid is added to large volumes of water as this minimises the heat generated. Water can absorb a relatively large amount of heat

- spills of acids or bases on bench tops or floors can be safely neutralised using weak bases, or weak acids. It is important to do this quickly as acids/bases are corrosive

- legal requirements specify that acidic wastes from factories not be discharged into waterways until they have been neutralised and diluted, a settling tank is useful to allow heat from neutralisation to dissipate before wastes are disposed

e.g. $HCO\underline{OH} + CH_3CH_2O\underline{H} \rightarrow HCOOCH_2CH_3 + H_2O$
methanoic acid acid + ethanol → ethyl methanoate + water

The underlined atoms join together to form water, so esterification is an example of a condensation reaction.

- ***describe the purpose of using acid in esterification for catalysis***

Esterification is a relatively slow equilibrium reaction at room temperature. The addition of a concentrated mineral acid, such as sulfuric acid, serves as a catalyst as it speeds up the reaction. It absorbs the water, as it is a dehydrating agent with a strong affinity to water, forcing the equilibrium to the right.

A strong acid like sulfuric acid can donate a proton to the unshared electron pairs of either the acid or the alkanol, this makes either of them more reactive. Eventually the proton is returned to solution.

Students:

- ***gather and process information from secondary sources to describe the conditions under which Haber developed the industrial synthesis of ammonia and evaluate its significance at that time in world history***

In the 19th century, the agricultural industry needed rapidly increasing quantities of nitrogenous fertilisers after it was realised that they could significantly increase crop yields. Large quantities of food were needed to feed burgeoning populations, especially in America and Europe. When the WWI broke out, a way to produce these fertilisers was desperately needed, as food was scarce and Germany was cut off from imports of fertilisers and foods. Ammonia was also needed to produce explosives for the war effort.

Haber developed a process to develop ammonia, as supplies of nitrogenous raw materials were rapidly dwindling. Peruvian guano and sodium nitrate from Chile had become exhausted by 1900. An alternative was needed to supply both agriculture and industry.

As Germany needed to meet increasing demands of fertilisers and explosives, Haber developed an industrial process to develop ammonia from atmospheric nitrogen. It was known that the atmosphere contains large quantities of nitrogen, and Haber used this to his advantage, using the readily available gas.

Without the development of the Haber process, Germany would not have been able to maintain their war effort, as they would've run out of food and explosives. The Haber process, was ultimately a factor that lengthened the war.

3. Manufactured products, including food, drugs and household chemicals, are analysed to determine or ensure their chemical composition

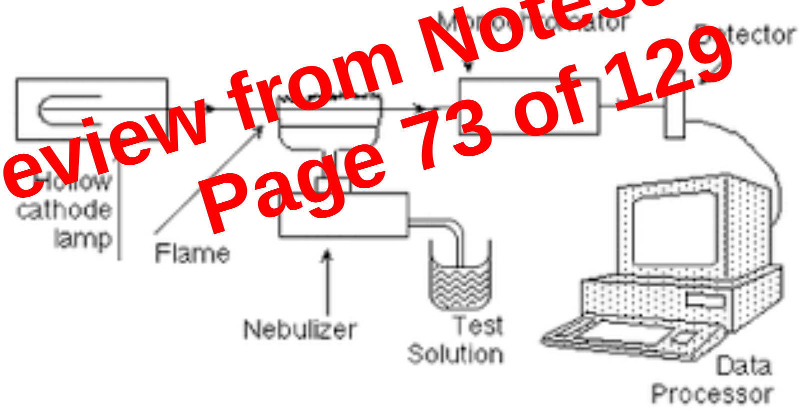
Students learn to:

- ***describe the use of atomic absorption spectroscopy (AAS) in detecting concentrations of metal ions in solutions and assess its impact on scientific understanding of the effects of trace elements***

When different metals are vapourised in a flame, they absorb light with specific frequencies. Special, hollow cathode lamps emit light with these frequencies and this is absorbed by the metal being examined. The amount of light absorption is proportional to the concentration of metal in the flame. This is compared to the absorption of known concentrations of standard solutions.

AAS relies on:

- the sample being heated sufficiently to obtain free atoms
- free atoms being able to absorb energy at certain discrete frequencies, this energy excites electrons from their ground state to a higher energy state
- the energy absorbed being proportional to the concentration to the concentration of the absorbing atoms



Uses for AAS:

- to test the purity of metallic samples in the mining industry
- to monitor pollution levels in waste waters, particularly heavy metals
- to detect harmful levels of metals in organisms, such as zinc in oysters or mercury in fish
- to monitor dangerous air-bourne metallic particles, such as lead
- for the quality control of alloys
- to detect minute contaminants in food, especially processed food

Trace elements are important for the proper functioning of plants and animals. They occur somewhere in the range of 1 to 100 ppm in living organisms and being able to detect them in such low concentrations has allowed scientists to work out how they assist in the healthy functioning of the organism. Scientists now have the ability to monitor these trace elements in soils, plant crops and ultimately in our diets and to take remedial action if they are deficient.

e.g. Functions of some metallic trace elements

Metal	***Function***
Copper	• haemoglobin formation • enzyme action
Zinc	• enzyme action • metabolism of amino acids • insulin synthesis
Selenium	• enzyme action
Manganese	• enzyme action • blood clotting • carbohydrate and fat metabolism
Cobalt	• red blood cell formation

AAS is also used to monitor concentrations of heavy metals that can be toxic to animals, humans and plants. For example, high concentrations of heavy metals in seaweed in Sydney Harbour have caused the death of small crustaceans. Zinc, lead, copper and cadmium have all been reported in elevated concentrations than at the time of the First Fleet. Higher than normal levels of certain metals in seafood caught in Sydney Harbour have recently prompted warnings about eating fish caught there.

DISCUSSION:
Accuracy – can be improved by carefully measuring quantities using an electronic balance and using the correct techniques to collect the precipitate formed. Precipitating from a hot solution will allow you to obtain a more accurate measure of the barium sulfate precipitate. High accuracy can also be achieved by using a filtering crucible instead of filter paper

Reliability – repeating the experiment several times and averaging the results improve reliability. Wash the precipitate several times with warm distilled water to remove soluble particles, then thoroughly dry it in a desiccator

Validity – the assumption on which validity relies is that all the barium sulfate, and only barium sulfate particles will precipitate. That is, there are no other particles that will precipitate out with the added barium

- ***analyse information to evaluate the reliability of the results of the above investigation and to propose solutions to problems encountered in the procedure***

A set of results is a reliable if you get consistent results with repeated measurements. This is why you repeat experiments and obtain an average value from closely agreeing values. In the experiment you made up 500mL while only testing 100mL, this allows for two repetitions or more.

All measurements need to be accurately done, and an electronic balance will give you an accurate mass.

Using fine analytical grade filter paper will ensure you trap as much of the $BaSO_4$ as possible. The reason for changing the soluble sulfate in fertiliser to $BaSO_4$ is that this substance is highly insoluble, meaning very little of it will remain in solution when you filter the precipitate.

Precipitating $BaSO_4$ from a hot solution minimises other species finding their way into the precipitate. Washing the precipitate with distilled water removes any soluble particles that may have been inadvertently attached themselves to it.

- ***gather, process and present information to interpret secondary data from AAS measurements and evaluate the effectiveness of this in pollution control***

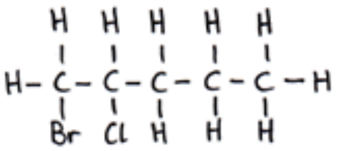
In and around cities and mining industries there will inevitably be higher than the average concentrations of harmful metals in the atmosphere. The greatest improvements in air quality are brought about by legislative control. AAS has an important role to play in assessing

- ***identify and name examples of isomers (excluding geometrical and optical) of haloalkanes up to eight carbon atoms***

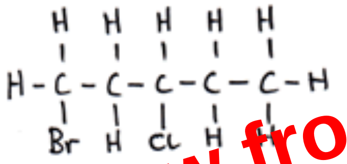
  In naming haloalkanes:
  - bromo-,fluoro-, chloro- and iodo- are used as prefixes to the hydrocarbon name
  - if more than one of these halogens is present in the molecule, precede the prefix with di-, tri- or tetra-
  - number the chain (left to right or right to left) so as to give the lowest set of numbers to the halogen group
  - halogen (halo) atoms are given before any alkyl side chains

  Isomers are molecules with the same molecular formula but different structural formulas. They consist of the same types and numbers of atoms but are arranged in different ways.

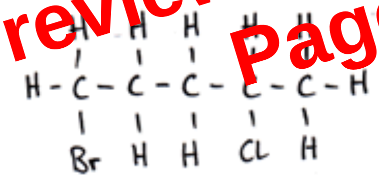
  e.g. Isomers of $C_5H_{10}BrCl$



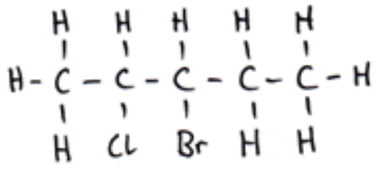
1-bromo-2-chloropentane



1-bromo-3-chloropentane



1-bromo-4-chloropentane



3-bromo-2-chloropentane

- ***discuss the problems associated with the use of CFCs and assess the effectiveness of steps taken to alleviate these problems***

  Being stable and insoluble, CFCs remain in the troposphere and do not get washed out by the rain. CFCs eventually make their way to the stratosphere where the UV energy results in them photo dissociating to release reactive chlorine radicals

- sea water contains Cl^-, Br^-, I^-, SO_4^{2-}, HCO_3^- and other salts of Na^+, K^+, Mg^{2+}, Ca^{2+}, and other metals. Acting as the worlds scavenger, sea water has amassed a variety of solutes

- ***describe and assess the effectiveness of methods used to purify and sanitise mass water supplies***

  1. The catchment area – the natural environment in this area should be preserved, with no mining, logging, grazing or other farming activities so that the water is relatively free of animal wastes, sediments, fertilisers, and harmful ions

  2. Screening – large insoluble matter is screened out using sieves

  3. Coagulation, flocculation and sedimentation – a coagulant may be added to the water to clump with the particles, forming larger particle that can be filtered out

  4. Filtration – sand filters remove fine, suspended solids and some microorganisms, while they are effective, they require large land areas to fulfil the water demands of modern cities. As flow rates increase, sand filtration becomes less effective

  5. Adsorption – activated carbon and ion exchange resins can be used as adsorbants to remove soluble contaminants from the water. The activated carbon can become saturated with adsorbing materials, needing costly replacement or regeneration. Ion exchange resins work by exchanging ions in the water with those on the resin

  6. Oxidation – strong oxidising agents such as ozone and chlorine dioxide can oxidise a range of substances in the water; ozone is used as a disinfectant and can destroy soluble contaminants

  7. Water stabilisation – pH should remain close to 7,many waters are stabilised by adding lime and sometimes carbon dioxide

  8. Disinfection – chlorination is the most widely used disinfectant in drinking water as it is cheap, easy and effective, but it can react with organic matter forming chlorinated organic compounds.

  Chloramines form when chlorine and ammonia are added together, they are not as effective as chlorine at killing micro-organisms, but they maintain their disinfecting ability longer and react less with organic matter.

  Chlorine dioxide is a highly reactive, unstable gas and a strong oxidant that can be used in low doses, however it is far more expensive.

  Ozone is the most powerful disinfectant. It destroys soluble contaminants, trace levels of insecticides and odour and taste

SHIPWRECKS, COROSION AND CONSERVATION

1. The chemical composition of the ocean infers its potential role as an electrolyte

2. Ships have been made of metals or alloys of metals

3. Electrolytic cells involve oxidation-reduction reactions

4. Iron and steel corrode quickly in a marine environment and must be protected

5. When a ship sinks, the rate of decay and corrosion may be dependent on the final depth of the wreck

6. Predictions of slow corrosion at great depths were apparently incorrect

7. Salvage, conservation and restoration of objects from wrecks requires careful planning and understanding of the behaviour of chemicals

- ***describe factors that affect an electrolysis reaction***

The higher the current the greater the rate of electrolysis.
The higher the voltage the greater the current.

–*effect of concentration*

The product of electrolysis can vary with the concentration of the ion present. The cell potentials given on standard potential tables are measured using 1 molL^{-1} concentration electrolyte solution. These potentials can change if the concentrations of the electrolytes vary. Increased concentrations of ions, increase the current and consequently the rate of electrolysis. Electrolytes that have more ions dissociated with have a higher rate of electrolysis.

–*nature of electrolyte*

Molten electrolytes with inert electrodes, can yield only one product for each electrode. For example, molten magnesium bromide would discharge magnesium metal and bromine gas.

In aqueous solution there is also the possibility that water will be one of the reactants at one or both of the electrodes. For the electrolysis of magnesium bromide, there are three possible reactions at the anode:

$2Br^-_{(aq)} \rightarrow Br_{2\,(aq)} + 2e^-$ $E^{\o} = -1.10$ V
$2Br^-_{(aq)} \rightarrow Br_{2\,(l)} + 2e^-$ $E^{\o} = -1.08$ V
$2H_2O_{(l)} \rightarrow O_{2\,(g)} + 4H^+_{(aq)} + 4e^-$ $E^{\o} = -1.23$ V

The equation with the lower numerical value for $E^{\o}$ is preferred and so the bromide ion discharges as liquid bromide.

At the cathode there are two possible reactions:

$Mg^{2+} + 2e^- \rightarrow Mg_{(s)}$ $E^{\o} = -2.36$ V
$2H_2O_{(l)} + 2e^- \rightarrow H_{2\,(g)} + 2OH^-_{(aq)}$ $E^{\o} = -0.83$ V

The equation with the lower numerical value for $E^{\o}$ is preferred and so hydrogen gas is formed at the cathode

Overall reaction: $2Br^-_{(aq)} + 2H_2O_{(l)} \rightarrow Br_{2\,(l)} + H_{2\,(g)} + 2OH^-_{(aq)}$

–*nature of electrodes*

Inert materials for the electrodes simply act as conductors of electricity. If the electrodes are not inert they may partake in the reaction. The equation with the lower numerical value for $E^{\o}$ is the one that is the preferred reaction.

Increased surface area of the electrode used increases the current and rate of electrolysis. Decreased distance between the electrodes increased the current and rate of electrolysis.

Part B: Electrolyse at 2V using 5 cm wide strips, same distance apart as A and 1.0 mol/L concentration electrolyte

Part C: Electrolyse at 2 V using 2cm wide strips but different distance apart and 1.0 mol/L concentration electrolyte

Part	*Electrodes (cm)*	*Separation (cm)*	*Concentration (mol/L)*	*Voltage (V)*	*Mass of Anode (g)*			*Mass of Cathode (g)*		
					Initial	*Final*	*Change*	*Initial*	*Final*	*Change*
A1	2	2	1.0	2	5.14	4.49	-0.65	6.17	6.79	+0.62
A2	2	2	1.0	4	4.91	4.43	-0.48	5.38	5.84	+0.4
A3	2	2	1.0	6	5.17	4.75	-0.42	6.19	6.63	+0.44
B	5	2	1.0	2	11.7	9.76	-1.94	16.34	18.51	+2.17
C	2	5	1.0	2	5.14	4.88	-0.36	5.62	5.92	+0.3
D	2	2	0.10	2	5.88	5.78	-0.1	5.65	5.75	+0.1

Part D: Electrolyse at 2 V using 2 cm wide strips, same distance apart as A but 0.10 mol/L concentration electrolyte

RESULTS:

* change in mass should've increased with the increase of voltage, but the electrodes broke
* change in mass should've increased with the increase in surface area, but the electrodes broke

CONCLUSION:

- increase in surface area of electrodes, increases rate of electrolysis
- increase in voltage fed to reaction, increases rate of electrolysis
- increase in concentration of electrolyte, increases rate of electrolysis

- ***identify data, choose equipment, plan and perform a first-hand investigation to compare the corrosion rate, in a suitable electrolyte, of a variety of metals, including named modern alloys to identify those best suited for use in marine vessels***

  EXPERIMENT: Comparing corrosion rates to identify those best suited to marine vessel

  AIM: to investigate the corrosion rates of a variety of metals

  METHOD:
  1. Obtain strips of metals and alloys such as aluminium, magnesium, copper, iron, zinc, brass, stainless steel and bronze. Place them separately into test tubes
  2. Add some sea water to partially cover each of the metals in the test tubes (sea water can be approximated by dissolving 5% w/v NaCl in water)
  3. Observe and record any changes to the metals over time, continuing the experiment over the span of one month

  RESULTS:
  - steel and aluminium corrode the least, and zinc and magnesium corrode the most
  - this makes steel , aluminium, iron, and all the other metals with minimal corrosion, best suited for use in marine vessels, whether in the hull or for smaller fittings

- ***plan and perform a first-hand investigation to compare the effectiveness of different protections used to coat a metal such as iron and prevent corrosion***

  EXPERIMENT: Protecting iron from corrosion

  AIM: to examine conditions which prevent or slow down the rate of rusting

  METHOD:
  1. Place a nail in a test tube and cover with ferroxyl indicator. Allow this to stand for some time, anodic and cathodic regions will show up
  2. In separate test tubes, covered with ferroxyl indicator, place the following:
     - an iron nail tightly wound with copper wiring
     - an iron nail tightly wound with magnesium ribbon
     - an iron nail painted with phosphoric acid and allowed to dry
     - an iron nail painted with outdoor paint
     - an iron nail coated with grease
     - two iron nails connected by leads to a 1.5 V battery