Chapter 11: Polymers

Knowledge organiser

Polymers

Polymers are very _____ molecules made up of lots of smaller molecules joined together in a _____ pattern. The smaller molecules are called _____. The process of turning many monomers into a polymer is called _____.

There are two main types of polymerisation.

Type of polymerisation	Monomers	Products of polymerisation
_____ polymerisation	molecules with C=C bonds, such as _____	just the polymer
_____ polymerisation	diols, dicarboxylic acids, or diamines	polymer and _____

Addition polymerisation

Addition polymerisation starts with molecules with a _____ _____ (e.g., alkenes) as the monomer. The carbon-carbon double bond breaks in each molecule, and the carbon atoms then link together.

many single _____ monomers → long chain of _____

The n refers to _____. The rounded brackets and the bonds sticking out of them represent where the next molecule in the chain goes.

The inside of the brackets is known as the _____ _____ – the section that repeats over and over again many thousands of times in the polymer.

Addition polymers are named after the monomer used to create them.

- An addition polymer made of ethene is called _____.
- An addition polymer made of _____ is called poly(propene).

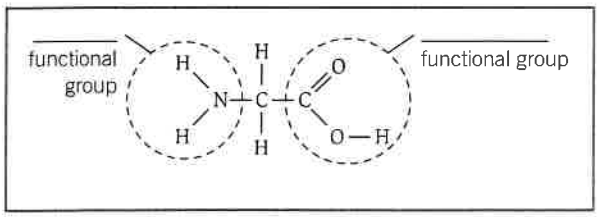
Natural polymers

Amino acids and proteins (HT only)

_____ reactions can also happen with just one monomer molecule, so long as the molecule has _____ different functional groups.

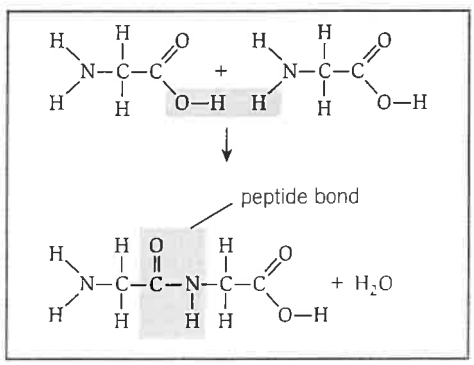
Amino acids have an _____ functional group and a _____ _____ functional group. The amine functional group has a _____ bonded to a carbon and two hydrogens.

_____ is the simplest amino acid.



When many molecules of glycine react together they form a _____.

There are many different types of amino acids. They can react together to form many different polypeptides. When lots of polypeptides come together they form something called a _____.

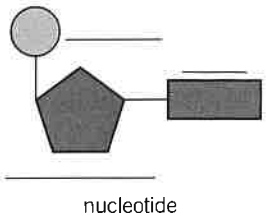


DNA

All genetic information is stored in _____. Genetic information contains the instructions for the functioning and development of _____.

DNA is made of _____ _____.

The polymers are made of four different monomers called _____.



_____ nucleotide

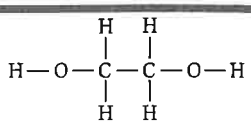
Starch and cellulose

Starch and cellulose are another two **natural polymers**. Both of these are made from _____ molecules joined together. Whether the resulting polymer is starch or cellulose depends on how the glucose molecules form _____ with each other.

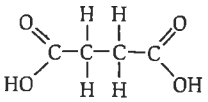
Condensation polymerisation (HT only)

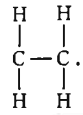
Condensation polymerisation can involve two different monomers, each has *two* functional groups.

Molecule **A** is a _____. It has two _____ groups: one at either end.



Molecule **B** is a _____. It has a _____ group at either end.

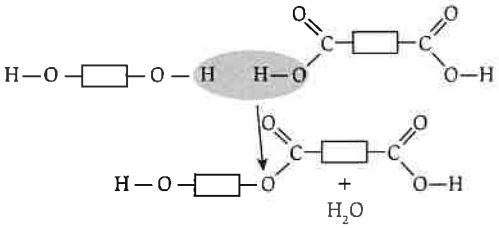


To simplify the diagrams, a rectangle is used to represent  . Draw molecules A and B.

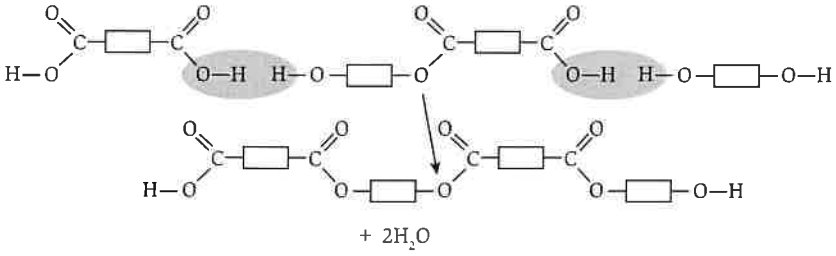
Molecule **A**

Molecule **B**

When molecule **A** and molecule **B** react together, the _____ group from the _____ and a hydrogen atom from the –OH group on the _____ join together to form _____.



Another molecule _____ and another molecule _____ can now react with either side of the molecule that has been formed.



You could keep adding more molecules in the pattern ABABABABA. Every time a molecule is added, a _____ molecule is produced. This type of reaction is called a _____ reaction.

If you keep adding molecules, a condensation polymer is produced. This is represented by:

When diols (compounds with two –OH groups) and dicarboxylic acids react together, they form _____.

Key terms

Make sure you can write a definition for these key terms.

addition polymerisation *amine* *amino acid* *condensation polymerisation* DNA
monomer *natural polymer* *nucleotide* *polymer* *polypeptide* *protein* *repeating unit*

Chapter 12: Chemical analysis

Knowledge organiser

Pure and impure

In chemistry, a _____ substance contains a single element or compound that is not _____ with any other substance.

Pure substances melt and boil at _____ temperatures.

An **impure** substance contains more than one type of element of compound in a _____.

Impure substances melt and boil at a _____ of temperatures.

Formulations

Formulations are examples of mixtures. They have many different _____ (substances that make them up) in very specific _____ (amounts compared to each other).

Scientists spend a lot of time trying to get the right components in the right proportions to make the most useful product.

Formulations include _____ _____.

Testing gases

Common gases can be identified using the follow tests:

Gas	What you do	What you observe if gas is present
hydrogen		
	hold a glowing splint near the gas	splint re-lights
	bubble the gas through limewater	the limewater turns milky (cloudy white)
chlorine		

Flame tests

Substances containing metals can produce a coloured light in a flame. This can be used to identify the metal. However, if there is more than one metal in the substance then this method will not work, as the colours mix and intense colours mask more subtle colours.

Metal	Flame colour
lithium	
sodium	
potassium	
	orange-red
	green

Instrumental methods

Instrumental analysis involves using complex scientific equipment to test substances.

Instrumental methods are rapid and accurate. They are also sensitive, which means _____ _____.

Flame emission spectroscopy

Flame emission spectroscopy is a type of instrumental analysis similar to a _____.

The sample solution is put into a flame and the light given off is passed through a _____. Instead of a human observing a colour, the instrument tells you exactly which _____ of light is being given off as a _____ _____. You can then compare the spectrum to a _____ to establish the identity of your sample. You can also measure the _____ of the substance in your sample solution.

Key terms

Make sure you can write a definition for these key term

chromatography flame emission spectroscopy fl
mobile phase precipitate pure R_f v

Chromatography

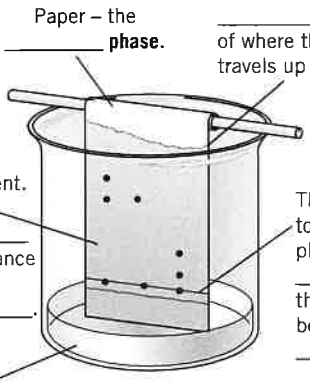
Chromatography is a method to _____ different components in a mixture. It is set up as shown here, with a piece of paper in a _____ containing a small amount of _____.

The R_f **value** is a _____ of how far up the paper a certain spot moves compared to how far the **solvent** has travelled.

$$R_f = \text{\_\_\_\_\_}$$

It will always be a number between _____ and _____.

The R_f value depends on the solvent and the _____, and different substances will have different R_f values. The R_f values for particular solvents can be used to identify a substance.



Testing for cations

Metal ions always have a _____ charge (i.e., they are cations). Sodium hydroxide solution can be used to identify some metal ions.

Cation	Positive result
aluminium ions, Al^{3+}	
calcium ions, Ca^{2+}	
magnesium ions, Mg^{2+}	
copper(II) ions, Cu^{2+}	
	forms a green precipitate
iron(III) ions, Fe^{3+}	

Testing for anions

Anion	Test	Positive result
carbonate, CO_3^{2-}		
chloride, Cl^-		
	add silver nitrate solution in the presence of nitric acid	cream precipitate formed
iodide, I^-		
	add barium chloride solution in the presence of hydrochloric acid	white precipitate formed

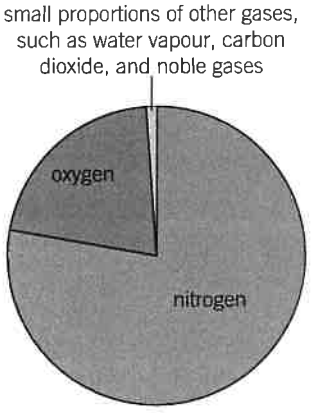
.

me test formulation impure instrumental analysis
lue solvent solvent front stationary phase

Chapter 13: The Earth's atmosphere

Knowledge organiser

The Earth's changing atmosphere

Period	Proportions of gases	Evidence
about 4.6 billion years to about 2.7 billion years ago	• **carbon dioxide, CO_2** Released by _____. Biggest component of the _____. • **oxygen, O_2** _____ oxygen present. • **nitrogen, N_2** Released by _____. • **water vapour, H_2O** Released by _____. Existed as vapour as Earth was too hot for it to _____. • **other gases** _____, and _____, may also have been present.	
about 2.7 billion years ago to about 200 million years ago	• **carbon dioxide, CO_2** Amount in atmosphere begins to _____ because: • water condenses to form the _____, in which CO_2 then _____ • algae (and later plants) start to _____ carbon dioxide + water ⟶ _____ + _____ _____ + _____ ⟶ _____ + _____ • CO_2 precipitates in the oceans as solid _____ (sediments) that form rocks • CO_2 taken in by plants and animals. When they die, the carbon in them is locked up as _____ • **oxygen, O_2** Starts to _____ as a product of photosynthesis. • **nitrogen, N_2** Continues to increase. Nitrogen is a very _____ molecule so any process that produces it causes the overall amount to build up over time. • **water vapour, H_2O** Starts to _____. As the Earth cools, the vapour condenses and forms the oceans.	
about 200 million years ago until the present	• **carbon dioxide, CO_2** about _____ • **oxygen, O_2** about _____ • **nitrogen, N_2** about _____ • **water vapour, H_2O** Very little overall. Collects in large clouds as part of the _____. • **other gases** Small proportions of other gases such as the _____.	

Key terms

Make sure you can write a definition for these key terms.

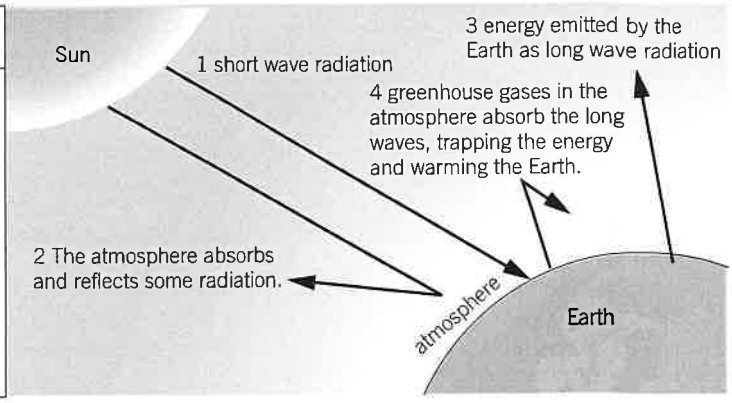
acid rain *atmosphere* *carbon footprint* *global climate change* *carbon monoxid*

Greenhouse gases

Greenhouse gases, such as _____, _____ and _____, absorb radiation and maintain temperatures on the Earth to support life.

However, in the last 150 years, more greenhouse gases have been released due to human activities.

- carbon dioxide – combustion of _____, _____
- methane – planting _____, _____



Global warming

Scientists have gathered peer-reviewed evidence to demonstrate that increasing the amount of _____ in the atmosphere will increase the overall _____ temperature of the Earth. This is called **global warming**.

However, it is difficult to make predictions about the atmosphere as it is so big and complex. This leads some people to doubt what scientists say.

Global climate change

Global warming leads to another process called **global climate change** – how the overall weather patterns over many years and across the entire planet will change.

There are many different effects of climate change, including:

-
-
-
-
-

Carbon footprints

Increasing the amount of greenhouse gases in the atmosphere increases the _____ of the Earth, which results in global climate change.

As such, it is important to reduce the release of greenhouse gases into the atmosphere. The amount of carbon dioxide and methane that is released into the atmosphere by a product, person, or process is called its _____ _____.

Other pollutants released in combustion of fuels

Pollutant	Origin	Effect
carbon monoxide		
particulates (soot and unburnt hydrocarbons)		
sulfur dioxide		
oxides of nitrogen		

global dimming *global warming* *greenhouse gas* *particulate* *pollutant*

Chapter 14: The Earth's resources 1

Knowledge organiser

Natural and synthetic resources

We use the Earth's resources to provide us with warmth, fuel, shelter, food, and transport.

- Natural resources are used for _____, _____, _____ and _____.
- _____ resources are made by scientists. They can replace or supplement natural resources.

When choosing and synthesising resources, it is important to consider _____ _____. This is development that meets the needs of current generations without compromising the ability of future generations to meet their own needs.

Finite and renewable resources

Some resources are **finite**. This means that _____ _____.

_____ are an example of a finite resource. They take so long to form that we use them faster than they are naturally formed.

Resources that will not run out are called _____ resources.

_____ is an example of a renewable resource. Trees can be grown to replace any that are cut down for wood.

Potable water

Water is a vital resource for life. _____ water is water that is safe to drink. However, most water on Earth is not potable.

Type of water	What it has in it
pure water	
potable water	
salty water (sea water)	
fresh water (from rivers, lakes, or underground)	

Fresh water

In the UK, potable water is produced from rain water that collects in lakes and rivers. To produce potable water:

1. _____
2. _____
3. _____

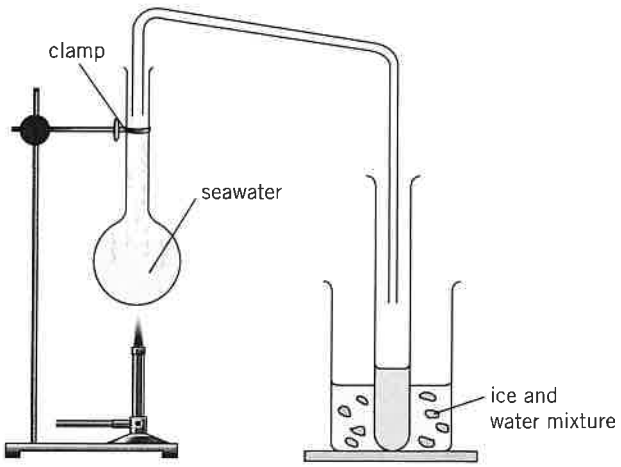
Salty water

Some countries do not have lots of fresh water available. _____ is the process to turn saltwater into potable water. This requires a lot of _____ and can be done by:

-
-

Reverse osmosis involves using _____ to separate the salts dissolved in the water. The water needs to be _____ and the salty water corrodes the pumps. As such, it is an _____ process.

Distillation



Waste water

Human activities produce lots of waste water as _____, _____ and _____.

- **Sewage** and agricultural waste contain _____.
- Industrial waste contains _____.

These need to be removed before the water can be put back into the environment.

Treating sewage water

screening and grit removal

The sewage passes through a _____ that _____ out large objects.

sedimentation

The sewage is left so that _____ settle out of the water. The sediments sink to the bottom of the tank. The liquid sits above the sediment.

Treating sludge

sewage sludge

This sediment is called _____. Sludge contains _____ _____.

anaerobic treatment

_____ are added to digest the organic matter. These bacteria break down the matter anaerobically – with a limited supply of _____.

biogas

The anaerobic digestion of sludge produces _____. Biogas is a mixture of _____, _____ and _____ sulfide. It can be used as fuel.

remaining sludge used as fuel

The remaining sludge can be dried out and can also be _____ as a fuel.

Treating effluent

effluent

The remaining liquid is called **effluent**. This effluent has no solid matter visible, but still contains some matter and harmful _____.

aerobic treatment

_____ are added to the effluent. These bacteria feed on organic matter and the harmful microorganisms in the effluent. The bacteria break down the matter by aerobic respiration – _____ needs to be present.

bacteria removed

The bacteria are allowed to settle out of the water.

discharged back to rivers

The water is now safe enough to be released back into the _____.

Chapter 14: The Earth's resources 2

Knowledge organiser

Metal extraction (HT only)

Metals are used for many different things. Some metals can be extracted from their ores by _____ or _____.

However, metal ores are a _____ resources and these processes require lots of energy.

Scientists are looking for new ways to extract metals that are more sustainable.

Phytomining and **bioleaching** are two alternative processes used to extract _____ from low grade ores (ores with only a little copper in them).

Phytomining

1. _____
2. _____
3. _____
4. _____

Bioleaching

1. _____
2. _____
3. _____

Both of these methods avoid the digging, moving, and disposing of large amounts of rock associated with traditional mining techniques.

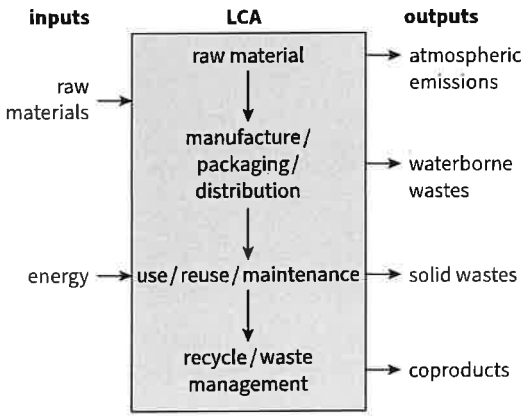
Life cycle assessment

A **life cycle assessment (LCA)** is a way of looking at the whole life of a product and assessing its impact on the environment and sustainability. It is broken down into four categories:

-
-
-
-

Some parts of an LCA are _____, such as the amount of water used or waste produced in the production of a product.

However, other parts of an LCA require judgements, such as the _____ effect, and so LCAs are not a completely objective process.



Key terms

Make sure you can write a definition for these key terms.

aerobic anaerobic biodegrade bioleaching distillation effluent finite resources life cycle assessment phytomining potable water recycling renewable resources reverse osmosis screening sedimentation sewage sludge sterilisation sustainable development

Disposal of products

When someone finishes with a product, it can be:

-
-
-
-

The table shows information about the extraction, processing, and disposal of some common materials.
This information is used when making a LCA.

Material	Extraction/processing	Disposal
metal	• • •	• •
plastic	•	• • •
paper	•	• • •
glass	•	• •
ceramics	• •	• •

Chapter 15: Making our resources 1

Knowledge organiser

Corrosion

Corrosion is when _____. Corrosion can be prevented in in two ways:

- _____
- _____

_____ is an example of corrosion. It is caused by iron reacting with oxygen *and* water from the environment.

Physical barriers

The material is covered with a physical barrier like grease, paint, or a thin layer of another metal by a process called _____.

Aluminium reacts with oxygen to make a very thin layer of _____ _____ around the metal that acts as a physical barrier. This layer then protects the rest of the metal from corrosion.

Sacrificial protection

A more _____ substance is placed on the material. The more reactive substance will react with the _____, and not the main material.

For example, iron is **galvanised** with zinc. The zinc then reacts with the _____ and _____ in place of the iron.

Alloys

Alloys allow us to tailor the properties of metals to specific uses.

Alloy	Composition	Properties	Use
bronze			
brass			
gold alloys			
high carbon steel			
low carbon steel			
stainless steel			
aluminium alloys			

Ceramics

Ceramics are materials with versatile properties that can have many different uses.

Ceramic	Manufacture	Properties	Uses
soda-lime glass			
borosilicate glass			
clay ceramics (pottery + bricks)			

Polymers

The properties of polymers depend on

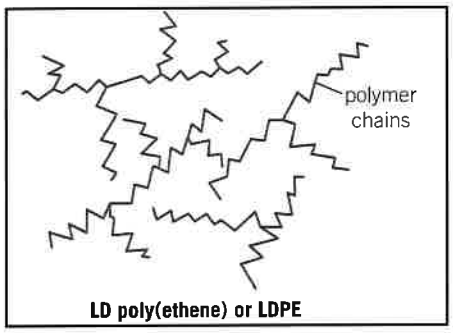
- _____
- _____

For example, **low density poly(ethene)** and **high density poly(ethene)** are both made from _____ monomers but have very different properties due to the way that the polymer chains line up in the material.

Low density poly(ethene)

LDPE is formed when the _____ polymerisation reaction of ethene is carried out under _____ _____ and in the presence of a small amount of _____.

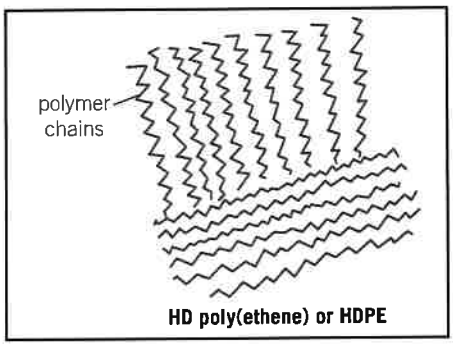
The branched polymer chains _____ pack together, so causing the low density of the polymer.



LD poly(ethene) or LDPE

High density poly(ethene)

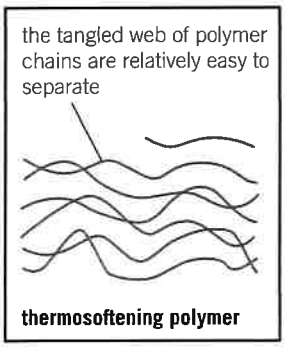
HDPE is formed when the _____ polymerisation reaction of ethene is carried out using a _____ at ____ °C. The polymer chains are _____ and can pack tightly together, so causing the high density of the polymer.



HD poly(ethene) or HDPE

Thermosoftening polymers

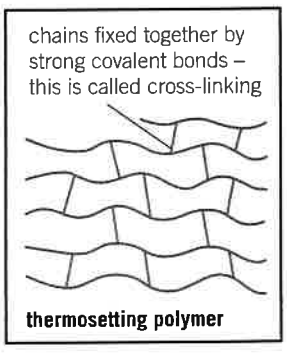
Thermosoftening polymers do not have _____ between the different chains, and _____ when they are heated.



thermosoftening polymer

Thermosetting polymers

Thermosetting polymers have _____ links between the different chains, and do not melt when they are heated.



thermosetting polymer

Composites

Composites are made from a main material (called a _____) with fragments or fibres of other materials (called _____) added into them. This means the material's properties can be made more useful.

_____ and _____ are examples of composites.

Chapter 15: Making our resources 2

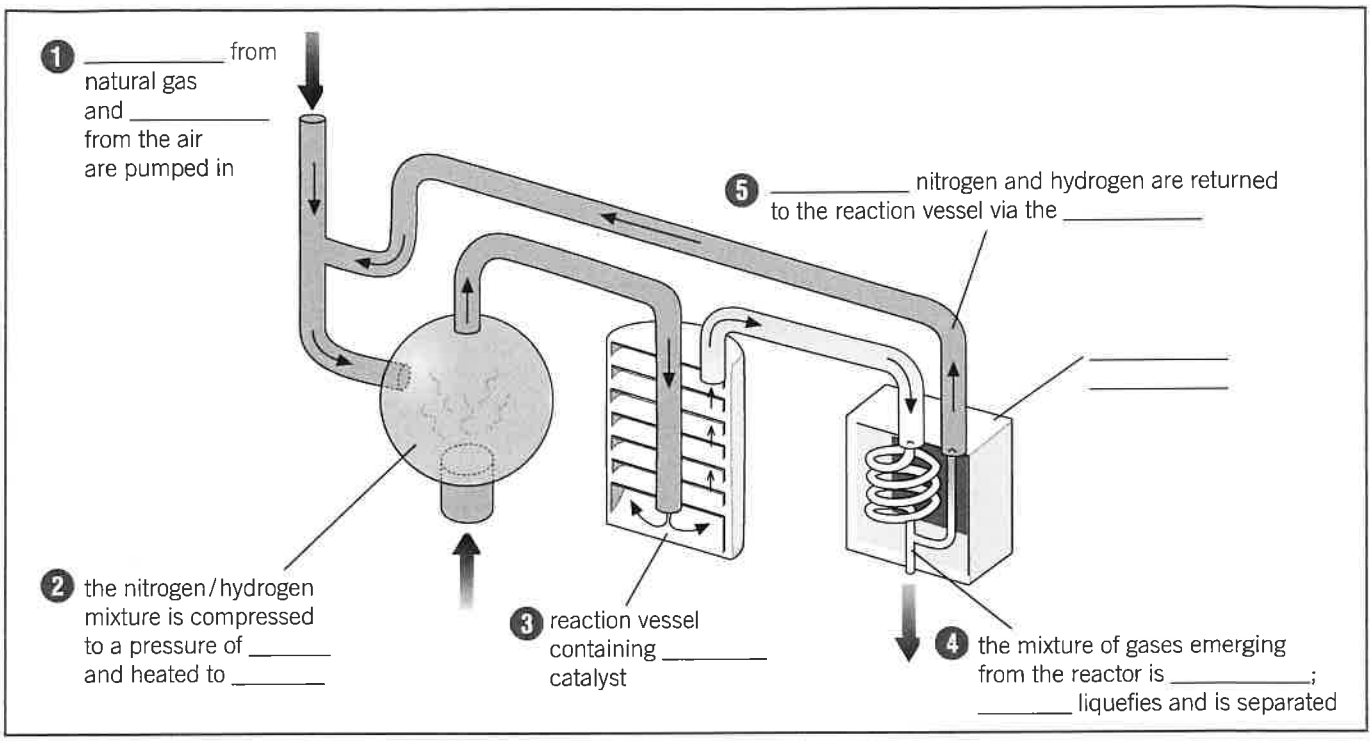
Knowledge organiser

The Haber process

Fertilisers are important chemicals used to _____. Ammonia is a vital component of many fertilisers. It is produced in the **Haber process**:

- nitrogen + hydrogen ⇌ ammonia
- _____(g) + _____(g) ⇌ _____(g)

It is a reversible reaction, so the conditions affect the yield.



Conditions

Compromise

The conditions used for the Haber process are a *compromise* to balance yield, cost, and rate. Name the conditions.

-
-
-

Temperature

The forward reaction is _____. Therefore, lowering the temperature would _____ the yield of ammonia, but would also _____ the rate of reaction.

Pressure

There are fewer gas molecules on the _____ side, so increasing the pressure would _____ the yield and the rate of reaction. However, it is very _____ to increase the pressure.

Catalyst

Iron is an effective catalyst for the Haber process. It does not increase the yield, but does _____ the rate.

Key terms

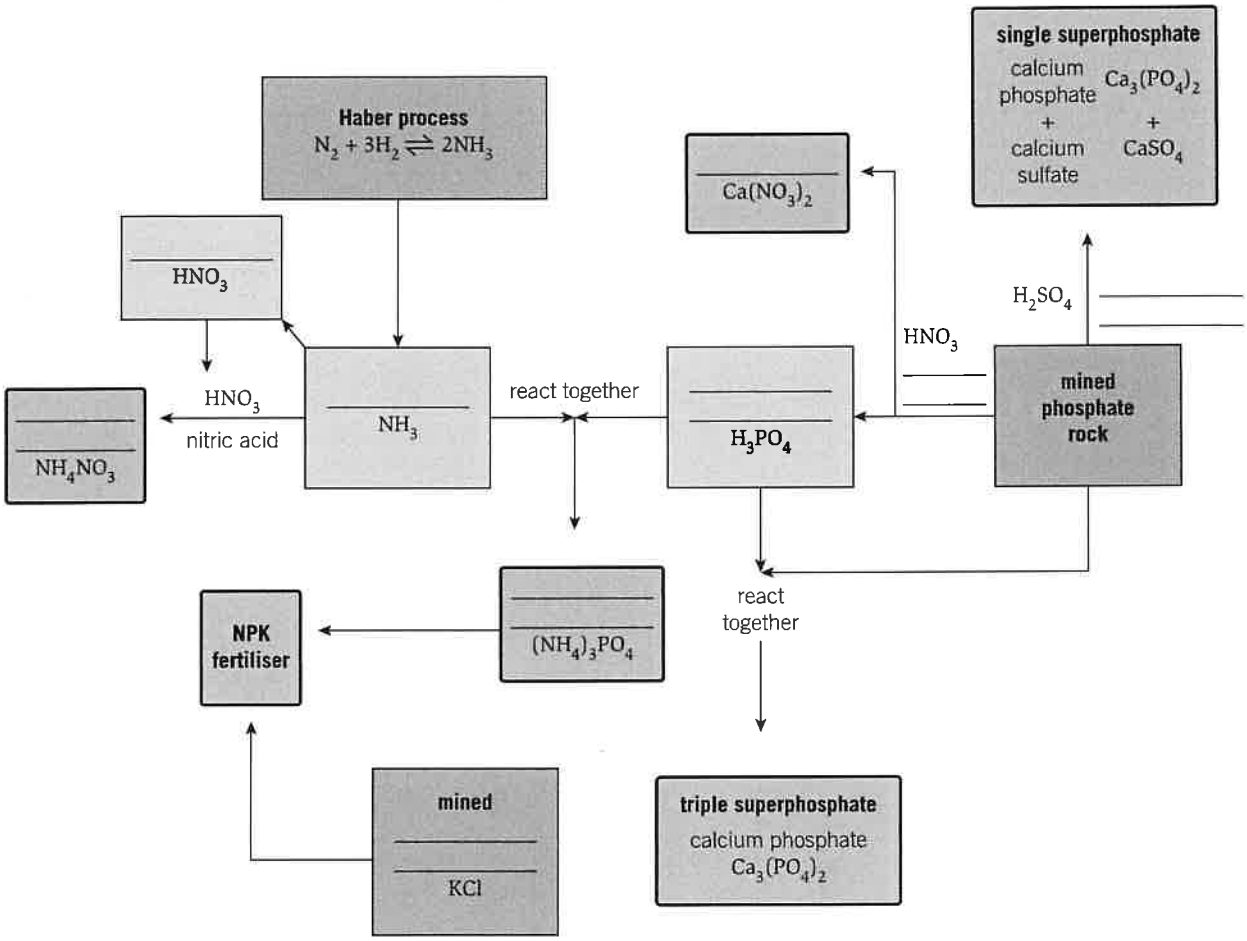
Make sure you can write a definition for these key terms.

alloy ceramic composite corrosion galvanise Haber process n

Fertilisers

Fertilisers are produced industrially to increase the amount of food obtained from crops. Compounds containing nitrogen, phosphorous, and potassium are used, and fertilisers with all three in them are called _____.

NPK fertilisers are formulations. Some of the substances that go into NPK fertilisers can be _____ straight from the ground (like potassium chloride or potassium sulfate). Others, like phosphate rock, need to be processed first. Phosphate rock can react with different _____ to make different products, which can either be used as fertilisers on their own or added to an NPK fertiliser. Name the substances.



Laboratory vs. industry

The compounds found in fertilisers can be produced in the laboratory as well as industrially:

	laboratory	industrial
Quantities produced		
Process		
Apparatus		
Speed		

atrix NPK fertiliser reinforce rusting thermosetting thermosoftening

Chapter 1: Atomic structure

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C1 questions	Answers
1	What is an atom?	
2	What is Dalton's model of the atom?	
3	What is the plum pudding model of the atom?	
4	What did scientists discover in the alpha scattering experiment?	
5	Describe the nuclear model of the atom.	
6	What did Niels Bohr discover?	
7	What did James Chadwick discover?	
8	Where are protons and neutrons?	
9	What is the relative mass of each sub-atomic particle?	
10	What is the relative charge of each sub-atomic particle?	
11	How can you find out the number of protons in an atom?	
12	How can you calculate the number of neutrons in an atom?	
13	Why do atoms have no overall charge?	
14	How many electrons would you place in the first, second, and third shells?	
15	What is an element?	
16	What is a compound?	
17	What is a mixture?	
18	What are isotopes?	
19	What are the four physical processes that can be used to separate mixtures?	
20	What is relative mass?	

Chapter 2: The Periodic Table

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C2 questions	Answers
1	How is the modern Periodic Table ordered?	
2	How were the early lists of elements ordered?	
3	Why did Mendeleev swap the order of some elements?	
4	Why did Mendeleev leave gaps in his Periodic Table?	
5	Why do elements in a group have similar chemical properties?	
6	Where are metals and non-metals located on the Periodic Table?	
7	What name is given to the Group 1 elements?	
8	Why are the alkali metals named this?	
9	Give the general equations for the reactions of alkali metals with oxygen, chlorine, and water.	
10	How does the reactivity of the alkali metals change down the group?	
11	Why does the reactivity of the alkali metals increase down the group?	
12	What name is given to the Group 7 elements?	
13	Give the formulae of the first four halogens.	
14	How do the melting points of the halogens change down the group?	
15	How does the reactivity of the halogens change down the group?	
16	Why does the reactivity of the halogens decrease down the group?	
17	What is a displacement reaction?	
18	What name is given to the Group 0 elements?	
19	Why are the noble gases inert?	
20	How do the melting points of the noble gases change down the group?	

Chapter 3: Bonding

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C3 questions	Answers
1	How are covalent bonds formed?	
2	Which type of atoms form covalent bonds between them?	
3	Describe the structure and bonding of a giant covalent substance.	
4	Describe the structure and bonding of small molecules.	
5	Describe the structure and bonding of polymers.	
6	Why do giant covalent substances have high melting points?	
7	Why do small molecules have low melting points?	
8	Why do large molecules have higher melting and boiling points than small molecules?	
9	Why do most covalent substances not conduct electricity?	
10	Describe the structure and bonding in graphite.	
11	Why can graphite conduct electricity?	
12	Explain why graphite is soft.	
13	What is graphene?	
14	Give two properties of graphene.	
15	What is a fullerene?	
16	What is a nanotube?	
17	Give two properties of nanotubes.	
18	Give three uses of fullerenes.	

19	What is an ion?	
20	Which kinds of elements form ionic bonds?	
21	What charges do ions from Groups 1 and 2 form?	
22	What charges do ions from Groups 6 and 7 form?	
23	Name the force that holds oppositely charged ions together.	
24	Describe the structure of a giant ionic lattice.	
25	Why do ionic substances have high melting points?	
26	Why don't ionic substances conduct electricity when solid?	
27	When can ionic substances conduct electricity?	
28	Why do ionic substances conduct electricity when melted or dissolved?	
29	Describe the structure of a pure metal.	
30	Describe the bonding in a pure metal.	
31	What are four properties of pure metals?	
32	Explain why pure metals are malleable.	
33	Explain why metals have high melting and boiling points.	
34	Why are metals good conductors of electricity and of thermal energy?	
35	What is an alloy?	
36	Explain why alloys are harder than pure metals.	
37	How big are nanoparticles?	
38	How are nanomaterials different from bulk materials?	
39	What is the relationship between side length and surface area-to-volume ratio?	
40	What are nanoparticles used for?	

Chapter 4: Calculations

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C4 questions	Answers
1	What is a mole?	
2	Give the value for Avogadro's constant.	
3	Which formula is used to calculate the number of moles from mass and M_r?	
4	Which formula is used to calculate the mass of a substance from number of moles and M_r?	
5	What is a limiting reactant?	
6	What is a unit for concentration?	
7	Which formula is used to calculate concentration from mass and volume?	
8	Which formula is used to calculate volume from concentration and mass?	
9	Which formula is used to calculate mass from concentration in g/dm^3 and volume?	
10	How can you convert a volume reading in cm^3 to dm^3?	
11	If the amount of solute in a solution is increased, what happens to its concentration?	
12	If the volume of water in a solution is increased, what happens to its concentration?	
13	What is the yield of a reaction?	
14	What is the theoretical yield of a reaction?	
15	Why is the actual yield always less than the theoretical yield?	• • •
16	What is the percentage yield?	
17	How is percentage yield calculated?	
18	What is atom economy?	
19	Why is a high atom economy desirable?	
20	How is percentage atom economy calculated?	

21	How can concentration in mol/dm^3 be calculated?	
22	What is a titration?	
23	What is the end-point?	
24	How should solution be added from the burette close to the end point?	
25	Why is a white tile used in titration?	
26	What is a titre?	
27	What volume does one mole of any gas occupy at room temperature and pressure?	

Chapter 5: Chemical changes

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C5 questions	Answers
1	What does reactivity mean?	
2	How can metals be ordered by their reactivity?	
3	What name is given to a list of metals ordered by their reactivity?	
4	In terms of electrons, what makes some metals more reactive than others?	
5	Why are gold and silver found naturally as elements in the Earth's crust?	
6	What is an ore?	
7	How are metals less reactive than carbon extracted from their ores?	
8	In terms of oxygen, what is oxidation?	
9	In terms of oxygen, what is reduction?	
10	Why can metals like potassium and aluminium not be extracted by reduction with carbon?	
11	How are metals more reactive than carbon extracted from their ores?	
12	What is a displacement reaction?	
13	What is an ionic equation?	
14	What type of substance is given as ions in an ionic equation?	
15	What is a spectator ion?	
16	What is a half equation?	
17	In terms of electrons, what is oxidation?	
18	In terms of electrons, what is reduction?	

19	In terms of pH, what is an acid?	
20	In terms of pH, what is a neutral solution?	
21	In terms of H^+ ions, what is an acid?	
22	How is the amount of H^+ ions in a solution related to its pH?	
23	What are the names and formulae of three main acids?	
24	How do you measure the pH of a substance?	
25	What is a strong acid?	
26	What is a weak acid?	
27	What is a salt?	
28	Which type of salts do sulfuric acid, hydrochloric acid, and nitric acid form?	
29	What are the products of a reaction between a metal and an acid?	
30	What are the products of a reaction between a metal hydroxide and an acid?	
31	What are the products of a reaction between a metal oxide and an acid?	
32	What are the products of a reaction between a metal carbonate and an acid?	
33	What is a base?	
34	What is an alkali?	
35	What is a neutralisation reaction?	
36	What is the ionic equation for a reaction between an acid and an alkali?	
37	How can you obtain a solid salt from a solution?	
38	When an acid reacts with a metal, which species is oxidised?	
39	When an acid reacts with a metal, which species is reduced?	
40	What are the four state symbols and what do they stand for?	

Chapter 6: Electrolysis

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C6 questions	Answers
1	What is electrolysis?	
2	What is the name of the positive electrode?	
3	What is the name of the negative electrode?	
4	What is an electrolyte?	
5	Where are metals formed?	
6	Where are non-metals formed?	
7	How can ionic substances be electrolysed?	
8	Why can solid ionic substances not be electrolysed?	
9	In the electrolysis of solutions, when is the metal *not* produced at the cathode?	
10	In the electrolysis of a metal halide solution, what is produced at the anode?	
11	In the electrolysis of a metal sulfate solution, what is produced at the anode?	
12	What is the half equation for the ionisation of water?	
13	What metals are extracted from ionic compounds by using electrolysis?	
14	In the electrolysis of aluminium oxide, why is the aluminium oxide mixed with cryolite?	
15	In the electrolysis of aluminium oxide, what are the anodes made of?	
16	In the electrolysis of aluminium oxide, why do the anodes need to be replaced?	

Chapter 7: Energy changes

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C7 questions	Answers
1	What is an exothermic energy transfer?	
2	What is an endothermic energy transfer?	
3	What is a reaction profile?	
4	What is the activation energy?	
5	What is bond energy?	
6	In terms of bond breaking and making, what is an exothermic reaction?	
7	In terms of bond breaking and making, what is an endothermic reaction?	
8	How are chemical cells made?	
9	What is a battery?	
10	How does the potential difference of a cell depend on the metals that the electrodes are made of?	
11	How can some cells be recharged?	
12	Why can some cells not be recharged?	
13	What is a fuel cell?	
14	In the hydrogen fuel cell, what is the overall reaction?	
15	In the alkaline hydrogen fuel cells, what are the half equations?	
16	Give an advantage of the hydrogen fuel cell.	
17	Give a disadvantage of the hydrogen fuel cell.	

Chapter 8: Rates and equilibrium

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C8 questions	Answers
1	What is the rate of a reaction?	
2	What is the equation for calculating the mean rate of reaction?	
3	What is the unit for rate of reaction in a reaction involving a change in mass?	
4	What is the unit for rate of reaction in a reaction involving a change in volume?	
5	What is the activation energy?	
6	What effect does increasing concentration have on the rate of reaction?	
7	Why does increasing concentration have this effect?	
8	What effect does increasing pressure have on the rate of reaction?	
9	Why does increasing pressure have this effect?	
10	What effect does increasing surface area have on the rate of reaction?	
11	Why does increasing surface area have this effect?	
12	What effect does increasing temperature have on the rate of reaction?	
13	Why does increasing temperature have this effect?	
14	What is a catalyst?	
15	How do catalysts increase the rate of a reaction?	
16	What is a reversible reaction?	
17	Which symbol shows a reversible reaction?	
18	What is dynamic equilibrium?	
19	What are the three reaction conditions that can be changed?	
20	What is Le Châtelier's principle?	
21	What is the effect of increasing the concentration of reactants on a reaction at dynamic equilibrium?	

22	What is the effect of increasing the concentration of reactants on a reaction at dynamic equilibrium?	
23	What is the effect of decreasing the concentration of products on a reaction at dynamic equilibrium?	
24	What is the effect of increasing pressure on a reaction at dynamic equilibrium?	
25	What is the effect of decreasing pressure on a reaction at dynamic equilibrium?	
26	What is the effect of increasing temperature on a reaction at dynamic equilibrium?	
27	What is the effect of decreasing temperature on a reaction at dynamic equilibrium?	

Chapter 9: Crude oil and fuels

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C9 questions	Answers
1	What is a hydrocarbon?	
2	How is crude oil formed?	
3	What are the alkanes?	
4	What are the first four alkanes?	
5	What is the general formula for the alkanes?	
6	How does boiling point depend on the chain length?	
7	How does viscosity depend on chain length?	
8	How does flammability depend on chain length?	
9	How can the different alkanes in crude oil be separated?	
10	What is a fraction?	
11	Name five useful fuels produced from fractional distillation.	
12	Name four useful materials produced from crude oil fractions.	
13	What is cracking?	
14	Name two methods to carry out cracking.	
15	What are the products of cracking?	
16	What are alkenes?	
17	What are alkenes used for?	
18	Describe the reactivity of alkenes compared to alkanes.	
19	How can you test for alkenes?	

Chapter 10: Organic reactions

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C10 questions	Answers
1	What is a homologous series?	
2	What is a functional group?	
3	What are alkenes?	
4	What is the general formula for alkenes?	
5	What is the product from an addition reaction of an alkene with a halogen?	
6	What is the product from the addition reaction of an alkene with hydrogen?	
7	What conditions are required for the addition reaction of an alkene with steam?	
8	What are alcohols?	
9	How are alcohols produced?	
10	What conditions are required to produce alcohols by fermenting?	
11	Name the first four alcohols.	
12	What are the products of a reaction between an alcohol and sodium?	
13	What is the organic product formed by the oxidation of an alcohol?	
14	Name an oxidising agent.	
15	What are carboxylic acids?	
16	What do carboxylic acids form when they react with sodium carbonate?	
17	How are carboxylic acids produced?	
18	Name the first four carboxylic acids.	
19	What is the organic product of a reaction between a carboxylic acid and an alcohol?	
20	What catalyst is normally used in the formation of esters?	
21	What occurs when pure carboxylic acids are added to water?	

Chapter 11: Polymers

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C11 questions	Answers
1	What are monomers?	
2	What is a polymer?	
3	What is a repeating unit?	
4	What is polymerisation?	
5	What are the two types of polymerisation?	
6	What kind of monomers are involved in addition polymerisation?	
7	What kind of monomers are involved in condensation polymerisation?	
8	What other products are made in condensation polymerisation?	
9	What does n represent in an equation showing polymerisation?	
10	What is a natural polymer?	
11	Give four examples of natural polymers.	
12	What are amino acids?	
13	What is a polypeptide?	
14	What is a protein?	
15	Which monomer makes up starch and cellulose?	
16	What is DNA?	
17	Which monomers are DNA made of?	
18	How is DNA arranged?	

Chapter 12: Chemical analysis

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C12 questions	Answers
1	In chemistry, what is a pure substance?	
2	What is the difference between the melting and boiling points of a pure and impure substance?	
3	What is a formulation?	
4	What are some examples of formulations?	
5	What is chromatography?	
6	How is R_f calculated?	
7	What is the test for hydrogen?	
8	What is the test for oxygen?	
9	What is the test for carbon dioxide?	
10	What is the test for chlorine?	
11	What is the test for aluminium, calcium, and magnesium ions?	
12	How can aluminium ions be distinguished from calcium and magnesium ones?	
13	What colour precipitates are formed when sodium hydroxide solution is added to solutions of copper(II), iron(II), and iron(III) ions?	
14	What is the test for a halide ion?	
15	What is the test for a carbonate ion?	
16	What is the test for a sulfate ion?	
17	What colours are produced by different metals in a flame test?	
18	What is instrumental analysis?	
19	What are the three advantages of instrumental analysis?	
20	What information does flame emission spectroscopy produce?	

Chapter 13: The Earth's atmosphere

Retrieval questions

Answer the following questions using the information from the knowledge organiser.

	C13 questions	Answers
1	What is the atmosphere?	
2	What was the early atmosphere composed of?	
3	How did the oceans form?	
4	How did the amount of carbon dioxide in the atmosphere decrease to today's levels?	
5	When did life start to appear, and what was the impact of this on oxygen in the atmosphere?	
6	How has the amount of nitrogen in the atmosphere changed over time?	
7	Why can scientists not be sure about the composition of the Earth's early atmosphere?	
8	What is the current composition of the atmosphere?	
9	What is a greenhouse gas?	
10	What type of radiation do greenhouse gases absorb?	
11	Name three greenhouse gases.	
12	Give two ways recent human activities have increased the amount of atmospheric carbon dioxide.	
13	Give two ways recent human activities have increased the amount of atmospheric methane.	
14	What is global warming?	
15	What is global climate change?	
16	What are some possible effects of climate change?	
17	What is a carbon footprint?	
18	How is carbon monoxide formed, and what is the danger associated with it?	
19	How are particulates formed, and what are the dangers associated with them?	
20	How is sulfur dioxide formed, and what are the dangers associated with it?	
21	How are oxides of nitrogen formed, and what are the dangers associated with them?	