DOT POINT

NSW CHEMISTRY MODULES 1 TO 4

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Contents

Words to Watch

account, account for State reasons for, report on, give an account of, narrate a series of events or transactions.

analyse Interpret data to reach conclusions.

annotate Add brief notes to a diagram or graph.

apply Put to use in a particular situation.

assess Make a judgement about the value of something.

calculate Find a numerical answer.

clarify Make clear or plain.

classify Arrange into classes, groups or categories.

comment Give a judgement based on a given statement or result of a calculation.

compare Estimate, measure or note how things are similar or different.

construct Represent or develop in graphical form.

contrast Show how things are different or opposite.

create Originate or bring into existence.

deduce Reach a conclusion from given information.

define Give the precise meaning of a word, phrase or physical quantity.

demonstrate Show by example.

derive Manipulate a mathematical relationship(s) to give a new equation or relationship.

describe Give a detailed account.

design Produce a plan, simulation or model.

determine Find the only possible answer.

discuss Talk or write about a topic, taking into account different issues or ideas.

distinguish Give differences between two or more different items.

draw Represent by means of pencil lines.

estimate Find an approximate value for an unknown quantity.

evaluate Assess the implications and limitations.

examine Inquire into.

explain Make something clear or easy to understand.

extract Choose relevant and/or appropriate details.

extrapolate Infer from what is known.

hypothesise Suggest an explanation for a group of facts or phenomena.

identify Recognise and name.

interpret Draw meaning from.

investigate Plan, inquire into and draw conclusions about.

justify Support an argument or conclusion.

label Add labels to a diagram.

list Give a sequence of names or other brief answers.

measure Find a value for a quantity.

outline Give a brief account or summary.

plan Use strategies to develop a series of steps or processes.

predict Give an expected result.

propose Put forward a plan or suggestion for consideration or action.

recall Present remembered ideas, facts or experiences.

relate Tell or report about happenings, events or circumstances.

represent Use words, images or symbols to convey meaning.

select Choose in preference to another or others.

sequence Arrange in order.

show Give the steps in a calculation or derivation.

sketch Make a quick, rough drawing of something.

solve Work out the answer to a problem.

state Give a specific name, value or other brief answer.

suggest Put forward an idea for consideration.

summarise Give a brief statement of the main points.

synthesise Combine various elements to make a whole.

What the book includes

This book provides questions and answers for each dot point in the NSW Chemistry Stage 6 Syllabus for each module in the Year 11 Chemistry course:

- Module 1 Properties and Structure Of Matter
- Module 2 Introduction To Quantitative Chemistry
- Module 3 Reactive Chemistry
- Module 4 Drivers Of Reactions

Format of the book

The book has been formatted in the following way:

1.1 Subtopic from syllabus.

1.1.1 Assessment statement from syllabus.

1.1.1.1 First question for this assessment statement.

1.1.1.2 Second question for this assessment statement.

The number of lines provided for each answer gives an indication of how many marks the question might be worth in an examination. As a rough rule, every two lines of answer might be worth 1 mark.

How to use the book

Completing all questions will provide you with a summary of all the work you need to know from the syllabus. You may have done work in addition to this with your teacher as extension work. Obviously this is not covered, but you may need to know this additional work for your school exams.

When working through the questions, write the answers you have to look up in a different colour to those you know without having to research the work. This will provide you with a quick reference for work needing further revision.

Module 3 Reactive Chemistry

Module 4 Drivers Of Reactions

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MODULE 1

Properties and Structure Of Matter

In this module you will:

- Analyse trends and patterns in the properties of pure substances and use them to make predictions about other pure substances.
- Determine ways substances can be separated from each other.
- Describe the properties of pure substances and mixtures.
- Explore the advancement of the periodic table of elements and of atomic theory, and consider the roles of models in advances in chemistry.
- Engage with all the Working Scientifically skills for designing, evaluating and conducting investigations, obtain and process data and communicate ideas about structural, physical and chemical aspects of matter.

1.1 Properties of matter.

INQUIRY QUESTION

How do the properties of substances help us to classify and separate them.

1.1.1 Explore homogeneous and heterogeneous mixtures through practical investigations.

- **Using separation techniques based on physical properties.**
- **Calculating percentage composition by weight of component elements and/or compounds.**

1.1.1.1 The particle theory of matter states that all matter consists of particles that are constantly moving. Distinguish between elements, compounds and mixtures in terms of the particle theory.

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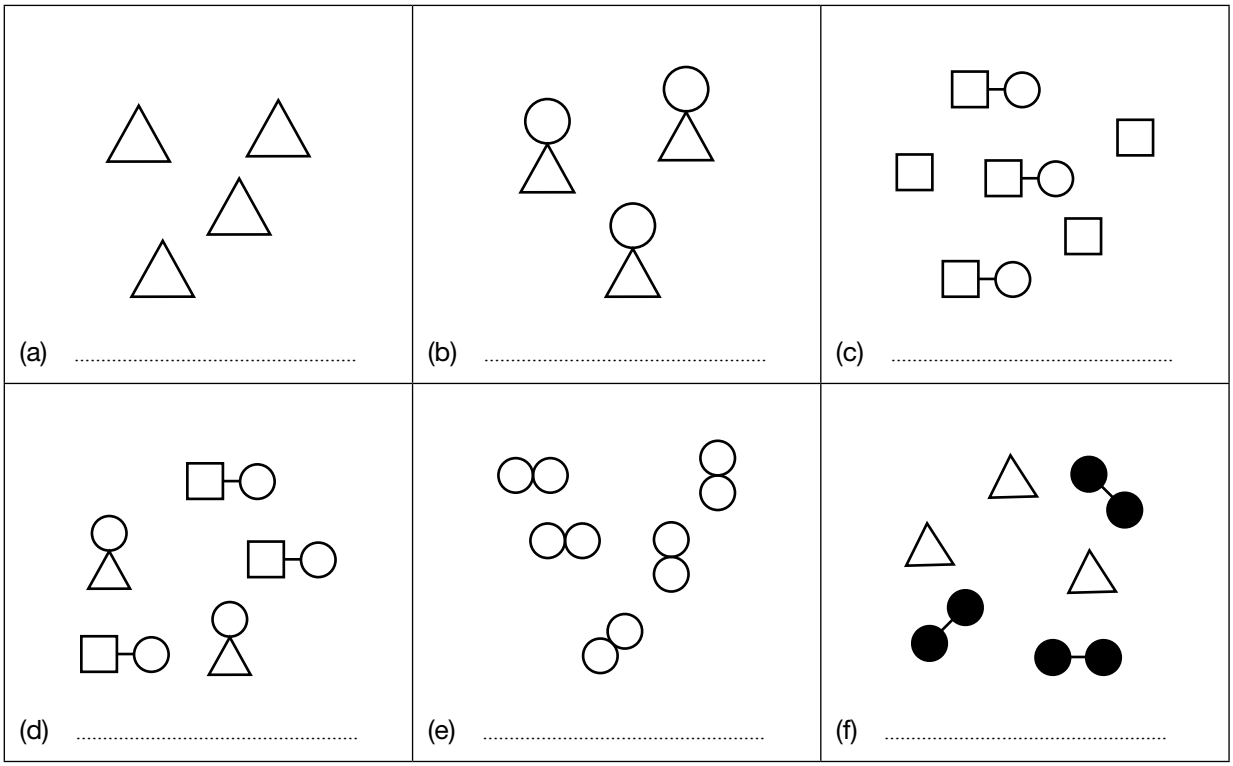
1.1.1.2 Identify each of the following diagrams as representing an element, mixture or compound.



(a) .....

(b) .....

(c) .....

(d) .....

(e) .....

(f) .....

1.1.1.3 You have investigated a number of homogeneous and heterogeneous mixtures. On what basis would you classify a mixture as homogeneous or heterogeneous? In your answer include two examples of each.

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1.1.1.4 The components of mixtures can be separated out in the laboratory using a number of different processes. Use diagrams to describe the following named processes.

Note: For diagrams you should use a pencil and a ruler and they should be clearly labelled.

(a) Filtration.	(b) Sedimentation and decanting.
(c) Evaporation and crystallisation.	(d) Fractional distillation of a mixture of liquids.
(e) Sieving.	(f) Using a separating funnel to separate two liquids.

1.1.1.5 Complete the following table to relate some mixtures and methods of separating their components. The first line has been completed for you.

Type of mixture	Example	Suitable process to separate components
Solids of different sizes.	A mixture of partly crushed rock particles and silt.	Sieving – particles smaller than the hole in the sieve pass through, large particles stay in the sieve.
A liquid and a solid that will not dissolve in that liquid.		
A solid dissolved in a liquid.		
Miscible liquids with different boiling points.		
Immiscible liquids with different densities.		
Gases.		

1.1.1.6 Air is a homogeneous mixture.

(a) Identify the composition of air and account for its description as homogeneous.

(b) Some junior students are arguing as to whether or not air is a mixture. They appeal to you – as the expert – to help settle the argument.

What arguments could you use to convince them that air is a mixture?

(c) Research to list the steps in the separation of gases such as the extraction of oxygen and nitrogen from air.

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(d) Why would you want to separate individual gases from air? .....

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1.1.1.7 Use the following table to summarise differences in properties of the components of mixtures that would allow for their separation.

Components of mixture	Property that makes separation possible	Process used to separate components
Sand and sodium chloride		
Sand and gravel		
Iron filings and sulfur		
Oil and water		
Nitrogen and oxygen in air		
Solid wastes from liquid sewage		
Solid particles in waste gases e.g. from combustion of coal to make electricity		

1.1.1.8

(a) Identify the components of one mixture that you separated in the laboratory.

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(b) Describe the method you used to carry out this separation.

Note: You should list the steps in your method clearly and include labelled diagrams to illustrate your method.

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1.1.1.9 Two year 11 students, Grace and Eva, are provided with a mixture of sand and salt and asked to carry out a gravimetric analysis of this mixture to determine the percentage of salt present. The total mass of the mixture is 4.90 grams. The students add water and stir to dissolve the salt. They filter the mixture and collect the residue. Eva allows the residue to dry thoroughly and then weighs the filter paper plus residue. Grace heats the filtrate in a weighed evaporating basin, evaporating it to dryness. The results Grace and Eva obtain are:

Mass of filter paper before filtering = 1.56 g

Mass of filter paper and dried residue = 3.01 g

Weight of evaporating basin (empty) = 23.43 g

Weight of evaporating basin after evaporating the filtrate = 26.68 g

(a) Calculate the following.

(i) The mass of the residue.

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(ii) The mass of the solid in the evaporating dish.

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(iii) The percentage composition of salt in the original mixture.

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(iv) The total mass of chemicals recovered after separation.

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(b) Assess the accuracy of the techniques used by these students and suggest possible improvements.

1.1.1.10

(a) List the steps a scientist would take to use gravimetric analysis to determine the percentage of mercury in a sample of mercury oxide.

(b) Identify three other situations in which scientists might use gravimetric analysis to provide useful data about mixtures.

(c) The label on a packet of oats contains the following information.

Contents	Per 100 g	Contents	Per 100 g
Energy	1600 kJ	Dietary fibre	6.9 g
Protein	9.4 g	Sodium	20 mg
Fat	5.9 g	Potassium	265 mg
Carbohydrate	68.6 g		

(i) Describe how the manufacturer could have determined such information.

(ii) Describe the purpose of providing such information on food packaging.

1.1.1.11

(a) Research an industrial separation process of your choice. (Examples could include gravimetric analysis of metal ores, fractional distillation of petroleum or air, or froth flotation to separate metallic minerals from gangue.) Then use the following scaffold to summarise your research findings.

Name of industrial separation process researched	
Components of mixture separated by this process.	
Properties of components that allow them to be separated by this process.	
Uses of components when they have been separated.	
Issues associated with any wastes produced during this process.	

(b) Explain how you assessed the reliability of the reference sources you used during this research.

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1.1.2 Investigate the nomenclature of inorganic substances using International Union of Pure and Applied Chemistry (IUPAC) naming conventions.

1.1.2.1 Research some uses of the IUPAC.

1.1.2.2 Use IUPAC naming rules to name compounds with the following formulas.

Formula	Name	Formula	Name
CaO		CuO	
$MgCl_2$		$Fe(OH)_3$	
NaH		$Ba_3(PO_4)_2$	
K_2O		$Mg(HCO_3)_2$	
$BeCO_3$		$ZnSO_4$	
P_2O_5		$Al(NO_3)_3$	

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1.1.3 Classify the elements based on their properties and position in the periodic table through their:

- **Physical properties.**
- **Chemical properties.**

1.1.3.1

(a) The periodic table lists all the known elements. How many elements occur naturally? .....

(b) The elements are listed in the periodic table in order of their .....

(c) Elements can be classified according to their physical and chemical properties. Distinguish between physical and chemical properties, giving examples of each.

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1.1.3.2 Identify the following properties as either physical or chemical.

(a) Melting point .....

(b) Hardness .....

(c) Malleability .....

(d) Decomposition .....

(e) Reaction with acid .....

(f) Density .....

1.1.3.3 Complete the following table to summarise the differences between the physical properties of metals and non-metals.

Physical property	Metals	Non-metals
Melting and boiling points		
Conductivity of heat		
Conductivity of electricity		
Malleability (able to be bent and hammered into shapes)		
Ductility (able to be stretched into wires)		
Lustre		

1.1.3.4 Complete the following passage by filling in the gaps and crossing out the incorrect words in the brackets.

Examples of semi-metals are ..... and .....

Semi-metals are like metals in that they are all crystalline solids at room temperature and they have (high/low) melting and boiling points.

Semi-metals are like non-metals in that they are (better/poorer) conductors of electricity than metals.

1.1.3.5 During your studies you have observed some elements.

(a) Identify one such element .....

(b) Based on your observations, and/or reference data, classify it as a metal, non-metal or semi-metal and justify your classification.

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(c) Use a diagram to show how you could test some elements to show whether or not they can conduct electricity.

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1.1.3.6 Analyse the following information to classify each of the elements described below as a metal or a non-metal.

(a) A malleable, silver-coloured element with melting point 1540°C and boiling point 3000°C.

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(b) A yellow powder which is a poor conductor of electricity.

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(c) A colourless gas at room temperature.

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1.1.3.7 Use the information in the table below to classify each element as a metal or a non-metal.

Element	Melting point (°C)	Melting point (°C)	Conductivity	Metal or non-metal
A	1083	2600	Good	
B	–157	–152	Poor	
C	44	280	Poor	
D	1770	4530	Good	
E	–210	–196	Poor	

1.1.3.8 Beginning chemistry students frequently make the mistake of classifying the following substances as non-metals – ammonia (NH_3), sodium carbonate (Na_2CO_3) and carbon dioxide (CO_2). Explain why it is not correct to classify any of these substances as a non-metal.

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1.1.3.9 Identify the following elements.

(a) A non-metal which is a good conductor of electricity .....

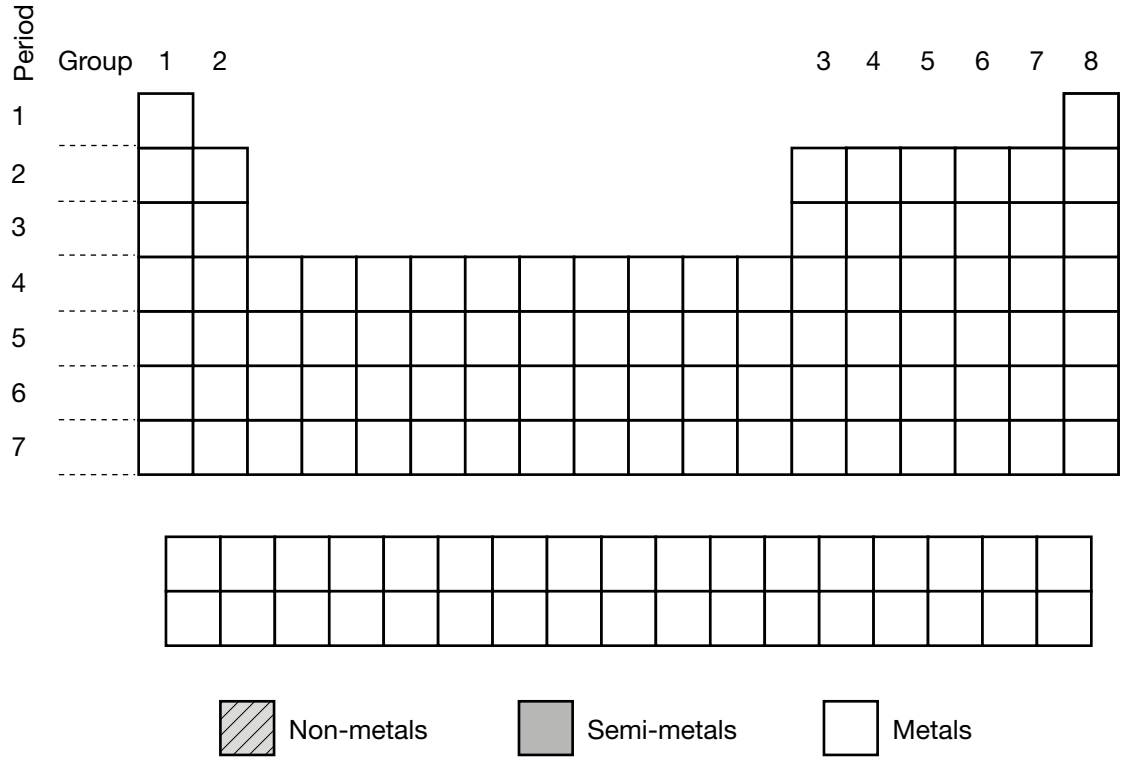
(b) A shiny, silver liquid metal at room temperature .....

(c) An inert gas used in advertising signs .....

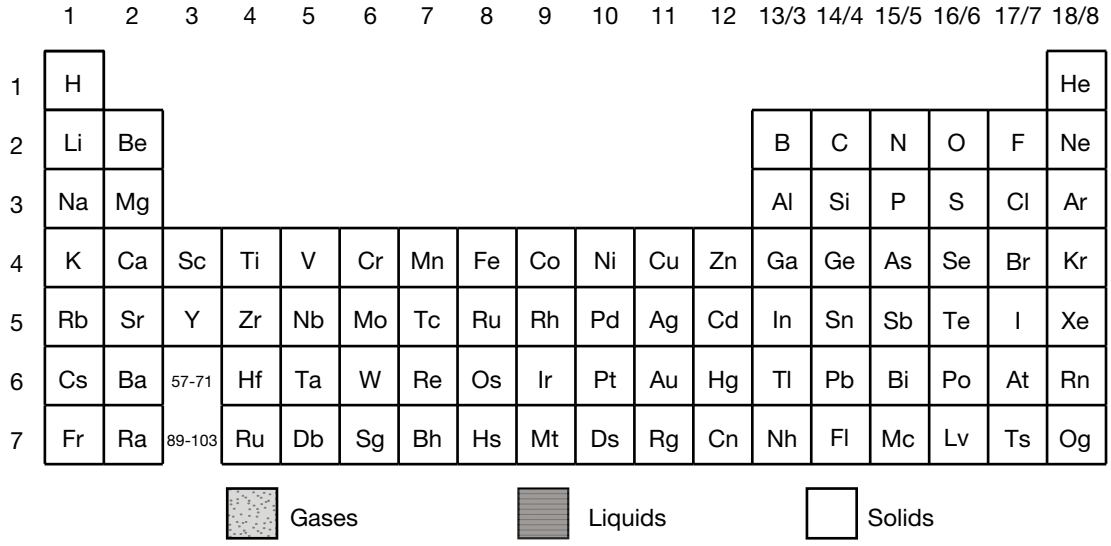
(d) A non-metal which is liquid at room temperature .....

1.1.3.10 Using a key, shade the following periodic table to indicate the positions of metals, non-metals and semi-metals.

Above the group numbers given, add numbers to show how groups can also be numbered from 1 to 18.



1.1.3.11 Using a key, shade the following periodic table to identify which main block elements occur as solids, liquids and gases at room temperature.



1.1.3.12 Identify whether each of the elements in the following table would exist as a solid, liquid or gas at room temperature (25°C).

Element	Melting point (°C)	Boiling point (°C)	Solid/liquid/gas at room temperature
A	1490	2900	
B	–7	58	
C	114	183	
D	–39	357	
E	–210	–196	

1.1.3.13 Write symbols or names for the following metals and non-metals.

Metals		Non-metals	
Potassium		Phosphorus	
Copper		Carbon	
Calcium			Ar
	Na		H
	Al		S
Mercury			I

1.1.3.14 For each of the elements listed in the table below, describe one use and the physical properties that account for that use. The first one has been completed for you.

Element	Use	Properties
Gold	Jewellery	Shiny lustre; malleable.
Carbon		
Aluminium		
Helium		
Iron		

1.1.3.15 Complete the table by matching the properties listed in the table with the names and uses of the elements shown below.

Names of elements described	Uses
Neon	Building construction
Selenium	Light sensitive switches
Helium	Jewellery
Aluminium	Filling balloons
Carbon (diamond)	Advertising signs
Iron	Wrapping food

Name of element	Properties	Use
	Conductor of electricity in the light, non-conductor in the dark.	
	Durable, clear, shiny solid.	
	Gas which is inert and has a very low density.	
	Strong, solid, malleable metal.	
	Durable metal, very malleable, can be rolled into thin sheets, insoluble in water.	
	Unreactive gas which emits red light when electricity is passed through the gas.	

1.1.3.16 Applied question.

The physical properties of a metal are usually given as:

- Hard and strong
- Solid at room temperature
- Shiny, silvery appearance
- High melting point
- Malleable and ductile
- Good conductor of electricity

A non-metal is usually not considered to have these physical properties. In terms of the physical properties mentioned above, what makes each of the following elements unusual?

(a) The metal lead. .....

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(b) The non-metal carbon in the forms of graphite and diamond. .....

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(c) The non-metal iodine. .....

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(d) The metal mercury. .....

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(e) The metal copper. .....

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Answers

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1.1.1.1 An *element* is a pure substance – it consists of only one type of the particles we call atoms.

A *compound* is also a pure substance – its particles consist of two or more types of atoms chemically combined together in a definite proportion.

A *mixture* is not a pure substance because it consists of two or more different types of particles which are not chemically joined together. These particles can be present in any proportion.

1.1.1.2 (a) Pure – an element

(b) Pure-a compound.

(c) Mixture.

(d) Mixture.

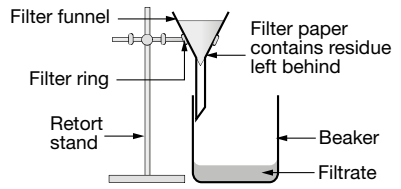
(e) Pure – an element.

(f) Mixture.

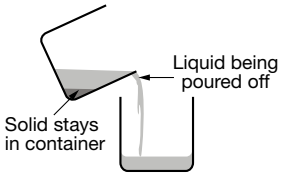
1.1.1.3 A *homogeneous mixture* contains two or more different substances but it looks like it is only one substance, e.g. a solution, blood, air. A *heterogeneous mixture* contains two or more different substances and you can see that it is not just one thing, e.g. fried rice, a mixture of sulfur and sand.

1.1.1.4

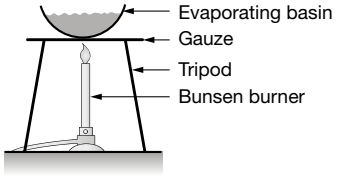
(a) Filtration.



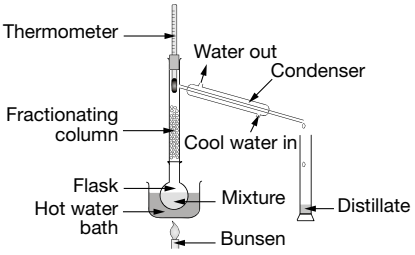
(b) Sedimentation and decanting.



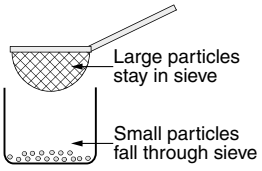
(c) Evaporation and crystallisation.



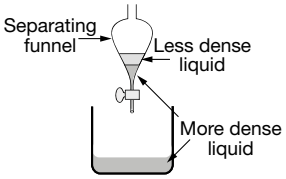
(d) Fractional distillation of a mixture of liquids.



(e) Sieving.



(f) Using a separating funnel to separate liquids.



1.1.1.5 Various, e.g.

Type of mixture	Example	Suitable process to separate components
Solids of different sizes.	A mixture of partly crushed rock particles and silt.	Sieving – particles smaller than the hole in the sieve pass through, large particles stay in the sieve.
A liquid and a solid that will not dissolve in that liquid.	Sand and salt water.	Filtering separates the sand from the salty water.
A solid dissolved in a liquid.	Salt water.	Distillation or evaporation and crystallisation.
Miscible liquids with different boiling points.	Petroleum.	Fractional distillation.
Immiscible liquids with different densities.	Oil and water.	Separating funnel.
Gases.	Nitrogen and oxygen from air.	Fractional distillation.

1.1.1.6

(a) Composition varies but is approximately 78% nitrogen, 21% oxygen, 0.9% argon, 0.03% carbon dioxide and varying tiny amounts of water vapour and other gases such as helium, neon, methane and krypton. It may also contain other components such as dust, pollutants and pollen. It is described as homogeneous as you cannot see all the individual components; it looks like one substance.

(b) Various, e.g.

- Like other mixtures, air varies in composition, e.g. the amount of carbon dioxide and water vapour can vary.
- Like other mixtures, air can be separated into its parts by physical methods, e.g. fractional distillation.
- Like other mixtures, air does not have a chemical formula.
- There is no such thing as a molecule of air. Air contains molecules of a number of chemicals, e.g. nitrogen, oxygen, carbon dioxide.
- Like other mixtures, no chemical reaction occurs when oxygen and nitrogen are mixed at room temperature.
- Like other mixtures, air has no fixed melting or boiling point. Elements and compounds do have fixed melting and boiling points.
- You could also point out that air contains both elements, e.g. nitrogen, and compounds, e.g. carbon dioxide, but they can be mixed in any proportion.

(c) Cool to liquefy the air, then carry out fractional distillation of the liquid air.

(d) Individual components of air have many uses. For example, oxygen is used in hospitals and in welding and nitrogen is used to manufacture ammonia which is then used to make many products including fertiliser and explosives.

1.1.1.7

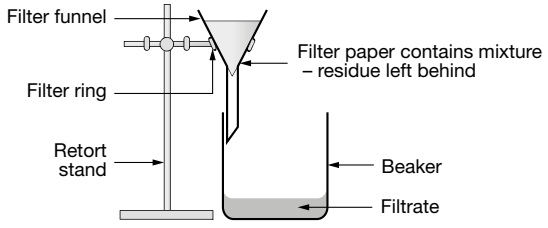
Components of mixture	Property that makes separation possible	Process used to separate components
Sand and sodium chloride	Solubility – salt is soluble, sand is not.	Add water, stir and filter – sand stays in filter paper. Evaporate filtrate to recover salt.
Sand and gravel	Particle size – gravel is bigger.	Sieving.
Iron filings and sulfur	Iron is magnetic, sulfur is not.	Use a magnet to remove iron filings.
Oil and water	Water has a higher boiling point. Or Oil is less dense.	Fractional distillation. Or Use a separating funnel.
Nitrogen and oxygen in air	Different boiling points – oxygen –183°C, nitrogen –196°C.	Cool air to a liquid then fractional distillation.
Solid wastes from liquid sewage	Solubility in water.	Filtration.
Solid particles in waste gases, e.g. from combustion of coal to make electricity	Ability to become charged.	Electrostatic precipitation of gases passing out through a chimney.

1.1.1.8

(a) Various, e.g. sand and salt.

(b) Various, e.g.

Place the mixture in a beaker. Add 100 mL water. Using a stirring rod, stir until all of the salt dissolves in the water. Set up the filtering equipment as shown. Pour the mixture into the filter paper, as shown in the diagram.



Allow time for the salty water to pass through the filter paper. Continually add more of the mixture (stirring before adding) until it has all been filtered. Dry the residue (sand) in the filter paper. Evaporate the filtrate to recover the salt crystals by heating it in an evaporating dish (see diagram).