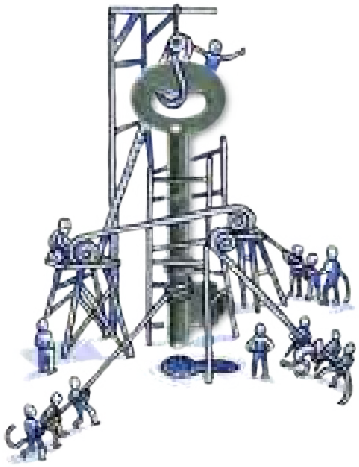
2 Separating mixtures



KEY QUESTIONS:

- How can we explain the term 'mixture'?
- What types of materials can be mixed?
- What methods can be used to separate a mixture into its original components?
- Which factors are important when choosing a method for separating a mixture into its components?
- Which materials can be recycled?
- Who is responsible for the disposal of waste materials?
- What are the negative consequences of poor waste management?

2.1 Mixtures

NEW WORDS

- mixture
- suspension
- opaque
- solution
- clear

What does it mean to *mix* something? Can you mime an explanation (that means you have to explain without saying a single word!)

Is it possible to mix water? Discuss this with your class.

One substance alone cannot be a mixture. A **mixture** is made up of two or more different substances.

A mixture can contain solids, liquids and/or gases. The components in a mixture are not chemically joined; they are just mixed. That means we do not need to use chemical reactions to separate them. Mixtures can be separated using physical methods alone and that is what this chapter is all about: how to separate mixtures.

There are many different kinds of mixtures. Before we learn how to separate them, it is worth looking at all the different kinds of mixtures briefly.

Different kinds of mixtures

A mixture of a solid and a solid

Soil is a mixture of different components.

Can you think of an example of a mixture of a solid and a solid? Soil is an example of a mixture of solids. What are the substances found in soil?

_____

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A mixture of a solid and a liquid

NEW WORDS
- emulsion
- abundant
- condense
- alloy
- pigment

What happens when clay or sand is mixed with water? Would you be able to see through a mixture of clay and water?

Can you see the difference between an opaque suspension of sand and clay in water (on the left) and a clear solution of sugar in water on the right?

The mixture of clay or sand with water is muddy. The small clay particles become suspended in the water. This kind of mixture is called a **suspension**. Suspensions are **opaque**; that means they are cloudy and we cannot see through them very well. What happens when sugar is mixed with water? Does the mixture become muddy? Why not? The sugar dissolves in the water and the mixture is called a **solution**. Solutions are **clear**; that means we can see through them.

A mixture of a solid and a gas

The black smoke from a burning building.

Have you ever seen smoke from a fire? What is the smoke made of? Do you think it is a mixture?

A mixture of a liquid and a liquid

Milk is not a single substance, but actually a mixture of two liquids! The one liquid component in milk is water, and the other is fatty oil. The reason milk is opaque is that tiny droplets of the oil is suspended in the water. Can you remember what a mixture is called when a solid is suspended in liquid?

When some liquids are suspended in liquid, we call the mixture an **emulsion**. Like suspensions, emulsions tend to be opaque.

A clear, transparent solution on the left and an opaque emulsion on the right

Are all liquid-liquid mixtures emulsions? (One way to recognise an emulsion is that it is opaque). Are all liquid-liquid mixtures opaque? Can you think of a liquid-liquid mixture that is not an emulsion? Discuss this with your class and give an answer below.

A mixture of vinegar and water is clear, and that is a clue that the mixture is a **solution**.

Solutions are special kinds of mixtures in which the particles are *so well mixed* that they are not separated from each other. We cannot make out separate substances anymore - everything looks the same when we look with the naked eye.

A mixture of a gas and a gas

We learnt in Gr. 6 Matter and Materials that the particles of gases are far apart. This means that gases can mix very easily, because it is easy for their particles to move in amongst each other. The air we breathe is not a single gas but actually a mixture of gases! Do you know what the two most **abundant** components are?

A mixture of a liquid and a gas

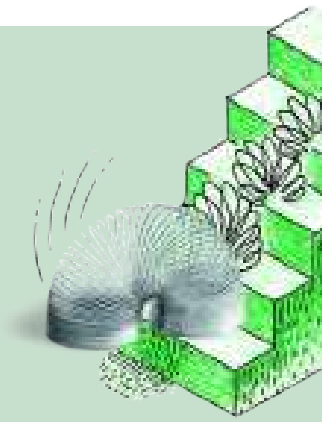
Do you remember that we discussed boiling in the previous chapter (Properties of Materials)? What happens to a liquid when it boils?

Can you see the water vapour in the picture of a boiling kettle? Point to it with your finger. Discuss this with your teacher and classmates and when you have agreed on an answer, draw an arrow onto the picture to indicate the water vapour.

Can we see most gases? Why do you think so?

Clouds and fog or mist are all examples of tiny water droplets suspended in air.

We have learnt that mixtures can be made of substances in the same state or in different states. The following activity will help us apply our new knowledge about mixtures to more examples.



ACTIVITY: Types of mixtures

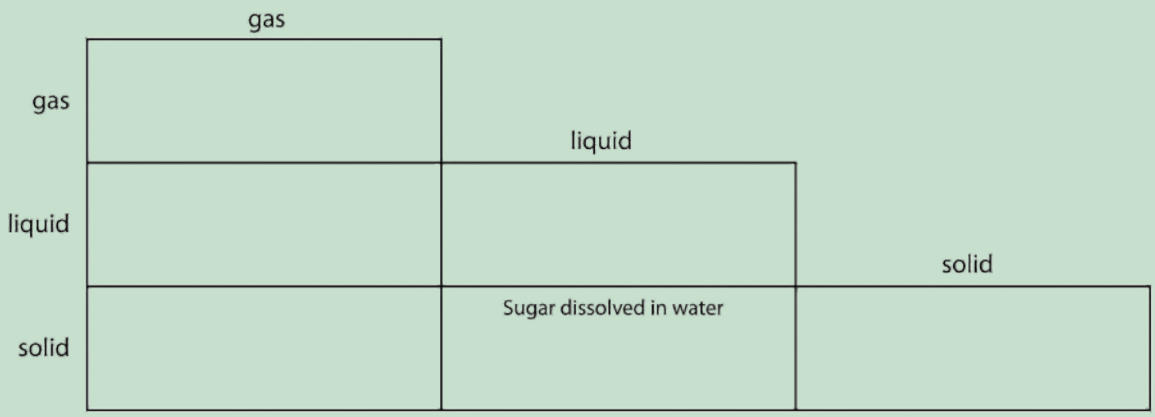
INSTRUCTIONS:

1. Look at the list of mixtures. Discuss in your group, or with your partner, what each mixture consists of.
2. Identify the type of substances (solid, liquid or gas) that are mixed in each of the examples on the list.
3. Write the name of each example in the appropriate block on the diagram.

Mixtures:

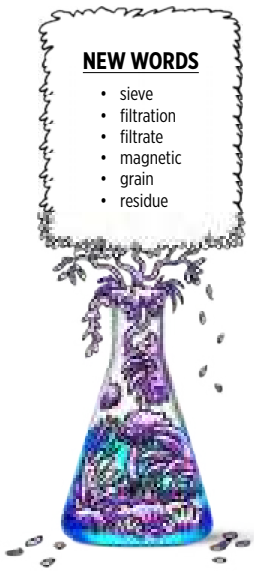
- air
- smoke
- hair oil (emulsion of oil and water)
- clear fruit juice (eg. apple juice)
- cloudy apple juice
- salty water
- **alloys** such as brass (used for coins) and stainless steel (used for rust-resistant metal items)
- foam plastic (like the material used for making mattresses and pillows)
- spray deodorant
- air freshener (aerosol type)
- paint
- dust cloud
- soil

For instance, sugar dissolved in water would go in the middle block of the bottom row, to show that it is a solid (sugar) mixed with a liquid (water).



Why do we make mixtures? Mixtures have many uses: perhaps we are mixing ingredients to bake a cake, or mixing metals to make a really strong alloy.

A cake is a mixture of ingredients, including flour, eggs and milk.



Many things around us occur naturally as mixtures: salty sea water, moist air, soil, compost, rocks (mixture of minerals) to name a few. Many mixtures are man made, for instance; Coca Cola, paint, salad dressing and so forth.

Mixtures are very useful. However, sometimes we need to separate mixtures into their components. Remember that the substances in a mixture have not combined chemically. They have not turned into new substances, but are still the same substances as before - they have just been physically combined. That is why we can use physical methods to separate them again.

2.2 Methods of physical separation

Now that we know about the different kinds of mixtures that are possible, we are going to learn about some ways of separating them.

How do we separate mixtures?

Suppose you were given a basket of apples and oranges. How would you sort them? You would probably pick out all the oranges from the apples by hand. The same method may not be suitable for all mixtures. You would probably not consider sorting sugar and sand **grains** by hand. Why not?

_____

Let us look at some of the most commonly used methods of physical separation.

Hand sorting

A mixture of different coloured beads.

How would you separate the mixture of beads in the adjacent picture into the different colours?

_____

_____

_____

ACTIVITY: Thinking about hand sorting

1. Would hand sorting also be a practical way to sort out the mixture of rice and lentil beans in the picture below?

A mixture of rice and lentils

2. Would hand sorting be a practical way to sort the pebbles out of a large pile of sand?

3. Besides what we discussed in the chapter, think of at least three other examples of mixtures that could be hand sorted.

4. When is hand sorting a good method for separating the components in a mixture?

Sieving

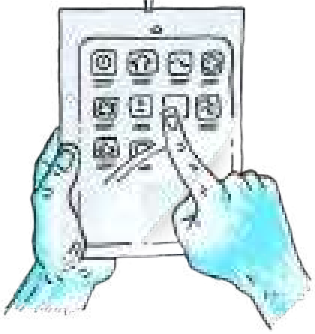
Can you think of a practical way to sort stones or pebbles from sand? Do you think picking the pebbles out by hand would work?

How would you separate the pebbles from the sand in this pile?

When we have large quantities of materials to sort and the different particles have different sizes, we can **sieve** the mixture. The smaller particles will fall through the openings in the sieve, while the larger particles stay behind.

TAKE NOTE

The clear liquid that has passed through the filter paper is called the **filtrate** and the particles that are left behind on the filter paper is called the **residue**



Filtration

Muddy water is poured through a funnel lined with filter paper to remove the small sand and clay particles.

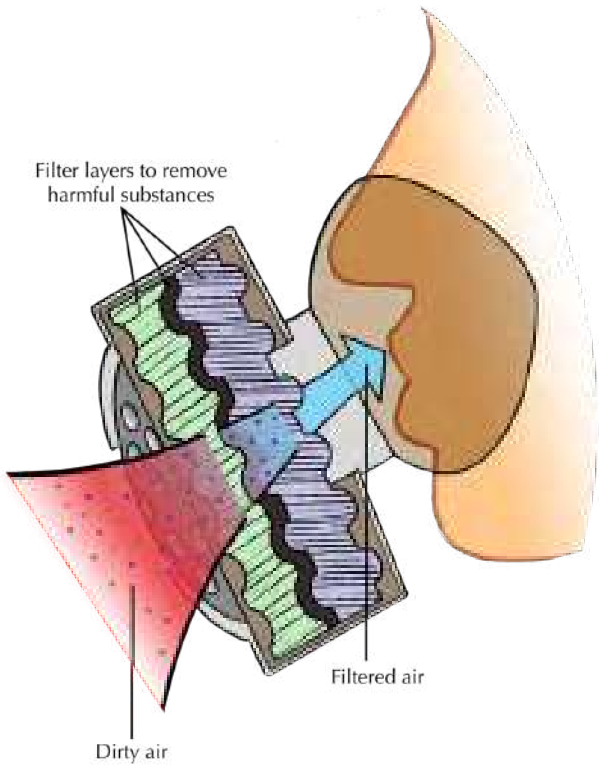
When the particles in a mixture are too small to be caught by a sieve and when the components of the mixture are in different states, we can separate them by **filtration** using a filter.

What type of mixture is the muddy water in the glass an example of?

A firefighter wears a mask to filter out the smoke.

Have you ever noticed how, when people have to work in dusty or smoky environments, they wear dust masks or smoke masks? Why do you think that is necessary?

The following diagram shows how a gas mask works. Layers of very fine filters trap harmful substances and dust or smoke particles, so that only clean air is let through.



A smoke mask consists of filter layers which clean the dirty air before it is breathed into the body.

ACTIVITY: Thinking about sieving and filtering

1. Besides what we discussed in the chapter, think of at least three other mixtures that could be sieved, and write them in the space below.

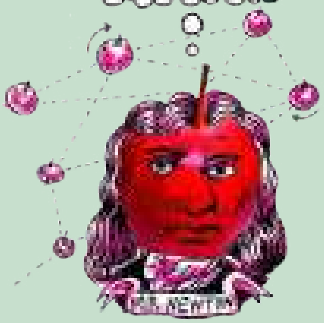
2. When is sieving a good method for separating the components in a mixture?

3. Nowadays most people use tea bags to make tea, but there was a time when people brewed tea from leaves and then poured the tea through a sieve into the cup. Why do you think they did this?

Tea leaves and bits have collected in the sieve after pouring the tea into the cup.

DID YOU KNOW?

In ancient cultures, grain and chaff was separated by a process called winnowing. They would throw the mixture into the air and the wind would blow away the lighter chaff, but not the heavier grain.



4. Sometimes the particles that we want to remove from a mixture are so small that they will pass easily through a sieve (think of the example of the muddy water from before). Can you think of a way to overcome this?

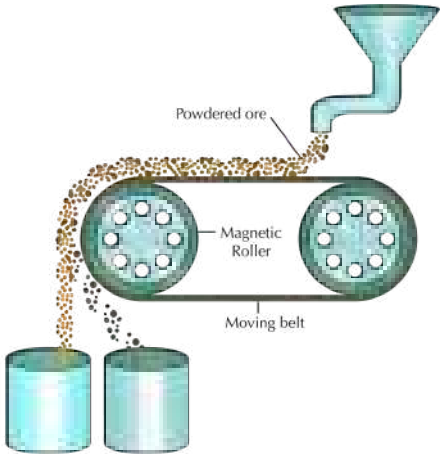
5. Besides what we discussed in the chapter, think of at least three other mixtures that could be filtered, and list them below.

6. When is filtering a good method for separating the components in a mixture?

Can you remember the activity from Gr. 6 when Tom used magnetism to separate different kinds of metals at his uncle's junk yard? The **magnetic** properties of the metals allowed them to be separated in this way.

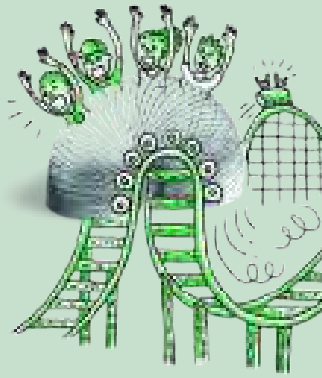
Magnetic separation

The following diagram shows how magnetic separation can be used to separate a mixture of components. In the example, mineral ore that contains two compounds (one magnetic, and the other non-magnetic) is being separated. The ore grains are fed onto a revolving belt. The roller on the end of the belt is magnetic. This means that all the magnetic grains in the ore will stick to the belt when it goes around the roller, while the non-magnetic grains will fall off the end. As soon as the magnetic grains move past the magnetic roller, they will also fall down.



In the above diagram, what colour are the non-magnetic grains and into which container do they fall? Label this on the diagram. What colour are the magnetic grains and which container do they fall into?

ACTIVITY: Thinking about magnetic separation



1. Besides what we discussed in the chapter, can you think of two other mixtures that could be separated magnetically? Write them in the space provided.

2. When is magnetic separation suitable for separating the components in a mixture?

How can we separate the components in a solution? Let's find out.

Separating solutions

The substances in a solution are mixed on the level of individual particles. In a sugar and water solution, the sugar particles and the water particles are mixed so well that we could not distinguish them with the naked eye. You might think that mixtures that are so 'well-mixed' are impossible to separate! But as we shall soon see, this is not true.

NEW WORDS

- evaporation
- condensation
- distillation
- still
- chromatography
- chromatogram
- solute
- solvent

Separation by evaporation

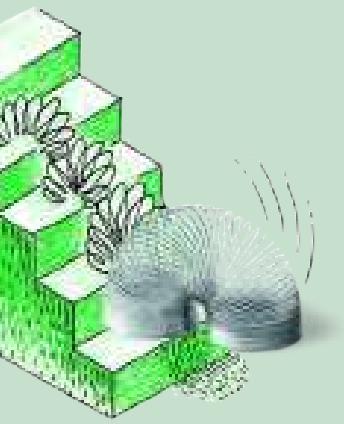
Do you know where most of the salt that we use in South Africa comes from? South Africa gets it salt from inland salt pans, coastal salt pans and seawater. A salt pan is a shallow dam in the ground where salt water **evaporates** to leave a layer of dry salt.

An aerial view of salt pans.

Salt pans in India. A man is busy collecting the dried salt to be packaged and sold.

When sea water is allowed to stand in shallow pans, the water gets heated by sunlight and slowly turns into water vapour, through evaporation. Once the water has evaporated completely, the solid salt is left behind.

Do you think this is a good method for separating salt from water? Do you think it would work for a sugar and water solution?



ACTIVITY: What if we want to keep both the water and the salt?

QUESTIONS:

1. Do you think separation by evaporation would be a good method to separate a salt-water-solution if you wanted to keep both the salt and the water? Why do you say so?

2. Can you think of a way to modify the method so that the water that evaporates is not lost? Perhaps the following diagram will help you to formulate a plan. Write an explanation.

3. What is happening in the kettle?

4. Can you say what change in state is happening inside the kettle? What is the process called?

5. What change of state is occurring on the cold surface of the metal plate? What is the process called? (Hint: the change of state from gas to liquid was covered in the previous chapter, under *Physical properties of materials*.)

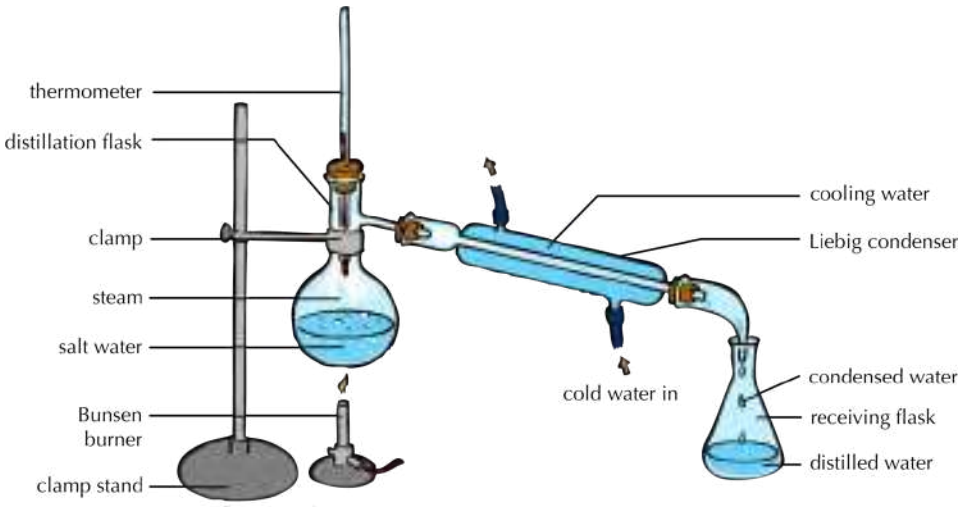
6. Does the salt evaporate with the water? How would you find out?

7. What can you tell about the purity of the water after it has evaporated and condensed?

The water that is lost through evaporation can be **condensed** on a cold surface. The cold metal plate will do the job, but it would be difficult to recover all the condensed water, because it will be dripping off the surface of the plate in many different places. Scientists have a solution for that problem: they use a special technique to separate mixtures like these without losing any of the components. The technique is called **distillation**.

Distillation

Distillation is the separation of one substance from another by evaporation followed by condensation. The apparatus used in this technique is called a **still**.



Experimental setup for distillation

Suppose we want to separate the water and salt in seawater. We would place the seawater in the round flask on the left of the picture (in the distillation flask). We would then boil the seawater to produce water vapour, or steam. The salt would not evaporate with the water, because only the water evaporates. The water vapour rises through the top of the flask and passes into the Liebig condenser.

Two Liebig condensers which are used in the distillation process

The Liebig condenser consists of a glass tube within a larger glass tube. The condenser is designed in such a way that cold water can flow through the space between the tubes. This cools the surface of the inner tube. The water vapour condenses against this cold surface and flows into the receiving flask. Since the salt has not evaporated, it stays behind in the distillation flask.

Distillation is also the best way to separate two liquids that have different boiling points, like water and ethanol for example. Let us have a look.

ACTIVITY: How can we separate two liquids with different boiling points?

QUESTIONS:

1. Can you remember the temperature at which water boils? Write it down below.

_____

2. What is this temperature called?

_____

3. Ethanol boils at a temperature lower than the boiling point of water, namely 78°C. Suppose you mix some water and some ethanol. The mixture is at room temperature to begin with. Now suppose you start heating the mixture. What temperature would be reached first: 78°C or 100°C?

_____

4. What do you think will happen when the mixture reaches a temperature of 78°C? Do you think the ethanol will start to boil?

_____

5. Will the water boil at the same time?

_____

DID YOU KNOW?

Crude oil is separated into different components using distillation. The components are evaporated, starting with lighter fuel (which has the lowest boiling point), then jet fuel, then petroleum, then motor car oil, until only tar is left. We call the separated components fractions, and the process, fractional distillation.

We can use the same distillation method that we used for separating seawater, to separate the two liquids. The principle is exactly the same, except that we will distill the mixture more than once. Here is how it works:

The mixture of the two liquids is placed in the distillation flask and heated to the lowest boiling point. In the case of an ethanol/water mixture, that temperature would be the boiling point of ethanol, namely 78°C. All of the liquid with that boiling point will evaporate, condense in the Liebig condenser, and pass into the receiving flask. The liquid with the higher boiling point will remain in the distillation flask. Suppose it contains a third substance that we want to separate. How would you do this?

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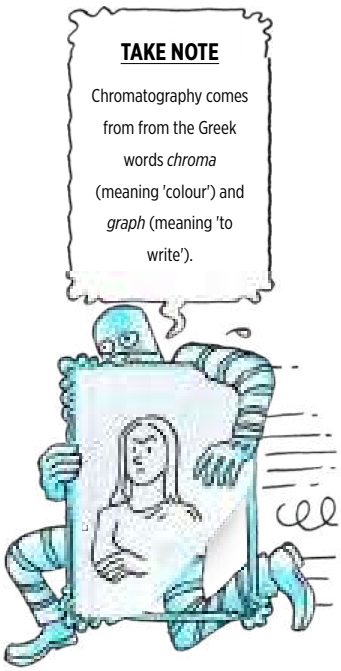
There is one more separation technique for us to explore. Have you noticed how ink on paper will sometimes 'run' when it gets wet?

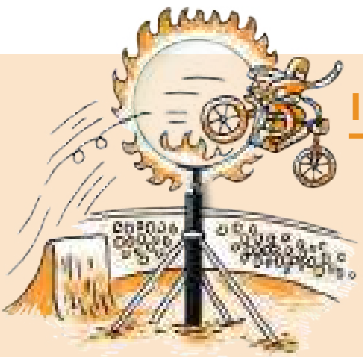
Can you see how the ink on this sign has run after being wet, probably by the rain?



Most inks are a mixture of different pigments, blended to give them just the right colour. A **pigment** is a chemical that gives colour to materials. When a mixture contains colourful compounds, it is often possible to separate the different components using a separating method called chromatography. Let's have a look at this next.

Chromatography

Chromatography is a method for separating coloured substances into individual pigments. We are going to explore this in the next investigation.



INVESTIGATION: Is black ink really black?

AIM: To separate the pigment components in ink using different liquids.

HYPOTHESIS:

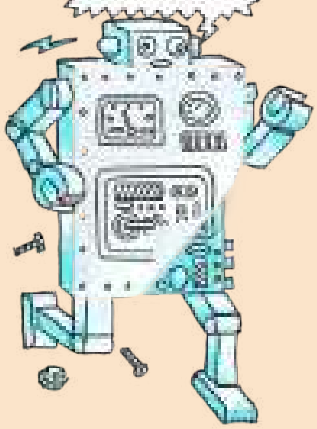
What do you propose the answer to our investigative question is? This is your hypothesis.

MATERIALS AND APPARATUS:

- absorbent paper cut into strips approximately 3 cm wide and 12 cm long
- clear drinking glass or beaker
- assorted black pens and markers
- tap water
- pencil
- paper clip or clothes peg
- filter paper
- dropper
- variety of liquid solvents (ammonia, surgical spirits, methylated spirits, and nail polish remover)

TAKE NOTE

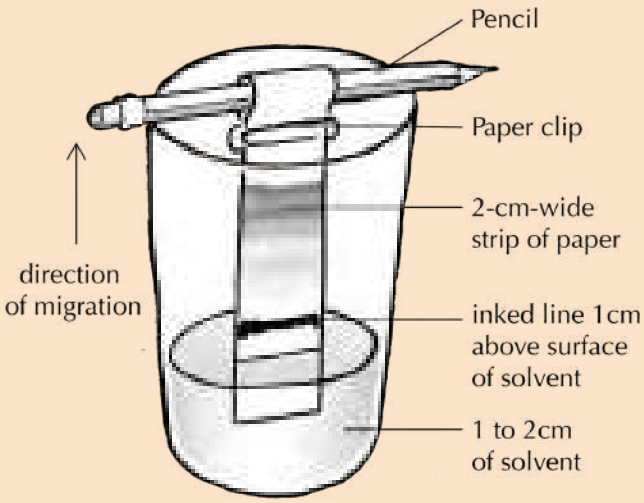
A **solvent** is a substance that dissolves a **solute**, resulting in a solution. A solvent is usually a liquid, but can also be a solid or a gas.



METHOD:

To make a strip chromatogram

1. Use a black pen or marker to draw a line across one end of the paper strip, 2 cm from the end.
2. Pour tap water into the beaker to a depth of approximately 1 cm.
3. Wrap the unmarked end of the paper strip around the pencil and secure it in place with a paper clip.
4. Before putting it into the glass, adjust the strip of paper so that the height of the inked line is approximately 1 cm above the surface of the liquid by holding it against the outside of the beaker.
5. Lower the strip into the glass and rest the pencil across the top of the glass as shown in the diagram. The end of the strip should be in the water, but the inked line should be above the surface of the water.
6. Allow the liquid to soak up into the paper, rising through the inked line.



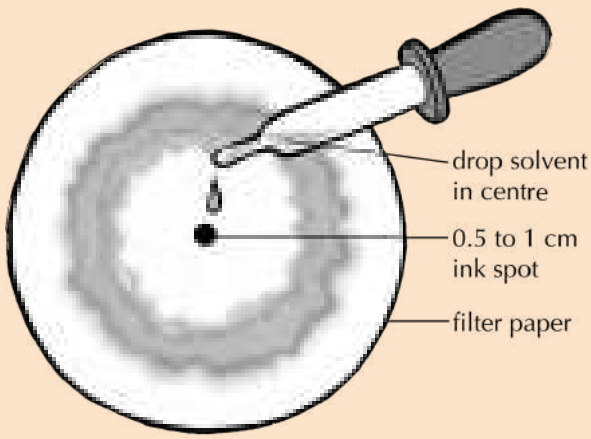
VISIT

Pen colour science.
bit.ly/13Py29D

7. When the migrating pigments approach the top of the strip, near the paper clip, remove the paper strip and allow it to dry on a flat, non-porous surface.
8. Make a similar strip chromatogram for each of the black pens you have collected.
9. Compare the chromatograms. Are they the same or are they different?
10. When you have finished comparing your chromatogram with those of the rest of the class, you can either stick your chromatogram in the following space, or draw a picture of it in the space.

To make a circular chromatogram

1. Lay a large round piece of filter paper on a smooth non-absorbent surface, like the surface of your desk, for instance.
2. Use one of the coloured pens to make a 0.5 to 1 cm ink spot in the centre of the disk.
3. Lay the paper disk flat over the top of a beaker.
4. Place a drop of water in the centre of the ink spot.
5. Add another drop of water every minute or so to make the chromatogram spread toward the edges of the paper disk.



6. Repeat the experiment with one of the other solvents (ammonia, alcohol or nail polish remover).

OBSERVATIONS:

1. Do the two chromatograms look the same or different? If they look different, and you have used the same pen, why do you think that is?

2. Which colour pigments were you able to observe?

3. Draw pictures of your chromatograms in the space below.

CONCLUSION:

1. What can you conclude about the pigments that make up black ink?

_____

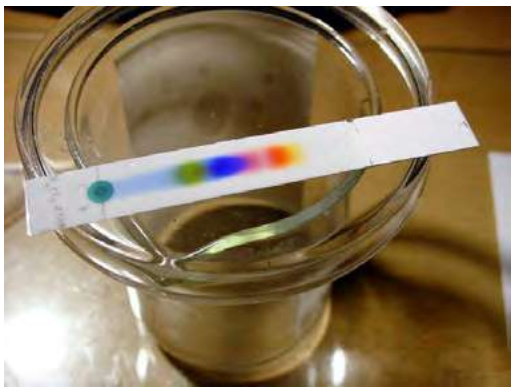
_____

A closer look at how this works:

In paper chromatography, liquid is drawn through the paper fibers. But, why do the pigments in the ink separate into bands of different colours?

The pigments in the ink are carried along by the liquid, but because they are different compounds, they get carried upward at different speeds. This causes them to appear as bands of different colours on the chromatogram.

Look at the picture of the chromatogram on the following page.



An example of a strip chromatogram

1. Which colour pigment is moving up the paper at the fastest speed? Why do you say so?

2. Which colour pigment is moving up the paper at the slowest speed?

Why are the different pigments carried at different speeds?

Pigments migrate at different speeds because of differences in their properties: large pigment particles tend to move more slowly. Furthermore, particles that dissolve well in the liquid will tend to stay in the liquid and be carried to the top quickly, while particles that bind well to the paper will tend to move more slowly.

Now that we have learnt about some of the different ways in which mixtures can be separated, we are going to apply what we know to separate a mixture made of many components.

ACTIVITY: Separating a complex mixture

Imagine you are a member of a team of scientists working together in a laboratory. Your team has been given an important job. You have been given a beaker that contains a mixture of substances to separate.

The mixture contains the following components:

- sand
- iron filings
- salt
- ethanol
- water

Your job is to design a procedure for separating the mixture into its individual components. How would you do that? Your procedure should be summarised in the form of a flow chart.

Before you start, imagine what the mixture would look like. Draw a picture of the a clear container and the different contents in the mixture in the space.

To help you design your procedure, here are a few guiding questions and a template for your flow chart:

1. What is the physical state (solid, liquid or gas) of each of the components in the mixture? Fill these into the table.

Component (substance)	State (solid liquid or gas)	Dissolved or undissolved?

2. Name the solids that will not dissolve in the mixture. These are the undissolved solids.

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3. Name the dissolved solids in the mixture.

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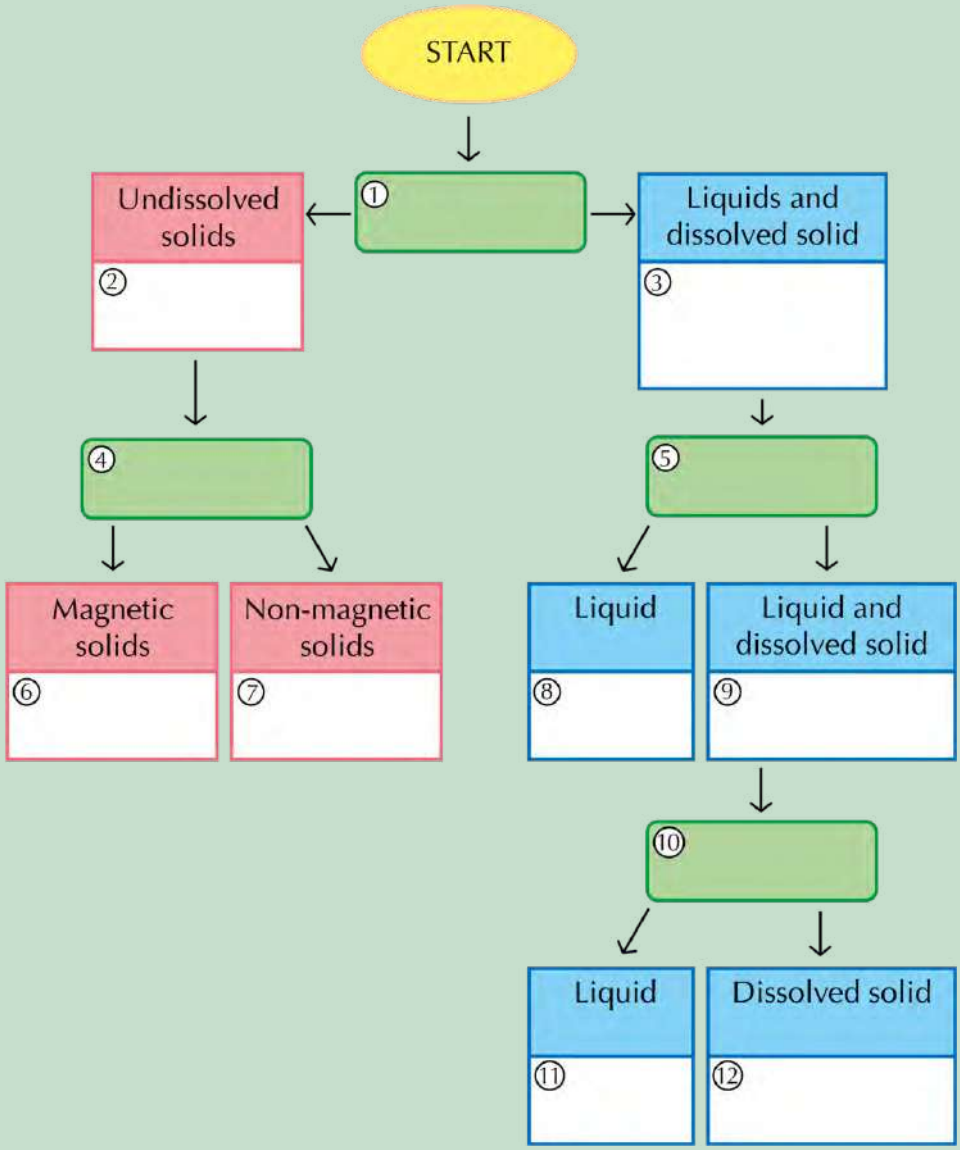
4. What would be the best method for separating the undissolved solids from the liquids in the mixture? Write the name of this method in the block numbered 1 of the flowchart below.
5. Write the names of the undissolved solids in block 2 of the flowchart.
6. What remains after the undissolved solids have been removed from the mixture? Write the names of these compounds in block 3.
7. How could we separate the undissolved solids? (Hint: look at the flow chart for some ideas.) Write the name of this process in block 4.
8. Write the names of the two undissolved solids in blocks 6 and 7.

9. How could we separate the liquids from the dissolved solid? We could evaporate them, but then they would be lost. What other option is available if we want to separate the components in a solution? Write the name of this process in block 5.
10. Which liquid would be distilled first? (Hint: which liquid has the lowest boiling point?) Write the name of this liquid in block 8.
11. What remains in the solution when the first liquid is removed? Write the names of these components in block 9.
12. How can we separate the liquid from the dissolved solid? (Hint: this process is the same as the one in block 7.) Write the name of the process in block 10.
13. Write the names of the final two components in blocks 11 and 12.

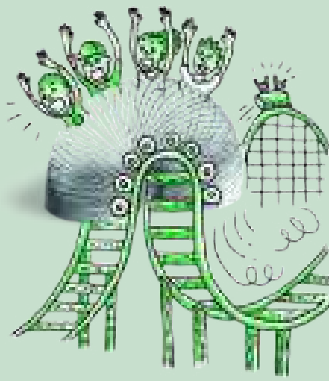


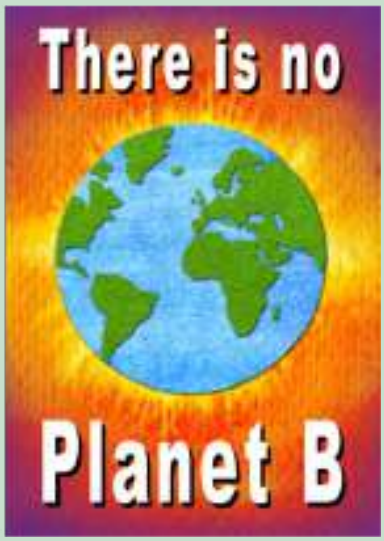
So far, we have been discussing materials, their properties, how to mix them and how to separate them if they are mixed. The final section of this chapter deals with waste materials and what we can do to reduce their impact on the environment.

2.3 Sorting and recycling materials

Over time, some of our things get old and break and we need to throw them away. When we buy food or other items, the packaging used for wrapping these items is also thrown away. But what does 'away' mean? Does it mean these waste items just disappear? Where do you think our rubbish goes once we 'throw it away'?

ACTIVITY: What happens when we throw things away?





INSTRUCTIONS:

1. Work in groups of 3 to 4.
2. In your group, spend 5 minutes discussing the posters and what you think they mean.

QUESTIONS:

1. Write a paragraph to explain the messages on the posters. What do you think they mean?

2. Do you think it is possible to stop throwing things away altogether?

3. Can you suggest ways to reduce the amount of trash that is thrown away in your home?

How is household waste managed by local authorities?

In some suburbs, recycling is actively encouraged and special transparent recycling bags are provided for this purpose. Do you have recycling in your community? Is the recyclable waste collected from your home or do you have to drop it off at a container or a depot? Did you know that some people even make money selling recyclable waste that they collect?

Do you know which materials from household waste can be recycled? What are the four main categories?

Have you seen colourful bins similar to these around your school or in shopping areas? They are for recycling.

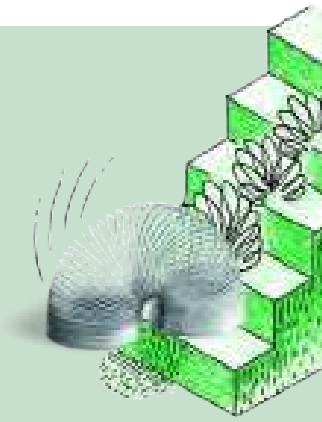
If you ever need to dispose of objects, like batteries and fluorescent light bulbs that contain harmful substances, be sure to use the correct recycling bin.

Careers in chemistry

Do you know what chemists do? Let's discover the possibilities of chemistry!

Chemists study various chemical elements and compounds, their properties and how they react with each other. We will learn about elements and compounds in the next chapter. Chemists are also responsible for developing new materials with specific properties; such as new medicines; innovative materials for building buildings and other structures; materials that could be used for making fuels from renewable sources and many others.

If you study chemistry after you have finished school, you can work as a researcher, a laboratory technician, a science teacher and many other important and stimulating jobs! Be curious and discover the possibilities! Science can help us solve problems in the world around us.



ACTIVITY: Careers research task

INSTRUCTIONS:

1. Below is a list of different careers that all use chemistry in some way. Have a look through the list and then select one that you find most interesting.
2. Do an internet search to find out the career involves.
3. Write a short description of this career. Find out what level of chemistry you will need for this particular career.
4. There are many other careers besides the ones listed here which use chemistry in some way, so if you know of something else which is not listed here and it interests you, follow your curiosity and discover the possibilities!

Some careers involving chemistry:

- Chemical education/teaching
- Chemistry researcher
- Environmental chemistry
- Mining industry
- Oil and petroleum industry
- Pharmaceuticals and drug discovery
- Space exploration
- Waste management

VISIT

A useful site to find out more about some chemistry-related careers.

bit.ly/19cXkqe

Your descriptions of the career you are interested in:

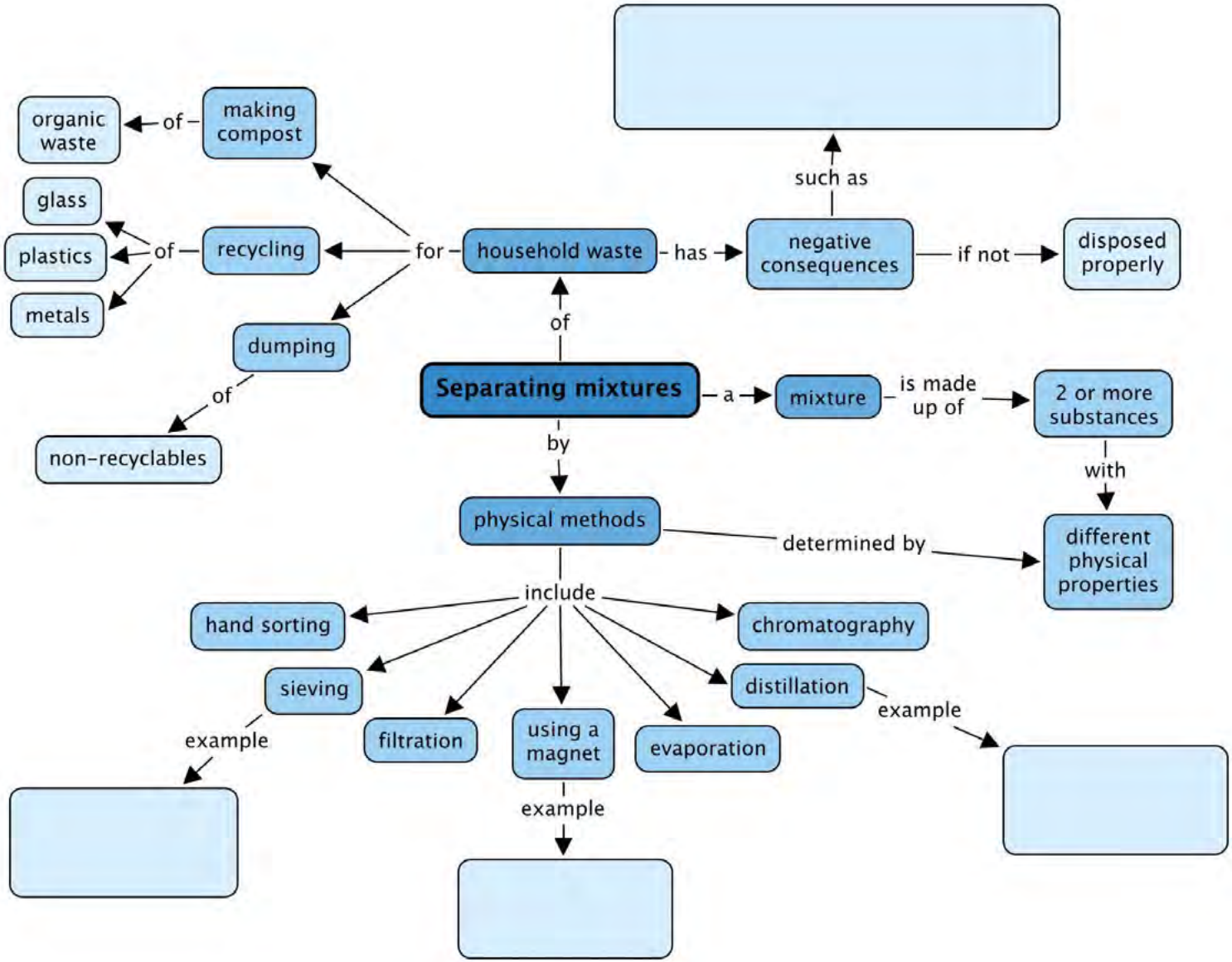
SUMMARY:

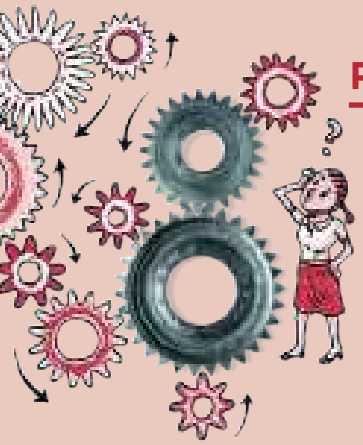
Key Concepts

- A mixture consists of two or more components that have different physical properties.
- The components in a mixture are not chemically joined; they do not change their chemical identities and they retain their physical properties as well.
- When we want to separate a mixture, we can use the differences in the physical properties of the components of the mixture to separate the components from each other.
- Hand sorting is a suitable separation method for a mixture that contains a relatively small number of large items.
- Sieving is a suitable separation method when the pieces to be separated are sized differently.
- Filtration is a good method for separating an undissolved solid from a liquid.
- Components with different magnetic properties can be separated using magnetic separation.
- Evaporation is a suitable separation method for removing a liquid from a solid.
- Distillation is a suitable method for separating two liquids with different boiling points.
- Chromatography is a good method for separating coloured pigments from each other.
- Waste disposal should be managed in a responsible way so that the negative impact on the environment is as small as possible.
- Metals, plastics, paper and glass can be recycled.
- Organic waste can be turned into compost.
- Responsible waste disposal is everyone's responsibility, but it is usually managed by the local authorities, who have systems for sorting and recycling waste.
- Poor waste management leads to negative consequences for humans, animals and the environment. Some of these are:
  - pollution of the soil, water resources and the environment;
  - health hazards and the spread of disease;
  - blockage of sewers and drainage systems;
  - land wasted when it is used to dump or bury garbage (landfills); and
  - materials and other resources wasted when they could have been recycled.

Concept Map

We looked at physical methods to separate mixtures and these are shown in the concept map. Give an example of the types of mixtures you could separate using three of these methods. What negative consequences does human waste have on the environment? Fill these in the concept map.

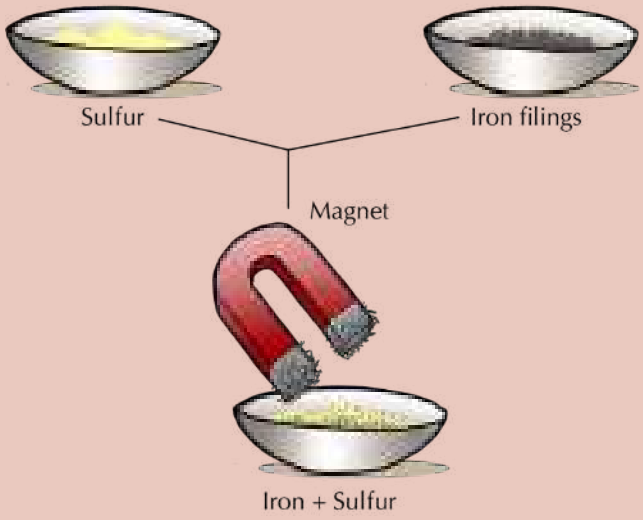

Separating mixtures
by
physical methods
include
hand sorting
sieving
example
filtration
using a magnet
example
evaporation
distillation
example
chromatography
determined by
different physical properties
of
household waste
for
making compost
of
organic waste
recycling
of
glass
plastics
metals
dumping
of
non-recyclables
has
negative consequences
such as
if not
disposed properly
a
mixture
is made up of
2 or more substances
with



REVISION:

1. Two important words have been left out of the following paragraph. The missing words are **chemical** and **physical**. Rewrite the sentences and fill in the missing words in the paragraph by placing each one in the correct position:
   The components in a mixture have not undergone any _____ changes. They still have the same properties they had before they were mixed. That is why mixtures can be separated using _____ methods. [1 mark]

2. In the diagram below, iron filings and sulfur have been mixed. Write a short paragraph (2 sentences) to explain how the mixture can be separated using magnetic separation. [2 marks]

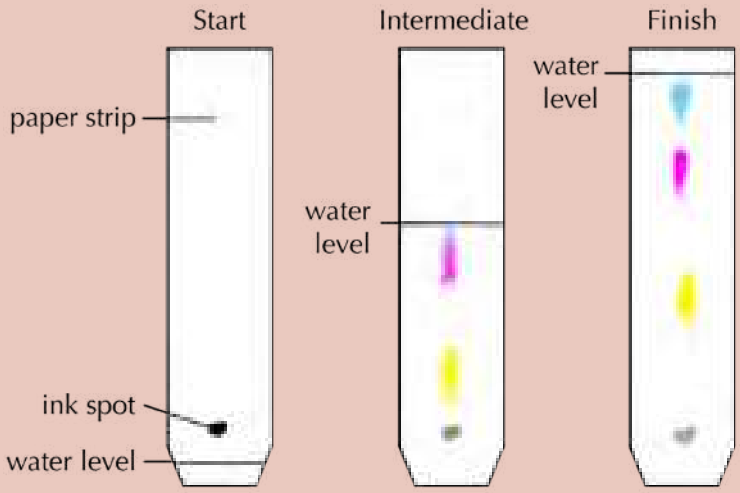


3. A vacuum cleaner creates a suspension of dust in air as it sucks up the dust on the floor. Clean air comes out of the vacuum cleaner. How does the vacuum cleaner separate the dust from the air? [2 marks]

4. Write a short paragraph (3 sentences) to explain how salt is produced from seawater. [3 marks]

5. Choose the correct word to complete the sentence from the following list: colours; boiling points, tastes. Write the word below.
Suppose we want to separate two liquids using distillation as separation method. This will only be possible if the two liquids have different... [1 mark]

6. The diagram below shows a strip chromatogram that is being prepared from a spot of black ink. The strip on the left shows the chromatogram at the start of the experiment, the strip in the middle shows the chromatogram halfway through the experiment, and the strip on the right shows the chromatogram at the end of the experiment.



a) How many different pigments does the black ink consist of? Explain your answer. [1 mark]

b) Which pigment is moving up the paper at the fastest speed? Arrange the pigments in order of increasing speed of movement. [2 marks]

7. The table below contains a list of mixtures. In the right hand column, next to each mixture, write the **best** method for separating the mixture into its components. [8 marks]

Mixture	**Separation method**
Salt and water	
Sand and iron filings	
Sand and water	
Colour pigments in ink	
Stones and sand	
Ethanol and water	
Oranges and apples	
Sugar and iron filings	

8. Name the 4 classes of materials that can be recycled. [4 marks]

_____

_____

_____

_____

9. Write a sentence to say how you would dispose of each of the following non-recyclable materials: vegetable peels; old running shoes; expired medicine. [3 marks]

_____

_____

_____

_____

TOTAL: 27 marks

Are these just cogs? Be curious! What else could they be?