Chapter 2: Mixtures

2.1 Mixtures are a combination of two or more substances

Student book answers (pages 30–31)

Check your learning 2.1

Remember and understand

1 What is a pure substance?

A pure substance is not combined with anything else.

Apply and analyse

2 Identify the following as pure or a mixture:

a cup of tea

A cup of tea is a mixture.

b soft drink

A soft drink is a mixture.

c table salt

Table salt is pure.

d soap

Soap is a mixture.

e olive oil

Olive oil is pure.

3 For any that you think are not pure, write down what substances you think they may contain.

A cup of tea is a mixture of water and dissolved chemicals from the tea; it may also contain milk and sugar.

A soft drink is a mixture containing sugars, flavours, water and dissolved gases.

Soap is a mixture of fats and oils.

Evaluate and create

4 In which mixture(s) would you find sediment?

Sediment is found in a suspension.

5 Complete the table below for mixtures.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type of mixture | Substances involved | Appearance when light shines through | Separates on standing? | Example |
| Suspension | Solid + liquid | Cloudy | Yes, slowly | Milo in milk, juice with pulp included, muddy water |
| Emulsion | Two or more liquids as a colloid | Cloudy | Sometimes – particularly if an emulsifier is not present | Salad dressing, milk, mayonnaise, soap, lotion |
| Colloid | Solid in a liquid, but can also involve only liquids, only gases or even a solid suspended in a gas | Cloudy | No | Hair gel, paint, butter, fog |
| Solution | Solid and liquid | Clear | No | Seawater, cordial, tea |

2.2 A solution is a solute dissolved in a solvent

Student book answers (pages 32–33)

Check your learning 2.2

Remember and understand

1 If someone asked for a dilute glass of cordial, would you add a lot of cordial or only a little?

A small amount of cordial would be added to a lot of water.

2 How could you increase the amount of a solute that will dissolve in a solvent?

To increase the amount of solute that will dissolve in a solvent, warm it or stir it.

3 Scientifically, how do you describe a solution that will not allow any more solute to dissolve?

A saturated solution is a mixture where the solvent is no longer able to dissolve any more of the solute.

4 True or false: you can see the particles of a solute in a solution.

False. The dissolved particles in a solution are too small to be seen.

Apply and analyse

5 Do all solutes dissolve in water? Explain your answer.

No. Water is a good solvent but not the only one. Some paints, for example, will not dissolve in water but will dissolve in turpentine.

6 What happens to the sugar particles when they dissolve in water?

The sugar particles separate from each other and become evenly spread through the liquid.

Evaluate and create

7 Are the particles in a suspension, colloid or emulsion soluble? Explain.

The particles in a suspension, colloid and emulsion are not soluble because the bonds between the molecules of both components of the mixtures are not broken and will stay together if they can.

2.3 Mixtures can be separated according to their properties

Student book answers (pages 34–35)

Check your learning 2.3

Remember and understand

1 What do the following words mean?

a sediment

A sediment is the substance that settles to the bottom in a mixture.

b flocculation

Flocculation is the process of adding a chemical (the flocculant) to a mixture causing the suspended particles to clump together.

c decant

To decant a mixture involves carefully pouring the liquid away, leaving the sediment behind.

d density

Density is a property of a material that relates its mass to its volume. The particles in a more dense object are packed together more tightly than in a less dense object.

2 What property differs between tin cans and aluminium cans?

‘Tin’ cans contain steel, which is magnetic, but aluminium is not. (Note ‘tin’ cans are not really made of tin these days; the term refers to ‘tinned’ steel, which is a steel can with a coating or plating of tin.)

Apply and analyse

3 Why does flotation allow oil spills to be cleaned up more easily?

Oil floats on water, enabling oil spills to be cleaned up by scooping the oil off the surface of the water.

4 If a suspension doesn’t separate, what can be done to cause sedimentation?

Sedimentation can be achieved by adding a flocculant to the suspension. This allows the suspended particles to clump together. This then makes the particles heavy enough to settle to the bottom.

5 In what situation might you rely on people to separate a mixture by hand?

Student answers will vary, but should make note that few materials are usually separated by hand and usually only if the amount of substance is very small. Situations could include cooking, panning for gold etc.

Evaluate and create

6 What are the limitations for using magnetism to separate a mixture?

Only magnetic materials will be attracted to a magnet during magnetic separation. Magnetic materials include iron (or steel), nickel and cobalt. Please note that aluminium is not magnetic.

2.4 Mixtures can be separated according to their size and mass

Student book answers (pages 36–37)

Check your learning 2.4

Remember and understand

1 What filters are used around your home and school? What substances do these filters allow to pass through them and what substances do they collect?

Student responses will vary but may include: a coffee filter allows water to pass through and the coffee to be collected; the filter within a vacuum cleaner allows air to pass through but collects the dust; a pasta colander or strainer allows the water to pass through and the pasta to be collected.

2 For each of the following pairs, write a sentence explaining the difference between them:

a mixture – pure substance

In a pure substance all the particles are the same, whereas a mixture contains two or more pure substances mixed together.

b sedimentation – flotation

Sedimentation separates mixtures by allowing insoluble substances to settle to the bottom, whereas flotation separates mixtures by allowing the insoluble substances to float to the top.

c residue – filtrate

In the process of filtering, the filtrate is what passes through the filter and the residue is left behind in the filter.

3 Complete the sentences below by filling in the missing words.

sieve, solid, liquid, filter, filter, residue, filtrate

Apply and analyse

4 Why would a forensic scientist who was investigating a crime want to compare a mixture of different types of sand found in a suspect’s car to a similar mixture found at the crime scene?

The sand found in the car of the suspect may look similar, but may not match the sand found at the crime scene when analysed more thoroughly.

Evaluate and create

5 Is a butterfly net an example of a filter? Explain.

A butterfly net could be likened to a filter because the holes within the net allow air to pass through but collect the butterflies.

6 List two places where centrifuges are used.

Student answers will vary. Typically, centrifuges are commonly used in medical laboratories to separate blood and in research laboratories to isolate DNA or other samples. Dairy farms can centrifuge milk to obtain the whey or casein for other products.

2.5 The boiling point of liquids can be used to separate mixtures

Student book answers (pages 38–39)

Check your learning 2.5

Remember and understand

1 Explain the difference between evaporation and crystallisation.

Evaporation is when a liquid is removed from dissolved solids by heating. Crystallisation is when a solid forms, often as small crystals.

Apply and analyse

2 Give an example of a mixture you would separate using evaporation and crystallisation. Explain why distillation may not be appropriate.

Evaporation and crystallisation would be used instead of distillation in instances where the vapour that has evaporated from the mixture is not needed (e.g. when thickening a sauce or drying out food).

3 What separation technique is being conducted in Figure 2.27?

Evaporation and crystallisation.

Evaluate and create

4 Draw the equipment set-up that could be used to produce pure water from sea water by distillation.

Student answers will vary. Typically a diagram similar to Figure 2.26 on page 39 with sea water

2.6 Solubility can be used to separate mixtures

Student book answers (pages 40–41)

Check your learning 2.6

Remember and understand

1 What was used to make the first inks?

The early Greeks used a mixture of soot and vegetable gum for writing. The Chinese made red ink from mercury sulfate and black ink from iron sulfur mixed with sumac tree sap.

2 How does chromatography separate inks and dyes?

Chromatography separates inks and dyes because different colours will flow at different rates over the chromatography paper.

3 When is chromatography used to separate substances?

Chromatography is used to separate very similar substances that have many similar physical properties and cannot be separated with other methods.

4 What is the solvent used in the chromatography for drugs at the airport?

A gas is used as the solvent in chromatography at the airport.

5 What does solubility mean?

Solubility means how easily a substance dissolves in a solvent.

Apply and analyse

6 Some people think they can disguise drugs at airports by putting them in a strong smelling substance such as coffee beans. Explain why this will not work with airport security.

Student answers will vary; typically, airport security uses sniffer dogs with a highly developed sense of smell far beyond that of humans. The suspect coffee would be separated from the drugs by chromatography.

2.7 Science as a human endeavour: Waste water is a mixture that can be separated

Student book answers (pages 42–43)

Extend your understanding 2.7

1 Water use is often an indication of the amount of waste water produced per person every year. A graph of the annual water consumption per person is shown in Figure 2.36.

a Which city uses the highest amount of water per person each year?

Brisbane

b Which city uses the lowest amount of water per person each year?

Gold Coast

c How much water does the average person in Canberra use?

160 kL

d Can you suggest why a person living in Brisbane uses more water than a person living in Melbourne?

Brisbane has a warmer climate for more of the year than Melbourne, so the population of Brisbane might consume more water than the population of Melbourne.

2 Describe what type of objects might be removed during the primary treatment of waste water.

Primary treatment of waste water removes any large products and any suspended particles that are forced to clump together and are removed as sludge.

3 How can an algal bloom damage a river?

An algal bloom can cause other aquatic life to starve.

4 What is the purpose of the tertiary treatment of waste water?

Tertiary treatment of waste water kills any bacteria and removes any final products. Chlorine can also be added and acts to purify the water for the last time.

5 Draw a cartoon that shows one stage of the treatment process. Join your cartoon with those from others in your class who drew the other two stages, so that combined you show all levels of the water treatment process.

Student answers will vary.

Review 2

Student book answers (pages 44–45)

Remember and understand

1 Examine Figure 2.37 and identify the suspension, the solution and the colloid.

a solution

b suspension

c colloid

2 What is the major difference between evaporation and distillation?

Evaporation allows the vapour to escape. Distillation collects and condenses the vapour into a liquid.

3

a Which separation technique is used to separate the parts of blood?

Centrifuging is used to separate the parts of blood.

b Which physical property is being used to separate this mixture?

The different components of blood differ in their mass and density. The heaviest or most dense end up at the bottom.

4 Give an example of a mixture that could be separated into its parts by filtration.

Student answers will vary but may include muddy water or dusty air.

5 What safety recommendations would you give to someone using evaporation and crystallisation?

Student answers will vary but may include safety procedures for using a Bunsen burner; wearing appropriate safety clothing; turning off the heating equipment before the solution has fully evaporated, otherwise the crystals may start to spit; scald warnings for water vapour and steam; to let all heating equipment cool before packing up etc.

6 Imagine dropping salt in sawdust. How would you separate the parts of this mixture?

Add water to the mixture to dissolve the salt, filter out the sawdust and then separate the water and salt with evaporation and crystallisation. If the water is required as well, use distillation.

7 A criminal buries an aluminium drink can containing DNA evidence in the sand. Could the aluminium can be separated from the sand using a magnet? Explain your answer.

No, aluminium is not magnetic. It could be separated from the sand though by filtration using a large sieve.

Apply and analyse

8 Nail polish remover and paint stripper are both useful solvents.

a What is a solvent?

A solvent is the substance that the solute is dissolved in.

b Identify the solute for each solvent.

In nail polish remover, the solute is the nail polish. In paint stripper, the solute is the paint.

9 Daniel was measuring the solubility of two chemicals (A and B) in water. He placed a spatula full of each substance in a separate test tube of water. Figure 2.38 shows what he saw.

Use the words **dissolve, solvent, solute** and **suspension** to explain what has happened in each test tube.

Solute B is dissolved completely in the water and forms the clear blue solution on the right. Solute A is not dissolved by the solvent water and forms the cloudy red suspension on the left.

10 Imagine you have just bought a large factory. Due to flood damage it is filled with tonnes of matchsticks mixed with tonnes of iron scraps.

a How would you separate this mixture?

Magnetic separation could be used to remove the iron scraps from the matchsticks.

b What equipment would you need to make this happen on such a large scale?

Student answers will vary; typically, to work on such a large scale an electromagnet and a conveyor belt would be needed to separate the iron scraps and matchsticks. The mixture could be moved along the conveyor belt and caused to fall off the end of the belt. At the end of the belt, an electromagnet could be used to attract the iron scraps into one container while the matchsticks simply fall into a separate container.

Evaluate and create

11 Look at the chromatograms in Figure 2.39, taken from blue pens belonging to suspects (A–D). Compare these with the one taken from the original forged cheque (X). Decide whether any of the suspects is likely to be the culprit.

The most similar chromatogram is that of suspect D.

12 A particular coloured dye is being created for Fashion Week.

a Look at the chromatogram of the dye mixture in Figure 2.40. How many pure dyes were mixed to create the colour?

Four different dyes were used to make the final colour.

b Explain how chromatography could help create an exact copy of the dye for a rival manufacturer.

A rival manufacturer would be able to create an exact copy of the dye by observing the chromatogram of the dye and modifying their own colours until they match the pattern and distances travelled by the sample dye.

13 Do you think that performance-enhancing drugs are spoiling the image of sports? Pair up with a partner and make a list of all the implications of athletes using these drugs to compete.

Student answers will vary.

14 Which techniques, and in what order, would you use to separate a mixture of iron filings, sand, marbles and salt? Present your answer as a flow chart.

The flowchart should follow the sequence below:

• Separate the marbles by picking them out by hand or pass the mixture through a sieve

• Separate the iron filings with a magnet

• Place the sand and salt in water

• Decant or filter the sand out of the mixture

• Heat the salt solution to evaporate the water and crystallise the salt

15 People sometimes need to enter environments containing poisonous gases. In these situations, they will wear a gas mask. Use the Internet or other research tool to find out how gas masks interact with poisonous gases and how they change the air before it is inhaled by the person wearing the mask.

Student answers will vary.