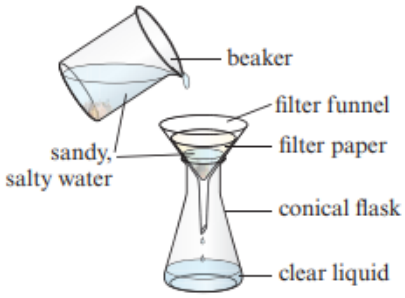
Topic 5.4 Using the properties of materials to separate mixtures

Exercise 5.4 Separating mixtures

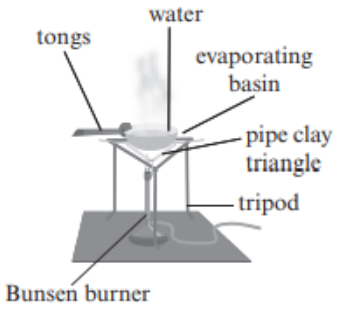
1 Safety glasses, filter funnel, filter paper, conical flask, evaporating basin, pipe clay triangle, tripod, Bunsen burner.

2 Diagram should be drawn using a pencil and ruler and be labelled with filter paper, filter funnel, conical flask, beaker, clear liquid, sandy, salty water.



3 Zara should take care with the wet filter paper as it can tear easily. If it tears, the contents of the beaker will flow into the conical flask.

4 Diagram should be drawn with a pencil and ruler. All items should be labelled.



5 Zara must wear safety glasses and take care when heating the evaporating basin as the contents may spit. Zara should use tongs to move the hot evaporating basin if it is not possible to leave the apparatus in place to cool. If a Bunsen burner isn't available, an alternative suitable heating arrangement such as a hot plate or spirit burner could be used.

6 Marcus could carefully pick up any large pieces of glass and sweep the rest of the mixture up with a dustpan and brush. To keep safe, he could wear thick gloves when he picks up the glass.

7 Marcus will use the different properties of the glass and copper sulfate to separate them: the glass will not dissolve in water, but the copper sulfate will. Marcus adds water to the mixture of glass and copper sulfate crystals and stirs it. The copper sulfate will dissolve, the glass will not. He should then filter the mixture. The pieces of glass will not pass through the filter paper. The solution of copper sulfate and water will pass through the filter paper. Marcus should be careful handling the small pieces of glass in the filter paper. He should wear gloves and dispose of it carefully.

8 Marcus should then put the solution of copper sulfate into an evaporating basin and heat it. The water will evaporate leaving the copper sulfate behind in the evaporating basin. He needs to be careful as the solution may spit as it starts to boil. If this happens he should turn the Bunsen burner off and leave the solution to evaporate fully. The property he uses to separate them is that water boils at 100 °C and changes state to form a gas, but the copper sulfate does not.

He may need to dissolve the crystals in distilled water to wash them if they are not clean and then reheat to remove the water (as above) and leave the crystals so that all the water evaporates off completely. This may take some time, but he could speed up the process by placing the evaporating basin in a warm oven.

Marcus should use tongs to move the hot evaporating basin if it is not possible to leave the apparatus in place to cool. If a Bunsen burner isn't available, an alternative suitable heating arrangement such as a hot plate or spirit burner could be used.

9 The condenser works to separate the water and food dye by using the different boiling points of the water and food dye.

Water boils at 100 °C and food dye does not. The mixture of water and food dye is placed in the flask and heated once the water is boiling. The water begins to evaporate leaving the food dye in the flask. The water vapour/steam passes out of the flask into the condenser where it is cooled by the flow of water in the outer tube. The steam/water vapour condenses back to liquid water, which is collected in the beaker. The food dye remains in the flask because it has a different boiling point from the water.

5.5 Acids and alkalis

Exercise 5.5 Acids and alkalis

1

Acid	Alkali
citric acid, corrosive, nitric acid, sour, lemon juice, cola, vinegar, sharp, harmful	sodium hydroxide, washing powder, harmful, corrosive, soap, washing soda

2

	
Corrosive	Flammable

3

Safety point	Reason
wearing safety glasses	To protect eyes from sparks and splashes.
standing up to work	If you spill anything it will not be in your lap.
placing bottle stoppers upside down on the bench	So that you do not get the chemical on the work surface or dirt into the bottle.
replacing the bottle stopper as soon as you have finished using the bottle	So that you are less likely to have a spill if you knock the bottle over and so that you do not mix up which stopper belongs on which bottle and you do not contaminate the chemicals.
working in an orderly way	So that you are less likely to have an accident, or mix up what you are doing and use the wrong chemical.

5.6 Indicators and the pH scale

Exercise 5.6A Finding mistakes in a table

Liquid	Colour with universal indicator solution	pH	
lemon juice	yellow	4	weakly ~~*alkaline*~~ *acid*
soap solution	blue/green	8	weakly alkaline
water	green	~~*5*~~ 7	neutral
hydrochloric acid	~~*blue*~~ *red*	2	strongly acid
sodium hydroxide	blue/purple	11	strongly alkaline

Exercise 5.6B Indicators

1 An indicator tells you if a substance is an acid or an alkali. Also credit any reference to pH and information about how acidic or alkaline a substance is, or if a substance is neutral.

2 Cut up some coloured plant material such as red cabbage or beetroot and place it in the mortar; crush it using the pestle; add some ethanol and crush it some more; remove some of the liquid using the pipette and place it in a test tube.

3 You could test your indicator solution by placing a little acid in a test tube and adding a few drops of the indicator. Record the colour. Then you could place a little alkali in another test tube and add a few drops of the indicator solution. Record the colour change. If your indicator works there will be different colours in the acid and the alkali.

4 If you try to use this type of indicator, you will not be able to see the colour change because the coffee or cola will stain it a darker colour, so

you will not be able to decide if it is an acid or an alkali.

Exercise 5.6C Indicators

1 pH1

2 Universal indicator is more useful than litmus because litmus only changes to red, blue or purple giving the indication acid, alkali or neutral. However, universal indicator has a range of colour changes, which enables us to determine the pH between 1 and 14.