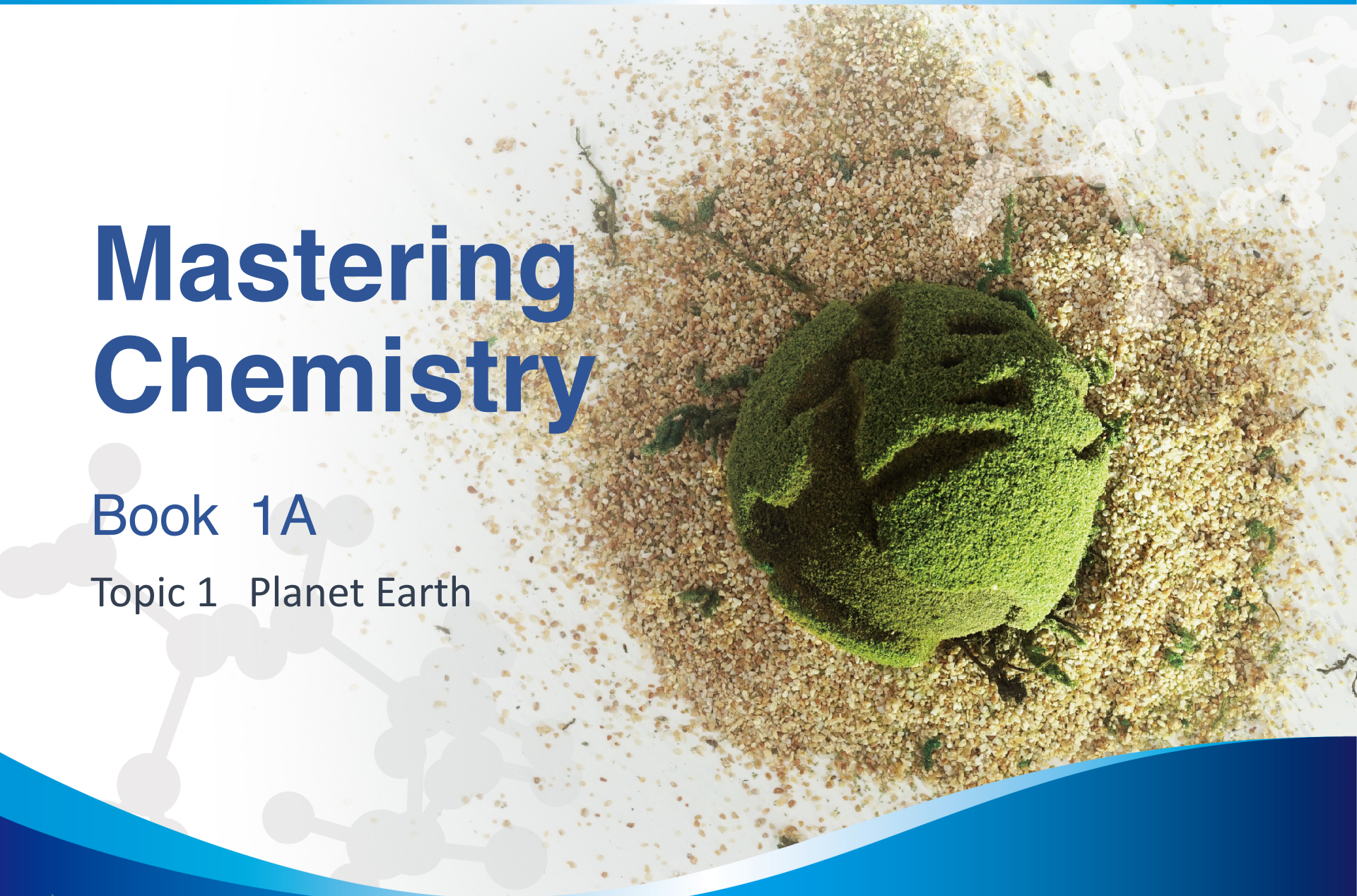
Mastering Chemistry

Book 1A

Topic 1 Planet Earth



Content

Content

3.1 Solutes and solvents (p. 44)

- The tea powder dissolved in water to form a mixture. Such a mixture is called a **solution (溶液)**. The tea powder was the **solute (溶質)** and water was the **solvent (溶劑)**.

This cup of tea was made by dissolving tea powder in water

3.1 Solutes and solvents (p. 44)

The substance that dissolves is called the solute.

A **solution** forms when one substance **dissolves** in another.

The substance that does the dissolving is called the solvent.

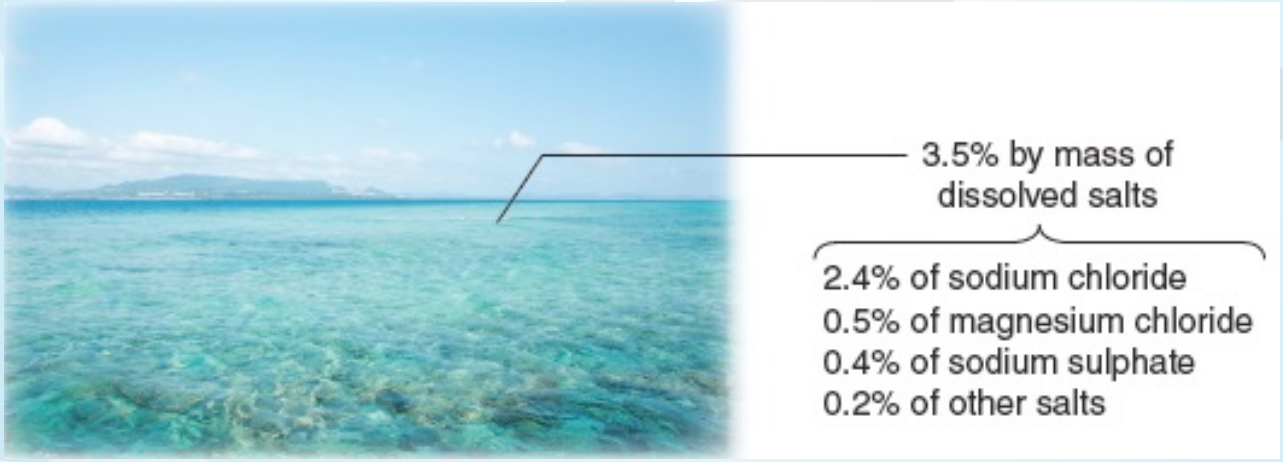
- Substances that dissolve in a solvent are said to be **soluble (可溶的)** in that solvent.
- Substances that do not dissolve in a solvent are **insoluble (不可溶的)** in that solvent.

3.1 Solutes and solvents (p. 45)

- A **dilute solution (稀溶液)** contains a small amount of solute in a given volume of solution.
- A **concentrated solution (濃溶液)** contains a large amount of solute in a given volume of solution.
- A **saturated solution (飽和溶液)** is a solution that has dissolved the most solute it can, at a given temperature.
- The **concentration (濃度)** of a solution is the amount of solute dissolved in a stated volume of solution.
  The units of concentration can be written as grams per cubic decimetre (g dm^{-3}). One cubic decimetre (dm^3) is equal to 1 000 cubic centimetres (cm^3).

3.2 Sea water – a solution of several salts (p. 45)

- Sea water is a solution of several salts, the main one is common salt — sodium chloride.
- Sea water covers over 70% of the surface area of the Earth. It contains 3.5% by mass of dissolved salts.



Sea water contains 3.5% by mass of dissolved salts

3.3 Obtaining common salt from sea water (p. 46)

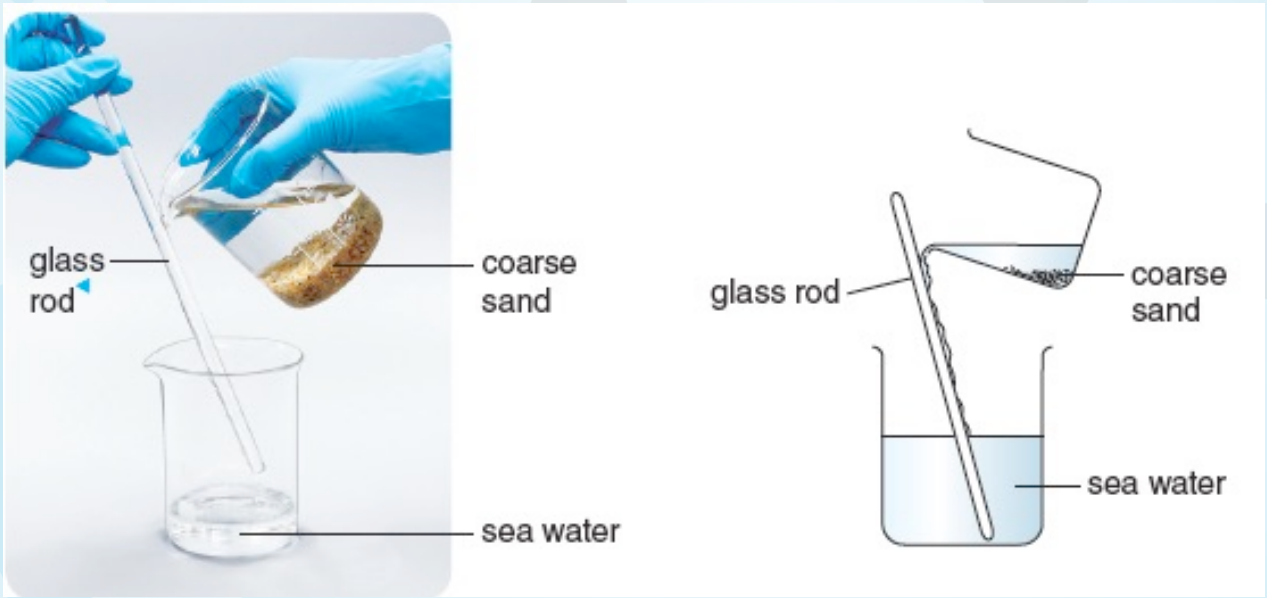
- Many mixtures contain useful substances mixed with unwanted materials. Chemists have developed many different separation methods to separate useful substances from the unwanted materials.

Decantation

- **Decantation (傾析)** is a quick method for separating a much denser insoluble solid from a liquid.
- The purpose may either be producing a clear liquid or removing unwanted liquid from the solid.

3.3 Obtaining common salt from sea water (p. 46)

- To separate sea water from coarse sand, allow the coarse sand to settle at the bottom of the container. Then carefully decant the sea water at the top into another container.



Separating sea water from coarse sand by decantation

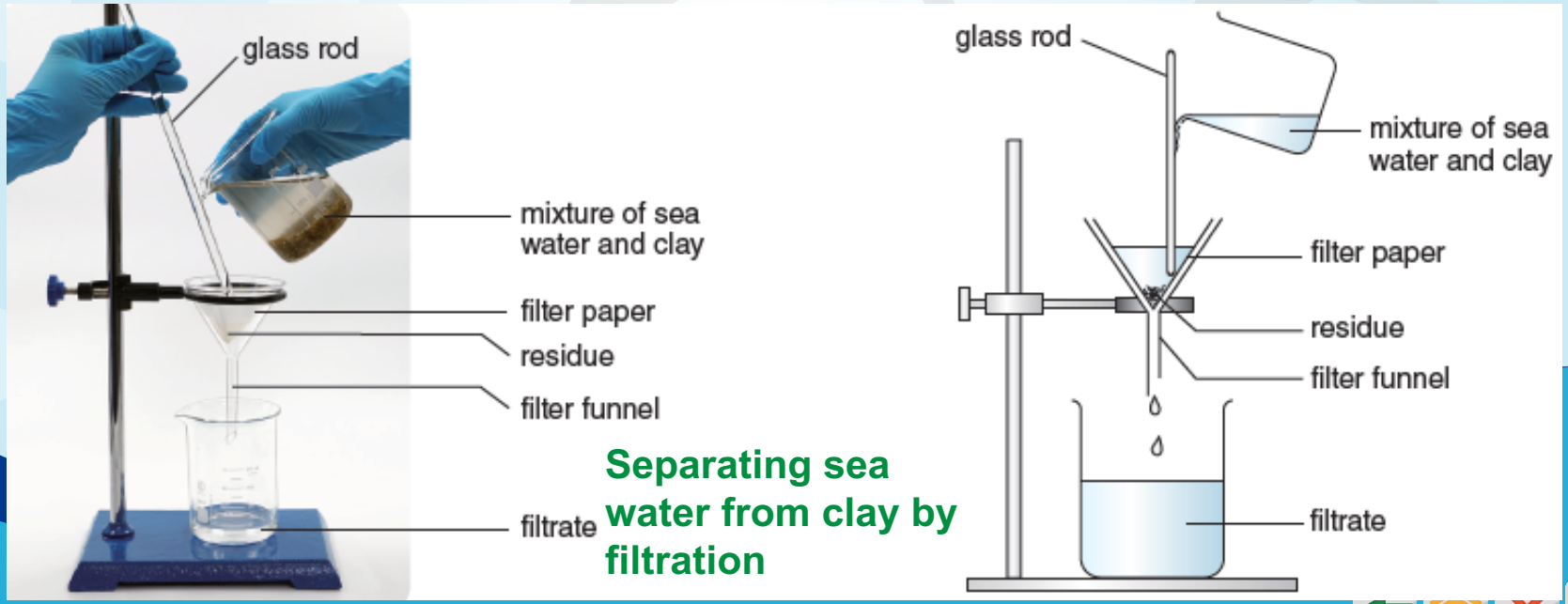
3.3 Obtaining common salt from sea water (p. 47)

Filtration

- We can also separate an insoluble solid from a liquid by **filtration (過濾)**.
- Filtration is a common technique to remove the clay.
- Filtration works because filter paper has tiny, microscopic holes.

3.3 Obtaining common salt from sea water (p. 47)

- A mixture of sea water and clay, particles of water and the dissolved salts are small enough to pass through the filter paper, but the larger particles of clay cannot.
- The clay stays behind on the filter paper as the **residue (殘餘物)** while the sea water passes through as the **filtrate (餾液)**.



Separating sea water from clay by filtration

3.3 Obtaining common salt from sea water (p. 48)

Evaporation

- **Evaporation (蒸發)** is the conversion of a liquid to vapour at any temperatures below the boiling point of the liquid.
- In some hot countries, sea water is led into shallow ponds. The water evaporates in the sun and leaves the common salt behind.

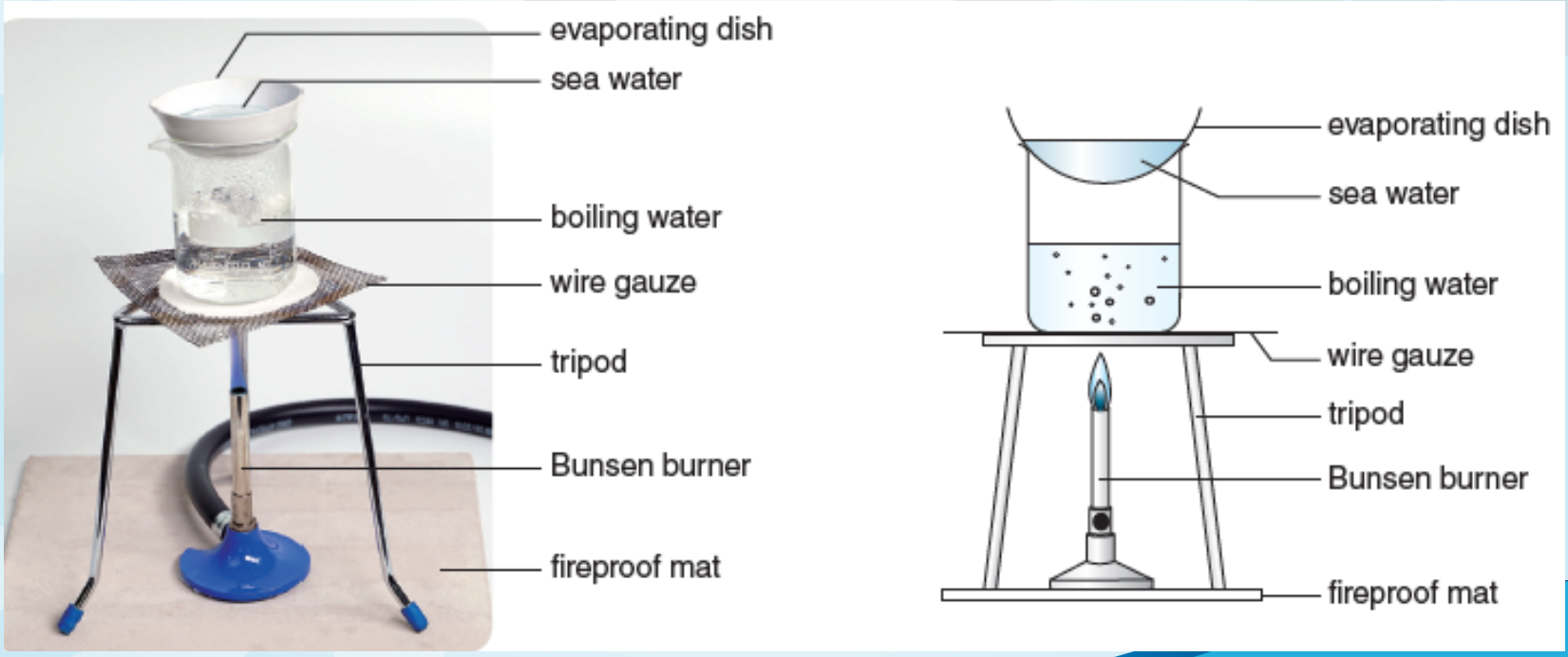
Salt can be obtained by evaporation of sea water

3.3 Obtaining common salt from sea water (p. 49)

Obtaining common salt from muddy sea water Ref.

Evaporation

- Common salt from sea water can be obtained in the laboratory using the experimental set-up below.



Obtaining common salt from sea water using a hot water bath

3.3 Obtaining common salt from sea water (p. 49)

Crystallisation

- **Crystallisation (結晶)** is the process of letting **crystals (晶體)** form from their solutions.

Sodium chloride crystals

- There are two common techniques of crystallisation.

3.3 Obtaining common salt from sea water (p. 50)

Crystallisation – by cooling a hot saturated solution

1 Heat the solution to evaporate some of the water. It becomes more concentrated.

2 Heat until the solution becomes saturated. Stop heating.

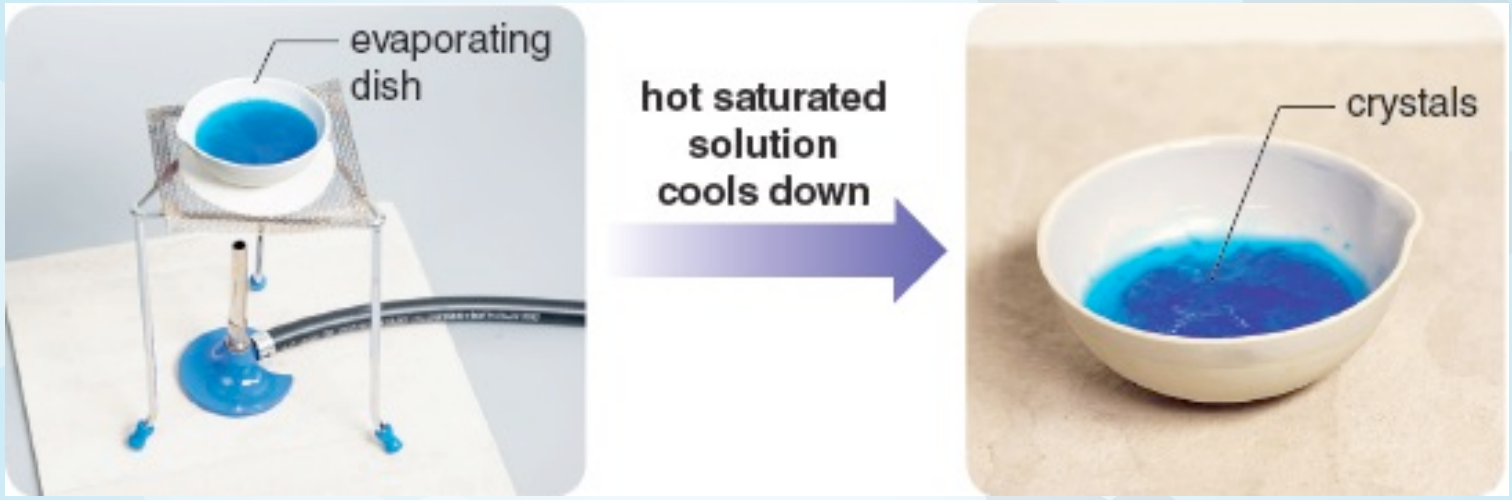
3 Leave the saturated solution to cool. Crystals start to form in it as the temperature falls.

4 Separate the crystals from the remaining solution by filtration.

Growing crystals *Ref.*

3.3 Obtaining common salt from sea water (p. 50)

Crystallisation – by cooling a hot saturated solution



Obtaining crystals by cooling a hot saturated solution

3.3 Obtaining common salt from sea water (p. 50)

Crystallisation – slow evaporation of a solution at room temperature

- We can also obtain crystals by evaporating a solution at room temperature.
- As the water evaporates, the remaining solution becomes more concentrated and finally becomes saturated.

A solution at room temperature

3.3 Obtaining common salt from sea water (p. 51)

Crystallisation – slow evaporation of a solution at room temperature

- The size of the crystals is related to the rate of evaporation of the water.
- If the water evaporates slowly, large crystals are formed. Rapid evaporation leads to the formation of much smaller crystals.

Crystals grow in solution

3.3 Obtaining common salt from sea water (p. 51)

Practice 3.1

For each of the following separations,
- suggest a separation method; and
- give the principle involved.

The first one has been done as an example.

Separation	Separation method	Principle involved
Ethanol from a mixture of ethanol and water	fractional distillation	Ethanol and water have a small difference in boiling points.
Sand from river water	filtration	Sand is insoluble in water.
Iodine from a solution of iodine in alcohol	evaporation	Alcohol has a lower boiling point than iodine.
Pure water from copper(II) sulphate solution	simple distillation	Water has a lower boiling point than copper(II) sulphate.
Nitrogen from liquefied air	fractional distillation	The components in air have different boiling points.

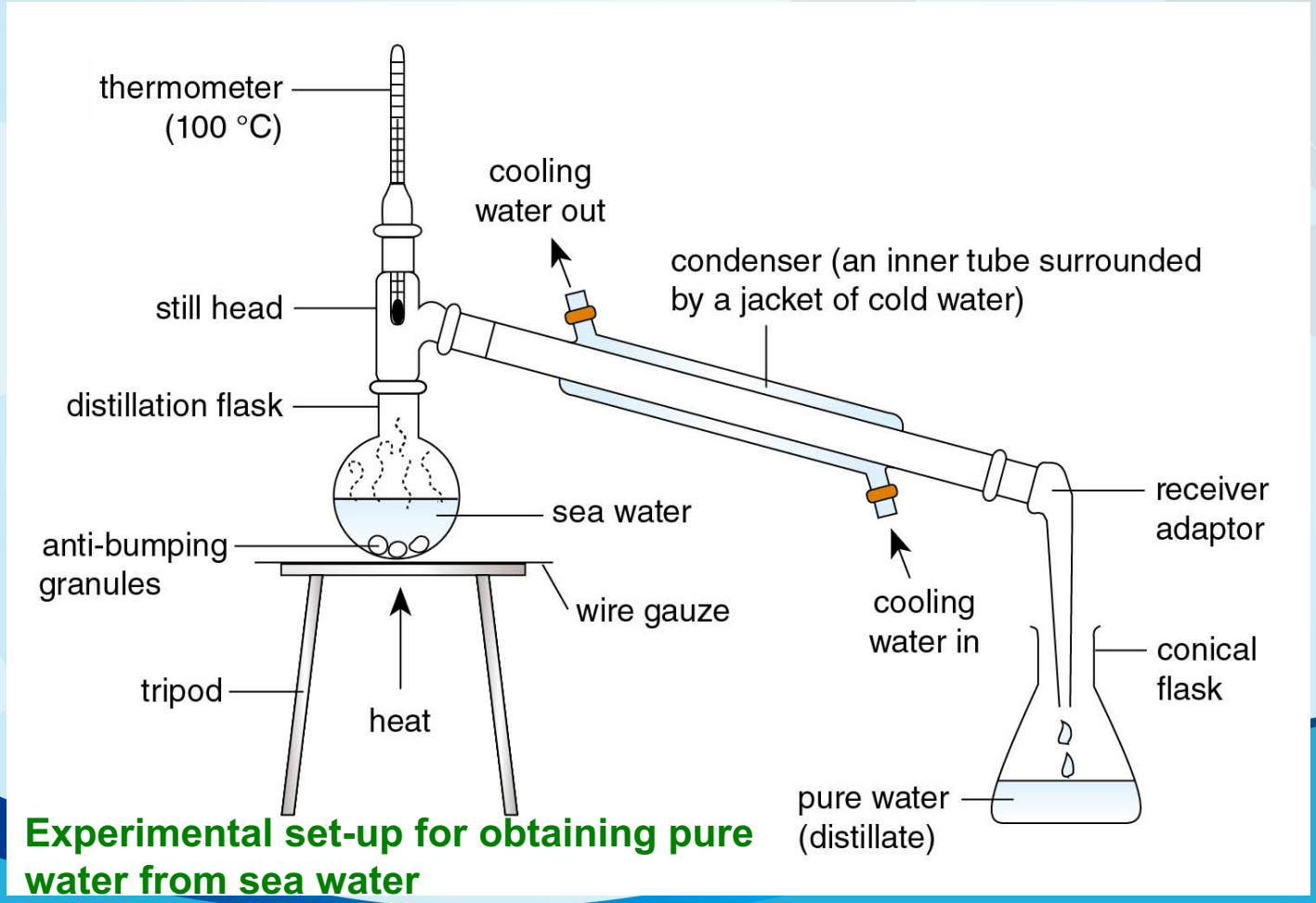
3.4 Obtaining pure water from sea water (p. 51)

- Separating a solvent from a solution can be carried out by **simple distillation (簡單蒸餾)**.
- This method relies on the solvent having a much lower boiling point than that of the solute.

Obtaining pure water from sea water *Ref.*

3.4 Obtaining pure water from sea water (p. 51)

- An experimental set-up for simple distillation.



Experimental set-up for obtaining pure water from sea water

3.4 Obtaining pure water from sea water (p. 52)

1 Heat the sea water in the distillation flask until it boils. Only the water turns into steam, leaving the non-volatile salts behind.

2 The steam travels along the inner tube of the water-cooled **condenser (冷凝器)** and condenses.

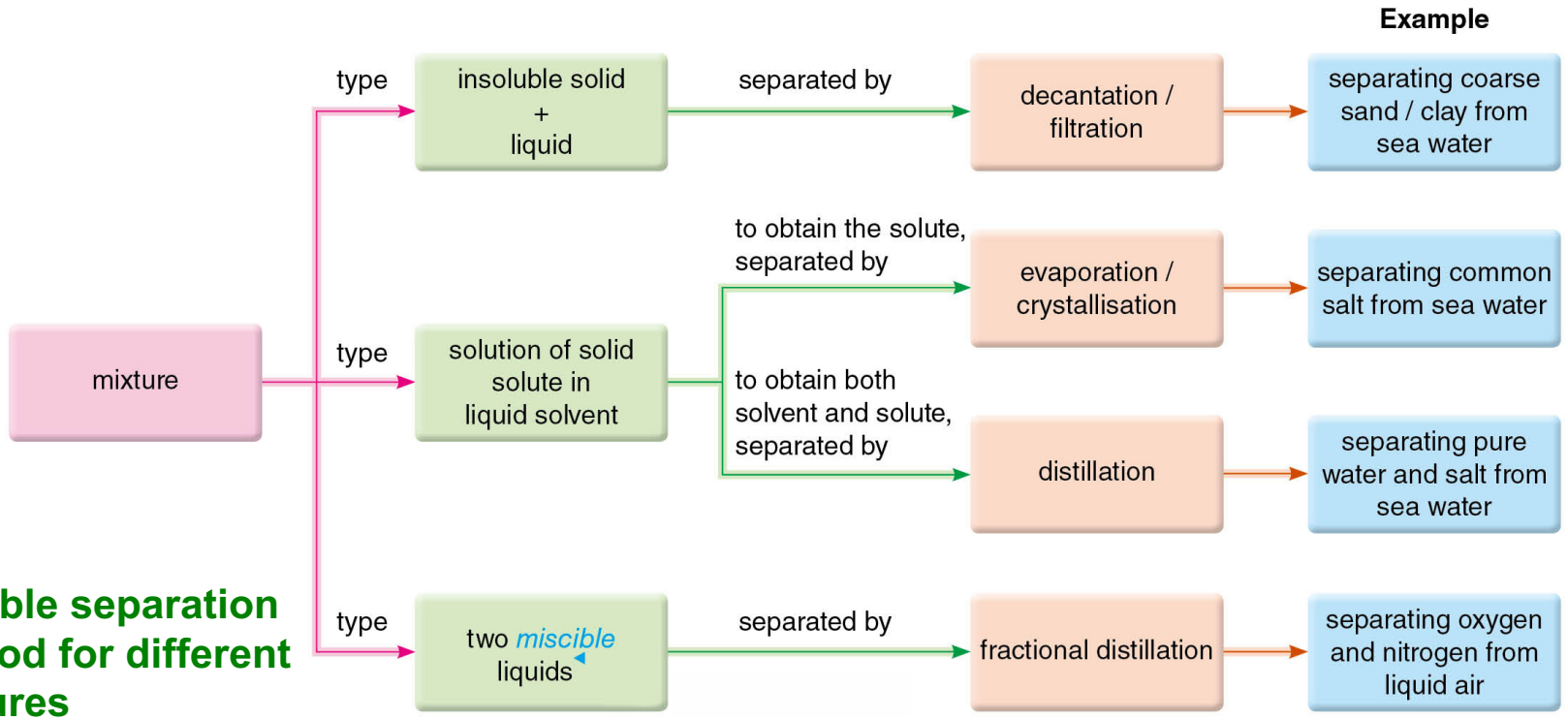
3 Collect the pure water (**distillate (餾液)**) in the conical flask.

- Bumping is violent boiling which can throw the liquid out of the container while the liquid is being heated. Adding a few anti-bumping granules ensures smooth boiling and cuts the risk of bumping.

3.5 How to choose a separation method? (p. 53)

- The most suitable separation method for a particular mixture depends on the type of mixture; and which substance in the mixture you want.

Suitable separation method for different mixtures



3.6 Showing what chemical species common salt contains (p. 55)

Flame test

Conducting flame tests for different metal compounds *Ref.*

- Certain metals in compounds can be identified by using a **flame test (焰色試驗)**.

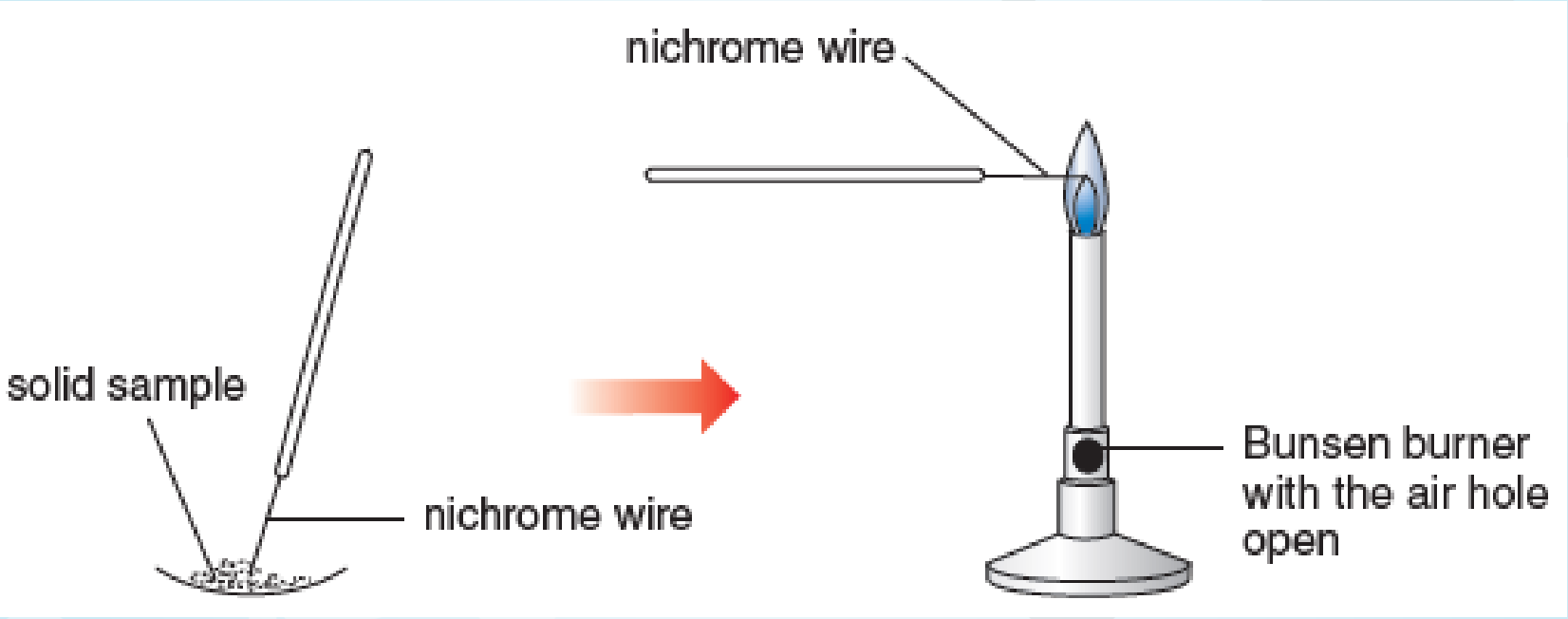
1 Clean a **nichrome wire (鎳鉻線)**. To do this, you first dip the wire into concentrated hydrochloric acid and then hold it in a non-luminous flame.

2 Moisten the clean wire by dipping it into the acid again. Then dip it into the solid sample and let some solids stick to it.

3 Hold the wire in the hottest part of a non-luminous flame and observe the colour of the flame.

3.6 Showing what chemical species common salt contains (p. 55)

Flame test



Proceduce for flame test

3.6 Showing what chemical species common salt contains (p. 55)

Flame test

What does common salt contain? *Ref.*

- The flame colours of compounds of some metals are shown below.

lilac
(compound of potassium)

golden yellow
(compound of sodium)

brick-red
(compound of calcium)

bluish green
(compound of copper)

Flame colours of compounds of some metals

3.6 Showing what chemical species common salt contains (p. 57)

Test for chlorides – aqueous solution of silver nitrate

- Compounds made up of chlorine are called **chlorides (氯化物)**.
- To test whether a sample is a chloride, first dissolve the sample in water, then add excess dilute nitric acid, followed by an aqueous solution of silver nitrate.
- Appearance of a white **precipitate (沉澱物)** suggests that the sample is a chloride.

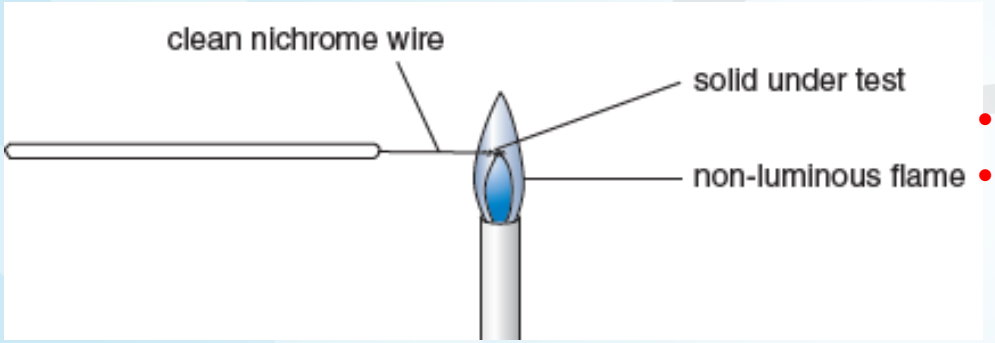
A white precipitate is formed when excess dilute nitric acid and aqueous solution of silver nitrate are added to a solution of chloride

3.6 Showing what chemical species common salt contains (p. 57)

Practice 3.2

A student is given a solid sample X.

a) The student carries out a flame test on X.
The diagram shows the apparatus used.



- Does not melt / high melting point
- Does not colour the flame / chemically inert / unreactive / does not react with oxygen or air

i) Suggest TWO reasons why nichrome is a suitable material to use as the wire in this test.

ii) Why is a luminous Bunsen flame NOT suitable for the test?

Difficult to observe the colour produced by the substance under test.

iii) What colour would be observed if X is a calcium compound?

Brick-red flame

3.6 Showing what chemical species common salt contains (p. 57)

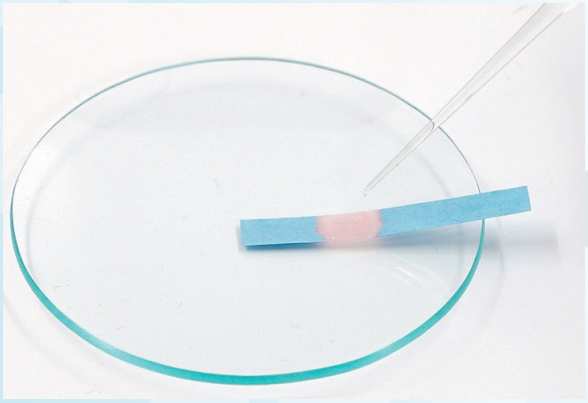
Practice 3.2 (continued)

b) It is suspected that X is a chloride.
Suggest how the student can show this.

1 Dissolve X in water.
2 Add excess dilute nitric acid.
3 Add an aqueous solution of silver nitrate.
A white precipitate is produced if X is a chloride.

3.7 Tests for the presence of water (p. 58)

- Water turns blue cobalt(II) chloride pink.
- Water turns **anhydrous (無水的)** copper(II) sulphate changes from white to blue.



Blue cobalt(II) chloride paper turns pink when water is added to it

Anhydrous copper(II) sulphate changes from white to blue when water is added to it

3.8 Electrolysis of sea water (p. 58)

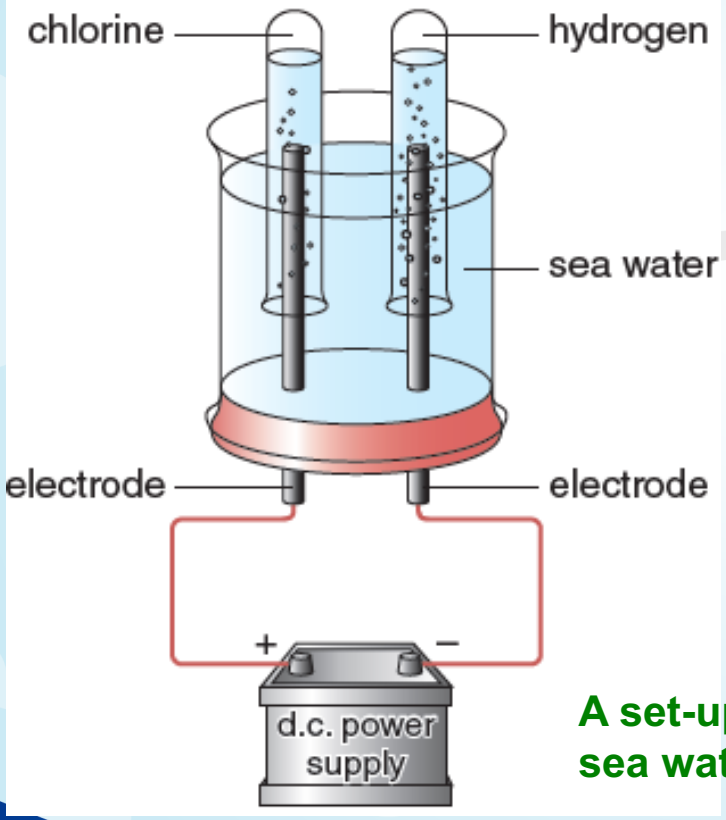
- Sea water is mainly a solution of sodium chloride in water. Water is a compound made up of hydrogen and oxygen.

- Passing a direct current through sea water can rearrange the constituent elements to produce three useful substances – chlorine gas, hydrogen gas and sodium hydroxide solution.

- The process is called **electrolysis (電解)**.

3.8 Electrolysis of sea water (p. 58)

- A set-up for the electrolysis of sea water using carbon electrodes is shown below.



A set-up for the electrolysis of sea water

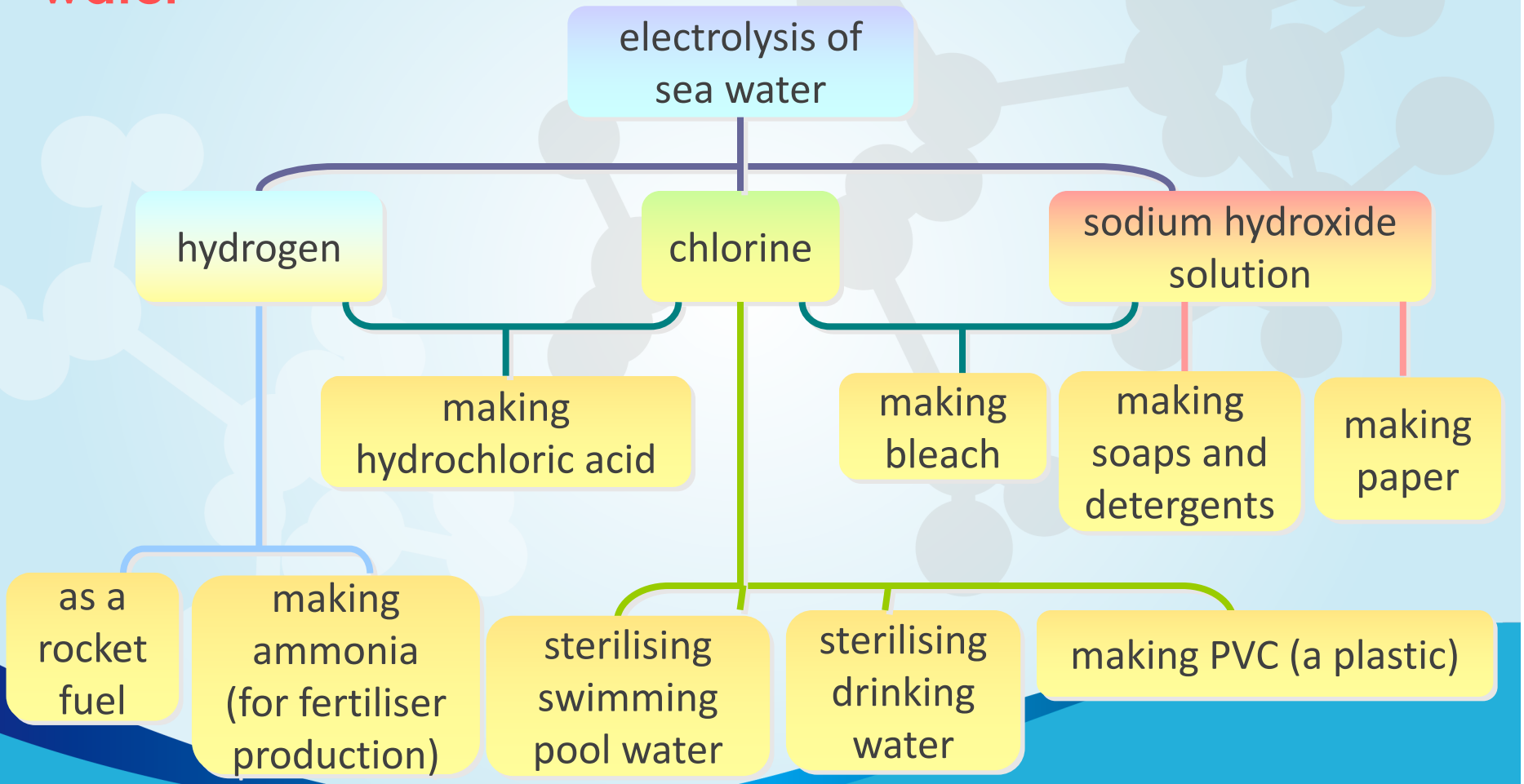
3.8 Electrolysis of sea water (p. 58)

- When we pass a direct current through sea water, chlorine gas is formed at the positive electrode. Hydrogen gas is formed at the negative electrode.
- Eventually, the solution in the set-up becomes sodium hydroxide solution.

$$\text{sea water} \xrightarrow{\text{direct current}} \text{chlorine gas} + \text{hydrogen gas} + \text{sodium hydroxide solution}$$

3.8 Electrolysis of sea water (p. 59)

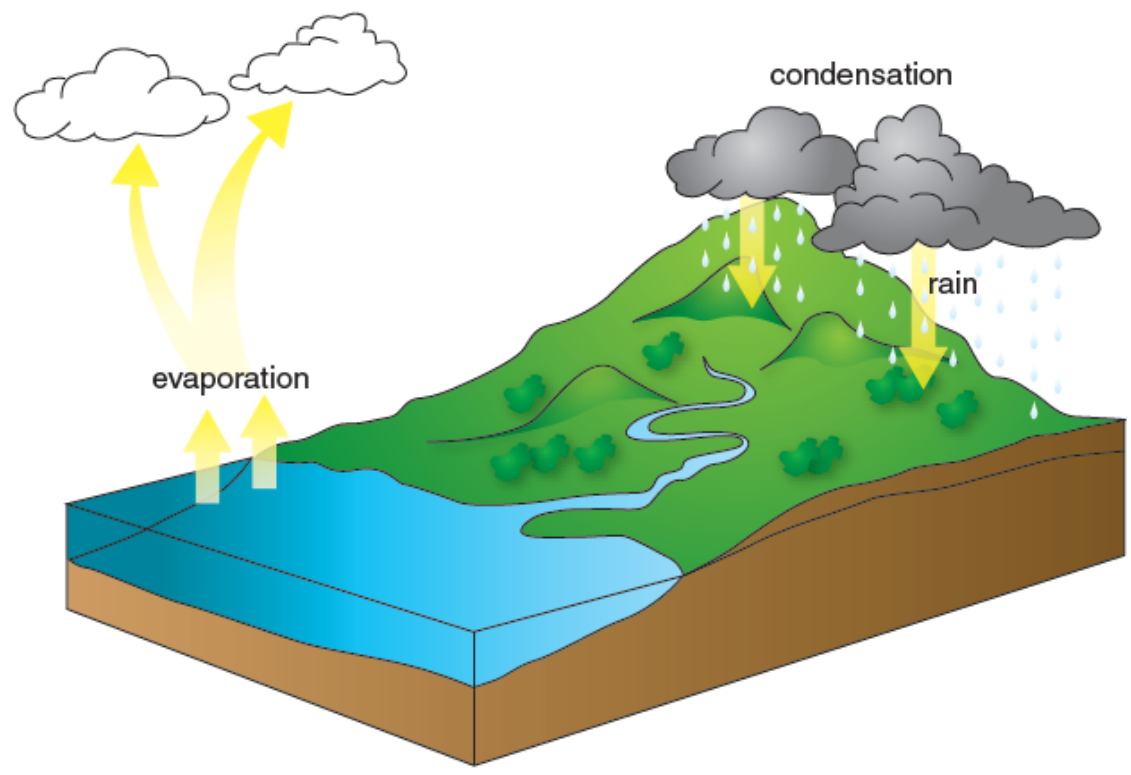
Uses of products obtained from the electrolysis of sea water



3.9 Physical change and chemical change (p. 60)

Physical change

A is a **physical change** (物理變化) is a change in which no new substance is formed.



All processes in the water cycle are physical changes

3.9 Physical change and chemical change (p. 60)

Physical change

- Many physical changes can be reversed, including
  - freezing juice to make an ice lolly;
  - mixing sand with water;
  - dissolving sugar in water.

3.9 Physical change and chemical change (p. 61)

Sublimation – physical change

- A few solids do not melt when they are heated. Instead, they turn directly into gas. This change of state is called **sublimation (昇華)** — the solid sublimes.
- Carbon dioxide is a white solid called dry ice at temperatures below –78.5 °C. When heated to just above –78.5 °C, it changes into carbon dioxide gas directly.

Dry ice is solid carbon dioxide

3.9 Physical change and chemical change (p. 61)

Practice 3.3

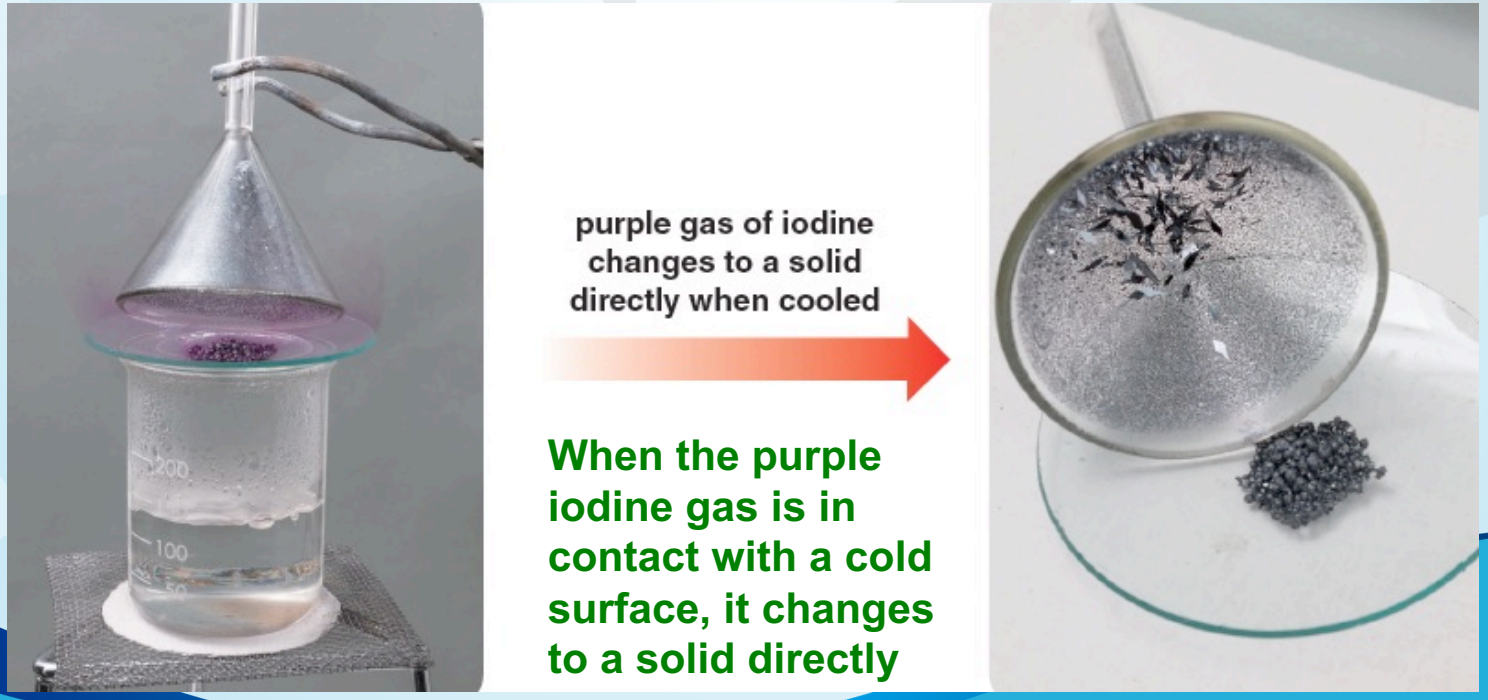
Suggest how you could reverse each of the three physical changes listed above.

Warming the ice until it melts
Using filtration
Using distillation

3.9 Physical change and chemical change (p. 61)

Sublimation – physical change

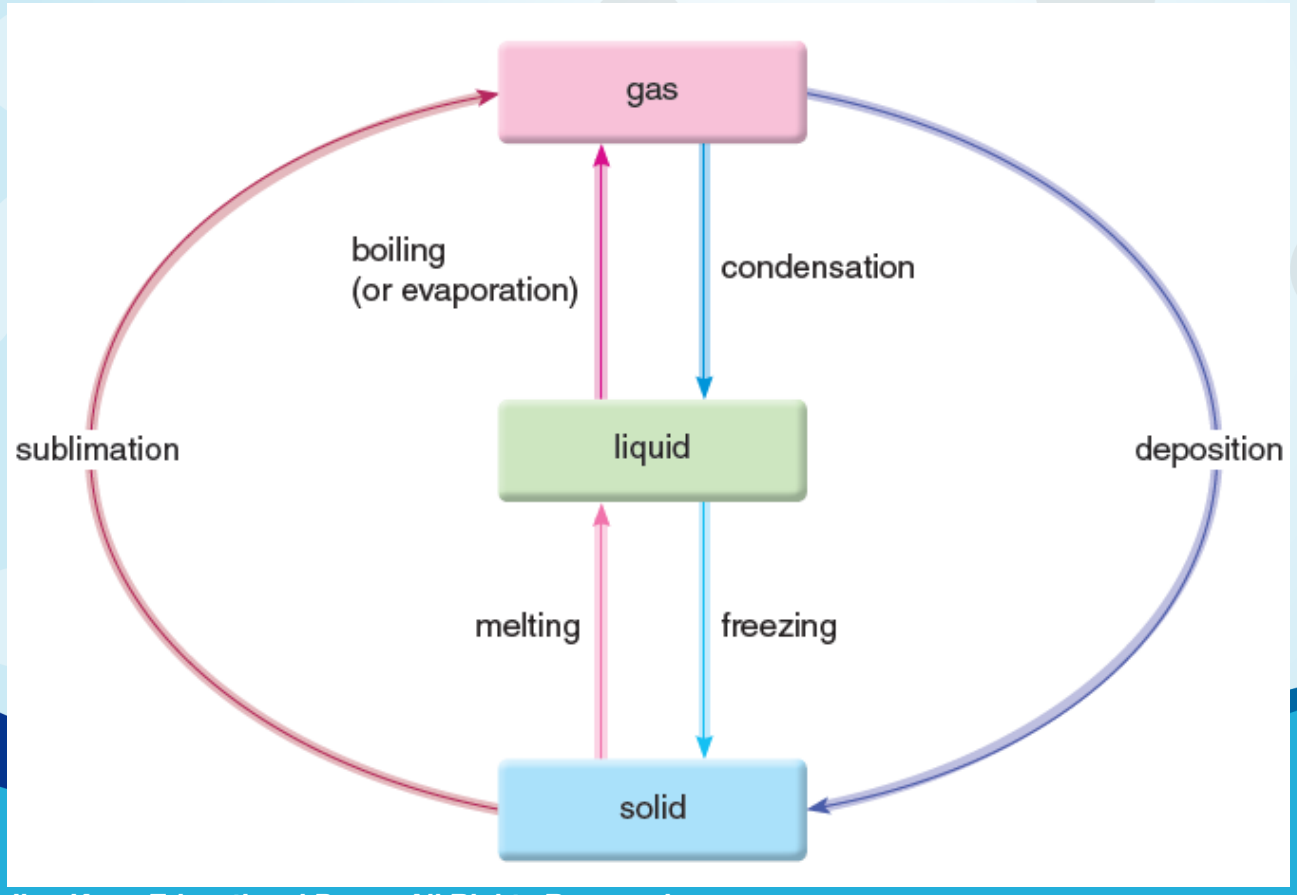
- **Iodine (碘)** produces a purple gas when heated. When in contact with a cold surface, the gas changes to a solid directly.



3.9 Physical change and chemical change (p. 62)

Physical change

- The words used to describe the changes of states of a substance:



Words used to describe the changes of states of a substance

3.9 Physical change and chemical change (p. 62)

Chemical change

A chemical change (化學變化) is a change in which at least one new substance is formed.

- Many chemical changes are difficult to reverse, including
  - frying;
  - iron rusting;
  - burning wood.

3.9 Physical change and chemical change (p. 62)

Practice 3.4

Classify each of the following processes as either a physical or a chemical change.

Process	Physical change or chemical change
a) Bleaching the hair	chemical change
b) Mowing the grass	physical change
c) Casting silver in a mold	physical change
d) Lighting a match	chemical change
e) Mixing sea water with silver nitrate solution	chemical change
f) Cutting an aluminium foil in half	physical change

3.10 Physical property and chemical property (p. 63)

Physical properties (物理性質) of a substance are properties that can be observed or measured without changing the chemical composition of a substance.

- Common physical properties:

melting point

electricity conductivity

boiling point

colour

odour

state

solubility

hardness

density

3.10 Physical property and chemical property (p. 63)

Chemical properties (化學性質) of a substance are properties that can be observed or measured only when the substance undergoes a chemical change to form new substance(s).

- Common chemical properties:

flammability

oxidisability

toxicity

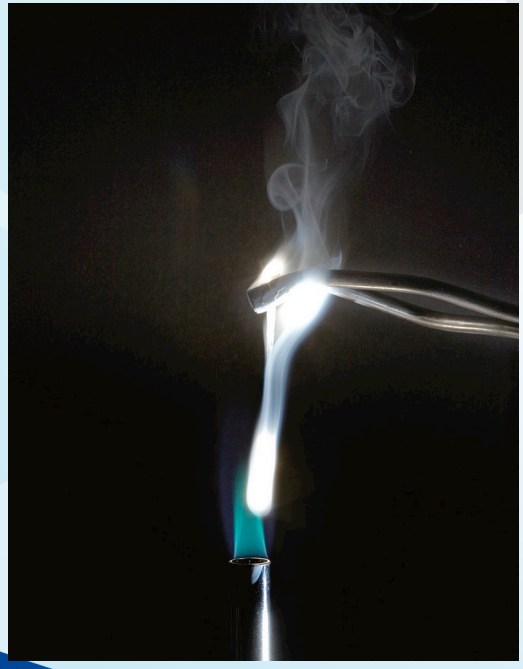
reactivity with other substances

chemical stability

3.10 Physical property and chemical property (p. 64)

- One chemical property of magnesium is that it burns brightly in oxygen to form a new substance, magnesium oxide.

magnesium + oxygen ⟶ magnesium oxide



Magnesium burns brightly in oxygen

3.10 Physical property and chemical property (p. 64)

Practice 3.5

Identify each of the following statements as describing a physical property or a chemical property of the substance.

Statement	Physical property or chemical property
a) Sodium burns in chlorine to give sodium chloride.	chemical property
b) Copper can be drawn into wires.	physical property
c) A wooden block can float on water.	physical property
d) Oxygen can relight a glowing splint.	chemical property
e) Vinegar has a sour taste.	physical property

Key terms (p. 65)

solution	溶液	concentration	濃度
solute	溶質	decantation	傾析
solvent	溶劑	filtration	過濾
soluble	可溶	residue	殘餘物
insoluble	不可溶	filtrate	濾液
dilute solution	稀溶液	evaporation	蒸發
concentrated solution	濃溶液	crystal	晶體
saturated solution	飽和溶液	crystallisation	結晶

Continued on next page

Key terms (p. 65)

simple distillation	簡單蒸餾	electrolysis	電解
condenser	冷凝器	physical change	物理變化
distillate	餾液	sublimation	昇華
flame test	焰色試驗	iodine	碘
nichrome wire	鎳鉻線	chemical change	化學變化
chloride	氯化物		
precipitate	沉澱物		
anhydrous	無水的		

Summary (p. 66)

1 A solution forms when one substance (solute) dissolves in another substance (solvent).

solute + solvent = solution

2 a) A dilute solution contains a small amount of solute in a given volume of solution.

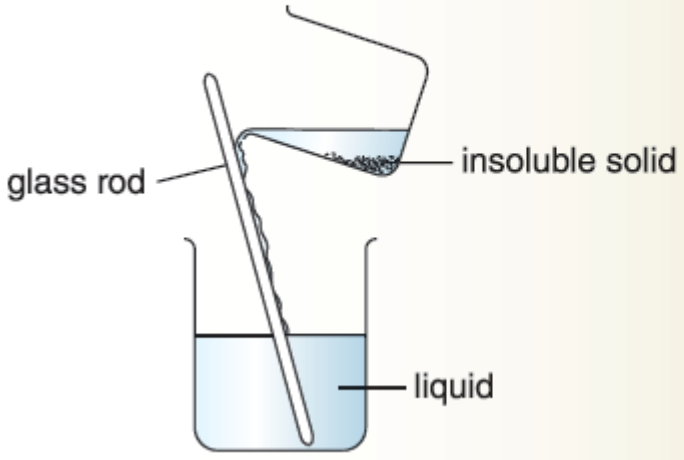
b) A concentrated solution contains a large amount of solute in a given volume of solution.

3 A saturated solution is a solution that no more solute dissolves in it, at a given temperature.

4 Sea water contains 3.5% by mass of dissolved salts, including 2.4% of sodium chloride.

Summary (p. 66)

5 The following table summarises some common separation methods:

What to separate	Method of separation and experimental set-up
Separating a much denser insoluble solid from a liquid	Decantation 

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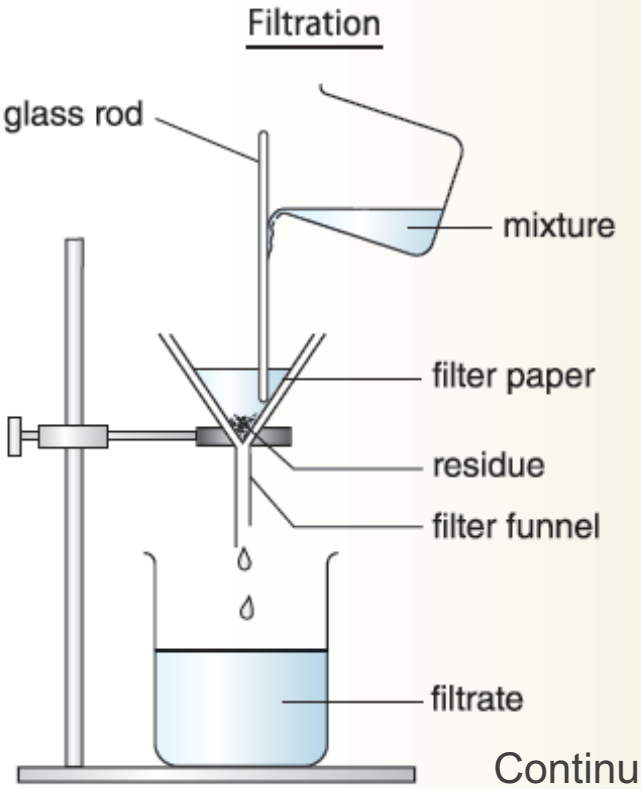
Summary (p. 67)

5 The following table summarises some common separation methods:

What to separate	Method of separation and experimental set-up
Separating an insoluble solid from a liquid	Filtration 

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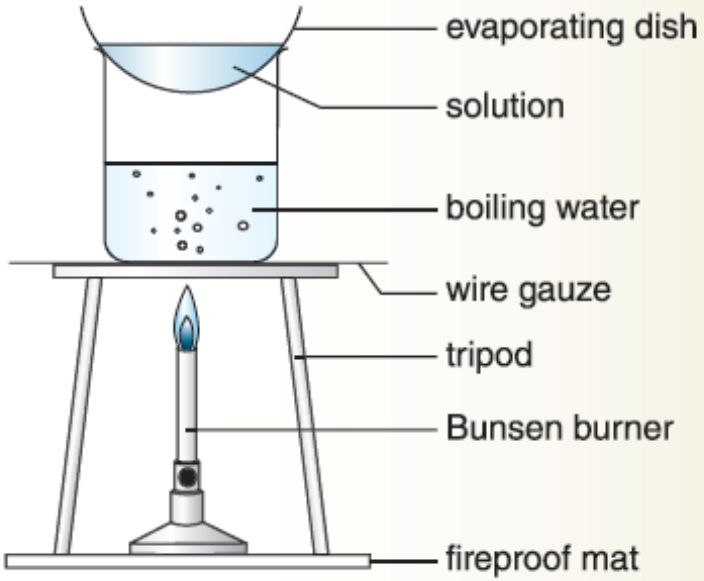
Summary (p. 67)

5 The following table summarises some common separation methods:

Separating a dissolved solid (solute) from a solution	Evaporation 

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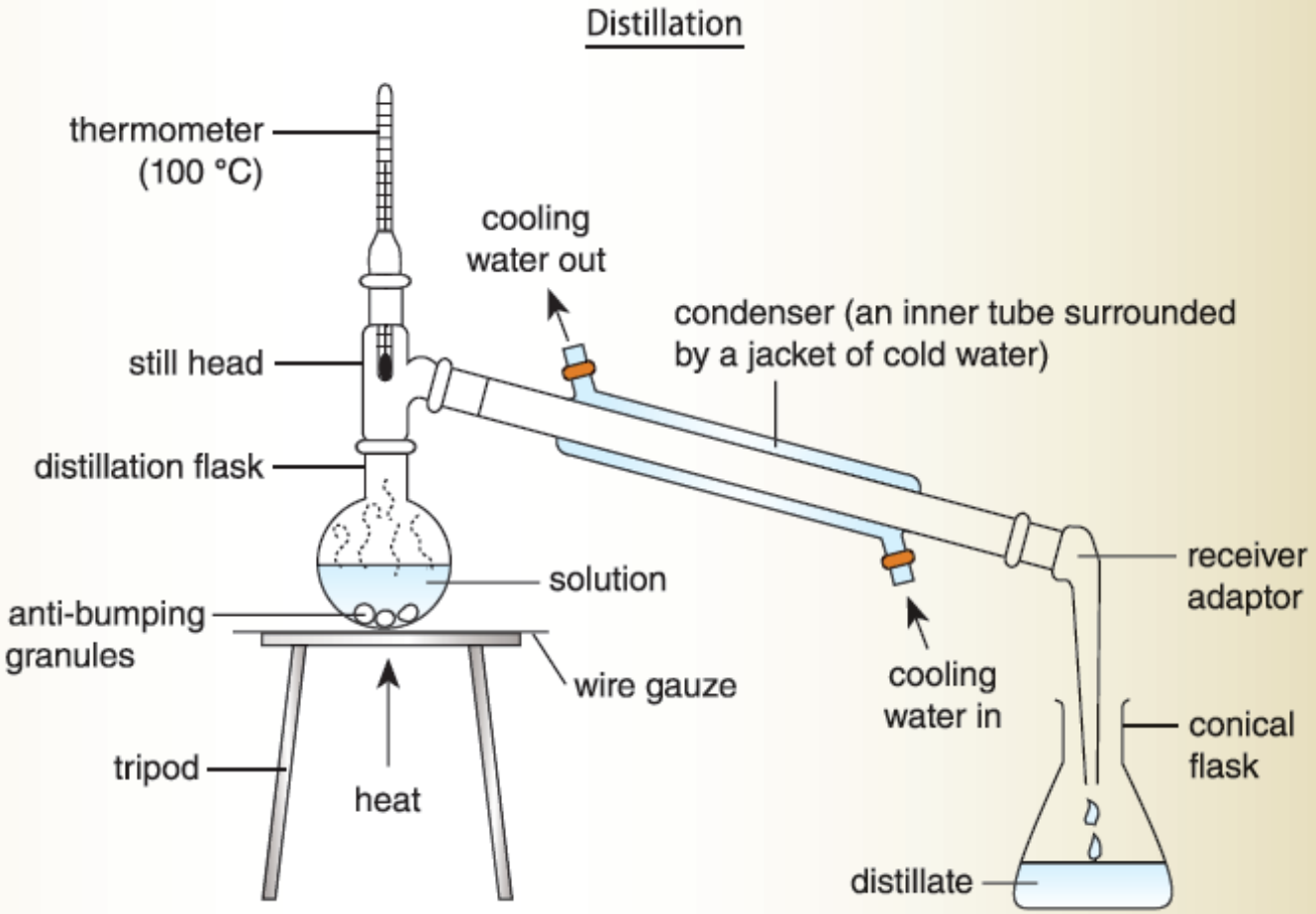
Summary (p. 67)

5 The following table summarises some common separation methods:

Separating a solvent from a solution



Summary (p. 68)

6 The following table lists the flame colours of compounds of some metals:

Solid	Flame colour
Compound of potassium	lilac
Compound of sodium	golden yellow
Compound of calcium	brick-red
Compound of copper	bluish green

Summary (p. 68)

7 To test for a chloride, first dissolve the sample in water, then add excess dilute nitric acid, followed by an aqueous solution of silver nitrate. Appearance of a white precipitate suggests that the sample is a chloride.

8 A simple test for water is that it can turn blue cobalt(II) chloride paper pink. It can also turn anhydrous copper(II) sulphate from white to blue.

9 Electrolysis of sea water produces three useful substances:

$$\text{sea water} \xrightarrow{\text{direct current}} \text{chlorine gas} + \text{hydrogen gas} + \text{sodium hydroxide solution}$$

Summary (p. 68)

10 A physical change is a change in which no new substance is formed.

11 A chemical change is a change in which at least one new substance is formed.

12 Physical properties of a substance are properties that can be observed or measured without changing the chemical composition of the substance. Examples are:

- appearance;
- colour;
- odour;
- density;
- melting point;
- boiling point;
- solubility.

Summary (p. 68)

13 Chemical properties of a substance are properties that can be observed or measured only when the substance undergoes a chemical change to form new substance(s). Examples are:

- iron reacts with sulphur to form iron(II) sulphide;
- magnesium reacts with oxygen to form magnesium oxide.

Unit Exercise (p. 69)

Note: Questions are rated according to ascending level of difficulty (from 1 to 5):

 question targeted at level 3 and above;

 question targeted at level 4 and above;

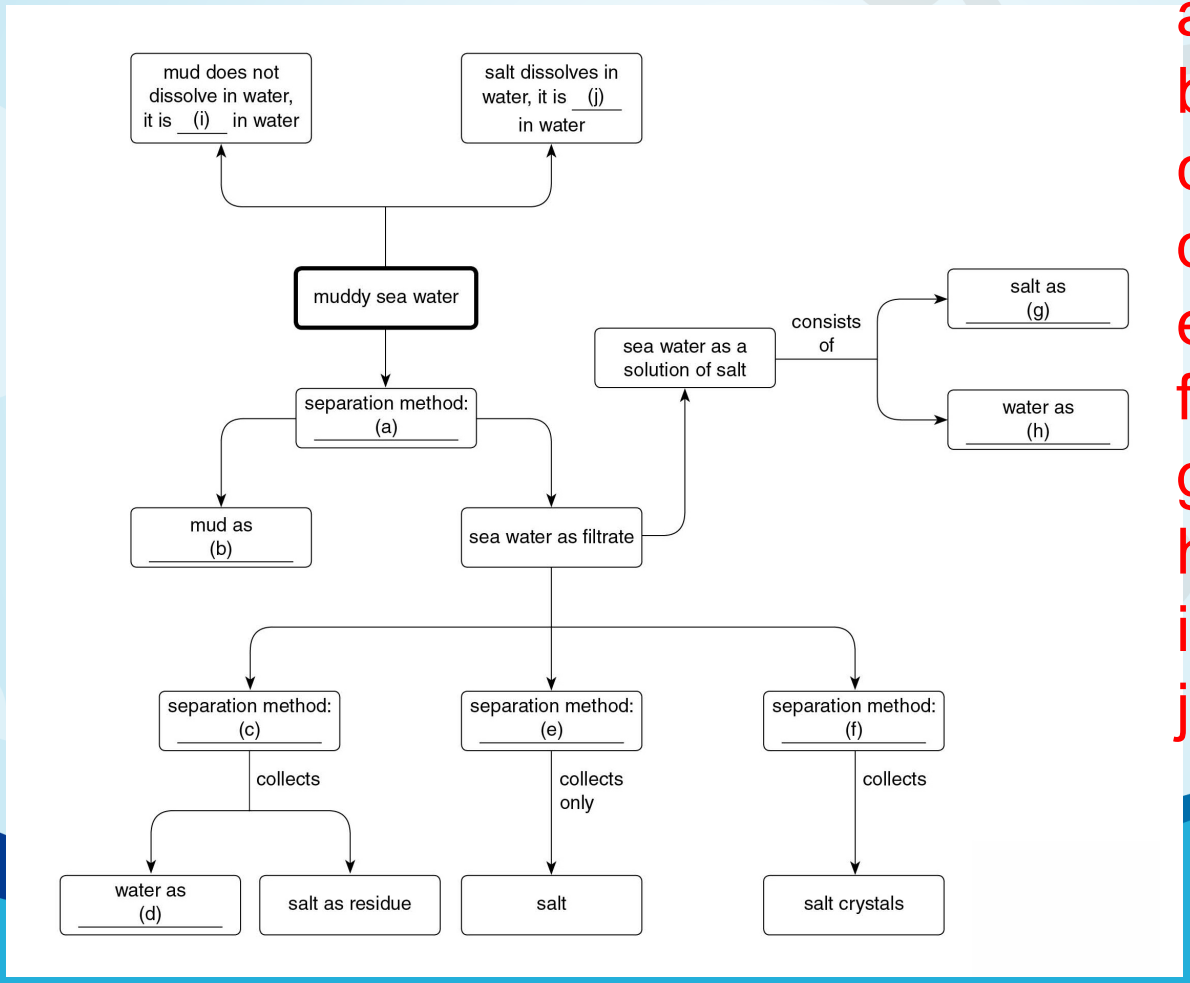
 question targeted at level 5.

‘ * ’ indicates 1 mark is given for effective communication.

Unit Exercise (p. 69)

Part I KNOWLEDGE AND UNDERSTANDING

1 Complete the following concept map.



a) filtration
b) residue
c) distillation
d) distillate
e) evaporation
f) crystallisation
g) solute
h) solvent
i) insoluble
j) soluble

Unit Exercise (p. 70)

Part II MUTIPLE CHOICE QUESTIONS

2 Which of the following processes is most suitable for extracting sodium chloride from sea water?

A Electrolysis
B Crystallisation
C Simple distillation
D Fractional distillation

Answer：B

(HKDSE, Paper 1A, 2018, 1)

Unit Exercise (p. 70)

3 Which of the following is the most suitable separation method for the purpose?

	Purpose	Separation method
A	separating sugar from sugar solution	filtration
B	separating cooking water from vegetables	fractional distillation
C	separating dust from air	distillation
D	separating mud from sea water	decantation

Answer：D

Unit Exercise (p. 70)

4 The following steps are involved in the crystallisation of zinc sulphate, but not in correct order.

I Filter off the crystals.
II Heat the solution to concentrate it.
III Leave the solution to cool and form crystals.
IV Check that a saturated solution has formed.

What is the correct order of the steps?

A I → IV → III → II
B I → III → II → IV
C II → IV → III → I
D II → III → I → IV

Answer : C

Unit Exercise (p. 70)

5 Which of the following separation methods does NOT involve a change in the state of matter?

A Decantation
B Evaporation
C Fractional distillation
D Simple distillation

Answer：A

Unit Exercise (p. 70)

6 What processes does distillation involve?

A Condensation then evaporation
B Crystallisation then filtration
C Evaporation then condensation
D Filtration then crystallisation

Answer：C

Unit Exercise (p. 70)

7 Which of the following compounds does NOT give a characteristic flame colour in flame test?

A Calcium chloride
B Potassium chloride
C Sodium chloride
D Silver chloride

Answer：D

Unit Exercise (p. 70)

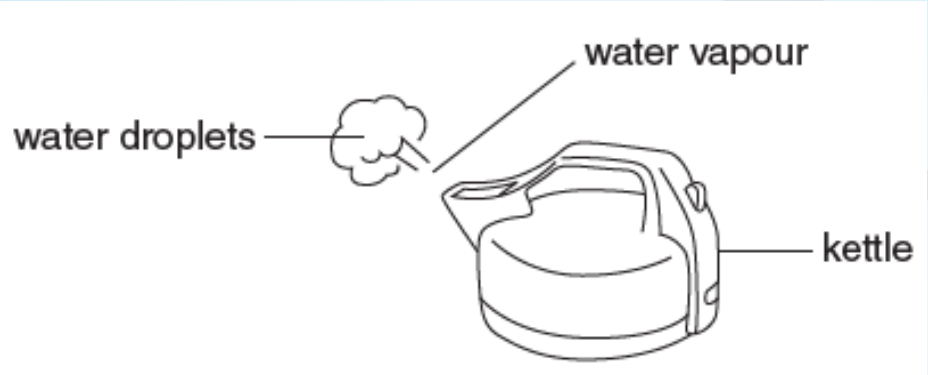
8 Which of these changes is a physical change?

A Digesting food
B Exploding fireworks
C Iron rusting
D Squeezing oranges for juice

Answer：D

Unit Exercise (p. 70)

9 The diagram shows a kettle of boiling water.



As the water vapour cools it turns into droplets of liquid water.

The change of state when water vapour changes into liquid water is described as

A boiling.

B condensation.

C evaporation.

D sublimation.

Answer : B

(Edexcel IGCSE, Paper 1C, Jun. 2016, 1)

Unit Exercise (p. 71)

10 Which of these is an example of a chemical change?

A Adding sodium chloride to water
B Breaking a glass bottle
C Freezing water to make ice cubes
D Passing an electric current through sea water

Explanation:
Passing an electric current through sea water rearranges the constituent elements and produces three useful substances — chlorine gas, hydrogen gas and sodium hydroxide solution.

Answer：D

Unit Exercise (p. 71)

11 Which of the following statements concerning sea water is / are correct?

(1) It is a mixture.
(2) It gives a lilac flame in flame test.
(3) It gives a white precipitate when mixed with silver nitrate solution.

A (1) only
B (2) only
C (1) and (3) only
D (2) and (3) only

Explanation:
(2) The main salt in sea water is sodium chloride. Thus, sea water gives a golden yellow flame in flame test.

Answer : C

Unit Exercise (p. 71)

12 Which of the following statements concerning water is / are correct?

(1) It is a compound.
(2) It can be separated into its constituent elements by distillation.
(3) It turns cobalt(II) chloride paper from pink to blue.

A (1) only
B (2) only
C (1) and (3) only
D (2) and (3) only

Explanation:
(2) Water can be separated into its constituent elements by electrolysis.
(3) Water turns blue cobalt(II) chloride paper pink.

Answer：A

Unit Exercise (p. 71)

13 Which of the following are uses of chlorine?

(1) As a rocket fuel
(2) Making bleach
(3) Sterilising swimming pool water

A (1) and (2) only
B (1) and (3) only
C (2) and (3) only
D (1), (2) and (3)

Answer：C

Unit Exercise (p. 71)

Part III STRUCTURED QUESTIONS

14 The following techniques are used to separate mixtures.

A Evaporation

B Filtration

C Fractional distillation

D Simple distillation

Unit Exercise (p. 71)

14 (continued)

a) From this list, choose the most suitable technique to carry out each separation below.

i) Water from copper(II) sulphate solution D (1)

ii) Iron filings from a mixture of iron filings and water B (1)

iii) Propanone from a mixture of methanol and propanone C (1)

(Boiling point of methanol = 65 °C; boiling point of propanone = 56 °C)

iv) Common salt from sea water A (1)

v) Iodine from a mixture of iodine and sand E (1)

Unit Exercise (p. 72)

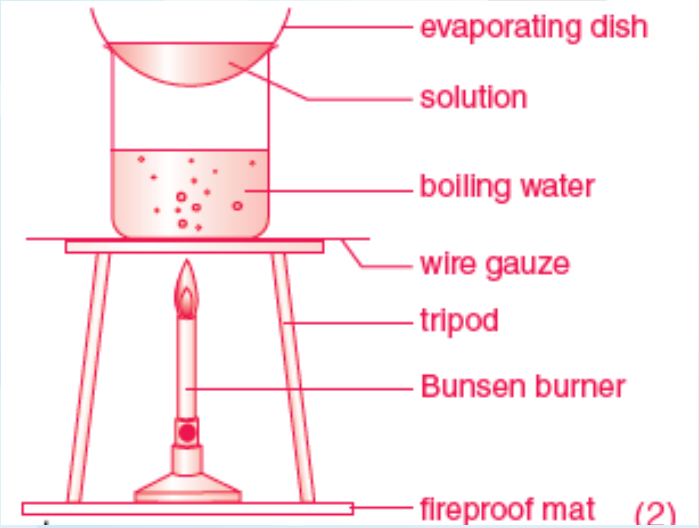
14 (continued)

b) Draw a labelled diagram of the experimental set-up for each process:

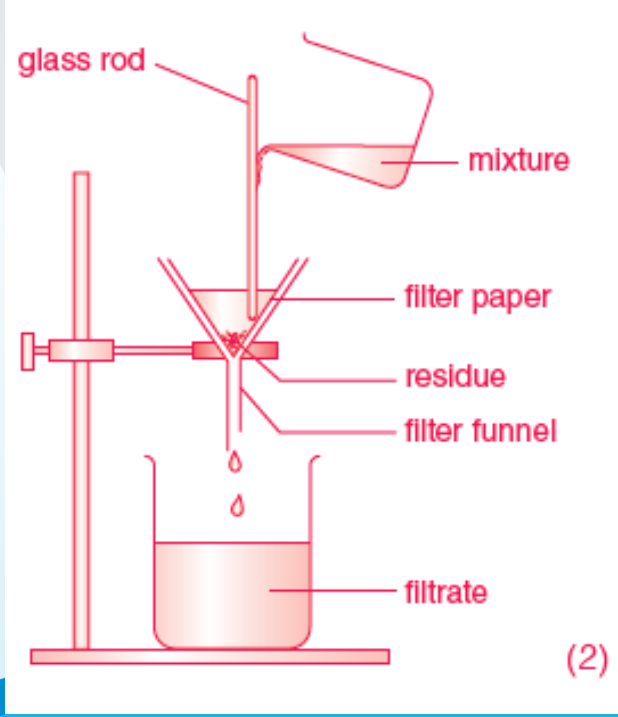
i) Evaporation

ii) Filtration

i)



ii)



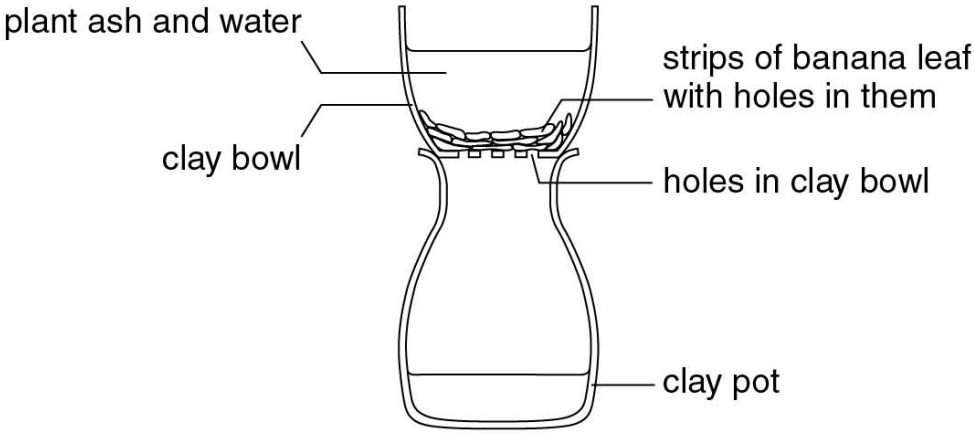
Unit Exercise (p. 72)

15 Plant ash is a mixture of large insoluble particles and salts which are soluble in water.

In parts of Africa, salts are traditionally obtained from plant ash.

Water is added to the plant ash.

The apparatus shown below is then used to remove the insoluble particles.



Unit Exercise (p. 72)

15 (continued)

Explain how this apparatus separates the salts from the insoluble particles.

(Cambridge IGCSE, 0620/23, Paper 2, Nov. 2013, 8(b))

Particles of water and the dissolved salts are small enough to pass through the holes, and move to the clay pot. (1)

The large insoluble particles are caught by the leaves and remain in the clay bowl. (1)

Unit Exercise (p. 72)

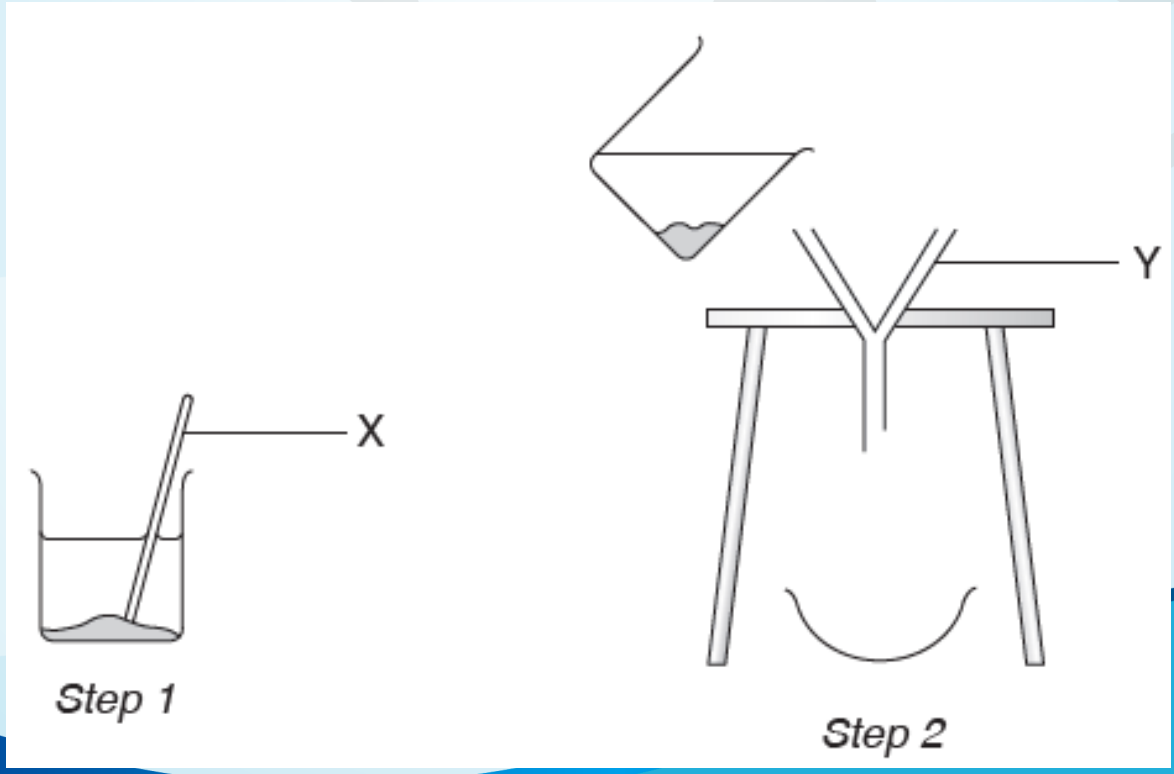
16 Complete the table below by stating the natural source and the method of extraction from the source for each element.

Element	Natural source	Method of extraction
Argon		
Chlorine		

(HKDSE, Paper 1B, 2015, 1(c))

Unit Exercise (p. 73)

17 Salt is soluble in water, but sand is insoluble in water. This difference allows a mixture of salt and sand to be separated as shown below. Water is added to the mixture in *Step 1*.



Unit Exercise (p. 73)

17 (continued)

a) Give the names of the pieces of apparatus labelled X and Y. X: glass rod (1) Y: filter funnel (1)

b) i) What should be placed in Y before the mixture from *Step 1* is poured through it?
Filter paper (1)

ii) What is the solid removed in *Step 2*?
Sand (1)

iii) Name the process carried out in *Step 2*.
Filtration (1)

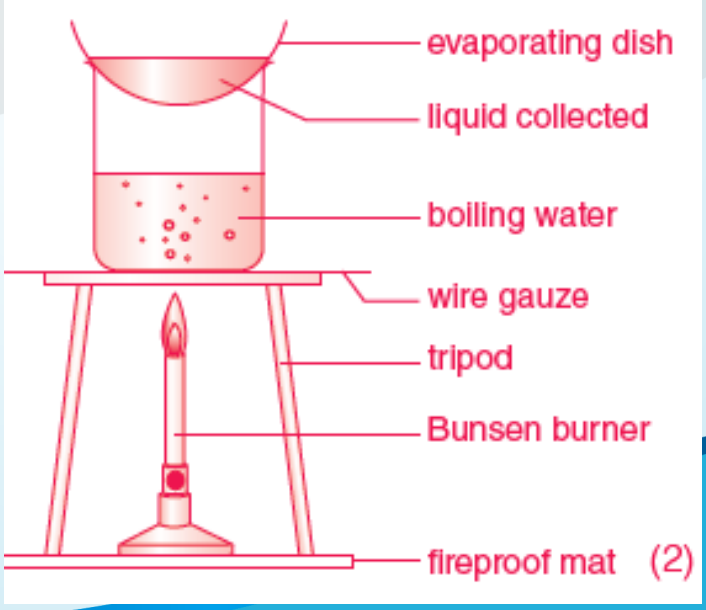
Unit Exercise (p. 73)

17 (continued)

c) After *Step 2*, the liquid collected in the dish is heated so as to remove the water.

i) Name the process involved. Evaporation (1)

ii) Draw a labelled diagram for the experimental set-up used.



(2)

Unit Exercise (p. 73)

18 a) A student uses a flame test to distinguish between separate samples of calcium chloride and potassium chloride.
This is the student's method.
There is one mistake in *Step 1* and one mistake in *Step 3*.

Step 1 Dip a platinum wire into some concentrated sodium hydroxide solution.
Step 2 Dip the platinum wire into the sample.
Step 3 Place the wire and sample into a luminous Bunsen flame.
Step 4 Record the colour of the flame.

Describe a correct method for *Step 1* and *Step 3*.

Step 1 Dip a platinum wire into concentrated hydrochloric acid. (1)
Step 3 Place the wire and sample into a non-luminous Bunsen flame. (1)

Unit Exercise (p. 73)

18 (continued)

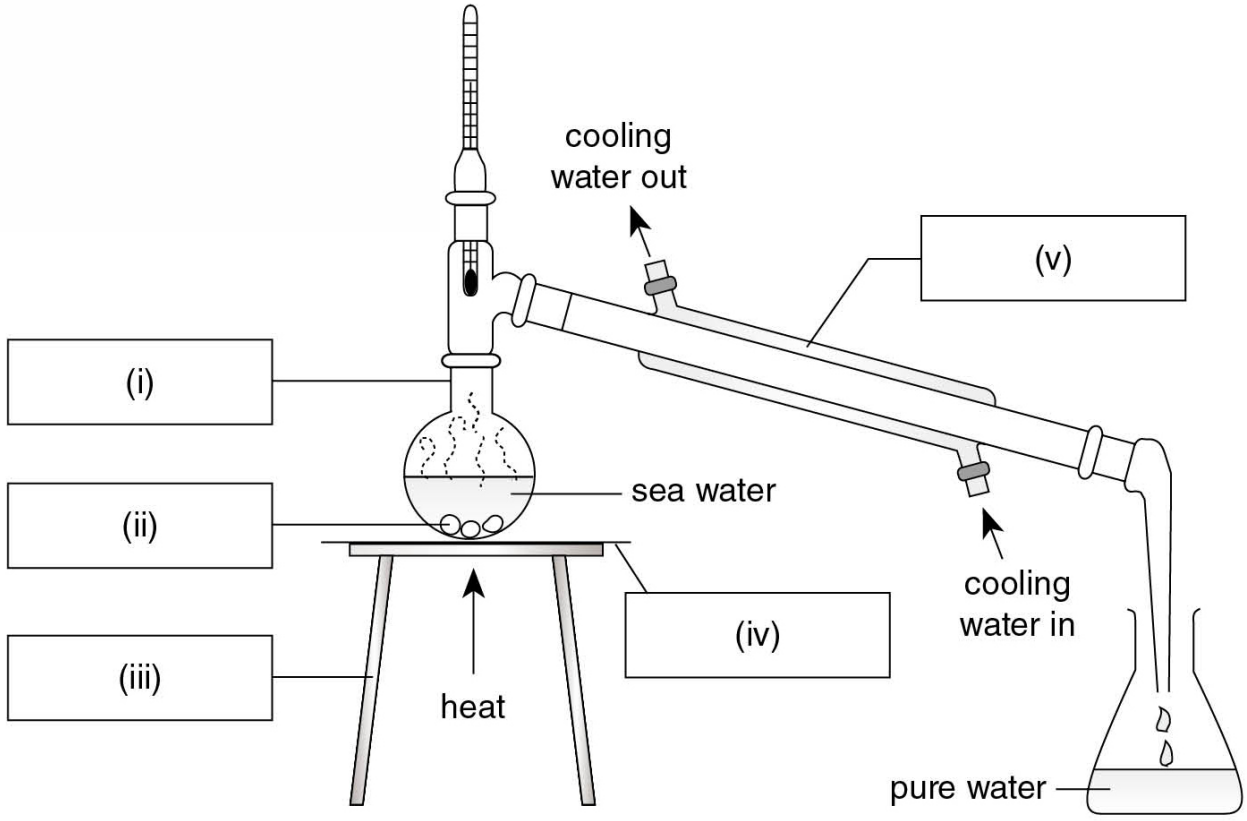
b) What colour is the flame when the test on potassium chloride is carried out correctly?

A Green
B Lilac (1)
C Orange
D Red

(Edexcel IGCSE, Paper 2C, Jan. 2016, 3(d)–(e))

Unit Exercise (p. 74)

19 The diagram below shows the apparatus which can be used to obtain pure water from sea water.



Unit Exercise (p. 74)

19 (continued)

a) State the name of this process. Distillation (1)

b) Give the names of the pieces of apparatus shown.

b) i) round-bottomed flask / distillation flask (1)
ii) anti-bumping granules (1)
iii) tripod (1)
iv) wire gauze (1)
v) condenser (1)

*c) Explain how pure water is obtained from sea water in the process.

c) Separation occurs because water and the salts in sea water have different boiling points. Water boils at a temperature lower than the salts. (1)
The sea water in the flask is heated until boiling. Only the water turns into steam, leaving the salts behind. (1)
The steam travels along the inner tube of the water-cooled condenser and condenses. (1)
Pure water is collected in the conical flask and salts are left in the flask. (1)
Communication mark (1)

Unit Exercise (p. 74)

*20 Describe how magnesium chloride crystals can be obtained from a dilute solution of magnesium chloride.

Heat the solution until it becomes saturated. (1)
Leave the saturated solution to cool. Crystals start to form. (1)
Separate the crystals from the remaining solution by filtration. Wash the crystals with a small amount of cold deionised water. Dry the crystals using filter papers. (1)
Communication mark (1)

Unit Exercise (p. 74)

21 The diagram shows the label from a bottle of mineral water.

XX Mineral Water			
mg in one dm^3			
calcium	55	hydrogencarbonate	248
magnesium	19	chloride	42
potassium	1	sulphate	23
sodium	24		

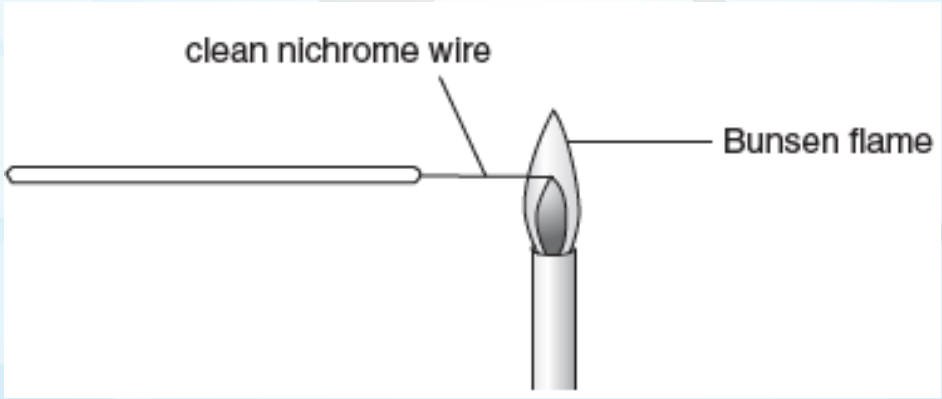
a) Describe a test you would carry out to confirm the presence of chloride in the water.

Add excess dilute nitric acid.
Add an aqueous solution of silver nitrate. (1)
A white precipitate is produced if chloride is present. (1)

Unit Exercise (p. 75)

21 (continued)

b) A student evaporated some of the mineral water and obtained the dissolved salts as a solid residue. He attempted to identify the metals using a flame test on the residue.
The diagram shows the apparatus used.



Unit Exercise (p. 75)

21 (continued)

b) i) Suggest TWO reasons why a nichrome wire is suitable for this test.

b) i)
- Does not melt / high melting point (1)
- Does not colour the flame / chemically inert / unreactive / does not react with oxygen or air (1)

ii) Why should the nichrome wire be cleaned between each test?

Impurities may affect the colour of the flame. (1)

iii) Why is a luminous Bunsen flame NOT suitable for carrying out a flame test?

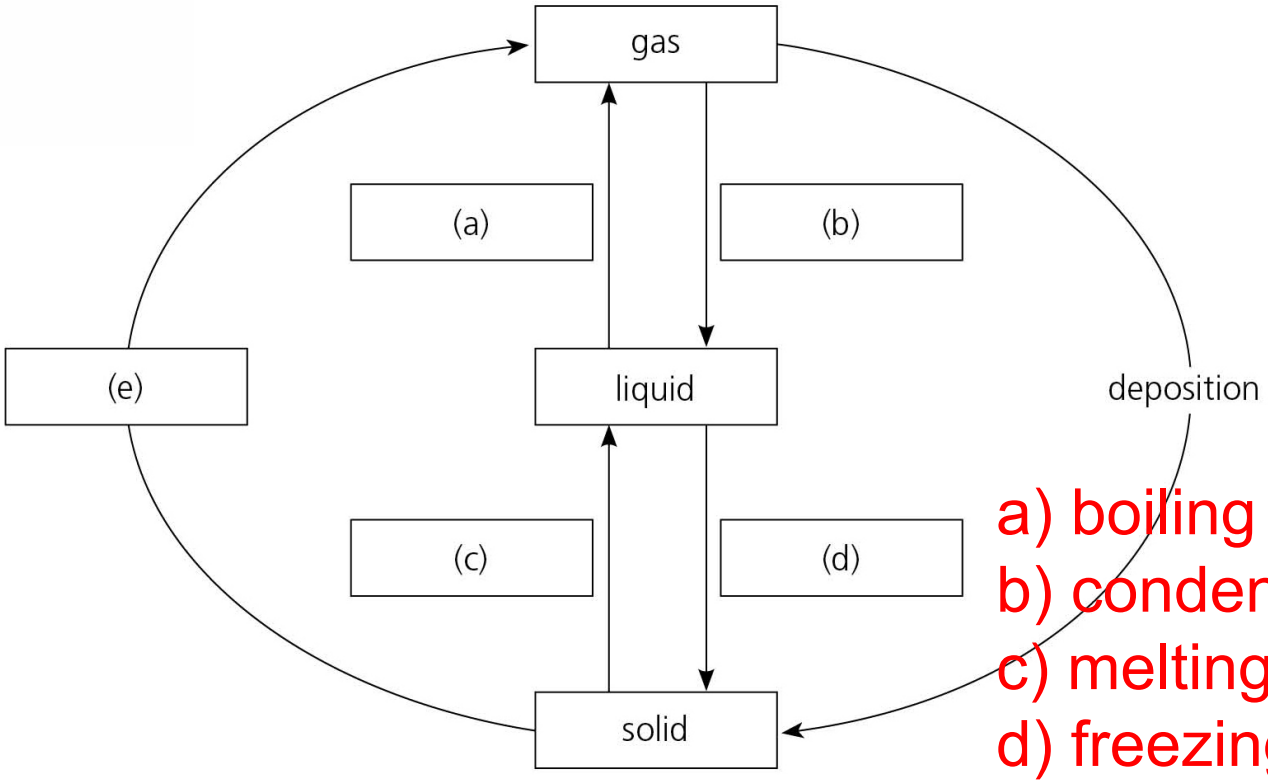
Difficult to observe the colour produced by the substance under test (1)

iv) Explain why the metals CANNOT be identified by using a flame test.

The flame colour is a mixture of colours due to the different metals. (1)

Unit Exercise (p. 75)

22 Fill in words to describe the changes of states of a substance.



a) boiling / evaporation (1)
b) condensation (1)
c) melting (1)
d) freezing (1)
e) sublimation (1)

Unit Exercise (p. 75)

23 Water is present in the atmosphere, in the oceans and in ice.

a) State TWO physical properties of water.

b) Describe a test for water. Give the test and the result.

c) Water is a good solvent. What do you understand by the term 'solvent'? A substance that dissolve other substance to form a solution. (1)

a) Any two of the following:
- Melting point 0 ℃ (1)
- Boiling point 100 ℃ (1)
- Colourless (1)
- Odourless (1)

(Other physicals properties of water are acceptable.)

b) Any one of the following:
- Test water with blue cobalt(II) chloride paper. (1)
  The cobalt(II) chloride paper turns from blue to pink. (1)
- Test water with anhydrous copper(II) sulphate. (1)
  The anhydrous copper(II) sulphate turns from white to blue. (1)

Unit Exercise (p. 76)

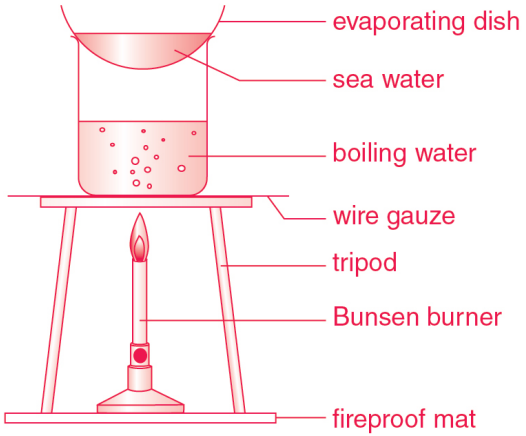
24 This question is about sea water.

a) When sea water is evaporated, a number of different compounds can be obtained.

i) Draw a labelled diagram for the experimental set-up for evaporating a sample of sea water.

ii) State the name of the compound which is present in the greatest quantity. Sodium chloride (1)

i)



(2)

Unit Exercise (p. 76)

24 (continued)

Drinking water can be obtained by purifying sea water. Explain why distillation rather than filtration is used to purify sea water for drinking.

Any one of the following:

- Distillation removes dissolved salts while filtration does not. (1)
- Distillation removes bacteria / germs while filtration does not. (1)

Unit Exercise (p. 76)

25 Electrolysis occurs when solutions of some compounds are decomposed by passing a direct electric current through them.

In an experiment, sodium chloride solution was electrolysed. Chlorine and hydrogen were produced. The remaining solution contained sodium hydroxide.

a) Chlorine is toxic to humans. It is used in water treatment.

i) Draw a hazard warning label that should be displayed on a cylinder of chlorine gas.

(1)

ii) Chlorine is added to water to make the water safe to drink.

Explain why adding chlorine makes water safe to drink. To kill bacteria. (1)

Unit Exercise (p. 76)

25 (continued)

b) i) Suggest a test to identify hydrogen.

b) i)
Test hydrogen with a burning splint. (1)
Hydrogen gives a 'pop' sound. (1)

ii) State ONE use of hydrogen.

Any one of the following:
- As a rocket fuel (1)
- Making ammonia (1)
- Making hydrochloric acid (1)

c) Sodium hydroxide is a compound.

i) Explain the meaning of the term 'compound'.

A compound is a pure substance that consists of two or more elements chemically joined together. (1)

ii) State ONE use of sodium hydroxide.

Any one of the following:
- Making bleach (1)
- Making soaps and detergents (1)
- Making paper (1)

Unit Exercise (p. 76)

26 There are two bottles of chemicals. The labels are missing from the bottles.

One bottle contains sodium chloride. The other bottle contains potassium chloride.

An analytical scientist wants to find out which chemical is in each bottle.

She decided to do a flame test on each chemical.

a) Describe how the scientist does the flame test.

You should include

- the equipment she uses;
- what she does;
- the results she would get for each chemical.

Unit Exercise (p. 76)

26 (continued)

You may draw a labelled diagram to help you answer the question.

Procedure

Any three of the following:

- Use a nichrome wire in the test. (1)
- Moisten a clean wire by dipping it into concentrated hydrochloric acid. (1)
- Dip the wire into the solid sample. (1)
- Hold the wire in the hottest part of a non-luminous flame. (1)

Results

Sodium chloride gives a golden yellow flame.
Potassium chloride gives a lilac flame. (1)

Unit Exercise (p. 77)

26 (continued)

b) Another scientist tests some water to find out if it contains chlorides.
To do the test she adds silver nitrate solution to the water.

i) What colour solid is made when silver nitrate solution is added to water containing chlorides?
White (1)

ii) What do we call the type of solid formed in this reaction?
Draw a ring around ONE answer.

a crystal a precipitate a solvent

(1)

Unit Exercise (p. 77)

26 (continued)

c) Sodium chloride reacts with silver nitrate.
Sodium nitrate and silver chloride are made.
Write a word equation for this reaction.

sodium chloride + silver nitrate

→ sodium nitrate + silver chloride (1)

(AQA GCSE (Foundation Tier), Additional Applied Science, Unit 1, Jun. 2013, 6)

Unit Exercise (p. 77)

27 Classify each of the following as a physical or chemical change.

a) An ice cube is placed in the sun. Later there is a puddle of water. Physical change (1)

b) A bicycle changes colour as it rusts. Chemical change (1)

c) Baking soda is mixed with vinegar. This causes bubbles. Chemical change (1)

d) Chocolate syrup is dissolved in milk. Physical change (1)

e) A glass cup falls from the counter and shatters on the ground. Physical change (1)

f) A marshmallow is toasted over a campfire. Chemical change (1)

g) A solid is crushed to a powder. Physical change (1)

h) A mixture of iron and sulphur is heated. Chemical change (1)

Unit Exercise (p. 77)

*28 A student is provided with a mixture of three substances, ethanol, water and iron.

The table below gives information of these three substances:

Substance	State at room temperature	Melting point (°C)	Boiling point (°C)	Solubility in water
Water	liquid	0	100	soluble
Ethanol	liquid	–117	78	soluble
Iron	solid	1 538	2 861	insoluble

Unit Exercise (p. 77)

*28 (continued)

Suggest how the student can separate the mixture to obtain pure samples of the three substances. Explain in detail how each method works.

Filter the mixture to obtain iron. (1)
Wash iron with water and dry. (1)
Water and ethanol has different boiling points. They can be separated by fractional distillation. (1)
Heat the mixture. Ethanol distills off as it has a lower boiling point. (1)
Communication mark (1)