SEPARATION TECHNIQUES – IGCSE (MCQS)

2 Which method is most suitable to obtain zinc carbonate from a suspension of zinc carbonate in water?

A crystallisation

B distillation

C evaporation

D filtration

0620_s/12/qp11

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2 An aqueous solution is coloured.

Which method of separation would show that the solution contains ions of different colours?

A chromatography

B crystallisation

C distillation

D filtration

0620_s/11/qp11

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3 The table gives the solubility of four substances in ethanol and in water.

A mixture containing all four substances is added to ethanol, stirred and filtered.

The solid residue is added to water, stirred and filtered.

The filtrate is evaporated to dryness, leaving a white solid.

Which is the white solid?

	solubility in	
	ethanol	water
A	insoluble	insoluble
B	insoluble	soluble
C	soluble	insoluble
D	soluble	soluble

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2 A fruit drink coloured orange contains a dissolved mixture of red and yellow colouring agents. One of these colouring agents is suspected of being illegal.

Which method could be used to show the presence of this illegal colouring agent?

A chromatography

B distillation

C evaporation

D filtration

0620_s/10/qp11

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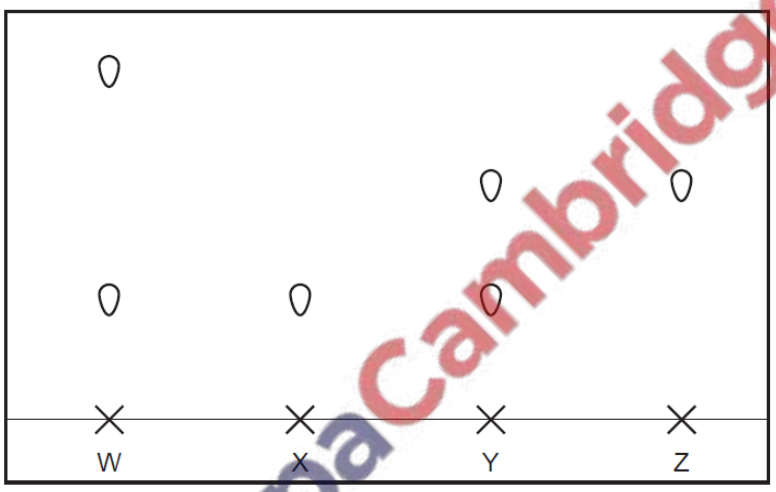
3 The diagram shows the paper chromatograms of four substances, W, X, Y and Z.



Which two substances are pure?

A W and X **B** W and Y **C** X and Y **D** X and Z

0620_s/09/qp11

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3 Chromatography and fractional distillation can be used to separate compounds.

In which type of separation is a thermometer needed for checking that complete separation has occurred?

A chromatographic separation of two colourless solids

B chromatographic separation of two solids of different colours

C fractional distillation of two colourless liquids

D fractional distillation of two liquids of different colours

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4 Which mixture can be separated by adding water, stirring and filtering?

A barium chloride and sodium chloride

B copper and magnesium

C diamond and graphite

D silver chloride and sodium nitrate

0620_s/07/qp1

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2 Which method can be used to obtain crystals from aqueous copper(II) sulphate?

A chromatography

B electrolysis

C evaporation

D neutralisation

0620_s/06/qp1

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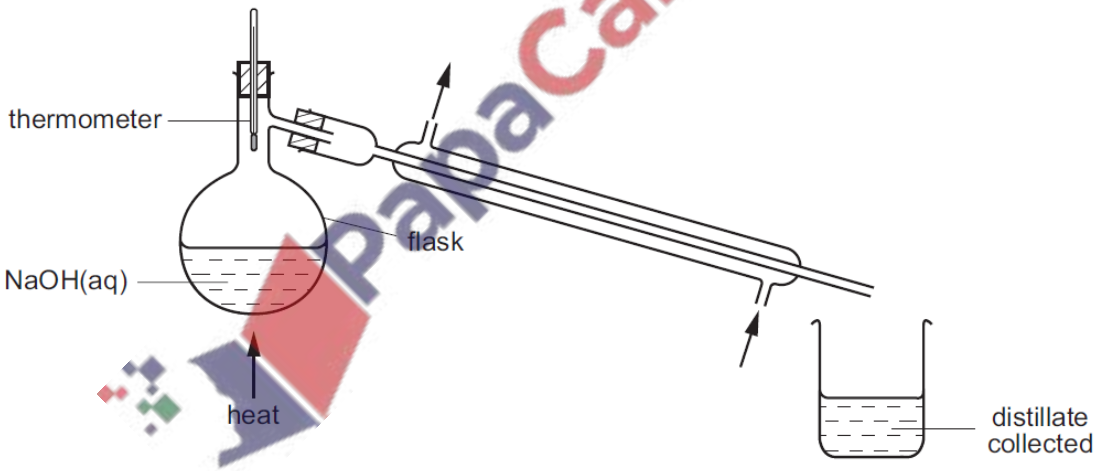
30 The pH of some aqueous sodium hydroxide is measured. The solution is then distilled as shown.



How do the pH values of the distillate and of the solution left in the flask compare with the original?

	pH of the distillate	pH of the solution left in the flask
A	higher	higher
B	higher	lower
C	lower	higher
D	lower	lower

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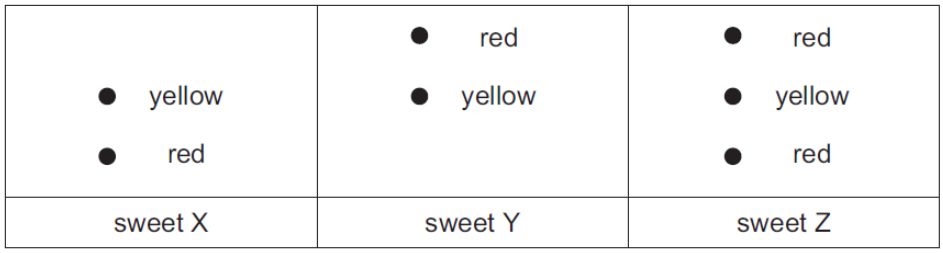
4 The diagram shows a chromatogram obtained from three sweets, X, Y and Z.



How many different red dyes are present in the sweets?

A 1 **B** 2 **C** 3 **D** 4

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3 Some chemical compounds are purified by recrystallisation.

What can be used to test the purity of the crystals?

A melting point

B colour of crystals

C size of crystals

D solubility

0620_s/03/qp1

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4 What could be the melting point and boiling point of water containing a dissolved impurity?

	melting point / °C	boiling point / °C
A	+3	96
B	+3	104
C	–3	96
D	–3	104

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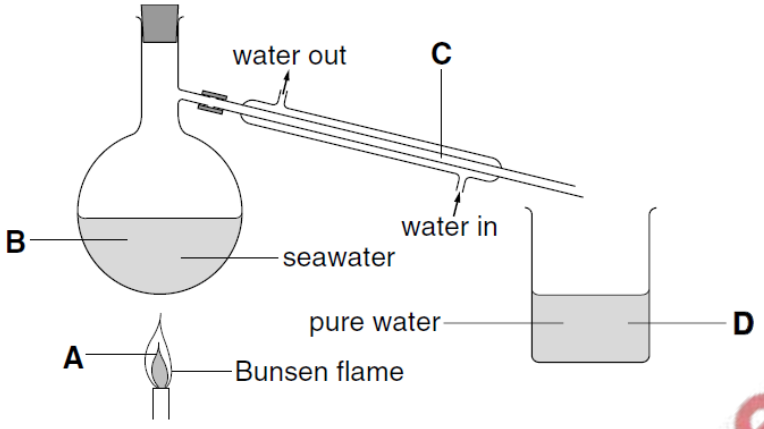
1 The diagram shows how to obtain pure water from seawater.

Where do water molecules lose energy?



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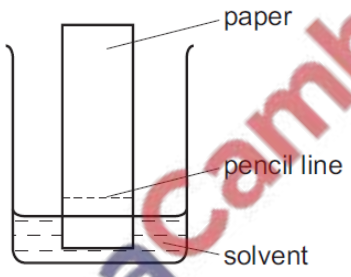
3 A student is investigating a coloured mixture using chromatography.



Where should he place the coloured mixture?

A in the solvent

B just above the pencil line

C just below the pencil line

D on the pencil line

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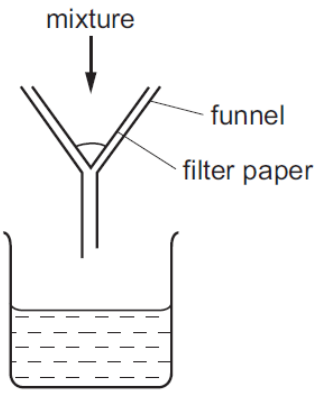
2 A mixture is separated using the apparatus shown.



What is the mixture?

A aqueous copper chloride and copper

B aqueous copper chloride and sodium chloride

C ethane and methane

D ethanol and water

0620_w/14/qp11

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3 Ethanol is made by fermentation.

How is ethanol obtained from the fermentation mixture?

A chromatography

B crystallisation

C electrolysis

D fractional distillation

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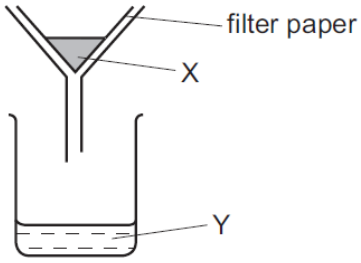
2 The diagram shows a method for separating a substance that contains X and Y.



Which types of substance can be separated as shown?

A compounds

B elements

C mixtures

D molecules

0620_w/13/qp13

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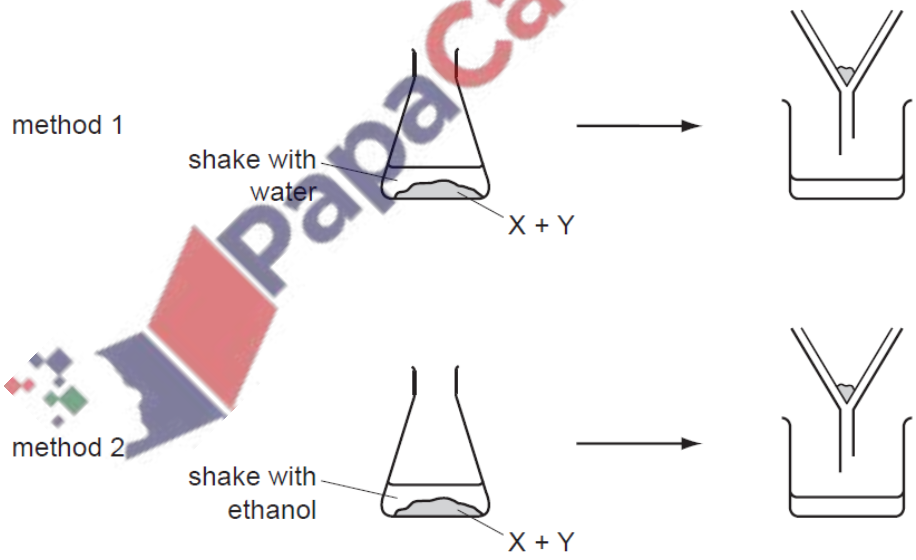
8 A solid mixture contains an ionic salt, X, and a covalent organic compound, Y.

Two students suggest methods of separating the mixture as shown.



Which methods of separation are likely to work?

	1	2
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

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3 Diagram 1 shows the paper chromatogram of substance X.

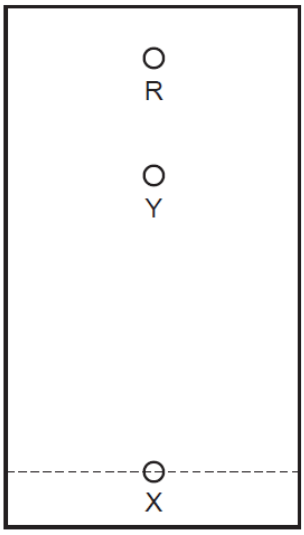

diagram 1

Diagram 2 shows the cooling curve for substance Y.

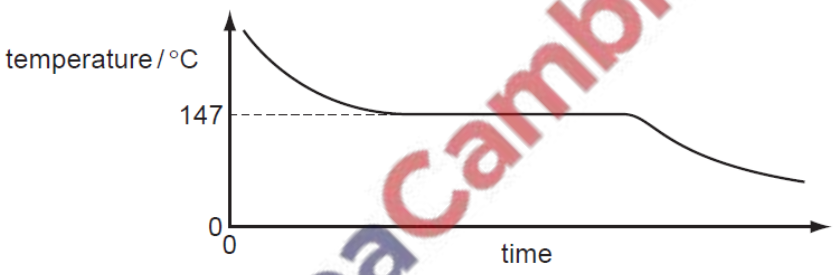

diagram 2

Which statement about X and Y is correct?

A X is a mixture and Y is a pure substance.

B X is a pure substance and Y is a mixture.

C X and Y are mixtures.

D X and Y are pure substances.

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2 Solid W melts at exactly 54 °C and boils at exactly 302 °C.

Solid X, when dissolved in water and examined using paper chromatography, shows a blue colour and a red colour.

Which row is correct?

	contains only one substance	contains more than one substance
A	W and X	–
B	W	X
C	X	W
D	–	W and X

0620_w/12/qp13

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2 A mixture of sulfur and iron filings needs to be separated. The solubilities of sulfur and iron filings in water and carbon disulfide are shown in the table below.

	solubility in water	solubility in carbon disulfide
sulfur	✗	✓
iron filings	✗	✗

What are possible methods of separating the sulfur and iron filings?

	using water	using carbon disulfide	using a magnet
A	✓	✓	✗
B	✗	✓	✓
C	✓	✗	✓
D	✗	✓	✗

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3 Mixture 1 contains sand and water.

Mixture 2 contains salt and water.

Which method of separation could be used to obtain each of the required products from each mixture?

	mixture 1		mixture 2	
	to obtain sand	to obtain water	to obtain salt	to obtain water
A	crystallisation	distillation	filtration	filtration
B	crystallisation	filtration	filtration	distillation
C	filtration	distillation	crystallisation	filtration
D	filtration	filtration	crystallisation	distillation

0620_w/11/qp11

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22 A salt is made by adding an excess of an insoluble metal oxide to an acid.

How can the excess metal oxide be removed?

A chromatography

B crystallisation

C distillation

D filtration

0620_w/10/qp11

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3 A mixture of ethanol and methanol are separated by fractional distillation.

This method of separation depends on a difference in property X of these two alcohols.

What is property X?

A boiling point

B colour

C melting point

D solubility

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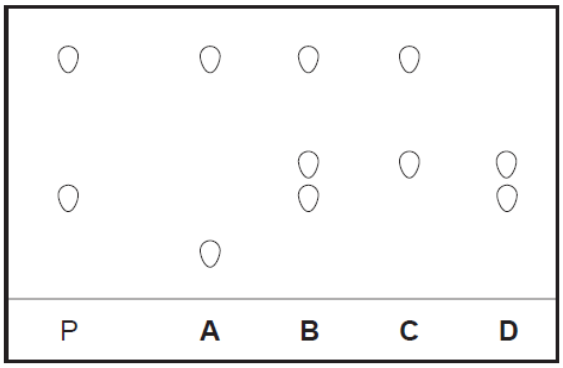
2 Chromatography is used to find out if a banned dye, P, is present in foodstuffs.

The results are shown in the diagram.

Which foodstuff contains P?



0620_w/10/qp11

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3 A student separates salt from a mixture of salt and sand.

What is the correct order of steps for the student to take?

A filter → evaporate → shake with water

B filter → shake with water → evaporate

C shake with water → evaporate → filter

D shake with water → filter → evaporate

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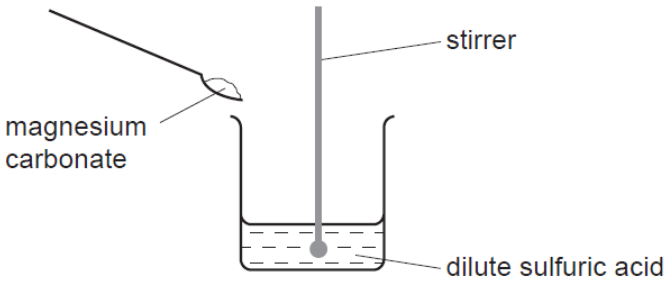
2 A student carries out an experiment to prepare pure magnesium sulfate crystals.

The diagram shows the first stage of the preparation.



He adds magnesium carbonate until no more reacts.

Which process should he use for the next stage?

A crystallisation

B evaporation

C filtration

D neutralisation

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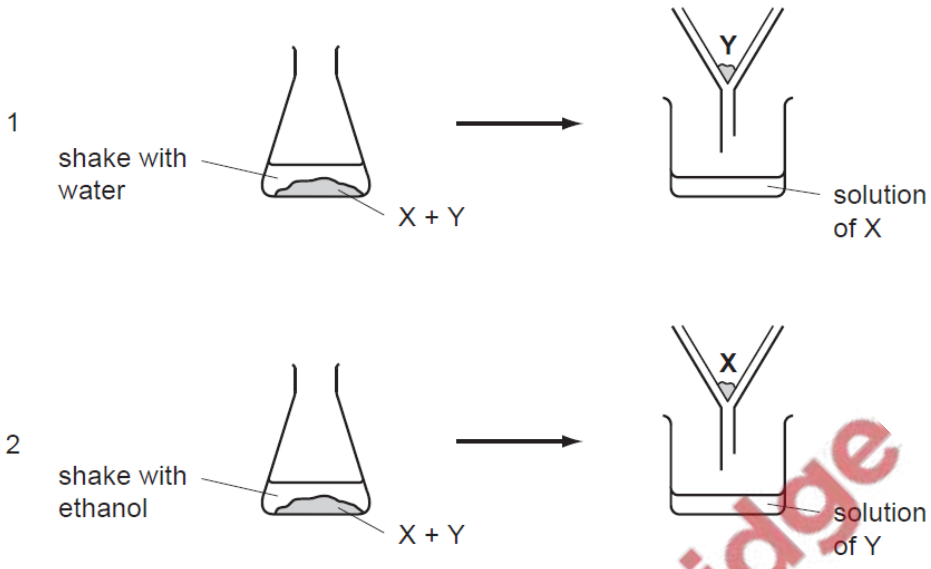
4 A solid mixture contains an ionic salt, X, and a covalent organic compound, Y.

Two students suggested methods of separating the mixture as shown.



Which methods of separation are likely to work?

	1	2
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

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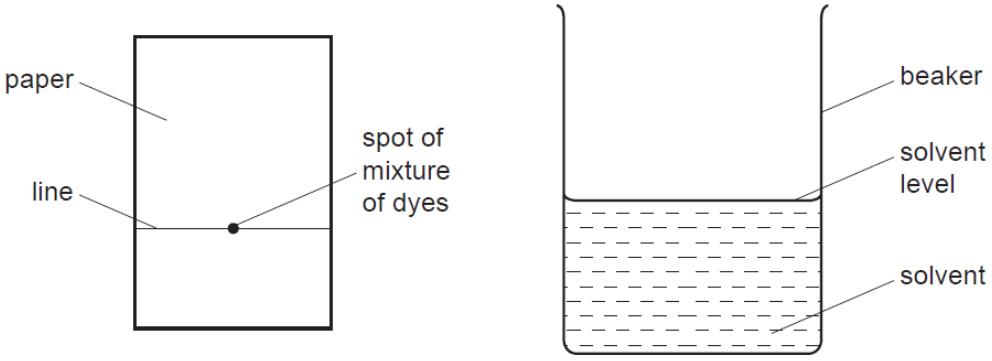
2 An experiment is carried out to separate a mixture of two dyes. A line is drawn on a piece of chromatography paper and a spot of the dye mixture placed on it. The paper is dipped into a solvent and left for several minutes.



Which statement about this experiment is correct?

A The dyes must differ in their boiling points.

B The dyes must differ in their solubilities in the solvent.

C The line must be drawn in ink.

D The line must be placed below the level of the solvent.

0620_w/08/qp1

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4 A sample of a drug is analysed by using a chemical test for aspirin and measuring its melting point.

The chemical test is positive but the melting point is 130 °C not 135 °C as it should be.

What is correct?

	the sample contains aspirin	the sample has an impurity
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

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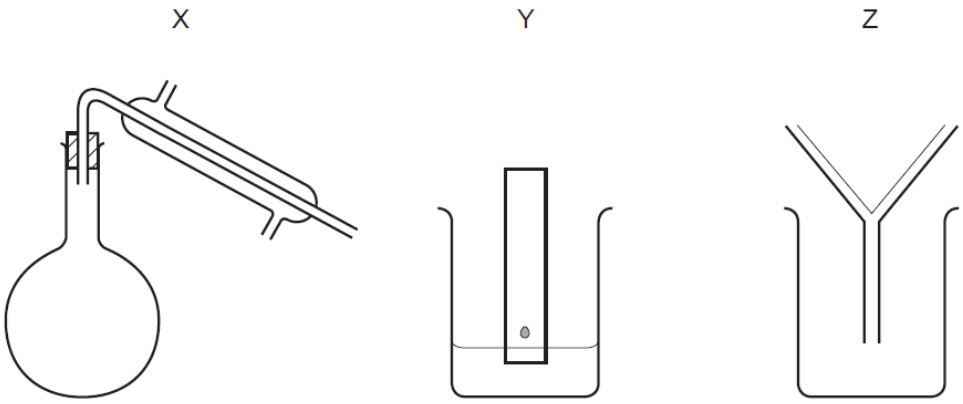
3 The outline diagrams show three methods of separation.

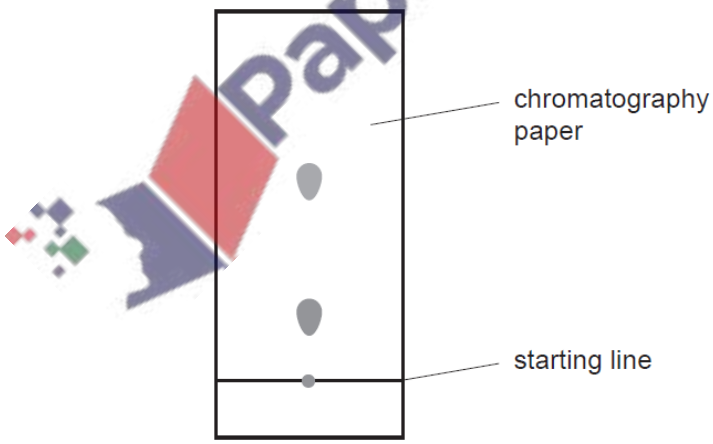


What are the three methods called?

	X	Y	Z
A	chromatography	distillation	filtration
B	distillation	chromatography	filtration
C	distillation	filtration	chromatography
D	filtration	chromatography	distillation

0620_w/07/qp1

3 A coin is dissolved in an acid. Chromatography is used to test the solution formed. The diagram shows the chromatogram obtained.



What is the coin made from?

A a metal element

B a non-metal element

C a mixture of metals

D a mixture of non-metals

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3 Which mixture can be separated by adding water, stirring and filtering?

A barium chloride and sodium chloride

B calcium carbonate and sodium chloride

C copper and magnesium

D ethane and ethene

0620_w/03/qp1

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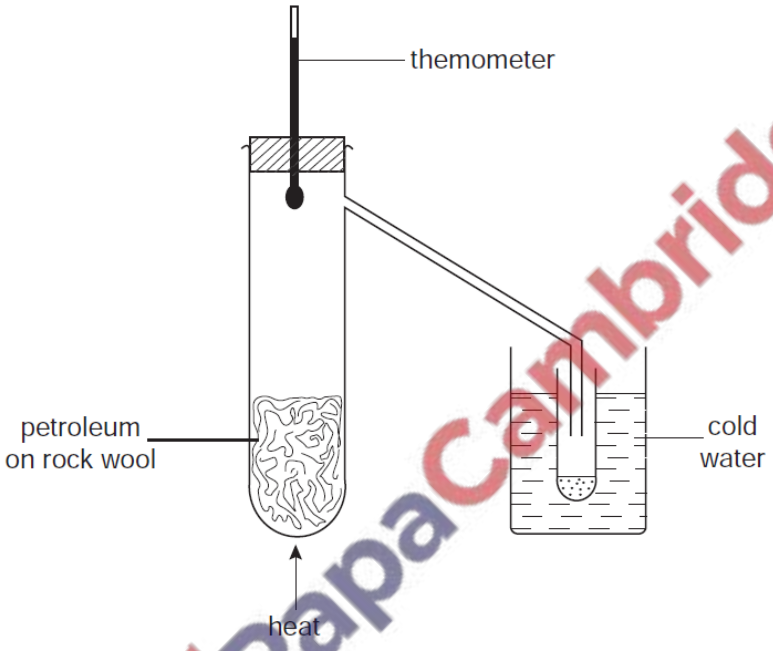
37 A student sets up the apparatus shown to separate petroleum into its different liquid parts.



Why does this method of separation work?

The liquids in petroleum have different

A boiling points,

B densities,

C functional groups,

D melting points.

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3 Which stages occur in distillation?

A condensation then evaporation

B condensation then filtration

C evaporation then condensation

D filtration then evaporation

0620_w/02/qp1

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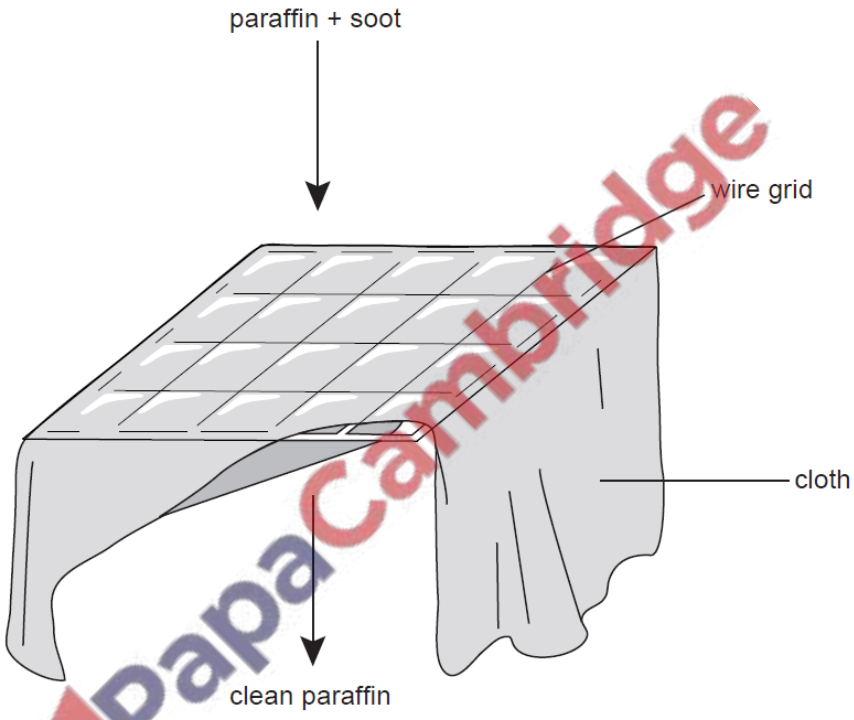
4 Some paraffin is contaminated with soot (carbon). The soot is removed as shown.



Which method is used to remove the soot?

A cracking

B crystallisation

C diffusion

D filtration

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3 Which two methods can be used to separate a salt from its solution in water?

1 crystallisation

2 decanting

3 distillation

4 filtration

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 and 4

0620_s/14/qp12

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3 Alcohol and water are completely miscible. This means when mixed together they form only one liquid layer.

Which method is used to separate alcohol from water?

A crystallisation

B filtration

C fractional distillation

D precipitation

0620_s/14/qp11

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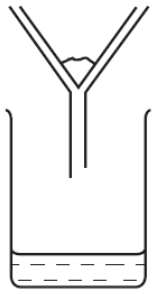
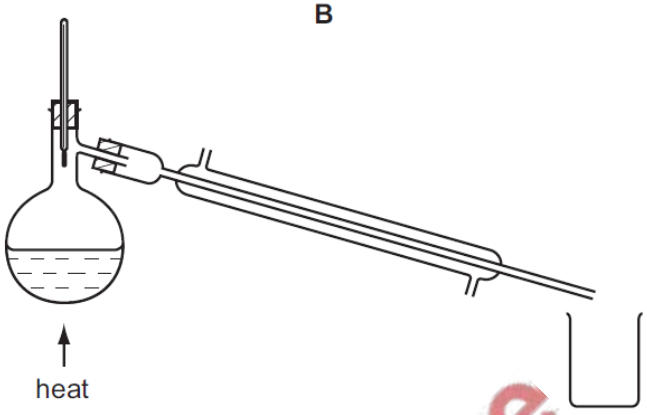
3 Methanol, CH_3OH, and ethanol, C_2H_5OH, are miscible liquids.

Which diagram shows apparatus that is used to obtain methanol from a mixture of ethanol and methanol?

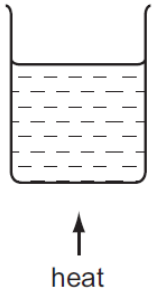
A



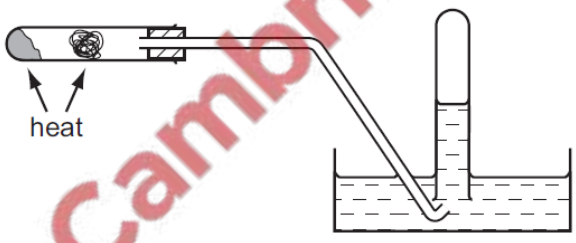
B



C



D



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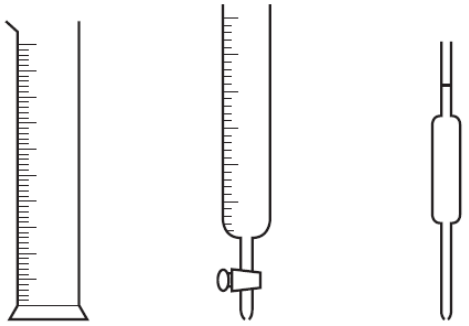
EXPERIMENTAL – IGCSE (MCQS)

2 The diagram shows three pieces of apparatus that are used for measuring the volume of a liquid.



1 2 3

What are these pieces of apparatus?

	1	2	3
A	burette	measuring cylinder	pipette
B	burette	pipette	measuring cylinder
C	measuring cylinder	burette	pipette
D	measuring cylinder	pipette	burette

0620_w/14/qp11

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2 A student measures the rate of two reactions.

In one reaction, there is a change in mass of the reactants during the reaction.

In the second reaction, there is a change in temperature during the reaction.

Which piece of apparatus would be essential in **both** experiments?

A balance

B clock

C pipette

D thermometer

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3 Part of the instructions in an experiment reads as follows.

Quickly add 50 cm^3 of acid.

What is the best piece of apparatus to use?

A a burette

B a conical flask

C a measuring cylinder

D a pipette

0620_w/12/qp11

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30 A liquid turns white anhydrous copper sulfate blue and has a boiling point of 103°C.

Which could be the identity of the liquid?

A alcohol

B petrol

C salt solution

D pure water

0620_w/11/qp11

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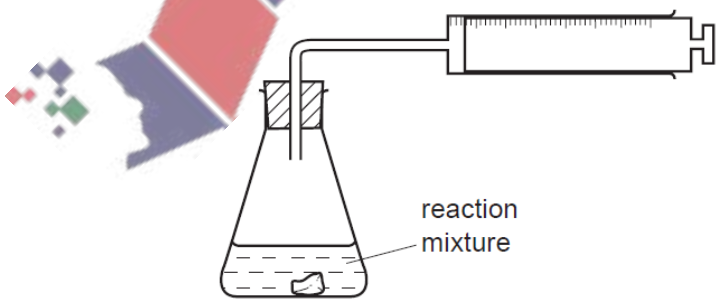
15 An experiment to determine the rate of a chemical reaction could be carried out using the apparatus shown.



Which reaction is being studied?

A $Cl_2 + 2KBr \rightarrow 2KCl + Br_2$

B $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

C $NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$

D $NaOH + HCl \rightarrow NaCl + H_2O$

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2 A student was provided with only a thermometer, a stopwatch and a beaker.

What could the student measure?

A 10.5 g solid and 24.8 cm^3 liquid

B 10.5 g solid and 25 °C

C 24.8 cm^3 liquid and 45 seconds

D 25 °C and 45 seconds

0620_w/11/qp11

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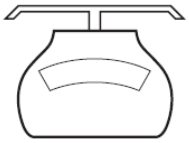
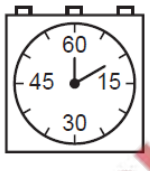
15 The diagrams show some pieces of laboratory equipment.

1
balance



2
stop-clock



3
thermometer

Which equipment is needed to find out whether dissolving salt in water is an endothermic process?

A 1 only **B** 1 and 3 **C** 2 and 3 **D** 3 only

0620_w/10/qp11

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2 Part of the instructions in an experiment reads as follows.

Quickly add 50 cm^3 of acid.

What is the best piece of apparatus to use?

A a burette

B a conical flask

C a measuring cylinder

D a pipette

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13 Which piece of apparatus is essential to measure the speed of a reaction?

A accurate balance

B gas syringe

C stopwatch

D thermometer

0620_w/06/qp1

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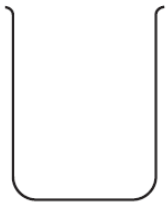
2 A student mixes 25 cm^3 samples of dilute hydrochloric acid with different volumes of aqueous sodium hydroxide. Each time, the student measures the change in temperature.

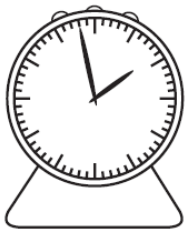
Which piece of apparatus is **not** needed?

A



beaker

B



clock

C

measuring cylinder

D

thermometer

0620_w/06/qp1

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3 Which piece of apparatus should be used for the **accurate** measurement of 30.0 cm^3 of a liquid?

A a beaker

B a burette

C a conical flask

D a measuring cylinder

0620_w/06/qp1

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2 The reaction between solution **P** and solution **Q** is exothermic.

A student is told to test this statement by mixing equal volumes of the two solutions and measuring the temperature change.

Which two pieces of apparatus should the student use?

A balance and clock

B balance and thermometer

C pipette and clock

D pipette and thermometer

0620_w/05/qp1

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29 What is used to test for the presence of water?

A anhydrous copper(II) sulphate

B aqueous barium chloride

C aqueous sodium hydroxide

D Universal indicator paper

0620_w/04/qp1

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4 A student wishes to extract a coloured solution from some berries to make an indicator solution.

Which of the listed instructions should the student follow?

1	crush the berries
2	add acid
3	add a solvent
4	filter the mixture
5	distil the filtrate

A 1, 2 and 4

B 1, 3 and 4

C 2, 3 and 5

D 2, 4 and 5

0620_w/04/qp1

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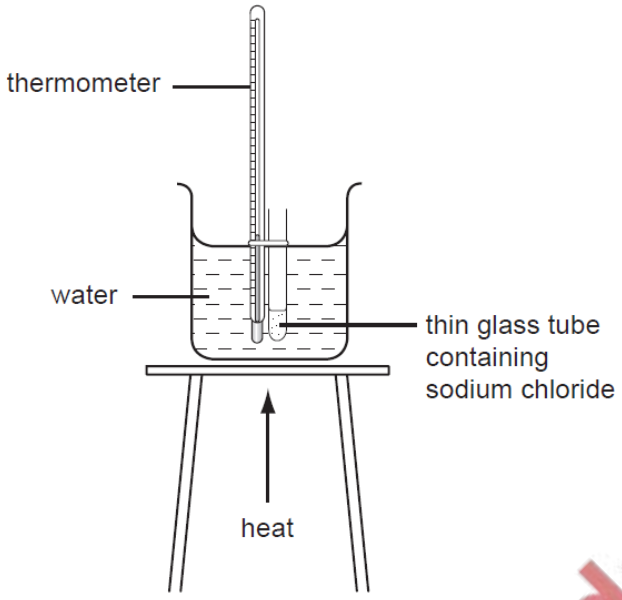
3 The apparatus shown **cannot** be used to determine the melting point of sodium chloride, Na^+Cl^-.



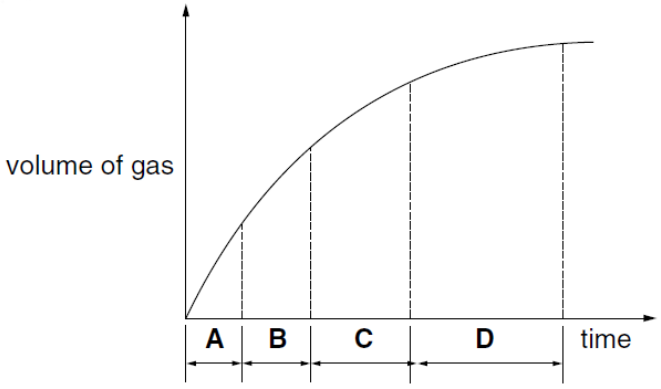
Why is this?

	melting point of sodium chloride is greater than 100 °C	sodium chloride dissolves in the water
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

0620_w/04/qp1

14 The graph shows how the total volume of a gas given off from a reaction changes with time.

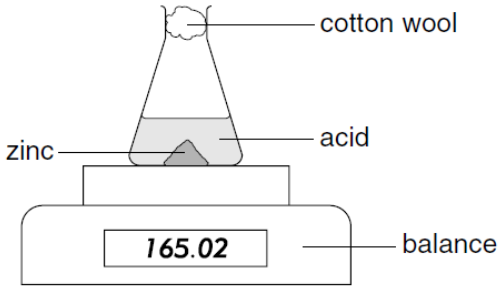
In which time interval is **least** gas given off?



0620_w/03/qp1

PapaCambridge

4 A student investigates the speed of the reaction between a lump of zinc and an acid at room temperature.



Which other item of apparatus does the student need for this experiment?

A Bunsen burner

B measuring cylinder

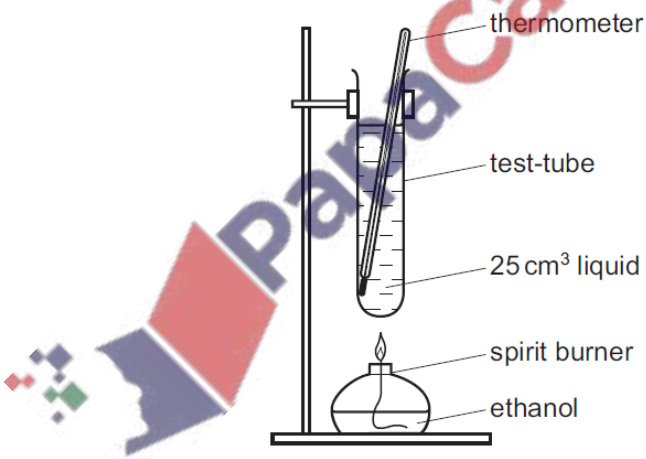
C stop clock

D thermometer

0620_w/03/qp1

---

2 A liquid is heated until it boils.



Which result shows that the liquid in the test-tube is pure water?

A Condensation forms at the top of the test-tube.

B Steam is produced.

C The thermometer reads 100 °C.

D There is nothing left behind in the test-tube.

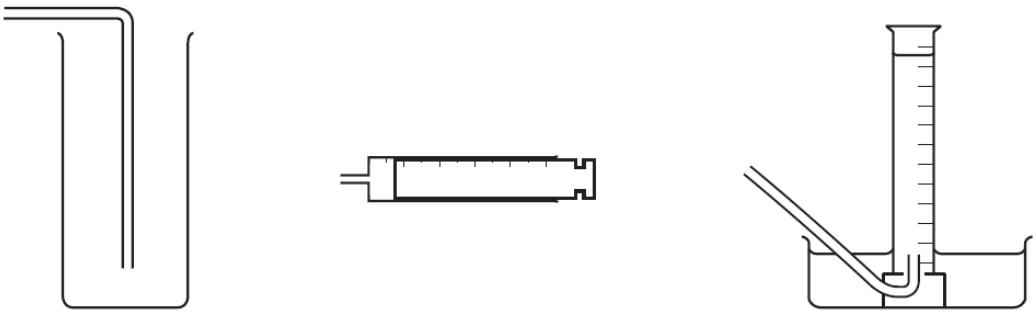
0620_s/14/qp12

PapaCambridge

17 An experiment is carried out to investigate the rate of reaction when calcium carbonate is reacted with hydrochloric acid.

The volume of carbon dioxide gas given off is measured at different intervals of time.

The diagram shows pieces of apparatus used to collect gases.



1
downward delivery

2
gas measuring syringe

3
over water in graduated tube

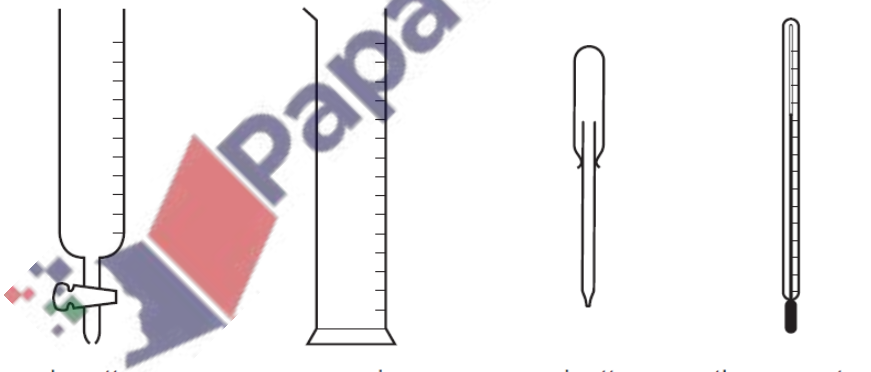
Which apparatus is suitable to collect and measure the volume of the carbon dioxide?

A 1, 2 and 3 **B** 2 and 3 only **C** 1 only **D** 3 only

0620_s/14/qp11

---

2 The four pieces of apparatus shown below are used in chemical experiments.



burette

measuring cylinder

pipette

thermometer

Which statement about the apparatus is correct?

A The burette measures the volume of liquid added in a titration.

B The measuring cylinder measures the mass of a substance used in an experiment.

C The pipette measures the volume of gas given off in a reaction.

D The thermometer measures the density of a solution.

0620_s/14/qp11

PapaCambridge

2 Crystals of sodium chloride were prepared by the following method.

1 25.0 cm^3 of dilute hydrochloric acid was accurately measured into a conical flask.

2 Aqueous sodium hydroxide was added until the solution was neutral. The volume of sodium hydroxide added was measured.

3 The solution was evaporated and the crystals washed with approximately 15 cm^3 of water.

Which row shows the pieces of apparatus used to measure the 25.0 cm^3 of hydrochloric acid, the volume of aqueous sodium hydroxide and the 15 cm^3 of water?

	25.0 cm^3 of hydrochloric acid accurately	the volume of aqueous sodium hydroxide added	15 cm^3 of water approximately
A	burette	pipette	measuring cylinder
B	measuring cylinder	burette	pipette
C	pipette	burette	measuring cylinder
D	pipette	measuring cylinder	burette

0620_s/13/qp11

---

3 Lead iodide is insoluble in water.

Lead iodide is made by adding aqueous lead nitrate to aqueous potassium iodide.

Which pieces of apparatus are needed to obtain solid lead iodide from 20 cm^3 of aqueous lead nitrate?

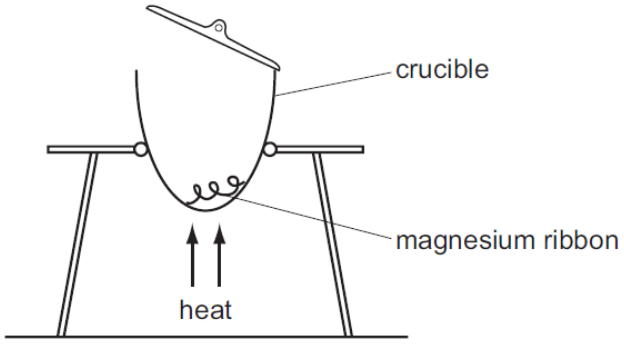
1 2 3 4 5

A 1, 2 and 4 **B** 1, 3 and 5 **C** 1, 4 and 5 **D** 2, 4 and 5

0620_s/13/qp11

PapaCambridge

2 The diagram shows an experiment to find the formula of magnesium oxide.



Which piece of apparatus would be needed in addition to those shown?

A a balance

B a measuring cylinder

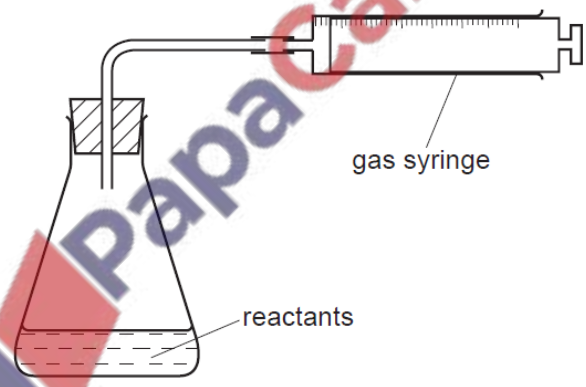
C a spatula

D a thermometer

0620_s/13/qp12

---

13 The apparatus shown is used to measure the speed of a reaction.



Which equation represents a reaction where the speed can be measured using this apparatus?

A $Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$

B $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

C $Fe(s) + CuSO_4(aq) \rightarrow Cu(s) + FeSO_4(aq)$

D $2Na(s) + Br_2(l) \rightarrow 2NaBr(s)$

0620_s/12/qp11

PapaCambridge

3 A student investigates how the concentration of an acid affects the speed of reaction with a 0.5 g mass of magnesium at 30 °C.

The student has a beaker, concentrated acid, water and the apparatus below.

P a balance

Q a clock

R a measuring cylinder

S a thermometer

Which pieces of apparatus does the student use?

A P, Q and R only

B P, Q and S only

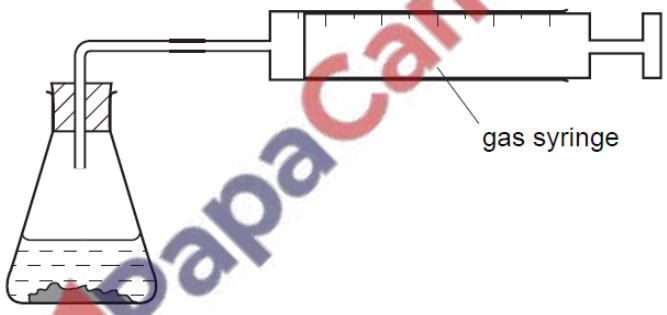
C Q, R and S only

D P, Q, R and S

0620_s/12/qp11

---

15 The apparatus shown can be used to measure the rate of some chemical reactions.



For which two reactions would the apparatus be suitable?

reaction 1 $AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$

reaction 2 $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

reaction 3 $MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l)$

reaction 4 $ZnCO_3(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + CO_2(g) + H_2O(l)$

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

0620_s/11/qp11

PapaCambridge

3 A student carries out an experiment to find how fast 3 cm pieces of magnesium ribbon dissolve in 10 cm^3 samples of sulfuric acid at different temperatures.

Which piece of apparatus does the student **not** need?

A balance

B measuring cylinder

C stop-clock

D thermometer

0620_s/10/qp11

---

2 A student takes 2 g samples of calcium carbonate and adds them to 20 cm^3 samples of dilute hydrochloric acid at different temperatures. She measures how long it takes for the effervescence to stop.

Which apparatus does she use?

	balance	clock	filter funnel	measuring cylinder	thermometer
A	✓	✓	✓	✓	✗
B	✓	✓	✗	✓	✓
C	✓	✗	✓	✓	✓
D	✗	✓	✓	✗	✓

0620_s/09/qp11

---

2 A student is asked to measure the time taken for 4.00 g of magnesium carbonate to react completely with 25.0 cm^3 (an excess) of dilute hydrochloric acid.

Which pieces of apparatus does the student need?

A balance, clock, pipette

B balance, clock, thermometer

C balance, pipette, thermometer

D clock, pipette, thermometer

0620_s/08/qp1

PapaCambridge

26 The table shows the densities of some Group I metals.

Which of these metals sinks in benzene (density = 0.88 g / cm^3) but floats in nitrobenzene (density = 1.2 g / cm^3)?

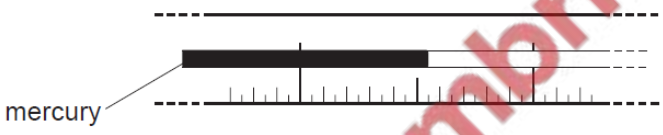
	metal	density, in g / cm^3
A	lithium	0.53
B	sodium	0.97
C	potassium	0.86
D	rubidium	1.53

0620_s/07/qp1

---

3 The boiling point of liquid X is lower than that of water. To test a student, a teacher covers up the numbers on a thermometer. The student places the thermometer in boiling liquid X.

The diagram represents part of the stem of this thermometer.



What could the temperature on the thermometer be?

A 75.5 °C **B** 84.5 °C **C** 104.5 °C **D** 105.5 °C

0620_s/07/qp1

---

2 A student investigates if, at 30 °C, the concentration of acid affects how rapidly it reacts with a known mass of magnesium.

The student has a beaker, concentrated acid, water and the apparatus below.

P a balance

Q a clock

R a measuring cylinder

S a thermometer

Which of these pieces of apparatus does the student use?

A P, Q and R only

B P, Q and S only

C Q, R and S only

D P, Q, R and S

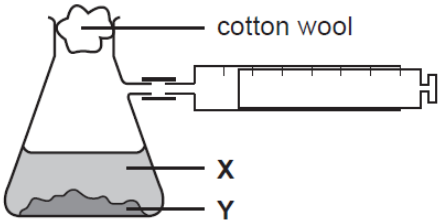
0620_s/07/qp1

PapaCambridge

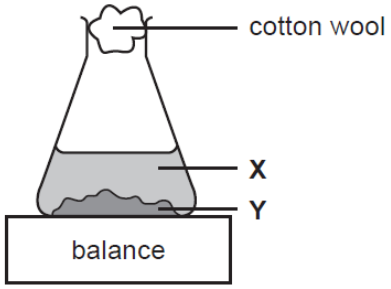
16 A liquid **X** reacts with solid **Y** to form a gas.

Which **two** diagrams show suitable methods for investigating the speed of the reaction?

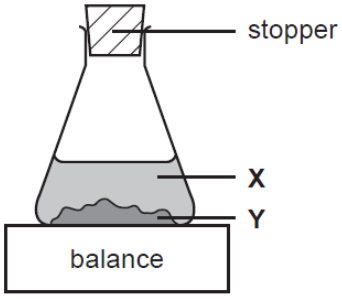
1



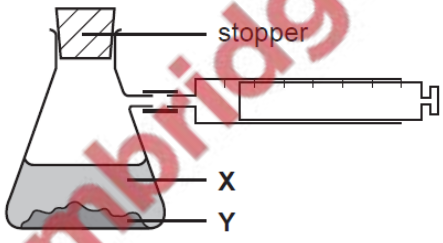
2



3



4



A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

0620_s/05/qp1

---

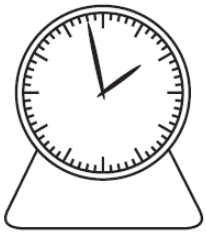
2 A student mixes 25 cm^3 samples of dilute hydrochloric acid with different volumes of aqueous sodium hydroxide. Each time, the student measures the change in temperature to test if the reaction is exothermic.

Which piece of apparatus is **not** needed?

A

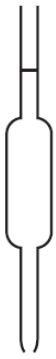
burette

B



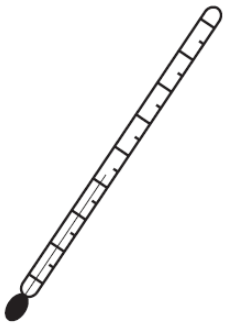
clock

C



pipette

D



thermometer

0620_s/05/qp1

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3 In an experiment, a student needs to measure out 36.50 cm^3 of a solution.

Which piece of apparatus would measure this volume most accurately?

A beaker

B burette

C measuring cylinder

D pipette

0620_s/05/qp1

SEPARATION TECHNIQUES – IGCSE (THEORY)

1 An important aspect of chemistry is purity and methods of purification.

(a) Give an example of substances used in everyday life which must be pure.

..... [1]

(b) A list of techniques used to separate mixtures is given below.

chromatography **crystallisation** **diffusion** **dissolving**

evaporation **filtration** **fractional distillation** **simple distillation**

(i) From the list, choose the most suitable technique to separate the following.

water from sea-water .....

helium from a mixture of helium and methane .....

ethanol from a mixture of ethanol and propanol .....

iron filings from a mixture of iron filings and water .....

a mixture of two amino acids, glycine and alanine .....

[5]

(ii) Describe how you would obtain a pure sample of copper(II) sulfate-5-water crystals from a mixture of copper(II) sulfate-5-water with copper(II) oxide using some of the techniques listed above.

.....

.....

.....

.....

..... [4]

[Total: 10]

0620/w14/qp32

PapaCambridge

1 A list of techniques used to separate mixtures is given below.

filtration

diffusion

fractional distillation

simple distillation

crystallisation

chromatography

From this list, choose the most suitable technique to separate the following mixtures.
A technique may be used once, more than once or not at all.

(a) butane from a mixture of propane and butane ..... [1]

(b) oxygen from liquid air ..... [1]

(c) water from aqueous magnesium sulfate ..... [1]

(d) potassium chloride from aqueous potassium chloride ..... [1]

(e) silver chloride from a mixture of silver chloride and water ..... [1]

(f) glucose from a mixture of glucose and maltose ..... [1]

[Total: 6]

0620/w12/qp31

---

1 A list of techniques used to separate mixtures is given below.

fractional distillation **simple distillation** **crystallization** **filtration** **diffusion**

From the list choose the most suitable technique to separate the following.

water from aqueous copper(II) sulphate .....

helium from a mixture of helium and argon .....

copper(II) sulphate from aqueous copper(II) sulphate .....

ethanol from aqueous ethanol .....

barium sulphate from a mixture of water and barium sulphate ..... [5]

[Total: 5]

0620/w07/qp3

PapaCambridge

2 The table shows the melting points, boiling points and electrical properties of the six substances **A** to **F**.

substance	melting point / °C	boiling point / °C	electrical conductor at room temperature	electrical conductor of substance dissolved in water
A	961	2193	good	does not dissolve
B	113	444	does not conduct	does not dissolve
C	0	100	very poor	very poor
D	803	1465	does not conduct	good
E	–5 to -10	102 to 105	good	good
F	-85	-60	does not conduct	does not dissolve

(i) Which **three** substances are solids at room temperature?

..... [1]

(ii) Which **one** is an ionic compound?

..... [1]

(iii) Which **one** is a gas at room temperature?

..... [1]

(iv) Which **two** substances are liquids at room temperature?

..... [1]

(v) Which substance is a metal?

..... [1]

(vi) Which **one** is an impure substance?

..... [1]

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(iii) Explain why the chromatogram must be sprayed with a locating agent before the amino acids can be identified.

.....

.....[1]

(iv) Explain how it is possible to identify the amino acids from the chromatogram.

.....

.....[2]

0620/w03/qp3

(d) The equilibrium mixture leaving the reaction chamber contains 15% ammonia. Suggest how the ammonia could be separated from the mixture.

	boiling point / °C
hydrogen	–253
nitrogen	–196
ammonia	–33

.....

..... [2]

0620/s14/qp33

(c) Most helium is obtained from natural gas found in the USA. Natural gas contains methane and 7% helium. One possible way to obtain the helium would be to burn the methane.

(i) Write an equation for the complete combustion of methane.

..... [1]

(ii) Suggest why this would **not** be a suitable method to obtain the helium.

.....

..... [1]

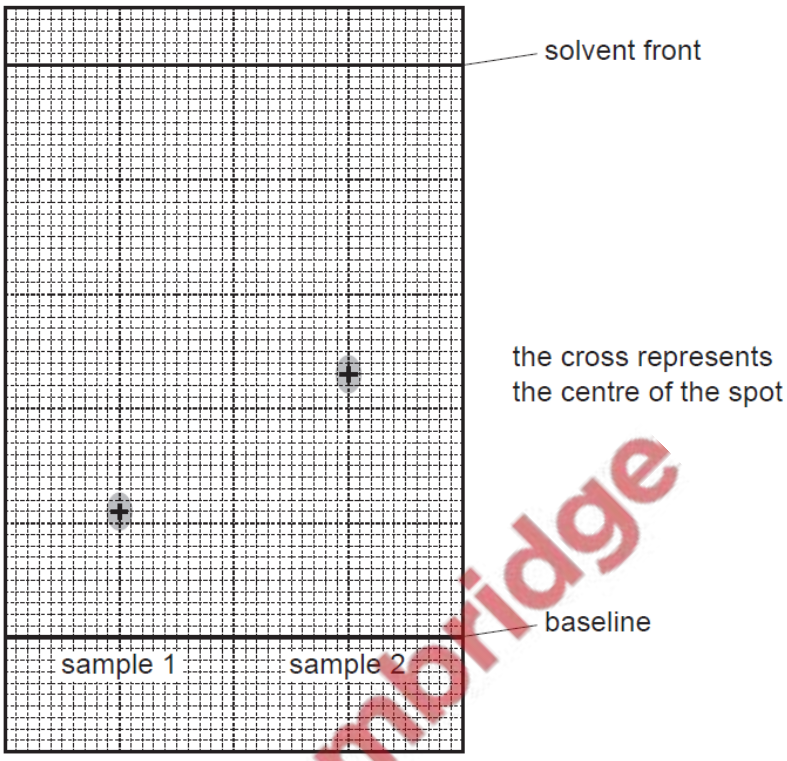
(iii) Suggest another method, other than diffusion, by which helium could be separated from the mixture of gases in natural gas.

..... [1]

0620/s14/qp31

PapaCambridge

(c) Esters can be used as solvents in chromatography. The following shows a chromatogram of plant acids.



An ester was used as the solvent and the chromatogram was sprayed with bromothymol blue.

(i) Suggest why it was necessary to spray the chromatogram.

.....

..... [2]

(ii) Explain what is meant by the R_f value of a sample.

.....

..... [1]

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(iii) Calculate the R_f values of the two samples and use the data in the table to identify the plant acids.

plant acid	R_f value
tartaric acid	0.22
citric acid	0.30
oxalic acid	0.36
malic acid	0.46
succinic acid	0.60

sample 1 R_f = ... It is ..... acid.

sample 2 R_f = ... It is ..... acid. [2]

[Total: 11]

0620/s13/qp32

---

6 Sulfuric acid and malonic acid are both dibasic acids. One mole of a dibasic acid can form two moles of hydrogen ions.

$$H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$$

Dibasic acids can form salts of the type Na_2X and CaX.

(a) Malonic acid is a white crystalline solid which is soluble in water. It melts at 135 °C. The structural formula of malonic acid is given below. It forms salts called malonates.

$$CH_2(COOH)_2 \text{ or } HOOC-CH_2-COOH$$

(i) How could you determine if a sample of malonic acid is pure?

technique used .....

result if pure ..... [2]

0620/s13/qp33

PapaCambridge

1 Substances can be classified as:

elements mixtures compounds

Elements can be divided into:

metals non-metals

(a) Define each of the following terms.

(i) *element*

.....

..... [2]

(ii) *compound*

.....

..... [2]

(iii) *mixture*

.....

..... [1]

(b) Classify each of the following as either an element, compound or mixture.

(i) brass ..... [1]

(ii) carbon dioxide ..... [1]

(iii) copper ..... [1]

(c) Which physical property is used to distinguish between metals and non-metals? It is possessed by all metals but by only one non-metal.

..... [1]

[Total: 9]

PapaCambridge

1 Petroleum contains hydrocarbons which are separated by fractional distillation.

(a) (i) Complete the following definition of a hydrocarbon.

A hydrocarbon is a compound which .....

..... [2]

(ii) Explain what is meant by the term *fractional distillation*.

.....

.....

..... [2]

(b) Some of the fractions obtained from petroleum are given below.
State a use for each fraction.

bitumen .....

lubricating fraction .....

paraffin fraction .....

gasoline fraction ..... [4]

[Total: 8]

PapaCambridge

1 The following techniques are used to separate mixtures.

A simple distillation	**B** fractional distillation	**C** evaporation
D chromatography	**E** filtration	**F** diffusion

From this list, choose the most suitable technique to separate the following.

(a) methane from a mixture of the gases, methane and ethane ..... [1]

(b) water from aqueous magnesium sulfate ..... [1]

(c) glycine from a mixture of the amino acids, glycine and lysine ..... [1]

(d) iron filings from a mixture of iron filings and water ..... [1]

(e) zinc sulfate crystals from aqueous zinc sulfate ..... [1]

(f) hexane from a mixture of the liquids, hexane and octane ..... [1]

[Total: 6]

0620/s11/qp31

---

1 Some grass is crushed and mixed with the solvent, propanone. The colour pigments are extracted to give a deep green solution.

(a) **(i)** Draw a labelled diagram to describe how you could show that there is more than one coloured pigment in the green solution.

PapaCambridge

[3]

(ii) Given a pure sample of chlorophyll, how could you show that the green solution from the grass contained chlorophyll?

.....

.....

.....

..... [2]

0620/s09/qp31

1 A major source of energy is the combustion of fossil fuels.

(a) **(i)** Name a solid fossil fuel.

..... [1]

(ii) Name a gaseous fossil fuel.

..... [1]

(b) Petroleum is separated into more useful fractions by fractional distillation.

(i) Name **two** liquid fuels obtained from petroleum.

..... and ..... [2]

(ii) Name **two** other useful products obtained from petroleum that are not used as fuels.

..... and ..... [2]

(iii) Give another mixture of liquids that is separated on an industrial scale by fractional distillation.

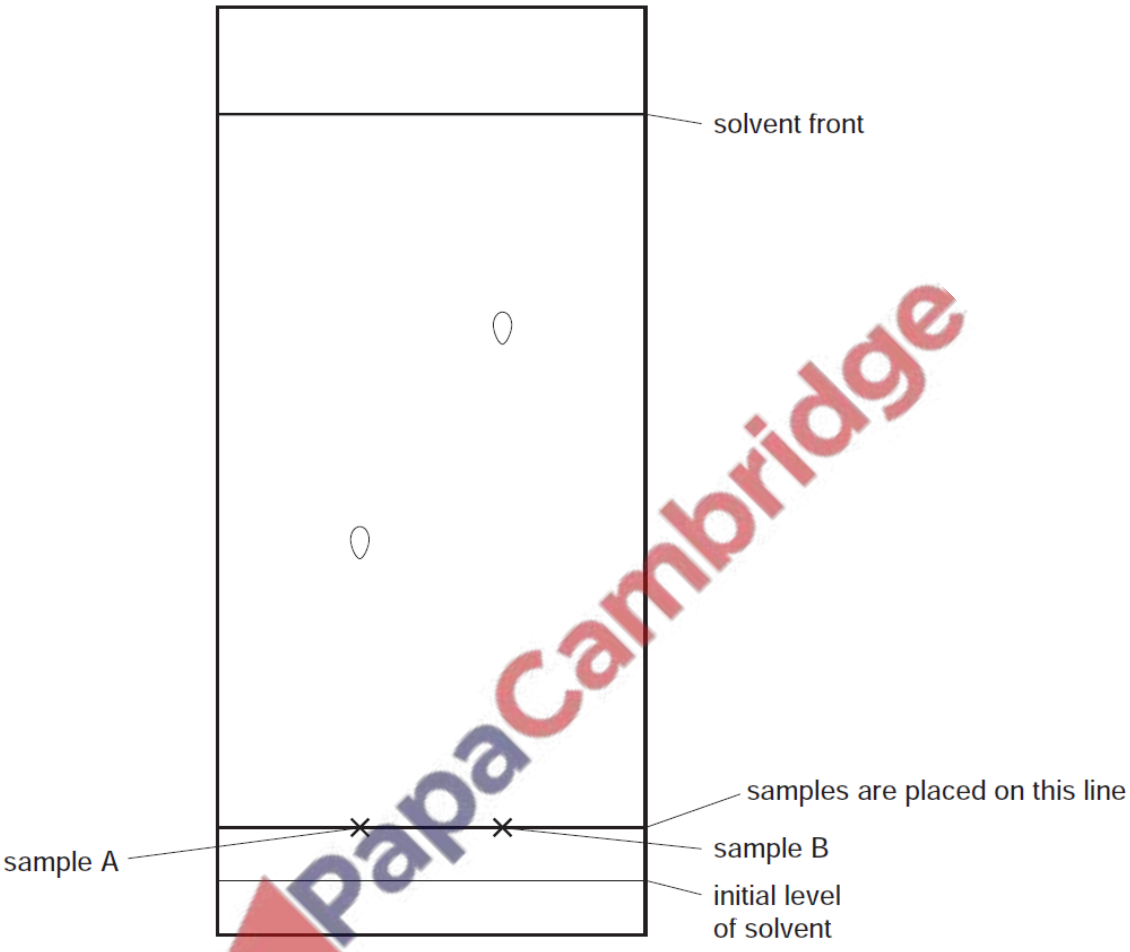
..... [1]

[Total: 7]

PapaCambridge

5 Enzymes are biological catalysts. They are used both in research laboratories and in industry.

(a) Enzymes called proteases can hydrolyse proteins to amino acids. The amino acids can be separated and identified by chromatography. The diagram below shows a typical chromatogram.



PapaCambridge

(i) The R_f value of a sample = $\frac{\text{distance travelled by sample}}{\text{distance travelled by solvent front}}$

Some R_f values for amino acids are:

glutamic acid = 0.4 glycine = 0.5 alanine = 0.7 leucine = 0.9

Identify the two amino acids on the chromatogram.

A is ..... B is ..... [2]

(ii) Explain why the chromatogram must be exposed to a locating agent before R_f values can be measured.

..... [1]

(iii) Measuring R_f values is one way of identifying amino acids on a chromatogram. Suggest another.

.....

[1]

(d) Traces of chlorine can be separated from bromine vapour by diffusion.
Which gas would diffuse the faster and why?

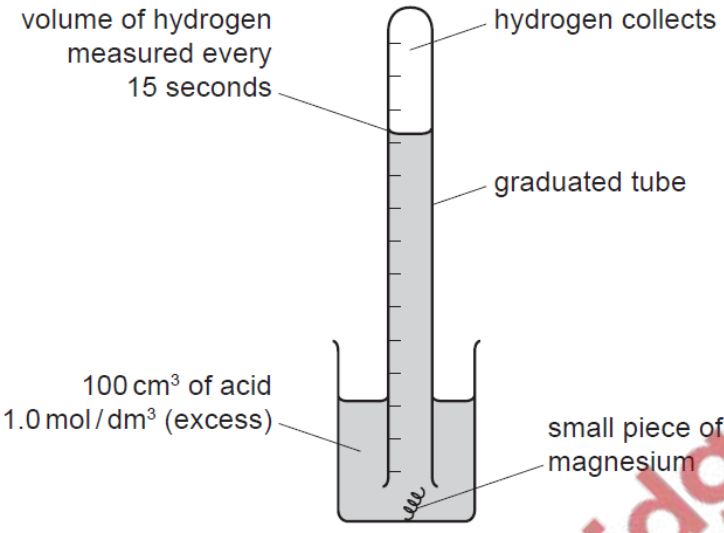
.....

.....

[2]

PapaCambridge

3 A diagram of the apparatus which could be used to investigate the rate of reaction between magnesium and an excess of an acid is drawn below.



(a) The magnesium kept rising to the surface. In one experiment, this was prevented by twisting the magnesium around a piece of copper. In a second experiment, the magnesium was held down by a plastic net fastened to the beaker.

(i) Suggest a reason why magnesium, which is denser than water, floated to the surface.

.....

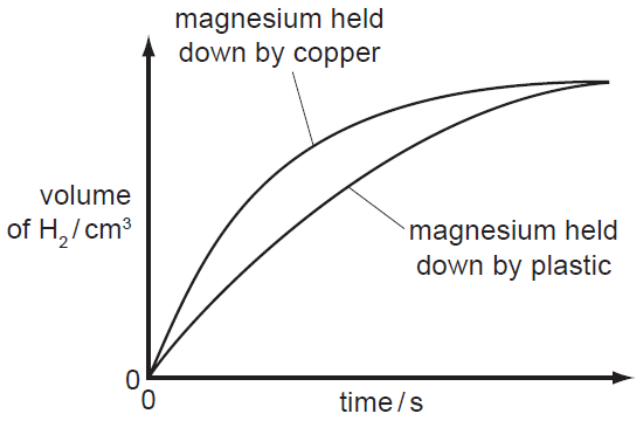
..... [1]

(ii) Iron, zinc and copper have similar densities. Why was copper a better choice than iron or zinc to weigh down the magnesium?

.....

..... [1]

(b) The only difference in the two experiments was the method used to hold down the magnesium. The results are shown below.



(d) The equilibrium mixture leaving the reaction chamber contains 15% ammonia. Suggest how the ammonia could be separated from the mixture.

	boiling point / °C
hydrogen	–253
nitrogen	–196
ammonia	–33

.....

..... [2]

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4 **(a)** Insoluble compounds are made by precipitation.

(i) Complete the word equation for the preparation of zinc carbonate.

..... + sodium carbonate → zinc carbonate + ...

....

[2]

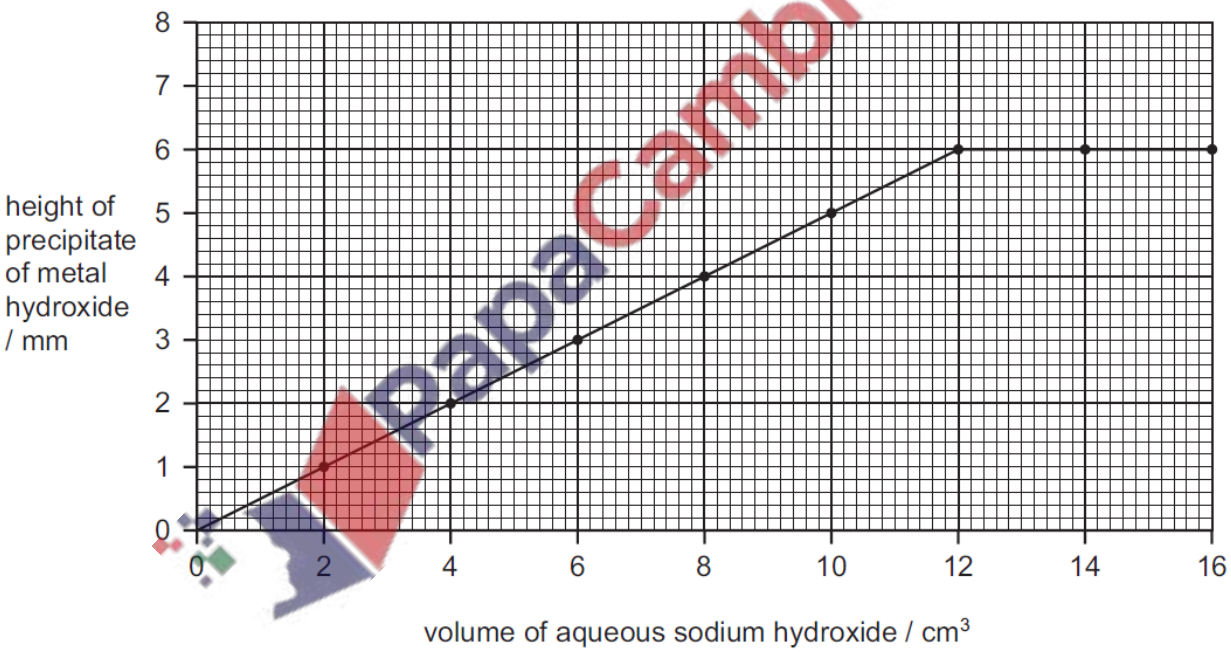
(ii) Complete the following symbol equation.

$Pb(NO_3)_2$ + ... $NaCl$ → ..... + ... [2]

(iii) Write an ionic equation for the precipitation of the insoluble salt, silver(I) chloride.

..... [2]

(b) 2.0 cm^3 portions of aqueous sodium hydroxide were added to 4.0 cm^3 of aqueous iron(III) chloride. Both solutions had a concentration of 1.0 mol/dm^3. After each addition, the mixture was stirred, centrifuged and the height of the precipitate of iron(III) hydroxide was measured. The results are shown on the following graph.



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(i) Complete the ionic equation for the reaction.

Fe^{3+} + ...OH^- → ..... [1]

(ii) On the same grid, sketch the graph that would have been obtained if iron(II) chloride had been used instead of iron(III) chloride? [2]

(iii) If aluminium chloride had been used instead of iron(III) chloride, the shape of the graph would be different. How are the shapes of these two graphs different and why?

difference in shape .....

.....

reason for difference .....

..... [2]

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