



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

GCSE CHEMISTRY

F

Foundation Tier Paper 2

Wednesday 10 June 2020

Morning

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information

- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	



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There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED**



0 2

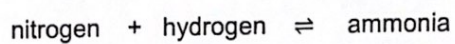
0 1

This question is about ammonia and fertilisers.

Ammonia is produced from nitrogen and hydrogen.

A catalyst is used to speed up the reaction.

The word equation for the reaction is:



0 1 . 1

What does the symbol \rightleftharpoons show about the reaction?

[1 mark]

The reaction is reversible

0 1 . 2

Which catalyst is used when ammonia is produced from nitrogen and hydrogen?

[1 mark]

Tick (✓) **one** box.

Chlorine

Iron

Oxygen

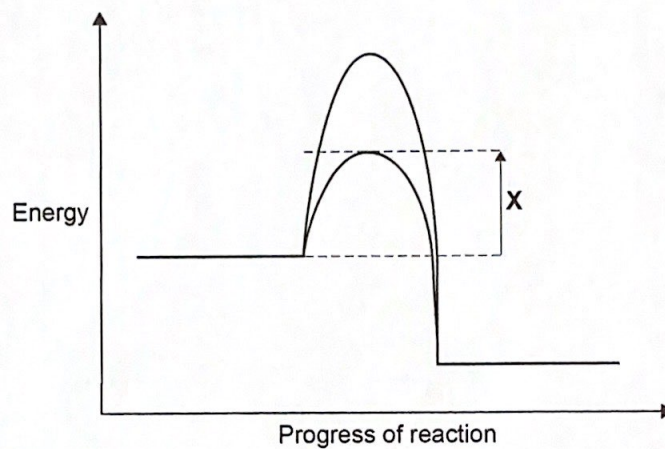
Turn over ►



0 1 . 3

Figure 1 shows the reaction profile for the production of ammonia both with a catalyst and without a catalyst.

Figure 1



What is represented by label X?

[1 mark]

Tick (✓) **one** box.

Activation energy with a catalyst

Activation energy without a catalyst

Overall energy change with a catalyst

Overall energy change without a catalyst



Ammonia is used to produce fertilisers.

NPK fertilisers contain the elements nitrogen, phosphorus and potassium.

A fertiliser contains:

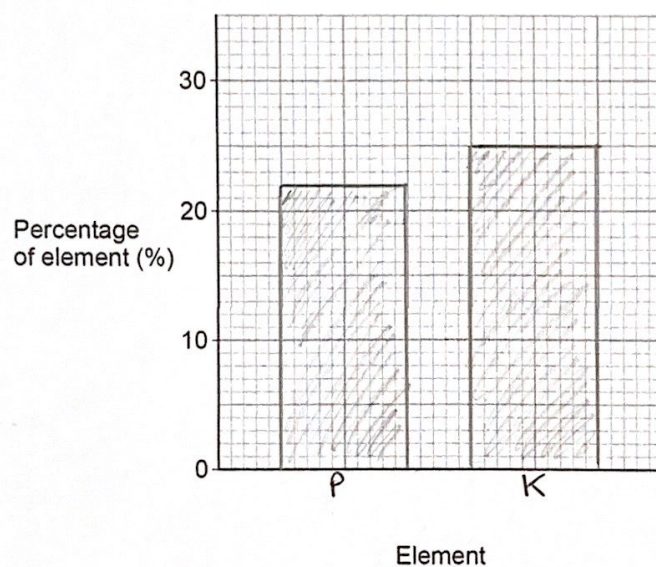
- 22% phosphorus
- 25% potassium.

0 1 . 4

Draw a bar chart on **Figure 2** to show the percentages of phosphorus and of potassium in this fertiliser.

[2 marks]

Figure 2



0 1 . 5

Why do the percentages of phosphorus and of potassium in this fertiliser **not** add up to 100%?

[1 mark]

There are other elements, such as nitrogen,
in the fertiliser

Turn over ►



Fertilisers help plants grow by adding essential elements to soil.

Table 1 shows the percentages of nitrogen, phosphorus and potassium in four fertilisers, **A**, **B**, **C** and **D**.

Table 1

Fertiliser	Percentage (%) of essential element		
	Nitrogen (N)	Phosphorus (P)	Potassium (K)
A	14	0	39
B	25	16	23
C	21	23	0
D	21	0	0

0 1 . 6 Plants lacking essential elements do not grow well because:

- too little phosphorus can cause slow plant growth
- too little potassium can cause leaves to have brown edges.

Which fertiliser helps prevent slow plant growth **and** brown leaf edges?

Use **Table 1**.

[1 mark]

Tick (✓) **one** box.

A B C D

0 1 . 7 Which fertiliser has the greatest total percentage of essential elements?

Use **Table 1**.

[1 mark]

Tick (✓) **one** box.

A B C D

8



0 2

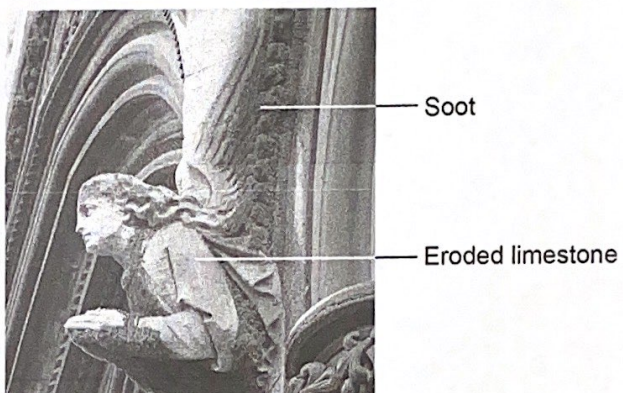
This question is about atmospheric pollution.

Figure 3 shows a limestone carving which has been damaged by atmospheric pollution.

The carving has been:

- blackened by soot
- eroded where the limestone has reacted with atmospheric pollutants.

Figure 3



0 2 . 1

What reacted with the limestone to cause the erosion?

[1 mark]

Tick (✓) **one** box.

Acid rain

Ammonia

Carbon monoxide

Oxygen



0 2 . 2 Soot is produced by the incomplete combustion of diesel oil.

Complete the sentences.

Choose answers from the box.

[2 marks]

ammonia	carbon	methane
nitrogen	oxygen	

Incomplete combustion happens when there is not enough oxygen.

Incomplete combustion produces particles of carbon.

0 2 . 3 Complete the sentence.

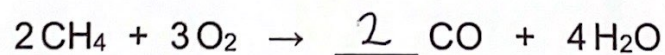
[1 mark]

Particles of soot in the atmosphere cause global dimming.

0 2 . 4 Carbon monoxide is produced by the incomplete combustion of methane.

Balance the equation for the reaction.

[1 mark]



Turn over ►



0 2 . 5 Car engines work at high temperatures.

Complete the sentences.

Choose answers from the box.

[3 marks]

air	methane	oxides of nitrogen
oxygen	petrol	sulfur dioxide

In car engines, nitrogen is present.

The nitrogen in car engines comes from air.

At high temperatures, the nitrogen reacts with oxygen.

This reaction produces oxides of nitrogen.

8



03

This question is about the rate of the reaction between hydrochloric acid and calcium carbonate.

A student investigated the effect of changing the size of calcium carbonate lumps on the rate of this reaction.

This is the method used.

1. Pour hydrochloric acid into a conical flask up to the 50 cm³ line.
2. Add 10.0 g of small calcium carbonate lumps to the conical flask.
3. Attach a gas syringe to the conical flask.
4. Measure the volume of gas produced every 20 seconds for 100 seconds.
5. Repeat steps 1 to 4 using 10.0 g of large calcium carbonate lumps.

03.1

The student used the 50 cm³ line on the conical flask to measure the volume of hydrochloric acid.

Suggest a piece of equipment the student could use to make the measurement of volume more accurate.

[1 mark]

measuring cylinder

03.2

Carbon dioxide gas is produced in the reaction between hydrochloric acid and calcium carbonate.

Which test is used to identify carbon dioxide gas?

[1 mark]

Tick (✓) **one** box.

A burning splint pops

A glowing splint relights

Damp litmus paper is bleached

Limewater turns milky

Turn over ►



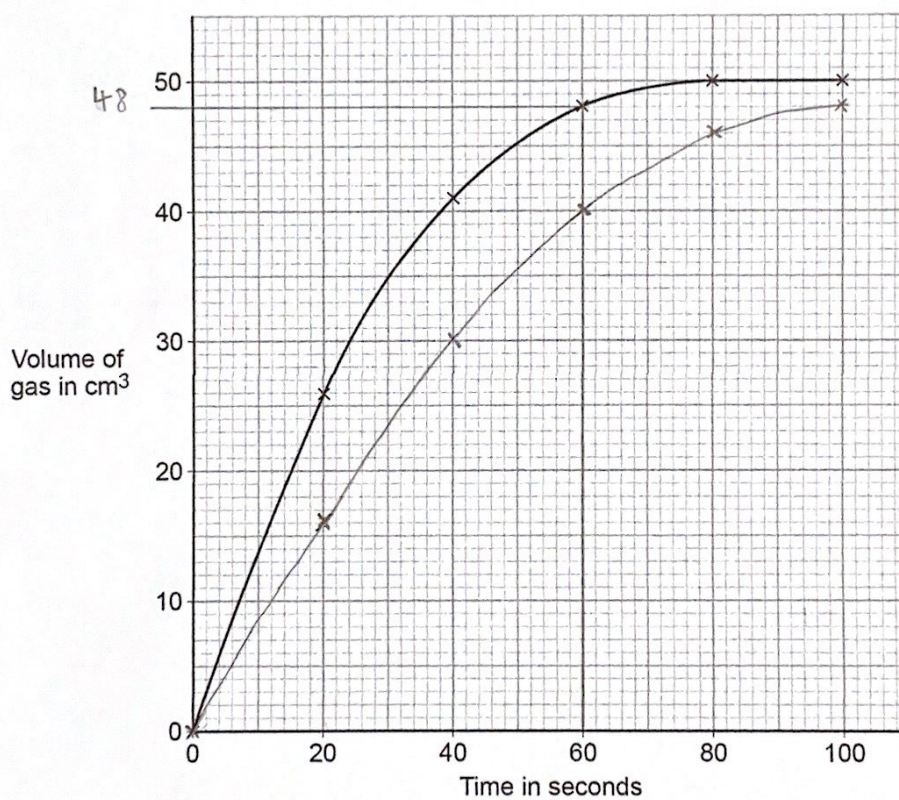
Table 2 shows the student's results for large calcium carbonate lumps.

Table 2

Time in seconds	Volume of gas in cm^3
0	0
20	16
40	30
60	40
80	46
100	48

Figure 4 shows the student's results for small calcium carbonate lumps.

Figure 4



0 3 . 3 Complete **Figure 4**.

You should:

- plot the data for large calcium carbonate lumps from **Table 2** on **Figure 4**
- draw a line of best fit for large calcium carbonate lumps.

[3 marks]

0 3 . 4 Determine the mean rate of reaction using **small** calcium carbonate lumps between 0 seconds and 60 seconds.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas produced}}{\text{time taken}}$$

Use **Figure 4**.

[3 marks]

Volume = 48

rate = $\frac{48}{60} = 0.8$

Mean rate of reaction = 0.8 cm³/s

0 3 . 5 Describe what happens to the volume of gas collected using **small** calcium carbonate lumps:

- between 0 and 20 seconds
- between 80 and 100 seconds.

Use **Figure 4**.

[2 marks]

Between 0 and 20 seconds The volume of gas increases

Between 80 and 100 seconds No change in the volume of gas

Turn over ►



03.6

The balance used to weigh 10.0 g of calcium carbonate lumps caused an error.

The balance always read 0.2 g before being used.

What type of error was caused by the balance?

[1 mark]

Tick (✓) **one** box.

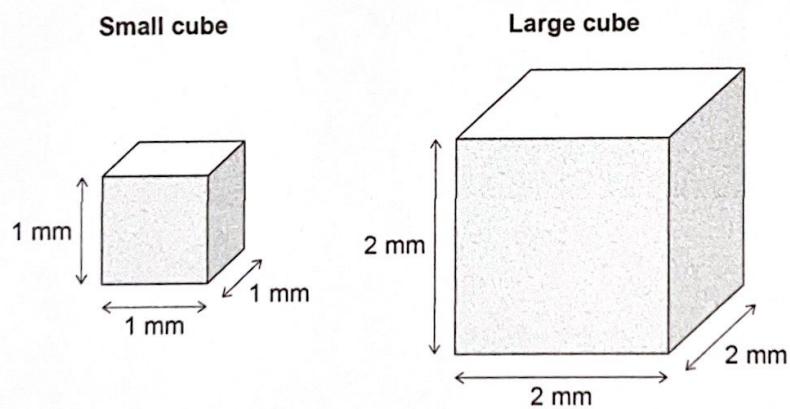
Human error

Random error

Systematic error

Figure 5 shows the dimensions of two cubes of calcium carbonate.

Figure 5



0 3 . 7 A cube of calcium carbonate has six faces.

Calculate the total surface area of the **large** cube of calcium carbonate.

Use Figure 5.

[3 marks]

$$2 \times 2 = 4 \text{ (area of one face)}$$

$$4 \times 6 = 24 \text{ (total surface area)}$$

Total surface area = 24 mm²

0 3 . 8 The large cube of calcium carbonate was divided into eight smaller cubes.

The eight smaller cubes have a greater total surface area than the one large cube.

Compare the rate of reaction when using the eight smaller cubes with the rate of reaction when using the large cube.

Complete the sentence.

Choose the answer from the box.

[1 mark]

faster

slower

the same

The rate of reaction of the eight smaller cubes is faster.

15



0 4

This question is about ink.

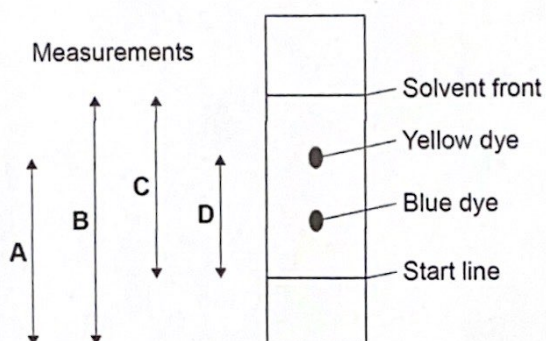
A student investigated green ink using paper chromatography in a beaker.

Figure 6 shows:

- the results the student obtained
- measurements A, B, C and D the student could make.

Figure 6

Diagram not to scale



0 4 . 1

The student calculated the R_f value of the blue dye.

The student measured:

- the distance moved by the blue dye = 2.7 cm
- the distance moved by the solvent = 9.0 cm

Calculate the R_f value of the blue dye.

Use the equation:

$$R_f = \frac{\text{distance moved by dye}}{\text{distance moved by solvent}}$$

[2 marks]

$$R_f = \frac{2.7}{9} = 0.3$$

$$R_f = 0.3$$



0 4 . 2 Which measurements on **Figure 6** are needed to calculate the R_f value of the yellow dye?

[1 mark]

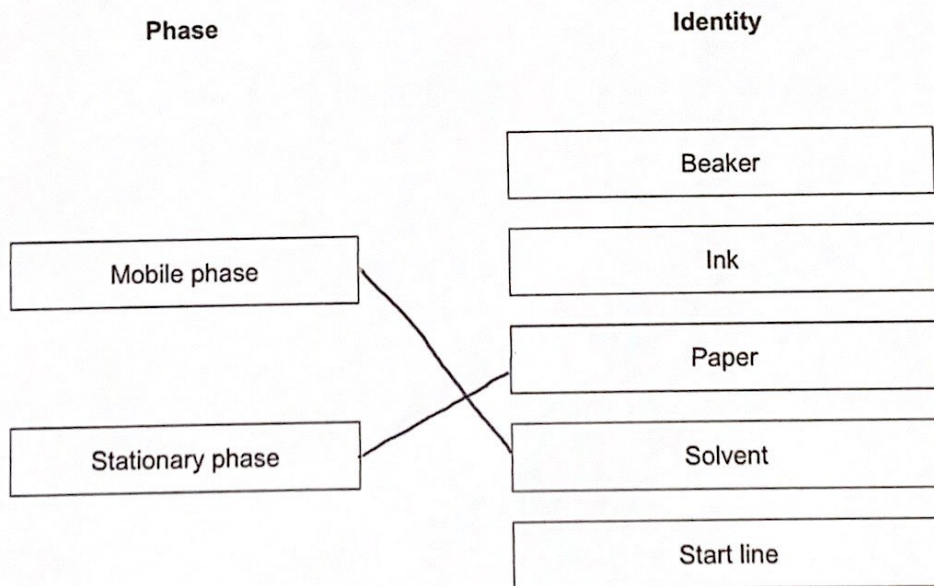
Tick (✓) **one** box.

- A and B
- A and C
- B and D
- C and D

0 4 . 3 Paper chromatography has a stationary phase and a mobile phase.

Draw **one** line from each phase to the identity of that phase in the student's investigation.

[2 marks]



Turn over ►



The green ink contains 85% yellow dye and 15% blue dye.

- 0 4 . 4 Determine the simplest whole number ratio of yellow dye : blue dye in the green ink. [1 mark]

$85 : 15$
 $17 : 3$

Yellow dye : Blue dye = $17 : 3$

- 0 4 . 5 Which word correctly describes the green ink? [1 mark]

Tick (✓) **one** box.

Compound

Element

Formulation

Solvent

- 0 4 . 6 The student repeated the investigation using green ink containing 75% yellow dye and 25% blue dye.

What would happen to the R_f value of the yellow dye?

[1 mark]

Tick (✓) **one** box.

The R_f value would decrease.

The R_f value would increase.

The R_f value would stay the same.

8



0 5

This question is about alloys.

Bronze and brass are both alloys which contain copper.

0 5 . 1

Bronze is an alloy of copper and one other metal.

What is the other metal in bronze?

[1 mark]

Tick (✓) **one** box.

- Aluminium
- Tin
- Zinc

0 5 . 2

Give **one** use of brass.

[1 mark]

Musical instruments and ornaments

Question 5 continues on the next page

Turn over ►



Alloys of gold are used to make jewellery.

0 5 . 3 The proportion of gold in an alloy is measured in carats:

- pure gold is 24 carat
- 50% gold is 12 carat.

Table 3 shows information about two gold rings, A and B.

A and B contain only gold and silver.

Complete Table 3.

[2 marks]

Table 3

Gold ring	Carat	Mass of metal in grams	
		gold	silver
A	12	7	7
B	18	9	3

0 5 . 4 Suggest **two** reasons why alloys of gold are used instead of pure gold to make jewellery.

[2 marks]

1 Harder than pure gold

2 Cheaper than pure gold



Steels are alloys of iron.

0 5 . 5 Spoons are made of stainless steel.

Spoons:

- are washed after use
- must not wear away quickly.

Suggest **one** reason why stainless steel is suitable for making spoons.

[1 mark]

It does not react with water so can be washed after use.

0 5 . 6 Steel horseshoes are shaped to fit the feet of horses.

Which type of steel is most easily shaped into horseshoes?

[1 mark]

Tick (✓) **one** box.

- | | |
|-------------------|-------------------------------------|
| High carbon steel | <input type="checkbox"/> |
| Low carbon steel | <input checked="" type="checkbox"/> |
| Stainless steel | <input type="checkbox"/> |

8

Turn over for the next question

Turn over ►



0 6

This question is about materials used to make plates.

Plates are made from ceramics, paper or poly(propene).

0 6 . 1

Paper plates are biodegradable and recyclable.

Which stage of a life cycle assessment (LCA) would contain this information?

[1 mark]

Tick (✓) **one** box.

Disposal at the end of useful life

Extracting and processing raw materials

Manufacturing and packaging

Use and operation during lifetime

0 6 . 2

Which **two** processes are used to make ceramic plates?

[2 marks]

Tick (✓) **two** boxes.

Forming a composite

Galvanising with zinc

Heating in a furnace

Melting sand and boron trioxide

Shaping wet clay



Poly(propene) is produced from an alkene.

0 6 . 3 Complete the sentences.

[2 marks]

The name for very large molecules such as poly(propene) is polymers.

The name of the alkene used to produce poly(propene) is propene.

0 6 . 4 The alkene needed to make poly(propene) is produced from crude oil.

Which **two** processes are used to produce this alkene from crude oil?

[2 marks]

Tick (✓) **two** boxes.

- | | |
|-------------------------|-------------------------------------|
| Chromatography | <input type="checkbox"/> |
| Cracking | <input checked="" type="checkbox"/> |
| Fermentation | <input type="checkbox"/> |
| Fractional distillation | <input checked="" type="checkbox"/> |
| Quarrying | <input type="checkbox"/> |

0 6 . 5 What type of bond joins the atoms in a molecule of poly(propene)?

[1 mark]

Tick (✓) **one** box.

- | | |
|----------|-------------------------------------|
| Covalent | <input checked="" type="checkbox"/> |
| Ionic | <input type="checkbox"/> |
| Metallic | <input type="checkbox"/> |

Turn over ►



Table 4 shows information about two polymers used to make plates.

Table 4

Polymer	Effect of heating the polymer
A	does not melt
B	melts at 50 °C

0 6 . 6 What type of polymer is polymer A?

Use Table 4.

[1 mark]

Thermosetting

0 6 . 7 Why does polymer A behave differently to polymer B when heated?

You should refer to crosslinks in your answer.

[1 mark]

Polymer A has crosslinks between polymer molecules

10



0 7

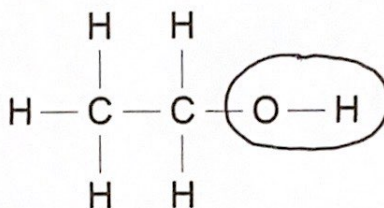
This question is about ethanol and ethanoic acid.

Ethanol is an alcohol.

0 7 . 1

Figure 7 shows the displayed structural formula of ethanol.

Figure 7



Draw a circle on Figure 7 around the alcohol functional group.

[1 mark]

0 7 . 2

An ethanol molecule contains atoms of three different elements.

Complete Table 5 to show:

- the name of each element
- the symbol for each element
- the number of atoms of each element in one molecule of ethanol.

Use Figure 7.

[3 marks]

Table 5

Name of element	Symbol for element	Number of atoms in one molecule of ethanol
Carbon	C	2
Hydrogen	H	6
Oxygen	O	1

Turn over ►



0 7 . 3 Ethanol removes grass stains from clothes.

What type of substance is ethanol when used to remove grass stains?

[1 mark]

Tick (✓) **one** box.

A solute

A solution

A solvent

Wine contains ethanol.

Wine is produced from grape juice by fermentation.

0 7 . 4 Complete the sentence.

[1 mark]

Grape juice can be fermented to produce wine because

grape juice contains sugar.

0 7 . 5 What is added to grape juice to cause fermentation?

[1 mark]

Yeast



0 7 . 6 Ethanol reacts with ethanoic acid to produce an ester.

What is the name of the ester produced when ethanol reacts with ethanoic acid? [1 mark]

Tick (✓) **one** box.

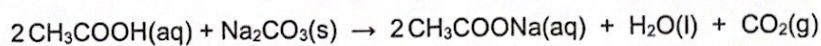
Ethane

Ethene

Ethyl ethanoate

0 7 . 7 Ethanoic acid reacts with sodium carbonate.

The equation for the reaction is:



What is the name of the liquid produced by this reaction? [1 mark]

Water

0 7 . 8 Vinegar is a solution that contains ethanoic acid.

400 cm³ of vinegar contains 20 g of ethanoic acid.

Calculate the mass of ethanoic acid in 1.0 dm³ of vinegar. [3 marks]

$$400 \text{ cm}^3 = 0.4 \text{ dm}^3$$

$$\frac{1}{0.4} \times 20 = 50 \text{ g}$$

Mass = 50 g

12

Turn over ►



0 8

This question is about chemical analysis.

A student tested copper sulfate solution and calcium iodide solution using flame tests.

This is the method used.

1. Dip a metal wire in copper sulfate solution.
2. Put the metal wire in a blue Bunsen burner flame.
3. Record the flame colour produced.
4. Repeat steps 1 to 3 using the same metal wire but using calcium iodide solution.

0 8 . 1

What flame colour is produced by copper sulfate solution?

[1 mark]

Green

0 8 . 2

Calcium compounds produce an orange-red flame colour.

The student left out an important step before reusing the metal wire.

The student's method did **not** produce a distinct orange-red flame colour using calcium iodide solution.

Explain why.

[2 marks]

The student did not clean the metal wire between tests so copper sulfate is still present and the colours are mixed.



0 8 . 3 The student added sodium hydroxide solution to:

- copper sulfate solution
- calcium iodide solution.

Give the results of the tests.

[2 marks]

Copper sulfate solution Blue precipitate

Calcium iodide solution White precipitate

0 8 . 4 To test for sulfate ions the student added dilute hydrochloric acid to copper sulfate solution.

Name the solution that would show the presence of sulfate ions when added to this mixture.

[1 mark]

Barium chloride

0 8 . 5 To test for iodide ions the student added dilute nitric acid to calcium iodide solution.

Name the solution that would show the presence of iodide ions when added to this mixture.

Give the result of the test.

[2 marks]

Solution Silver nitrate solution

Result yellow precipitate

8

Turn over ►



09

This question is about water.

09.1

In the UK, potable (drinking) water is produced from different sources of fresh water.

Explain how potable water is produced from fresh water.

[4 marks]

First the water is collected from an appropriate source of fresh water such as rivers, streams and lakes. The water passes through filter beds in order to remove any undissolved solids. Finally the water is sterilised to remove harmful microbes using chlorine, ozone or UV light.

09.2

A different country has:

- very little rainfall
- a long coastline
- plentiful energy supplies.

Suggest **one** process this country could use to obtain most of its potable water.

[1 mark]

Distillation



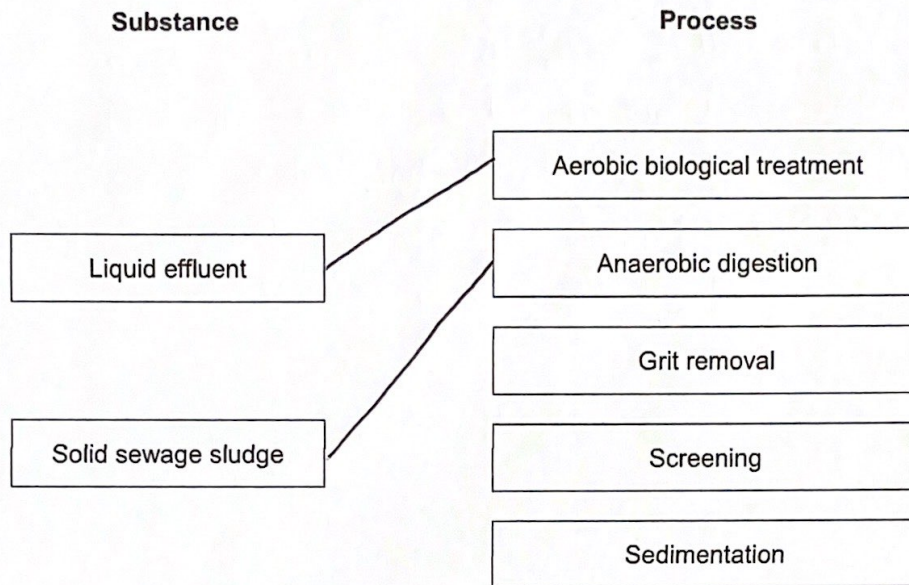
0 9 . 3 Waste water is not fit to drink.

Treatment of waste water produces two substances:

- liquid effluent
- solid sewage sludge.

Draw **one** line from each substance to the way the substance is processed.

[2 marks]



Question 9 continues on the next page

Turn over ►



Table 6 shows information about the disposal of processed solid sewage sludge in the UK in 1992 and in 2010.

Table 6

Year	Mass of processed solid sewage sludge in millions of kilograms				
	Used as fertiliser	Sent to landfill	Burned	Other methods	Total
1992	440	130	90	338	998
2010	1118	9	260	26	1413

0 9 . 4 Calculate the percentage of processed solid sewage sludge that was burned in 2010.

Give your answer to 3 significant figures.

Use Table 6.

[3 marks]

$$\frac{260}{1413} \times 100 = 18.40056617$$

$$= 18.4$$

Percentage (3 significant figures) = 18.4 %



0 9 . 5

Suggest **one** reason why the total mass of processed solid sewage sludge increased between 1992 and 2010.

[1 mark]

The population increased.

0 9 . 6

Between 1992 and 2010 the proportion of processed solid sewage sludge used as fertiliser increased.

Suggest **two** reasons why.

[2 marks]

1 Increasing population caused an increased food demand.

2 Conserves energy so is more sustainable.

13

Turn over for the next question

Turn over ►



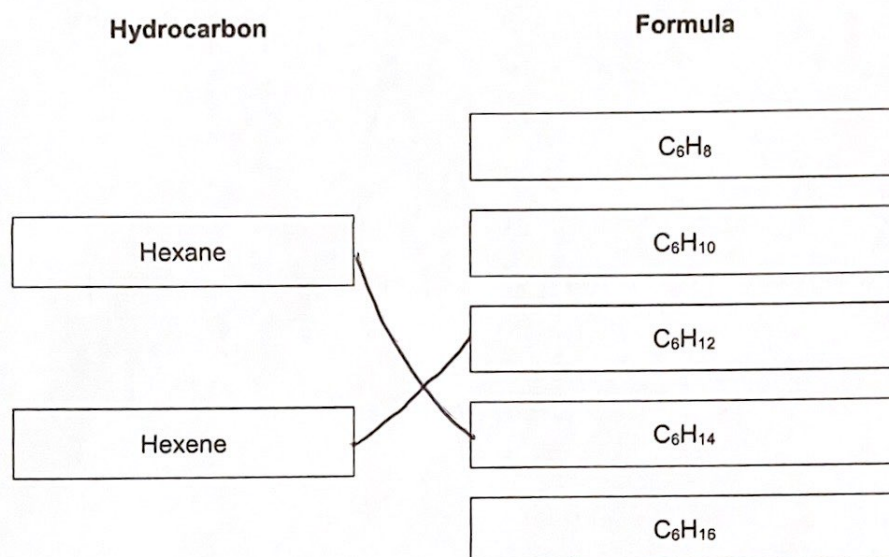
1 0

This question is about hydrocarbons.

Hexane and hexene are hydrocarbons containing six carbon atoms in each molecule.

Hexane is an alkane and hexene is an alkene.

1 0 . 1

Draw **one** line from each hydrocarbon to the formula of that hydrocarbon.**[2 marks]**

1 0 . 2

Bromine water is added to hexane and to hexene.

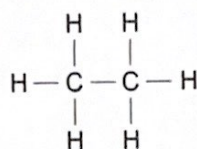
What would be observed when bromine water is added to hexane and to hexene?

[2 marks]Hexane remains orangeHexene turns colourless

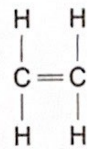
1 0 . 3 Ethane is an alkane and ethene is an alkene.

Figure 8 shows the displayed structural formulae of ethane and of ethene.

Figure 8



Ethane



Ethene

Compare ethane with ethene.

You should refer to:

- their structure and bonding
- their reactions.

[6 marks]

Ethane and ethene are both small hydrocarbons with 2 carbon atoms and covalent bonds. Ethane has 6 hydrogen atoms but ethene only has 4. Ethane only contains single bonds but ethene has a carbon to carbon double bond. Both molecules react with oxygen in complete combustion to form water and carbon dioxide and in incomplete combustion to form water, carbon monoxide and carbon. Ethene decolorises bromine water but ethane does not. Ethene is more reactive than ethane and can react with hydrogen, water, halogens and more. Ethene can also polymerise to produce poly(ethene) but ethane cannot.

10

END OF QUESTIONS

