A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE
CHEMISTRY

H

Higher Tier Paper 2

8462/2H

Wednesday 10 June 2020 **Morning**

Time allowed: 1 hour 45 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

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.**
- **Answer ALL questions in the spaces provided. Do not write 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**.

DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1 **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 1 . 1 **What flame colour is produced by copper sulfate solution? [1 mark]**

0 1 . 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]

0 1 . 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 _____

_____

_____

Calcium iodide solution _____

_____

_____

0 1 . 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]

_____

0 1 . 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 _____

_____

Result _____

_____

[Turn over]

8

0 2 **This question is about water.**

0 2 . 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]

0 2 . 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]

_____

_____

_____

[Turn over]

0 2 . 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]

SUBSTANCE	PROCESS
	Aerobic biological treatment
Liquid effluent	Anaerobic digestion
	Grit removal
Solid sewage sludge	Screening
	Sedimentation

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[Turn over]

TABLE 1 shows information about the disposal of processed solid sewage sludge in the UK in 1992 and in 2010.

TABLE 1

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 2 . 4 **Calculate the percentage of processed solid sewage sludge that was burned in 2010.**

Give your answer to 3 significant figures.

Use TABLE 1. [3 marks]

Percentage (3 significant figures) = _____ %

[Turn over]

0 2 . 5 Suggest ONE reason why the total mass of processed solid sewage sludge increased between 1992 and 2010. [1 mark]

0 2 . 6 Between 1992 and 2010 the proportion of processed solid sewage sludge used as fertiliser increased.

Suggest TWO reasons why. [2 marks]

1

2

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[Turn over]

0 3 **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.

0 3 . 1 **Draw ONE line from each hydrocarbon to the formula of that hydrocarbon. [2 marks]**

HYDROCARBON	FORMULA
	C_6H_8
Hexane	C_6H_{10}
	C_6H_{12}
Hexene	C_6H_{14}
	C_6H_{16}

0 3 . 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 _____

_____

_____

Hexene _____

_____

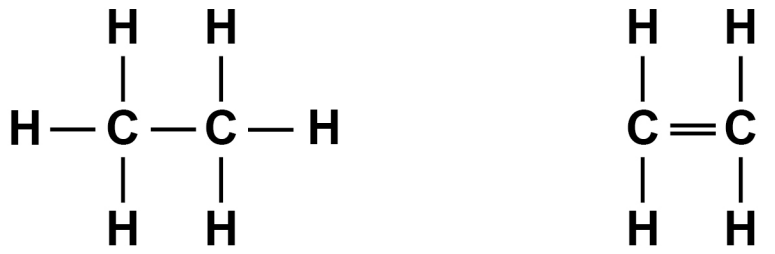
_____

[Turn over]

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

FIGURE 1 shows the displayed structural formulae of ethane and of ethene.

FIGURE 1



Ethane **Ethene**

Compare ethane with ethene.

You should refer to:

- **their structure and bonding**
- **their reactions.**

[6 marks]

[Turn over]

10

0 4 **This question is about ink.**

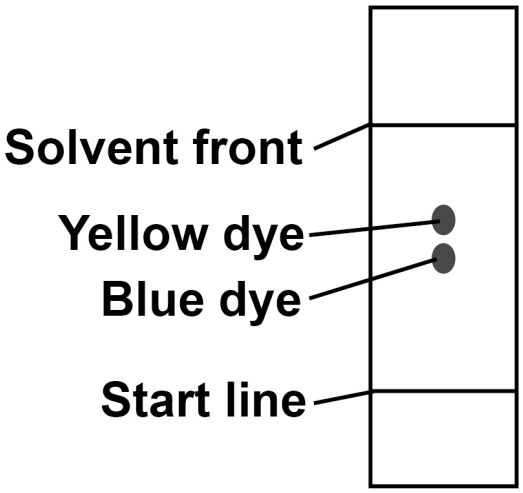
A student investigated green ink using paper chromatography in a beaker.

The student used water as the solvent.

FIGURE 2 shows the chromatogram obtained.

FIGURE 2

The diagram is not drawn to scale.



0 4 . 1 **The R_f value of the yellow dye = 0.60**

The distance moved by the yellow dye = 5.7 cm

Calculate the distance moved by the solvent.
[3 marks]

Distance moved by the solvent =

_____ **cm**

[Turn over]

0 4 . 2 **The green ink contains more than two compounds.**

Suggest ONE reason why only two spots are seen on FIGURE 2, on page 20. [1 mark]

0 4 . 3 **On the student's chromatogram, the yellow and blue spots are very close together.**

Which TWO ways could increase the distance between the spots? [2 marks]

Tick (✓) TWO boxes.

- ☐ **Allow the solvent front to travel further.**
- ☐ **Dry the chromatogram more slowly.**
- ☐ **Use a different solvent.**
- ☐ **Use a larger beaker.**
- ☐ **Use a larger spot of green ink.**

[Turn over]

0 4 . 4 **The manufacturers of the green ink always use the same proportions of yellow dye and blue dye.**

Suggest ONE reason why. [1 mark]

0 4 . 5 **The R_f value of a dye depends on:**

- **the solubility of the dye in the solvent**
- **the attraction of the dye to the paper.**

Which will DEFINITELY produce a smaller R_f value if the solvent and paper are both changed? [1 mark]

Tick (✓) ONE box.

☐ **The dye is less soluble in the new solvent and less attracted to the new paper.**

☐ **The dye is less soluble in the new solvent and more attracted to the new paper.**

☐ **The dye is more soluble in the new solvent and less attracted to the new paper.**

☐ **The dye is more soluble in the new solvent and more attracted to the new paper.**

8

0 5 This question is about materials used to make food plates.

Food plates are made from paper, polymers or ceramics.

TABLE 2 shows information about plates of the same diameter made from each of these materials.

TABLE 2

	Food plate material		
	Paper	Polymers	Ceramics
Raw material	Wood	Crude oil	Mined clay
Number packaged in 10 dm^3 cardboard box	500	100	50
Average number of times used	1	400	1000
Biodegradable?	Yes	No	No
Recyclable?	Yes	Yes	No

0 5 . 1 **TABLE 2 does NOT show information about energy usage.**

Suggest TWO pieces of information about energy usage which would help to produce a complete life cycle assessment (LCA) for the three food plate materials. [2 marks]

1 _____

_____

2 _____

_____

[Turn over]

REPEAT OF TABLE 2

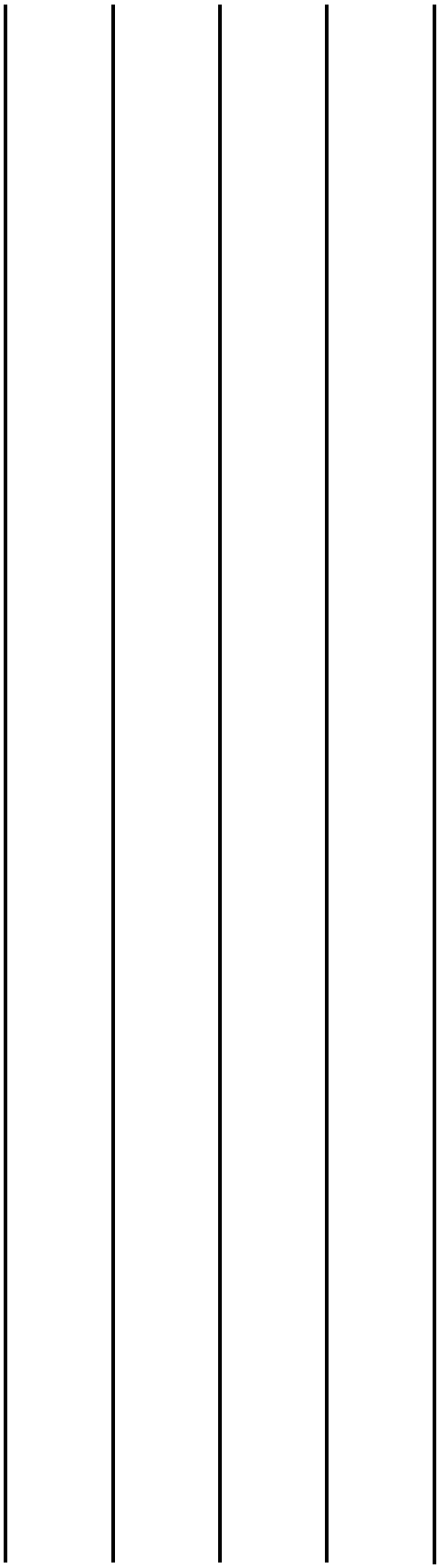
	Food plate material		
	Paper	**Polymers**	**Ceramics**
Raw material	**Wood**	**Crude oil**	**Mined clay**
Number packaged in 10 dm^3 cardboard box	**500**	**100**	**50**
Average number of times used	**1**	**400**	**1000**
Biodegradable?	**Yes**	**No**	**No**
Recyclable?	**Yes**	**Yes**	**No**

0 5 . 2 Evaluate the use of these materials for making food plates.

You should use features of life cycle assessments (LCAs).

Use TABLE 2. [4 marks]

[Turn over]



0 5 . 3 **Describe how ceramic food plates are produced from clay. [2 marks]**

[Turn over]

8

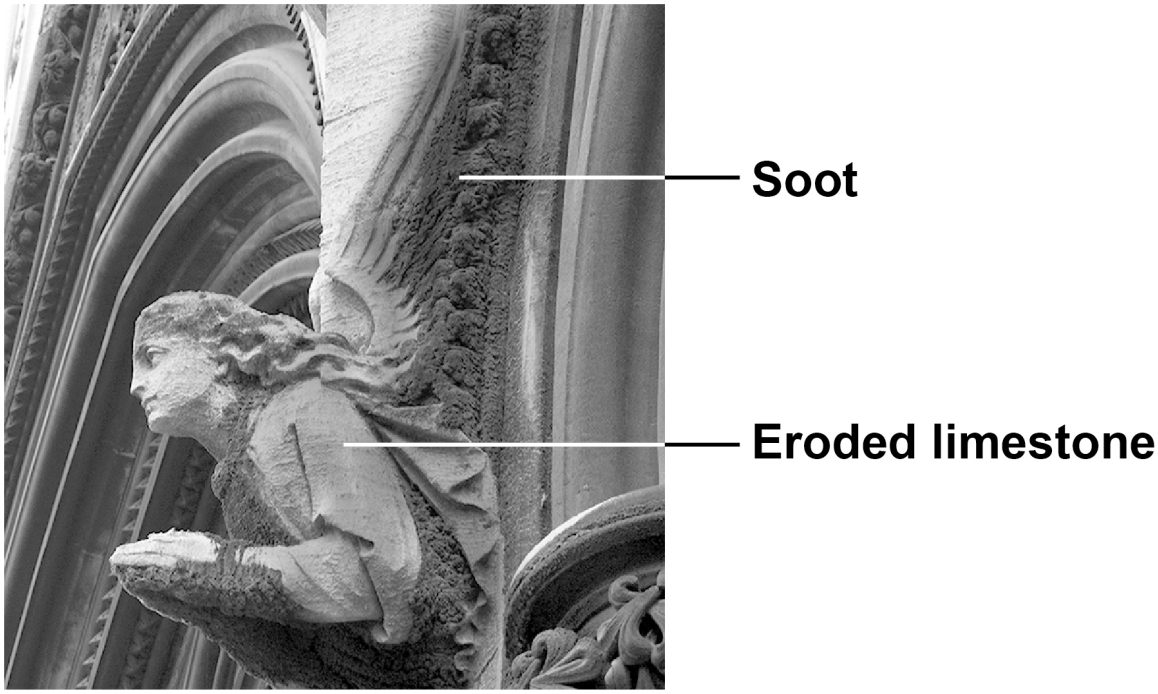
0 6 **This question is about atmospheric pollution.**

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 6 . 1 **Explain why soot is formed when some fossil fuels are burned. [2 marks]**

0 6 . 2 **Fossil fuels are burned in car engines.**

Explain how reducing the amount of sulfur in fossil fuels reduces the erosion of limestone. [4 marks]

0 6 . 3 **Oxides of nitrogen are atmospheric pollutants which are formed in car engines.**

Explain why oxides of nitrogen are formed in car engines. [2 marks]

8

0 7 This question is about carboxylic acids.

Carboxylic acids belong to a homologous series.

TABLE 3 shows information about the first three carboxylic acids in this homologous series.

TABLE 3

Name	Formula	pH of a 0.01 mol / dm^3 solution
Methanoic acid		2.91
Ethanoic acid	CH_3COOH	3.39
	CH_3CH_2COOH	3.44

0 7 . 1 Complete TABLE 3. [2 marks]

0 7 . 2 **Ethanoic acid ionises in water.**

The equation for the reaction is:

$$CH_3COOH(aq) \rightleftharpoons CH_3COO^-(aq) + H^+(aq)$$

Explain how the equation shows that ethanoic acid is a weak acid. [2 marks]

0 7 . 3 **A student adds a solution of ethanoic acid to zinc carbonate in an open flask on a balance.**

Explain what happens to the mass of the flask and its contents during the reaction. [3 marks]

0 7 . 4 **The student compares the rates of the reaction of zinc carbonate with:**

- **0.01 mol/dm^3 methanoic acid**
- **0.01 mol/dm^3 ethanoic acid.**

The rate of the reaction with methanoic acid is greater than the rate of the reaction with ethanoic acid.

Explain why.

You should refer to ions in your answer.

Use TABLE 3 on page 36. [3 marks]

Ethanoic acid reacts with ethanol to produce an ester.

0 7 . 5 Give the name of the ester produced when ethanoic acid reacts with ethanol. [1 mark]

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[Turn over]

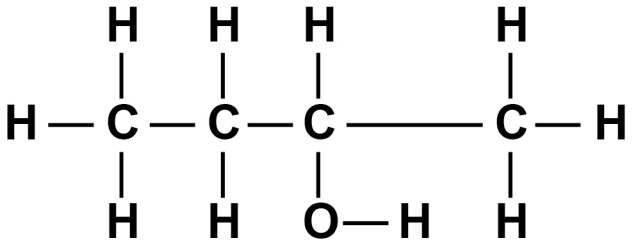
0 7 . 6 **Hexanedioic acid and ethanediol join together to produce a polyester.**

Ethanoic acid and ethanol join together in the same way to produce an ester.

Which is the displayed structural formula of the ester produced when ethanoic acid reacts with ethanol? [1 mark]

Tick (✓) ONE box.

☐



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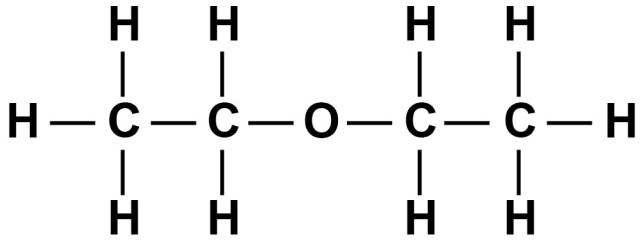

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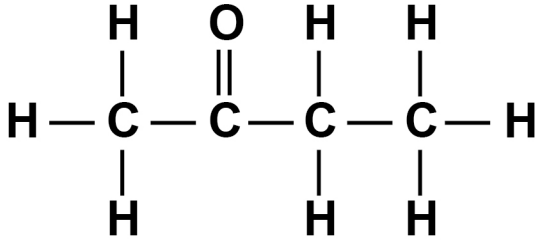

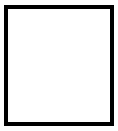

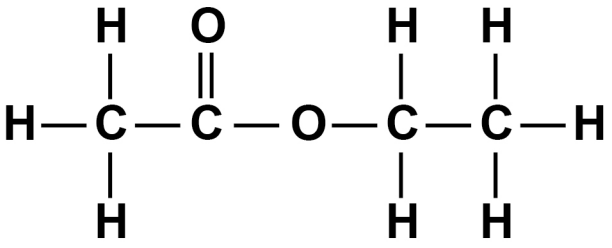

12

0 8 **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 40 cm^3 of hydrochloric acid into a conical flask.**
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 30 seconds for 180 seconds.**
5. **Repeat steps 1 to 4 using 10.0 g of large calcium carbonate lumps.**

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[Turn over]

The student calculated the number of moles of gas from each volume of gas measured.

TABLE 4 shows the student's results for large calcium carbonate lumps.

TABLE 4

Time in seconds	Number of moles of gas
0	0.0000
30	0.0011
60	0.0020
90	0.0028
120	0.0034
150	0.0038
180	0.0040

The student plotted the results for small calcium carbonate lumps on FIGURE 4, on the opposite page.

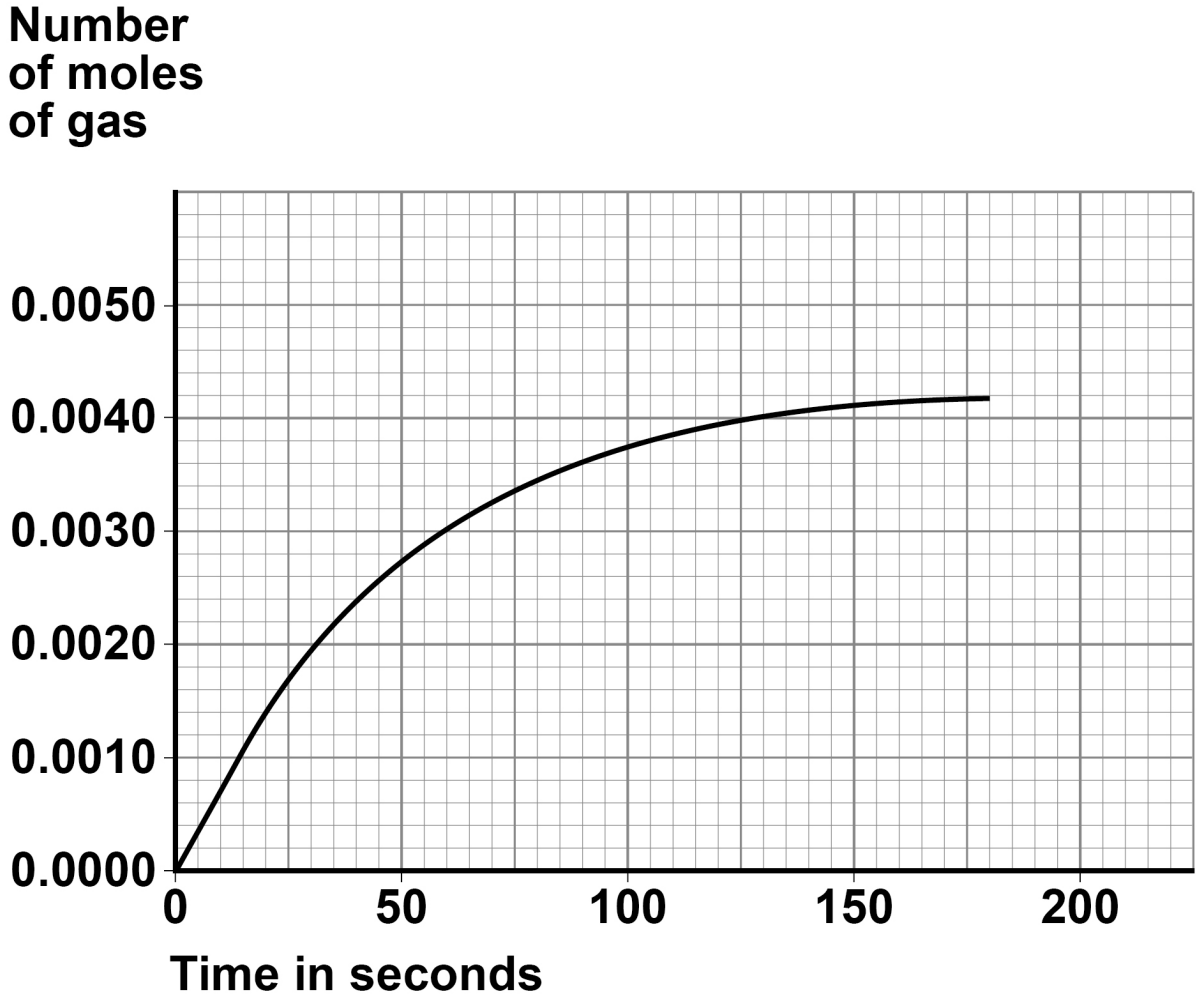
0 8 . 1 Complete FIGURE 4.

You should:

- **plot the data for large calcium carbonate lumps from TABLE 4**
- **draw a line of best fit.**

[3 marks]

FIGURE 4



[Turn over]

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0 8 . 2 **Determine the mean rate of reaction for SMALL calcium carbonate lumps between 20 seconds and 105 seconds.**

Give the unit.

Use FIGURE 4. [4 marks]

Mean rate of reaction = _____

Unit _____

[Turn over]

0 8 . 3 **The student concluded that the large calcium carbonate lumps reacted more slowly than the small calcium carbonate lumps.**

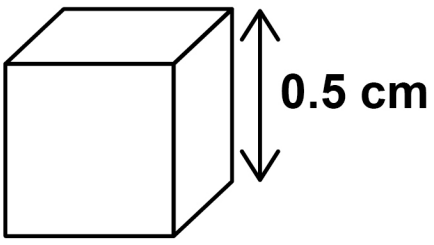
How do the student's results show that this conclusion is correct? [1 mark]

The difference in the rates of reaction of large lumps and of small lumps of calcium carbonate depends on the surface area to volume ratios of the lumps.

FIGURE 5 shows a cube of calcium carbonate.

FIGURE 5

FIGURE 5 is not drawn accurately



0 8 . 4 **Calculate the surface area to volume ratio of the cube in FIGURE 5.**

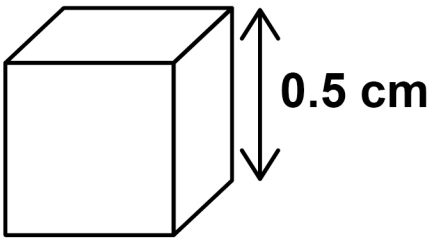
Give your answer as the simplest whole number ratio. [3 marks]

Surface area : volume = _____ : _____

[Turn over]

REPEAT OF FIGURE 5

FIGURE 5 is not drawn accurately



0 8 . 5 A larger cube of calcium carbonate has sides of 5 cm

Describe how the surface area to volume ratio of this larger cube differs from that of the cube shown in FIGURE 5. [1 mark]

_____

_____

_____

12

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[Turn over]

0 9 **This question is about algae.**

A student:

- **placed algae in water containing dissolved carbon dioxide**
- **shone bright light on the algae.**

Gas bubbles were collected as the algae photosynthesised.

0 9 . 1 **Describe a test that would identify the gas collected.**

Give the result of the test. [2 marks]

Test _____

_____

Result _____

_____

_____

0 9 . 2 **Glucose is produced when algae photosynthesise.**

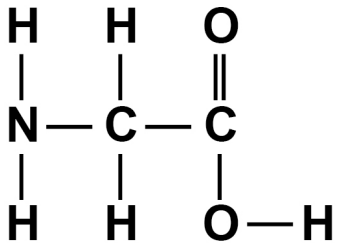
Name TWO naturally occurring polymers produced from glucose. [2 marks]

_____ **and** _____

[Turn over]

FIGURE 6 shows the displayed structural formula of an amino acid called glycine.

FIGURE 6



0 9 . 3 How many functional groups are there in the molecule in FIGURE 6? [1 mark]

Tick (✓) ONE box.

- ☐ **1**
- ☐ **2**
- ☐ **3**
- ☐ **4**

0 9 . 4 **Glycine reacts by condensation polymerisation to produce a polypeptide and one other substance.**

Name the other substance produced. [1 mark]

_____

_____

0 9 . 5 **Scientists think that algae may have used gases in Earth's early atmosphere.**

Algae need an element to produce the molecule in FIGURE 6 which is NOT present in water or carbon dioxide.

Which TWO gases from Earth's early atmosphere could have provided this element? [2 marks]

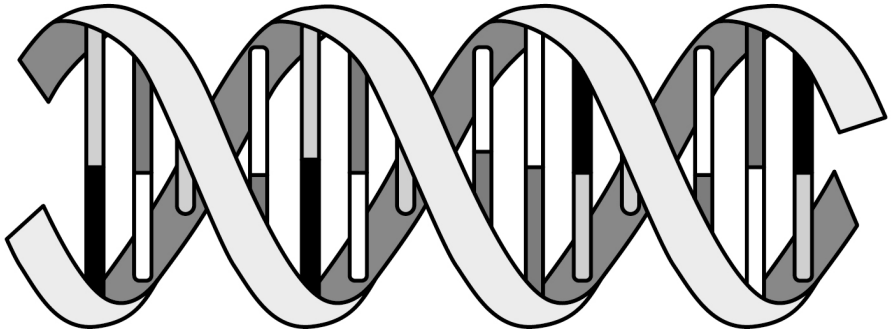
_____ **and** _____

[Turn over]

0 9 . 6 **The development and function of algae are controlled by a naturally occurring polymer.**

FIGURE 7 represents the shape and structure of this polymer.

FIGURE 7



Describe the shape and structure of this polymer. [3 marks]

[Turn over]

11

1 0 This question is about a reversible reaction.

The reaction between solutions of iron(III) ions (Fe^{3+}) and thiocyanate ions (SCN^-) is reversible.

The ionic equation for the reaction is:

$$Fe^{3+}(aq) + SCN^-(aq) \rightleftharpoons FeSCN^{2+}(aq)$$

Colour of solution: yellow colourless red

The colour of the equilibrium mixture is orange at room temperature.

1 0 . 1 Give the name of the solvent used to dissolve the ions in this reaction. [1 mark]

_____

_____

1 0 . 2 **A few drops of a colourless solution containing a high concentration of thiocyanate ions (SCN^-) are added to the orange equilibrium mixture.**

Explain the colour change observed.
[3 marks]

1 0 . 3 **A water bath is set up at a temperature above room temperature.**

When a test tube containing the orange equilibrium mixture is placed in the water bath, the mixture becomes more yellow.

Explain what this shows about the energy change for the forward reaction. [3 marks]

1 0 . 4 **Explain why a change in pressure does NOT affect the colour of the equilibrium mixture. [2 marks]**

1 0 . 5 **Other metal ions form coloured equilibrium mixtures with thiocyanate ions.**

Which metal ion could form a coloured equilibrium mixture with thiocyanate ions? [1 mark]

Tick (✓) ONE box.

☐ Al^{3+}

☐ Co^{2+}

☐ Mg^{2+}

☐ Na^{+}

END OF QUESTIONS

10

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Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.
Write the question numbers in the left-hand margin.

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For Examiner's Use	
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