



## C8 CHEMICAL ANALYSIS

Question Practice

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

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Time: **167 minutes**

Marks: **165 marks**

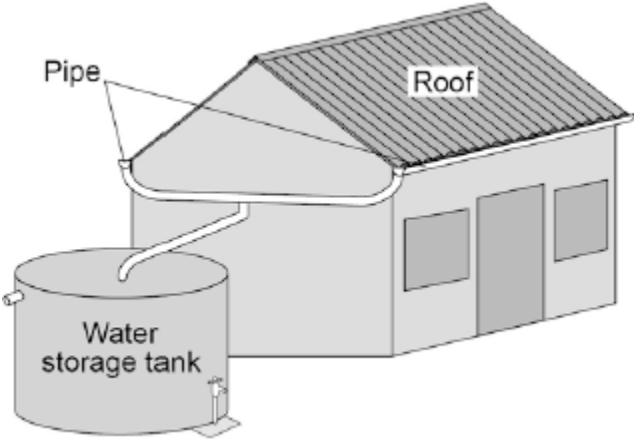
Comments: **HIGHER TIER**

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1

Rainwater is collected from the roofs of houses as shown in **Figure 1**.

**Figure 1**



(a) The water in the storage tank is **not** potable.

What does potable mean?

Tick **one** box.

- Contains dissolved substances
- Pure
- Safe to drink
- Tastes nice

(1)

(b) Why should the water in the tank be filtered to make it potable?

Tick **one** box.

To kill microbes

To remove dissolved gases

To remove dissolved solids

To remove undissolved solids

(1)

(c) A gas which bleaches litmus paper can be added to the water to make it potable.

Name this gas and explain why it is added.

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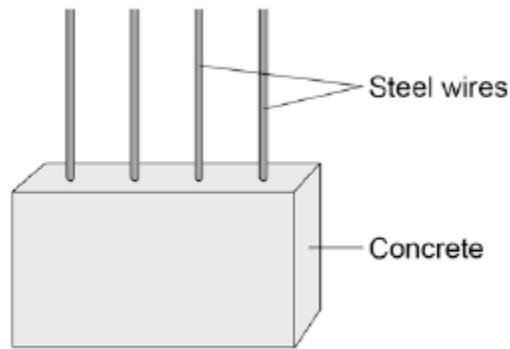
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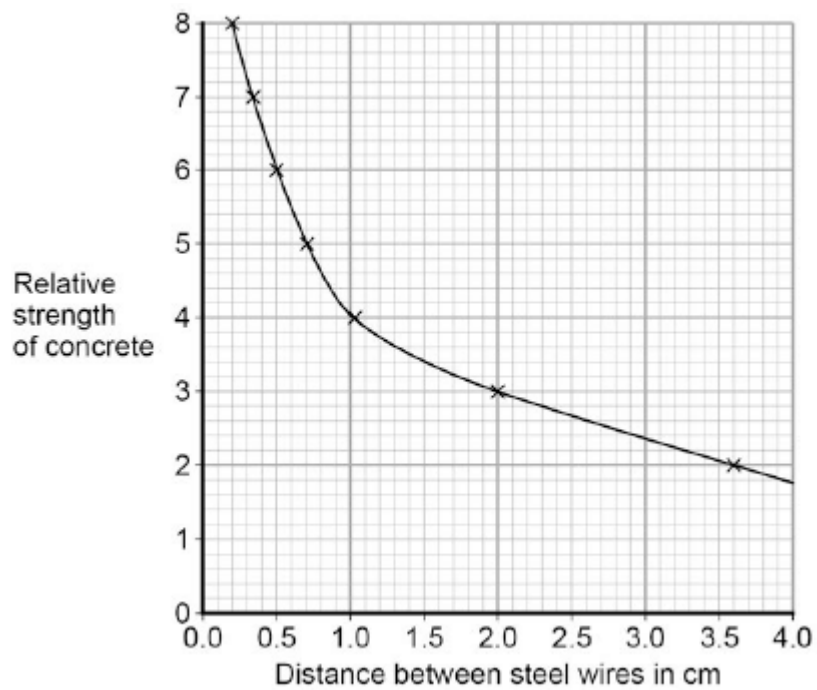
(d) The storage tank is made from concrete reinforced with steel wire, as shown in **Figure 2**.

**Figure 2.**



**Figure 3** shows how the distance between the steel wires affects the relative strength of the concrete.

**Figure 3**



Use values from **Figure 3** to describe the relationship shown by the graph.

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(2)  
(Total 6 marks)

2

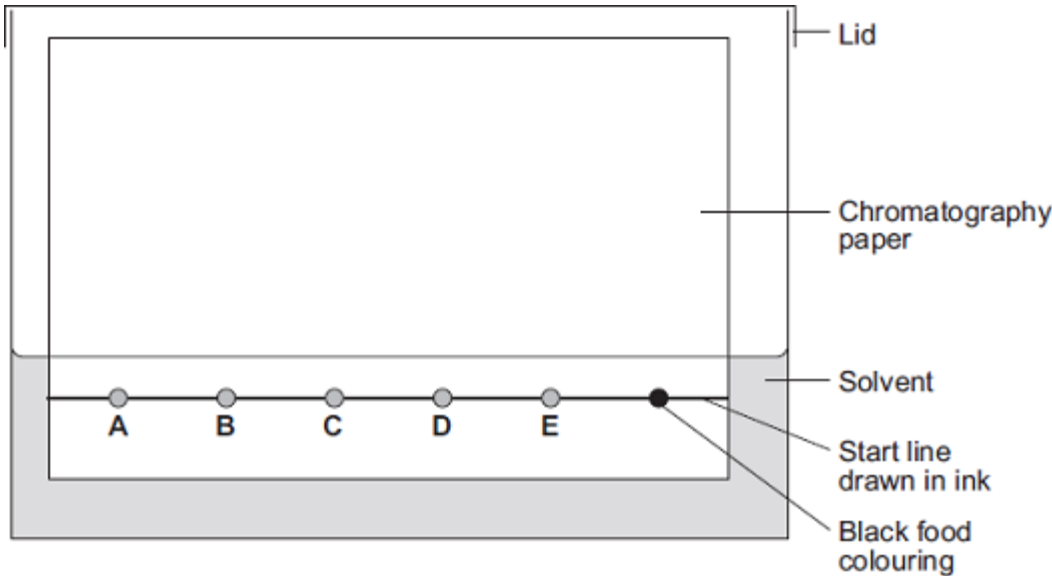
Chromatography can be used to separate components of a mixture.

(a) A student used paper chromatography to analyse a black food colouring.

The student placed spots of known food colours, **A**, **B**, **C**, **D** and **E**, and the black food colouring on a sheet of chromatography paper.

The student set up the apparatus as shown in **Diagram 1**.

**Diagram 1**



The student made **two** errors in setting up the apparatus. Identify the **two** errors and describe the problem each error would cause.

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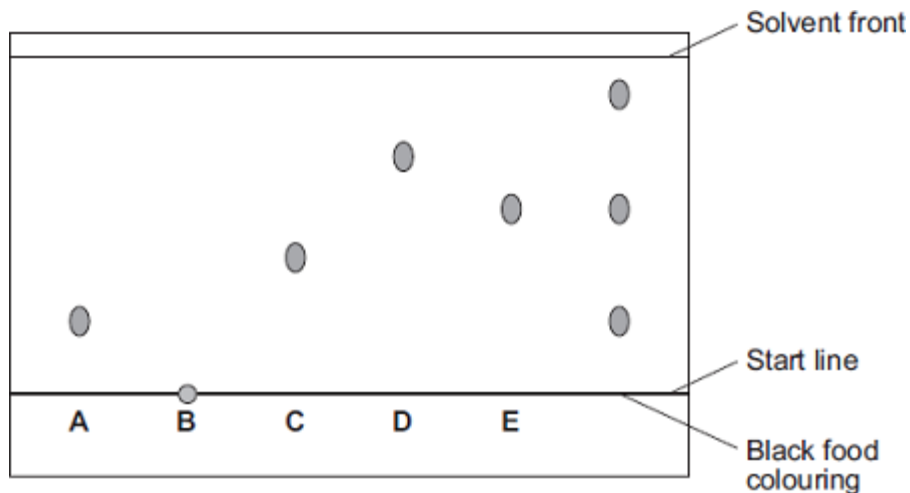
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(4)

(b) A different student set up the apparatus without making any errors.

The chromatogram in **Diagram 2** shows the student's results.

**Diagram 2**



(i) What do the results tell you about the composition of the black food colouring?

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(2)

(ii) Use **Diagram 2** to complete **Table 1**.

**Table 1**

	Distance in mm
Distance from start line to solvent front	_____
Distance moved by food colour <b>C</b>	_____

(2)

(iii) Use your answers in part **(b) (ii)** to calculate the  $R_f$  value for food colour **C**.

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$R_f$  value = \_\_\_\_\_

(1)

- (c) **Table 2** gives the results of chromatography experiments that were carried out on some known food colours, using the same solvent as the students.

**Table 2**

Name of food colour	Distance from start line to solvent front in mm	Distance moved by food colour in mm	R <sub>f</sub> value
Ponceau 4R	62	59	0.95
Carmoisine	74	45	0.61
Fast red	67	27	0.40
Erythrosine	58	17	0.29

Which of the food colours in **Table 2** could be food colour **C** from the chromatogram?

Give the reason for your answer.

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(2)

- (d) Two types of chromatography are gas chromatography and paper chromatography.

Give **one** advantage of gas chromatography compared with paper chromatography.

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(1)

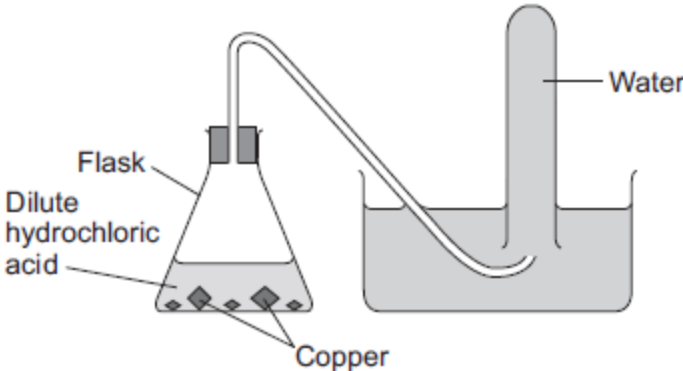
**(Total 12 marks)**

3

A student was trying to produce hydrogen gas.

Figure 1 shows the apparatus she used.

Figure 1



(a) No gas was produced.

The student's teacher said that this was because the substances in the flask did **not** react.

(i) Suggest why the substances in the flask did **not** react.

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(1)

(ii) Which two substances could the student have put in the flask to produce hydrogen safely?

Tick (✓) **one** box.

- Gold and dilute hydrochloric acid
- Potassium and dilute hydrochloric acid
- Zinc and dilute hydrochloric acid

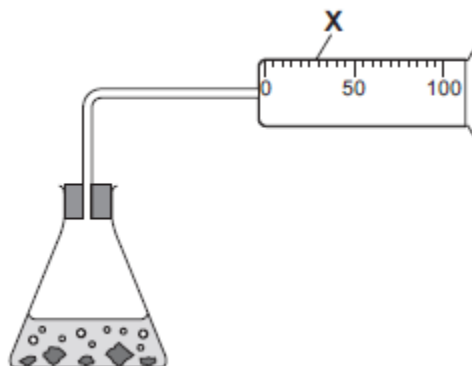
(1)



(b) Another student did produce hydrogen from two substances.

**Figure 2** shows the apparatus the student used to collect and measure the volume of the hydrogen gas.

**Figure 2**



Give the name of the apparatus labelled **X**.

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(1)

(c) The student did the experiment four times. Her results are shown in the table below.

Experiment	Volume of hydrogen collected in one minute in cm <sup>3</sup>
1	49
2	50
3	35
4	48

(i) One of the results is anomalous.

Which result is anomalous? Write your answer in the box.

Give a reason for your choice.

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(2)

(ii) Calculate the mean volume of hydrogen collected in one minute.

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Mean volume = \_\_\_\_\_ cm<sup>3</sup>

(2)

(iii) Give a reason why the experiment should be repeated several times.

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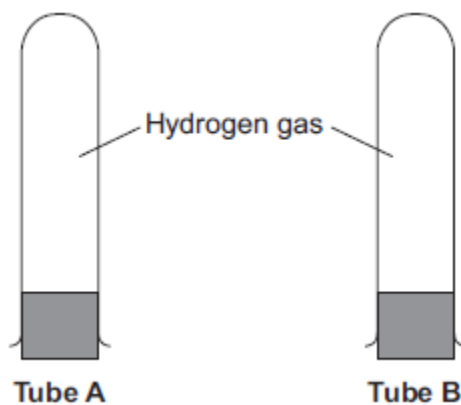
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(1)

(d) A teacher collected two tubes full of hydrogen gas, as shown in **Figure 3**.

**Figure 3**



She tested tube **A** with a lighted splint as soon as she took the bung out.

She tested tube **B** with a lighted splint a few seconds after taking the bung out.

(i) Suggest why tube **B** gave a much louder pop than tube **A**.

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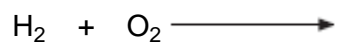
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(1)

- (ii) Complete and balance the chemical equation for the reaction that takes place when the hydrogen reacts in this test.



(2)

(Total 11 marks)

4

The label shows the ingredients in a drink called Cola.

<p style="text-align: center;"><b>Cola</b></p> <p>Ingredients:</p> <p>Carbonated water Sugar Colouring Phosphoric acid Flavouring Caffeine</p>
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- (a) (i) The pH of carbonated water is 4.5.

The pH of Cola is 2.9.

Name the ingredient on the label that lowers the pH of Cola to 2.9.

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(1)

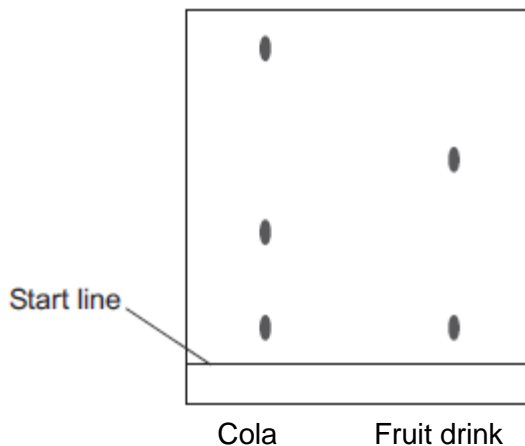
- (ii) Which ion causes the pH to be 2.9?

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(1)

- (b) A student investigated the food colouring in Cola and in a fruit drink using paper chromatography.

The chromatogram in the figure below shows the student's results.



- (i) Complete the sentence.

The start line should be drawn with a ruler and \_\_\_\_\_ .

Give a reason for your answer.

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(2)

- (ii) Suggest **three** conclusions you can make from the student's results.

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(3)

- (c) Caffeine can be separated from the other compounds in the drink by gas chromatography.

Why do different compounds separate in a gas chromatography column?

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(1)

(d) Caffeine is a stimulant.

Large amounts of caffeine can be harmful.

(i) Only **one** of the questions in the table **can** be answered by science alone.

Tick (✓) **one** question.

Question	Tick (✓)
Should caffeine be an ingredient in drinks?	
Is there caffeine in a certain brand of drink?	
How much caffeine should people drink?	

(1)

(ii) Give **two** reasons why the other questions **cannot** be answered by science alone.

Reason 1 \_\_\_\_\_

\_\_\_\_\_

Reason 2 \_\_\_\_\_

\_\_\_\_\_

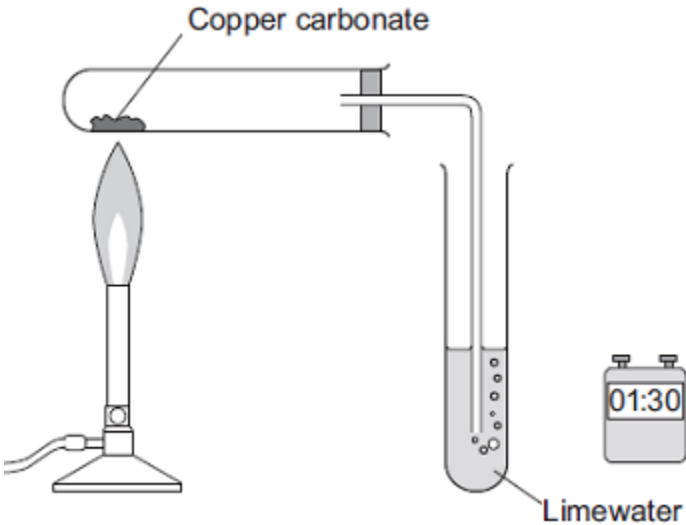
(2)

(Total 11 marks)

5

Carbon dioxide is produced when copper carbonate is heated.

A student investigated heating copper carbonate.  
The student used the apparatus to measure how long it took for carbon dioxide to be produced.  
The student also noted what happened during each minute for three minutes.



- (a) The student used changes to the limewater to measure how long it took for carbon dioxide to be produced.

Describe how.

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(2)

(b) The student wrote down her observations.

Time interval in minutes	Observations
Between 0 and 1	A slow release of gas bubbles. The limewater did not change. The solid in the test tube was green.
Between 1 and 2	A fast release of gas bubbles. The limewater changed at 1 minute 10 seconds.
Between 2 and 3	No release of gas bubbles. The solid in the test tube was black.

(i) Suggest the reason for the student's observations between 0 and 1 minute.

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(2)

(ii) Explain the student's observations between 1 and 2 minutes.

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(2)

(iii) Explain the student's observations between 2 and 3 minutes.

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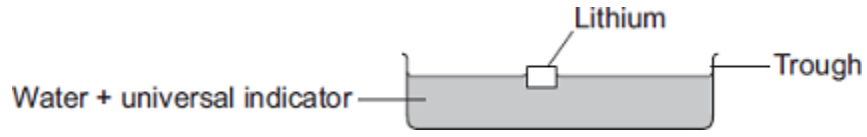
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(2)

6

A student was investigating the reaction of lithium and water.

She added a few drops of universal indicator to water in a trough and added a piece of lithium.



The word equation for the reaction is:



(a) (i) The lithium floated on the water.

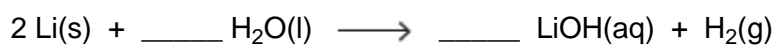
State **two** other observations that the student would **see** during the reaction.

1. \_\_\_\_\_

2. \_\_\_\_\_

(2)

(ii) Balance the symbol equation for the reaction of lithium and water.



(2)

(iii) Describe a simple test and the result that would show the gas was hydrogen.

\_\_\_\_\_  
\_\_\_\_\_

(1)

(iv) All Group 1 metals have similar reactions with water.

State why, in terms of electronic structure.

\_\_\_\_\_  
\_\_\_\_\_

(1)



(b) Lithium and other Group 1 metals have different properties from the transition metals.

Tick (✓) **two** properties that are properties of Group 1 metals.

They react with oxygen.

They form coloured compounds.

They are strong and hard.

They have low melting points.

**(2)**

(c) The electronic structure of a potassium atom is 2, 8, 8, 1

(i) Draw a diagram to show the electronic structure of a potassium ion.

Show the charge on the potassium ion.

**(2)**

(ii) Potassium is more reactive than sodium.

Explain why, in terms of electronic structure.

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(3)

(Total 13 marks)

7

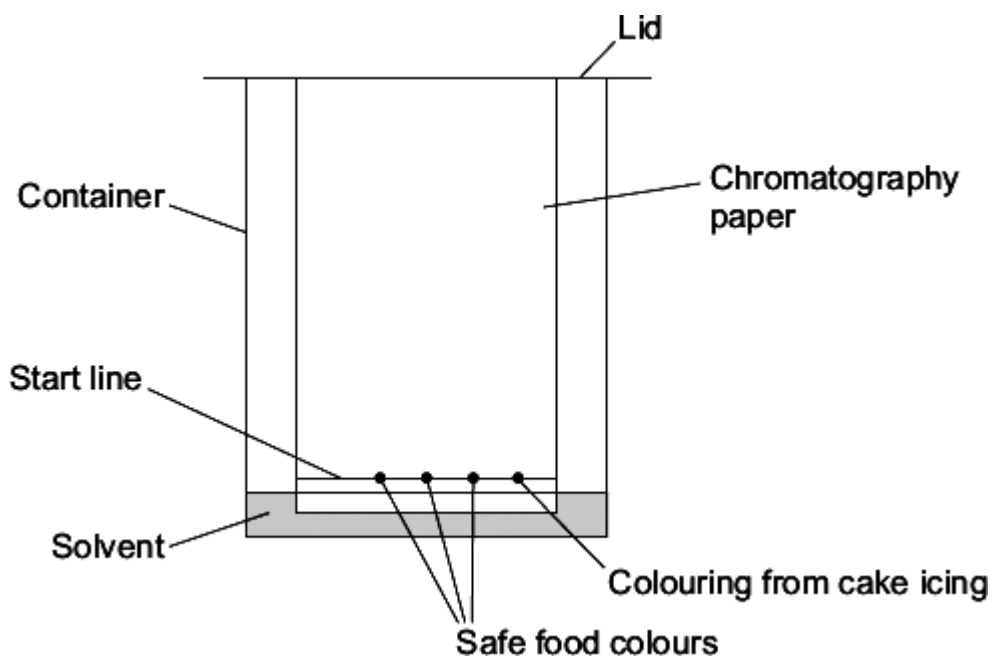
Icing on cakes is tested to check that safe colours were used when they were made.



By Megan Chromik [CC-BY-SA-2.0], via Wikimedia Commons

Paper chromatography is one method of testing which colours are in cake icing.

(a) The diagram shows an experiment a student did.



(i) Suggest why there is a lid on the container.

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(1)

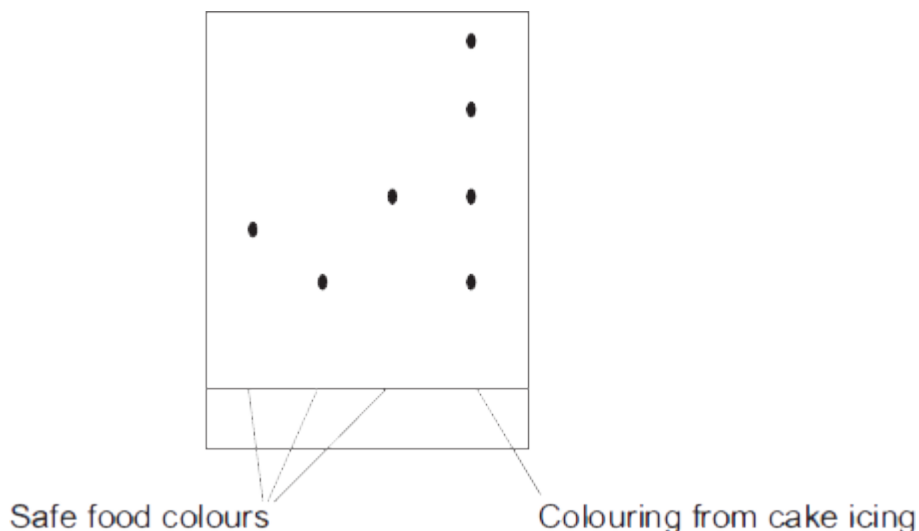
(ii) The start line should be drawn in pencil **not** in ink. Suggest why.

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(1)

(b) The diagram shows the results of the paper chromatography experiment.



(i) How many different food colours were used in the colouring from the cake icing?

\_\_\_\_\_

(1)

(ii) Is the cake icing safe to eat?

Give a reason for your answer.

\_\_\_\_\_  
\_\_\_\_\_

(1)

(c) Gas chromatography linked to mass spectroscopy is an example of an instrumental method. This method was used on a mixture of solvents.

(i) Give **two** advantages of gas chromatography compared with paper chromatography.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)

(ii) What does gas chromatography do to the mixture of solvents?

\_\_\_\_\_  
\_\_\_\_\_

(1)

(iii) What information does mass spectroscopy give?

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(1)

(Total 8 marks)

**8** Read the article.

**Problem food colourings**

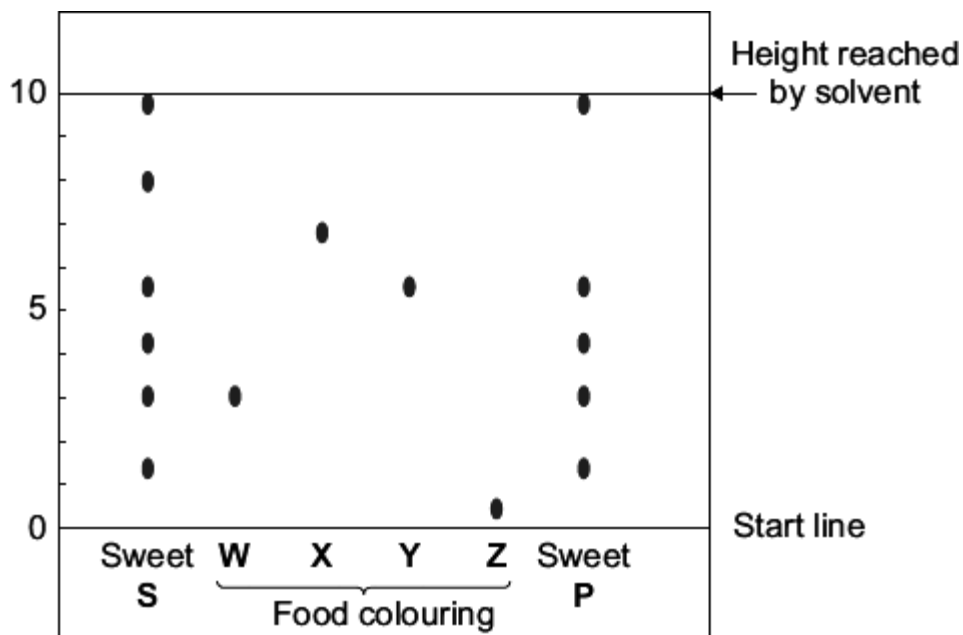
Scientists say they have evidence that some food colourings cause hyperactive behaviour in young children.

These food colourings are added to some sweets.

**W**, **X**, **Y** and **Z** are food colourings that may cause hyperactive behaviour in young children.

A scientist used chromatography to see if these food colourings were used in two sweets, **S** and **P**.

The results are shown on the chromatogram.



(a) Food colourings, such as **W**, **X**, **Y** and **Z**, are added to some sweets.

Suggest **one** reason why.

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(1)

(b) In chromatography, the  $R_f$  value =  $\frac{\text{distance moved by the colouring}}{\text{distance moved by the solvent}}$

Use the scale on the chromatogram to help you to answer this question.

Which food colouring, **W**, **X**, **Y** or **Z**, has an  $R_f$  value of 0.7?

(1)

(c) From the chromatogram, what conclusions can the scientist make about the colourings in sweets **S** and **P**?

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(3)

(Total 5 marks)

9

Some farmed salmon have a coloured additive in the food that they are given. This is a permitted additive that improves the colour of the fish meat.

A sample of the colour is extracted from a salmon.

Explain how paper chromatography could be used to confirm that this is the permitted additive.

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(Total 3 marks)

## Why blue sweets are turning white

A recent study identified a possible harmful effect on children's nervous systems by some artificial colours. Two of these colours are Brilliant Blue (E133) and Quinoline Yellow (E104). Both are artificial colours because they are made from coal. The company is to stop producing the blue sweets because it is removing all artificial colours and there is no natural blue alternative.

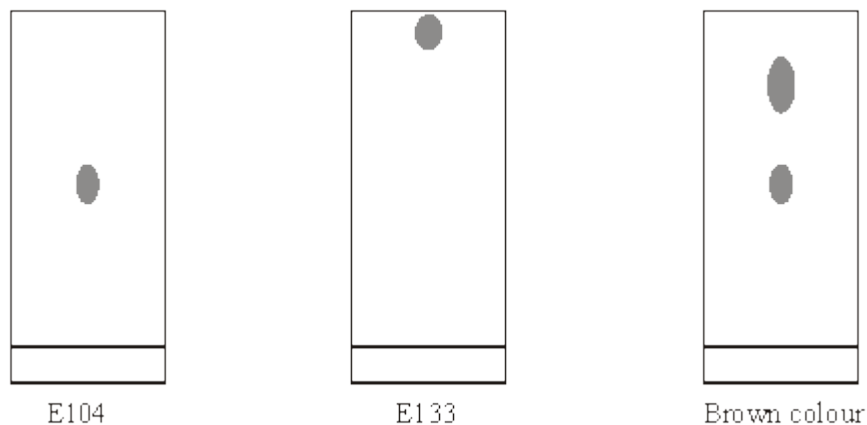
- (a) Suggest why it is important to be able to identify the colour additives in food.

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(1)

- (b) A brown colour used in sweets was analysed using chromatography. The results were compared with those from E104 and E133.



What do the results tell you about the brown colour and its suitability for use in sweets?

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(3)

- (c) Once all the unsuitable colours are removed, the company claims that its sweets are now 'free from artificial colours'.

Does this mean that the sweets contain no additives? Explain your answer.

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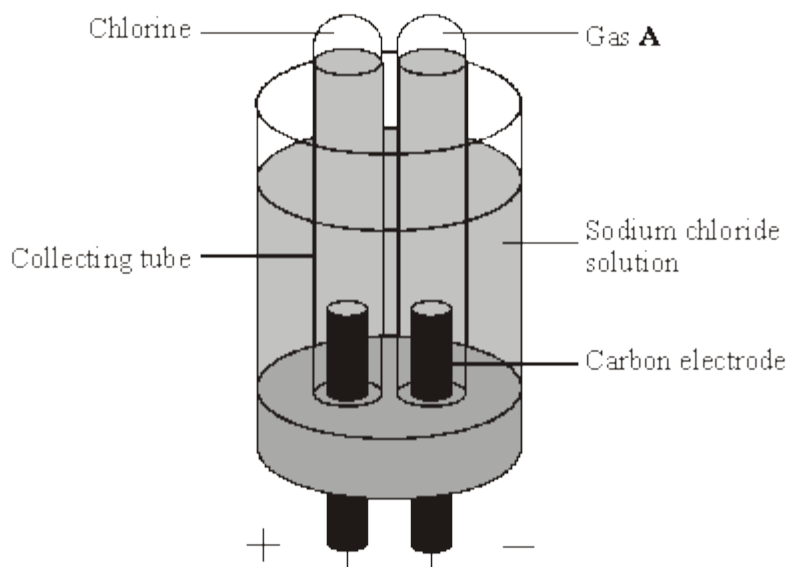
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(2)  
(Total 6 marks)

11

The electrolysis of sodium chloride solution is an important industrial process. The apparatus shown below can be used to show this electrolysis in the laboratory.



- (a) Name gas A. \_\_\_\_\_

(1)

- (b) Chlorine is produced at the positive electrode. Describe and give the result of a chemical test to prove that the gas is chlorine.

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(2)



(c) Chloride ions move to the positive electrode. Explain why.

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(1)

(d) A small quantity of chlorine is added to drinking water. Explain why.

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(1)

(e) The solution around the negative electrode becomes alkaline. Name the ion which makes the solution alkaline.

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(1)

(Total 6 marks)

12

Hydrogen peroxide,  $\text{H}_2\text{O}_2$ , is often used as a bleach. It decomposes forming water and oxygen.

(a) (i) Write the balanced chemical equation for the decomposition of hydrogen peroxide.

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(3)

(ii) Give a test for oxygen.

Test \_\_\_\_\_

Result of test \_\_\_\_\_

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(2)

(b) The rate of decomposition of hydrogen peroxide at room temperature is very slow. Manganese oxide is a catalyst which can be used to speed up the decomposition. Complete the sentence.

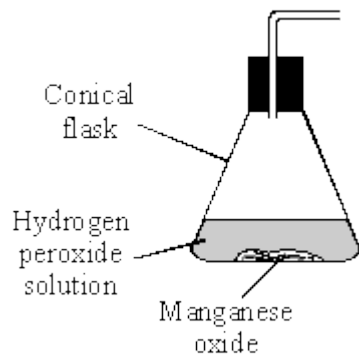
A catalyst is a substance which speeds up a chemical reaction. At the end of the

reaction, the catalyst is \_\_\_\_\_

(1)

(c) Two experiments were carried out to test if the amount of manganese oxide,  $\text{MnO}_2$  affected the rate at which the hydrogen peroxide decomposed.

(i) Complete the diagram to show how you could measure the volume of oxygen formed during the decomposition.

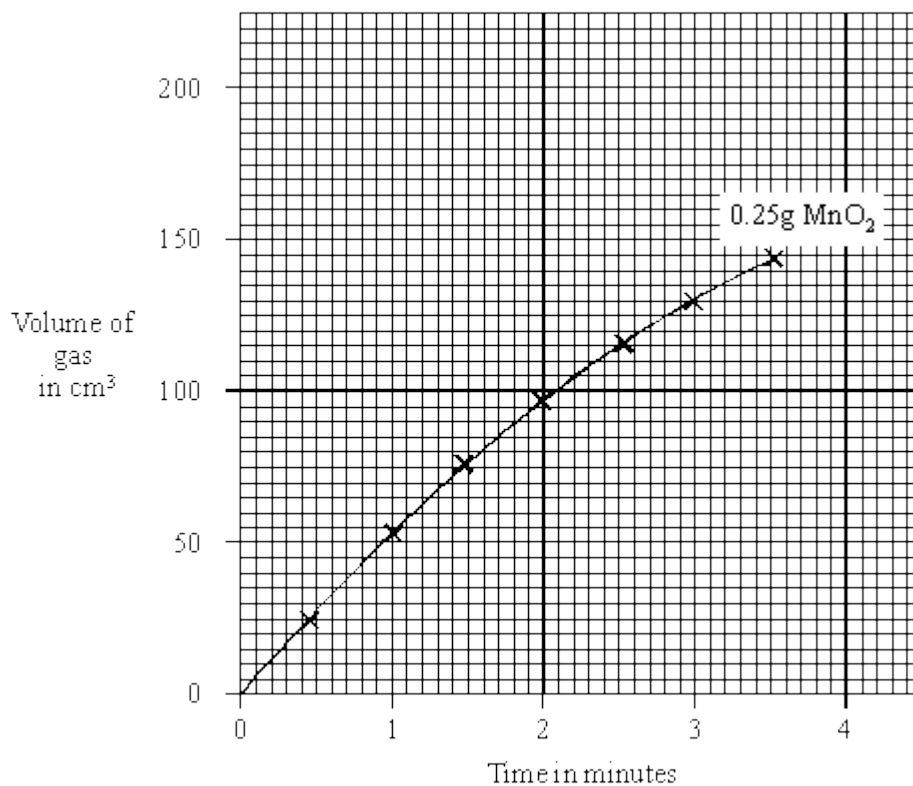


(2)

(ii) The results are shown in the table.

<b>Time in minutes</b>	0	0.5	1	1.5	2	2.5	3	3.5
<b>Volume of gas in cm<sup>3</sup> using 0.25 g MnO<sub>2</sub></b>	0	29	55	77	98	116	132	144
<b>Volume of gas in cm<sup>3</sup> using 2.5 g MnO<sub>2</sub></b>	0	45	84	118	145	162	174	182

Draw a graph of these results. The graph for 0.25 g MnO<sub>2</sub> has been drawn for you.



(3)

(iii) Explain why the slopes of the graphs become less steep during the reaction.

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(2)

- (iv) The same volume and concentration of hydrogen peroxide solution was used for both experiments. What **two** other factors must be kept the same to make it a fair test?

1. \_\_\_\_\_

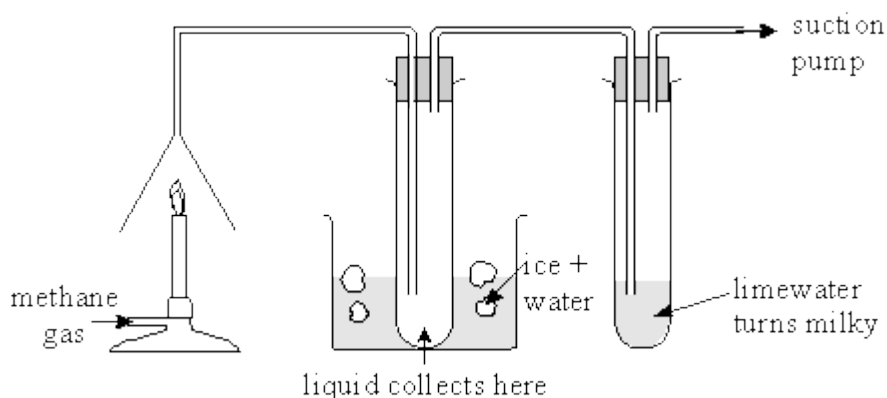
2. \_\_\_\_\_

(2)

(Total 15 marks)

13

Methane  $\text{CH}_4$  contains the elements carbon and hydrogen only. A student wanted to find out which new substances are produced when methane is burned. The student set up the apparatus shown below.



- (a) Which gas in the air reacts with methane when it burns?

\_\_\_\_\_

(1)

- (b) Name the liquid collected.

\_\_\_\_\_

(1)

- (c) Name the gas which turns limewater milky.

\_\_\_\_\_

(1)

- (d) When methane burns an exothermic reaction takes place. What is meant by an exothermic reaction?

\_\_\_\_\_

\_\_\_\_\_

(2)

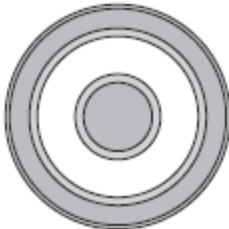
(Total 5 marks)

14

Scientists in the 16th century used the symbol shown in **Figure 1** for gold.

**Figure 1**

**Gold**



The scientists thought platinum was made from gold and silver, so they used the symbol for gold in the symbol for platinum. The symbol for platinum is shown in **Figure 2**.

**Figure 2**

**Platinum**



(a) Gold and platinum are elements.

What is meant by the term **element**?

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(1)

(b) Why is it incorrect to represent platinum as shown in **Figure 2**?

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(1)

(c) Scientists now use a formula such as  $\text{Ag}_2\text{O}$  to represent a substance.

What does the formula  $\text{Ag}_2\text{O}$  tell you about this substance?

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(2)

(Total 4 marks)

15

Aqamed is a medicine for children.

(a) The medicine is a formulation.

What is meant by a formulation?

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(1)

(b) Children often do not like taking medicine.

Suggest a substance that could be added to Aqamed to increase the desire for children to take it.

Give a reason for your suggestion.

Substance \_\_\_\_\_

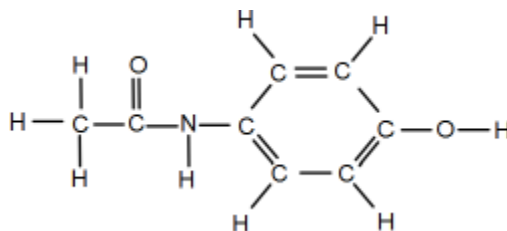
Reason \_\_\_\_\_

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(2)

(c) The main ingredient in Aqamed is a painkiller called paracetamol.

The figure below represents a molecule of paracetamol.



Give the molecular formula of paracetamol.

Calculate its relative formula mass ( $M_r$ ).

Relative atomic masses ( $A_r$ ): H = 1; C = 12; N = 14; O = 16

Molecular formula \_\_\_\_\_

Relative formula mass \_\_\_\_\_

\_\_\_\_\_

$M_r =$  \_\_\_\_\_

(2)

(d) Aspirin is a medicine for use by adults.

An aspirin tablet contains 300 mg of acetylsalicylic acid.

Calculate the number of moles of acetylsalicylic acid in one aspirin tablet.

Give your answer in standard form to three significant figures.

Relative formula mass ( $M_r$ ) of aspirin = 180

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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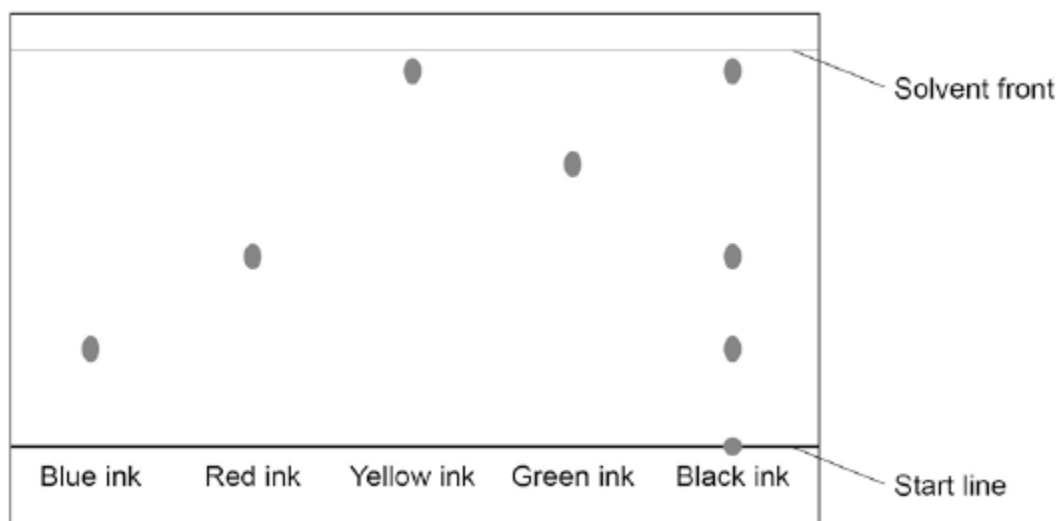
Number of moles = \_\_\_\_\_

(4)

(Total 9 marks)

16

The figure below shows a paper chromatogram of five different inks.



(a) Explain how paper chromatography separates substances.

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(3)

(b) Analyse the chromatogram. Describe and explain the result for black ink.

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(4)



(c) Use the figure above to calculate the  $R_f$  value of the blue ink.

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$R_f$  value = \_\_\_\_\_

(3)

(Total 10 marks)

17

This is part of an article about food additives.

### THE PERIL OF FOOD ADDITIVES

Some orange drinks contain the additives E102 (Tartrazine), E104 (Quinoline Yellow) and E110 (Sunset Yellow). These three coloured additives are thought to cause hyperactivity in children.

(a) State **two** reasons that a manufacturer might give to justify the use of these additives.

1. \_\_\_\_\_

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2. \_\_\_\_\_

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(2)

- (b) Some scientists asked 4000 twelve-year-old children to help them investigate if there is a link between these three coloured additives and hyperactivity.

How would the scientists use these 4000 children to investigate if there is a link between these three coloured additives and hyperactivity in children?

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**(4)**

- (c) A manufacturer used an independent scientist to show that their orange drink did not contain these three coloured additives.

- (i) Suggest why the manufacturer would use a scientist who was independent instead of using their own scientist.

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**(1)**

- (ii) The scientist had samples of E102, E104 and E110 and the orange drink. The scientist used paper chromatography for the test.

Describe how the scientist could use the results to show if the orange drink contained any of these three coloured additives.

You may include a diagram of the paper chromatography results.

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(2)

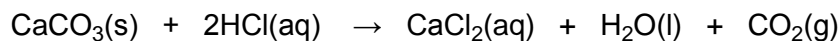
(Total 9 marks)

18

Limestone is used as a building material. Acid rain erodes limestone.

- (a) Limestone contains calcium carbonate.

The symbol equation for the reaction of calcium carbonate with hydrochloric acid is shown.



Describe a test to show that carbon dioxide is produced in this reaction.

Give the result of the test.

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(2)

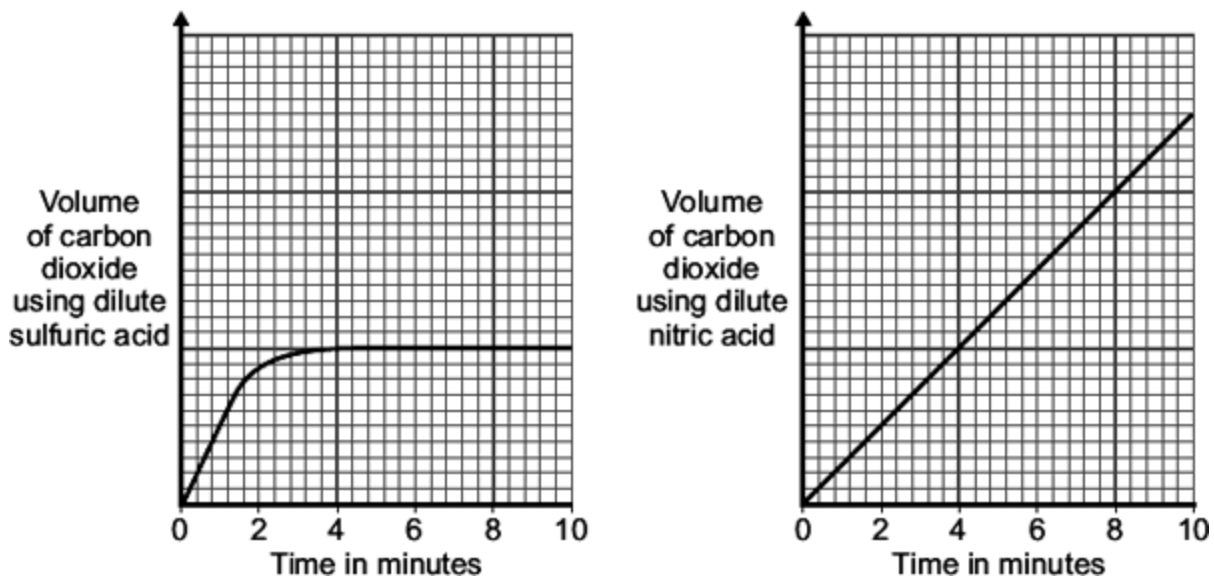
(b) Gases from vehicle exhausts produce sulfuric acid and nitric acid.

A student investigated the reaction of these two acids with calcium carbonate (limestone). The type of acid was changed but all other variables were kept the same.

The student measured the volume of carbon dioxide produced each minute for a total of 10 minutes. He did this first for the reaction between dilute sulfuric acid and a cube of calcium carbonate (limestone).

The student repeated the experiment using dilute nitric acid in place of the dilute sulfuric acid.

The results are shown below.



(i) State **two** variables that must be kept the same for this investigation.

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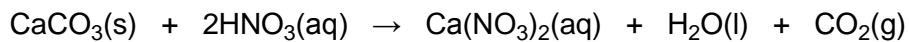
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(2)

- (i) Reacting calcium carbonate with sulfuric acid gave different results to nitric acid.

The symbol equations for the reaction of calcium carbonate with sulfuric acid and with nitric acid are shown below.



Describe how the results for sulfuric acid are different **and** use the symbol equations to explain this difference.

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(3)

(Total 7 marks)

19

Acids and bases are commonly found around the home.

- (a) Baking powder contains sodium hydrogencarbonate mixed with an acid.

- (i) When water is added, the baking powder releases carbon dioxide. How could you test the gas to show that it is carbon dioxide?

Test \_\_\_\_\_

Result of test \_\_\_\_\_

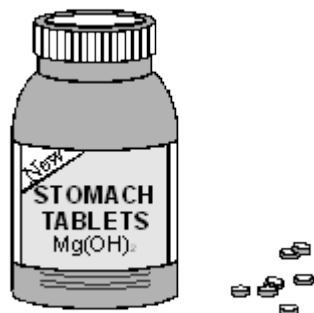
(2)

- (ii) Complete and balance the chemical equation for the reaction of sodium hydrogencarbonate with sulphuric acid.

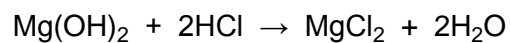


(2)

- (b) Indigestion tablets contain bases which cure indigestion by neutralising excess stomach acid.



- (i) One type of indigestion tablet contains magnesium hydroxide. This base neutralises stomach acid as shown by the balanced chemical equation.



Write a balanced **ionic** equation for the neutralisation reaction.

---

(2)

- (ii) How does the pH in the stomach change after taking the tablets?

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(1)

(c) Ammonium sulphate is used as a lawn fertiliser.



Using ammonia solution, describe how you would make the fertiliser ammonium sulphate.

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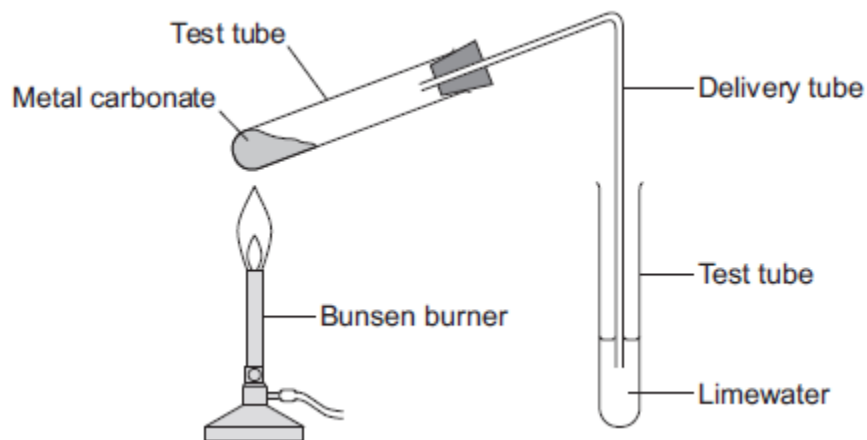
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**(3)**  
**(Total 10 marks)**

A student investigated heating metal carbonates.

The student used the apparatus in the figure below.



The student's results are shown in the table below.

Metal carbonate	Colour before heating	Colour after heating	Mass before heating in g	Mass after heating in g	Limewater
Copper carbonate	Green	Black	12.4	8.0	Turns cloudy
Potassium carbonate	White	White	13.8		
Zinc carbonate	White	White	12.5	8.1	

(a) Explain the observations seen when heating copper carbonate.

Include the names of the substances produced.

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(3)



(b) (i) Potassium carbonate did **not** decompose when heated.

State why.

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(1)

(ii) Complete the table above to show the results you would expect the student to obtain.

(3)

**(Total 7 marks)**

## Mark schemes

- 1** (a) Safe to drink 1
- (b) To remove undissolved solids 1
- (c) the gas is chlorine / Cl<sub>2</sub> 1
- which sterilises water 1
- (d) as distance between steel increases strength of concrete decreases 1
- change above and change below 1.0 cm separation is compared and described  
*must refer to graph values for this mark* 1
- [6]**
- 2** (a) start line drawn in ink 1
- so it will run / dissolve in the solvent / split up  
*allow mixes with the spots* 1
- spots under solvent **or** solvent above spots / start line 1
- so they will mix with solvent **or** wash off paper **or** colour the solvent **or** dissolve in the solvent 1
- (b) (i) contains **A** and **E** 1
- and one other (unknown substance)  
*if no other marks awarded, an answer saying it is made up of three colours gains 1 mark* 1
- (ii) 45 or 46 1
- allow any value from 45 to 46*
- 18  
*allow any value from 16 to 20*  
*award 1 mark if numbers correct but in cm* 1

(iii) 0.40

*allow ecf from (b)(ii)*

*ignore units*

1

(c) fast red

*allow ecf from (b)(iii)*

1

has same  $R_f$  value

*allow none of them, as none has the same  $R_f$  value for 2 marks*

1

(d) any **one** from:

- more accurate
- more sensitive
- uses small quantities of samples
- quicker / faster / more rapid
- can link to mass spectrometer (MS)

1

[12]

3

(a) (i) copper is less reactive than hydrogen **or** copper is unreactive

1

(ii) Zinc and dilute hydrochloric acid

1

(b) (gas) syringe

1

(c) (i) 35

*allow 3*

1

because not close to others

*accept it is much lower than the others*

*ignore references to trends or patterns*

*dependent on the first mark*

1

(ii)  $(49 + 50 + 48) / 3$

= 49

*correct answer with or without working gains 2 marks*

1

allow ecf from anomaly identified in (i) for **2** marks:

- Exp 1 anomalous gives 43.3
- Exp. 2 anomalous gives 44
- Exp. 4 anomalous gives 44.7

answer of 45.5 or 46 (anomaly not excluded) gains **1** mark

correct working **excluding anomaly** but with wrong answer gains **1** mark

1

(iii) so that a mean can be calculated

accept improves accuracy of the mean **or** so anomalies can be identified / discarded **or** to reduce effect of random errors

ignore makes it a fair test

ignore reliability, validity, repeatability, reproducibility

1

(d) (i) idea of mixing with oxygen / air, letting air / oxygen in

accept converse

1

(ii) H<sub>2</sub>O

do not accept incorrect additional products

1

balancing 2 ... (1) ... :

allow fractions or multiples

dependent on first mark

1

[11]

4

- (a) (i) (phosphoric) acid  
*allow phosphoric* 1
- (ii)  $H^+$  / hydrogen (ion)  
*if ion symbol given, charge must be correct* 1
- (b) (i) pencil 1
- so it will not run / smudge / *dissolve*  
*ignore pencil will not interfere with / affect the results*
- or**
- because ink would run / smudge / *dissolve*  
*ignore ink will interfere with / affect the results* 1
- (ii) any **three** from:  
*reference to spots / dots = max 2*  
*allow colouring for colour*
- 3 colours in Cola  
*allow more colours in cola or fewer colours in fruit drink*
  - 2 colours in Fruit drink
  - one of the colours is the same
  - two of the colours in Cola are different
  - one of the colours in Fruit drink is different  
*allow some of the colours in the drinks are different*
  - one of the colours in Cola is the most soluble  
*accept one of the colours in Cola has the highest  $R_f$  value* 3
- (c) different substances travel at different speeds **or** have different retention times  
*accept different attraction to solid*  
*ignore properties of compounds* 1
- (d) (i) Is there caffeine in a certain brand of drink? 1
- (ii) any **two** from:
- cannot be done by experiment
  - based on opinion / *lifestyle choice*
  - ethical, *social* or economic issue  
*accept caffeine has different effects on different people* 2

[11]

5

- (a) time from when the heating is started until 1

the limewater turns cloudy / milky

1

(b) (i) the temperature was not high enough

*accept the copper carbonate had not started to decompose / react  
accept it takes time to heat up the copper carbonate*

1

the bubbles of gas were air

*accept no carbon dioxide produced*

1

(ii) the copper carbonate was decomposing / reacting

*accept the temperature was high enough to cause decomposition /  
a reaction*

1

so carbon dioxide was produced

*allow correct word / symbol equation*

1

(iii) copper oxide was produced

*allow correct word / symbol equation*

1

because the copper carbonate had completely decomposed / reacted

*ignore all of the carbon dioxide had been given off*

1

[8]

6

(a) (i) any **two** from:

- bubbles / effervescence / fizzing  
*ignore hydrogen / gas produced*
- lithium disappears / gets smaller  
*allow dissolves  
do **not** allow melts / burns*
- lithium moves on the surface of the water  
*ignore floats*
- (universal indicator) turns blue / purple

2

(ii) 2

*left-hand side correct*

1

2

*right-hand side correct*

*allow multiples for full credit*

1

(iii) light / burn, which will give a (squeaky) pop / explosion

1

(iv) all have 1 electron in their outer shell / energy level  
*allow have the same number of electrons in their outer shell / energy level*

1

(b) They react with oxygen

1

They have low melting points

1

(c) (i) electronic structure [2,8,8] is drawn  
*incomplete inner shells scores a maximum of 1 mark*

1

charge is +

*allow [2,8,8]<sup>+</sup> for 1 mark*

1

(ii) because (in potassium) the outer shell electron is further away from the nucleus  
**or** because potassium atoms are larger than sodium atoms  
*it should be clear that the candidate is referring to the outer shell electron: if this is not clear a maximum of 2 marks can be awarded*

1

therefore the outer shell electron is less strongly attracted to the nucleus **or** is more shielded from the attraction of the nucleus and so the outer shell electron in potassium is more easily lost

1

*3 marks can be scored for answering the question in terms of sodium*

1

[13]

7

(a) (i) prevent evaporation of solvent  
*allow prevent loss of solvent*  
*allow to support the (chromatography) paper*

1

(ii) ink dissolves in the solvent  
*allow ink 'runs' / spreads **or** pencil does not 'run' / spread*  
*allow ink would affect the result / mixes with colours*

**or**

carbon / graphite does not dissolve in the solvent  
*accept pencil for carbon / graphite*

1

(b) (i) 4

1

- (ii) *no mark for 'no / don't know' ,*  
*ignore numbers*

any **one** from:

- because not all colours match
- not all colours are safe
- some colours could be unsafe
- some colours travelled higher (than safe colours)

1

- (c) (i) any **two** from:

*ignore reliable / precise*

- rapid / quick
- accurate
- sensitive **or** detects very small quantities  
*accept small sample*

2

- (ii) separates

1

- (iii) identifies solvents / compounds / substances

*accept (relative) molecular mass*

*accept formula mass*

*accept  $M_r$*

*accept relative mass*

*accept molecular ion peak*

1

**[8]**

**8**

- (a) (i) (improve) appearance

*allow add colour*

*allow these food colourings have not been proven to cause hyperactive behaviour in young children*

*do **not** accept taste / flavour / preservatives*

*ignore reference to E-numbers*

1

- (b) X

1



(c) any **three** from:

- S contains six / 6 colourings
- P contains five / 5 colourings  
*if neither of first 2 bullet points given allow 1 mark for S contains more colours than P or converse*
- both S and P contain the same  
five / 5 colourings
- both contain W **and** Y
- both sweets (may) cause hyperactivity  
*ignore unsafe*
- neither contain X **and** Z

3

[5]

9

use of solvent / solution / water / any named solvent

1

separates / carries colour(s) / dye(s)

*allow any idea of movement  
eg runs / moves*

1

match against Rf value / known chromatogram / similar pattern  
**or** comparison to permitted additive / colour

*removal of coloured additive from salmon does not gain any marks  
ignore reasons for separation  
maximum 2 if technique clearly doesn't work*

1

[3]

10

(a) check if safe to eat / healthy

**or**

permitted

*accept references to allergies / medical problems*

1

- (b) any **three** from:
- accept dye for colour*
- made up of two colours / dots
  - contains an unknown colour / dot
  - contains a harmful colour
  - contains E104 / quinoline yellow  
**or** does not contain E133 / brilliant blue
  - further analysis needed
- 3

- (c) ignore No or Yes but No must be implied
- there could be other additives (in the sweets)
- accept any other type of additives but **not** colourings*
- 1
- could still contain / use / add natural colours
- accept non-artificial for natural*
- or**
- named natural colours*
- 1

[6]

11

- (a) hydrogen
- accept  $H_2$*
- do **not** accept  $H$*
- 1

- (b) litmus paper / Universal Indicator paper / pH paper
- allow any suitable named indicator*
- 1
- bleached / turns white **or** loses its colour
- do **not** accept bleached cloth / leaves etc.*
- allow second mark unless incorrect indicator given*
- allow starch iodide paper (1)*
- goes black / blue black (1)*
- allow potassium iodide solution (1) goes brown / orange / black precipitate (1)*
- 1

- (c) because they have a negative charge **or** opposite charges attract
- accept (because) it is  $Cl^-$*
- accept chlorine,  $Cl$  **or** chlorine ions has a negative charge*
- do **not** accept  $Cl^-$  on its own*
- do **not** accept  $Cl_2$  o.e. has negative charge*
- 1

(d) kill bacteria / germs, etc. **or** sterilise / disinfect  
*accept destroys bacteria etc.*  
*ignore clean / purify water (owtte)*  
*do **not** accept just gets rid of bacteria* 1

(e) hydroxide (ion)  
*accept OH<sup>-</sup>* 1

[6]

12

(a) (i) H<sub>2</sub>O<sub>2</sub> reactant correct  
*ignore any state symbols* 1

H<sub>2</sub>O + O<sub>2</sub> products correct 1

2H<sub>2</sub>O<sub>2</sub> → 2H<sub>2</sub>O + O<sub>2</sub> balanced  
*accept correct multiple* 1

(ii) glowing splint 1

relights  
*accept 'bursts into flame'*  
*do **not** accept a lighted splint burns brighter **or** faster* 1

(b) unchanged  
*accept **not** used up **or** left (behind)* 1

(c) (i) gas syringe **or** measuring cylinder **either** with scale drawn **or** labelled 1

the apparatus as drawn would work 1

(ii) correct plotting of points  
***one** mark to be deducted for each error* 2

best fit graph line drawn (single line drawn) 1

(iii) concentration of hydrogen peroxide decreases  
*accept less particles of hydrogen peroxide to collide*  
*do **not** accept hydrogen peroxide gets used up*

1

rate of reaction decreases  
*accept reaction gets slower*

1

(iv) any two from:

- temperature
- pressure
- division of catalyst **or** manganese oxide  
*do **not** accept any other factors*

2

[15]

13

(a) oxygen/O<sub>2</sub>  
*for 1 mark*

1

(b) water/H<sub>2</sub>O  
*for 1 mark*

1

(c) carbon dioxide/CO<sub>2</sub>  
(if symbols are used they must be correct)  
*for 1 mark*

1

(d) gives out  
*for 1 mark*

1

heat or energy (2 independent marks)  
*for 1 mark*

1

[5]

14

(a) contains only one sort of atom

1

(b) platinum is not a compound / mixture / alloy

**or**

platinum is an element so should have own (unique) symbol

**or**

symbol shown represents 2 different sorts of atom

*allow platinum is (an element so) not made of gold and silver*

1

(c) it contains two silver ions **and** one oxide ion

*maximum of 1 mark if mention of being mixed together / covalently bonded*

*allow silver atoms for silver ions*

*allow oxygen atom / ion for oxide ion*

*allow for 1 mark:*

*it is silver oxide*

**or**

*it is made of silver and oxygen*

**or**

*it is a compound*

**or**

*correct ratio of 2:1 atoms / ions for incorrect element(s)*

2

[4]

15

(a) (medicine is) a mixture **and**

(designed as) a useful product

1

(b) sugar / flavouring

1

to make it taste better

**or**

colouring

to make it look more attractive

1

(c)  $C_8H_9NO_2$

*any order of elements*

1

151

1

- (d) mass of acetylsalicylic acid = 0.3 g 1
- $= \frac{0.3}{100} \text{ (mol)}$
- method mark – divide mass by  $M_r$*  1
- = 0.00167 (mol)
- allow 0.0016666(66)* 1
- $1.67 \times 10^{-3}$  (mol)
- correct answer with or without working scores 4 marks*
- allow ecf from steps 1, 2 and 3* 1

**[9]**

**16**

- (a) mobile phase / solvent moves through paper 1
- and carries substances different distances 1
- which depend on their attraction for paper and solvent
- allow which depend on solubility in solvent and attraction to paper* 1
- (b) **Level 2 (3–4 marks):**
- A relevant and coherent description which provides a clear analysis of the chromatogram. The response makes logical links between the points raised and uses sufficient examples to support these links.
- Level 1 (1–2 marks):**
- Simple statements are made which demonstrate a basic attempt to analyse the chromatogram. The response may fail to make logical links between the points raised.
- 0 marks:**
- No relevant content
- Indicative content**
- black ink is a mixture
  - because more than one spot
  - contains blue, red and yellow
  - because  $R_f$  values / positions match
  - does not contain green
  - contains an unknown
  - which is insoluble
  - yellow is most soluble or has highest  $R_f$  value, blue is least
- 4
- (c) both measurements from artwork for 1 mark ( $1.3 \pm 0.1$  cm and  $5.3 \pm 0.1$  cm) 1

correct equation used for **1** mark

1

$0.25 \pm 0.02$

1

*accept  $0.25 \pm 0.02$  without working shown for **3** marks*

*allow ecf from incorrect measurement to final answer for **2** marks*

[10]

17

(a) any **two** from:

*ignore reference to taste / shelf-life / sales etc*

- improve the colour / appearance
- additives are permitted / not banned / listed on the label
- link between additives and hyperactivity not proved
- maintain the low cost of the drink **or** natural colours would make the drink cost more

*allow cheaper if qualified*

2

(b) have a control group / placebo **or** test children before any drink given

1

give a drink to at least 3 groups **or** give a drink at least 3 times

1

give each additive to different group / children / at different times

1

observe / monitor / compare behaviour of group / children

1

(c) (i) so that there would be trust / respect / no bias

1

(ii) compare the colours / spots from the orange drink with those of the (three) additives

*accept diagram of chromatogram(s) with spots for E102, 104, 110  
and sample from the orange drink*

1

there should be no matching colours / spots

1

[9]

18

(a) limewater **or** calcium hydroxide solution

1

(reacts with carbon dioxide and) turns cloudy / milky

*linked to first point*

*if no other mark awarded 'puts out lighted splint' gains **1** mark*

1

(b) (i) any **two** from:

- same volume / amount of the acids
- concentration of the acids
- temperature
- same surface area / size / mass / amount of calcium carbonate
- same measuring equipment

2

(ii) any **three** from:

- (after about 4 minutes) the sulfuric acid stops reacting **or** nitric acid continues to react  
*accept more CO<sub>2</sub> with nitric acid at any time after 4 minutes*
- (initially) the reaction with sulfuric acid is faster
- (the reaction stops) because calcium sulfate is a solid  
*allow sulfuric acid produces a solid*
- (the reaction continues) because calcium nitrate is soluble / in solution / aqueous  
*allow nitric acid produces an (aqueous) solution*
- because the calcium sulfate prevents the sulfuric acid reacting with the calcium carbonate
- (the rate is faster) because sulfuric acid contains two hydrogens

3

[7]

19

(a) (i) test: limewater

*accept calcium hydroxide solution*

1

result: 'goes' cloudy

*accept white **or** milky*

*do **not** accept misty **or** chalky test must be correct before result mark can be considered*

1

(ii)  $2 \text{NaHCO}_3 + \text{H}_2\text{SO}_4 \rightarrow$

$\text{Na}_2\text{SO}_4 + (2) \text{H}_2\text{O} + (2) \text{CO}_2$

1

correctly balanced

1



- (b) (i)  $H^+ + OH^-$  1
- $\rightarrow H_2O$
- deduct **one** mark if incorrectly balanced
- accept  $H_3O^+$  instead of  $H^+$  then  $2H_2O$  needed for balance* 1
- (ii) pH increases 1
- accept numerical indication*
- (c) addition of sulphuric acid 1
- correct use of an indicator
- accept idea of forming a neutral solution* 1
- crystallisation (of neutral solution)
- accept description using evaporation* 1

**[10]**

**20**

- (a) (black) copper oxide formed 1
- explanation must be linked to correct observation*
- loss in mass is due to carbon dioxide / gas production 1
- limewater cloudy shows carbon dioxide produced 1
- (b) (i) any **one** from: 1
- ignore references to reactivity*
- (bunsen burner flame) not hot enough (to decompose potassium carbonate)
- accept temperature not high enough (to decompose potassium carbonate)*
- not all Group 1 carbonates decompose
- allow potassium is in Group 1* 1
- (ii) potassium carbonate: 1
- (mass) 13.8 g

(limewater) colourless

*accept no change for colourless*

*ignore clear*

1

zinc carbonate:

(limewater turns) cloudy

<b><i>Metal carbonate</i></b>	<b><i>Mass after heating in g</i></b>	<b><i>Limewater</i></b>
<i>Potassium carbonate</i>	13.8	<i>colourless</i>
<i>Zinc carbonate</i>		<i>cloudy</i>

1

[7]