

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

# Atmosphere part 4 AQA Triple Chemistry

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

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

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Time: **78 minutes**

Marks: **77 marks**

Comments:

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1.

Burgundy Mixture is a formulation used to kill fungi on grapevines.

It is made by mixing two compounds, **A** and **B**.

The ratio by mass of **A** : **B** in the mixture is 1 : 8

(a) Calculate the mass of A needed in a mixture containing 125 g of **B**.

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Mass of **A** = \_\_\_\_\_ g

(2)

Scientists test a solution of compound **A**.

The table shows their results.

Test	Result
Add sodium hydroxide solution	Blue precipitate
Add dilute hydrochloric acid and barium chloride solution	White precipitate

(b) Which **two** ions are in compound **A**?

Choose the answers from the box.

<b>bromide</b>	<b>chloride</b>	<b>copper</b>
<b>iron(II)</b>	<b>iron(III)</b>	<b>sulfate</b>

\_\_\_\_\_ ions and \_\_\_\_\_ ions

(2)

(c) The scientists think that compound **B** is sodium carbonate.

Describe how the scientists can test a solution of **B** to see if sodium ions are present.

Give the result of the test if sodium ions are present.

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(2)

(d) Describe how the scientists can test a solution of **B** to see if carbonate ions are present.

Give the result of the test if carbonate ions are present.

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**(3)**  
**(Total 9 marks)**

2.

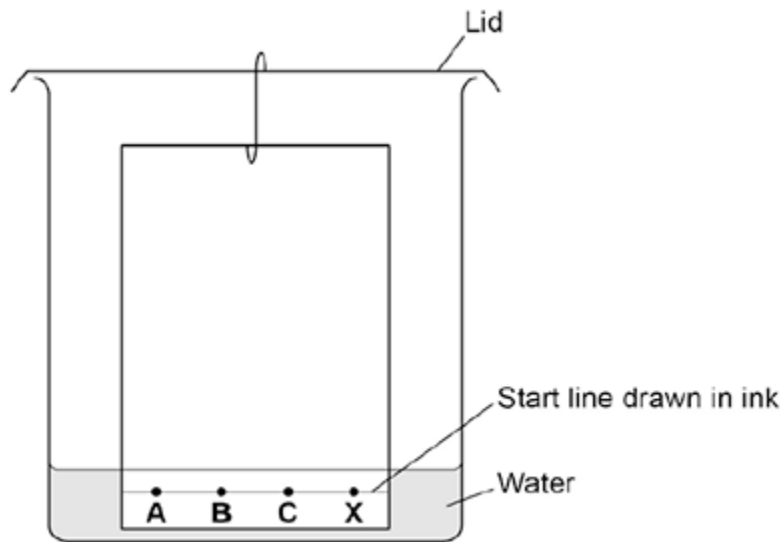
A student investigated a food colouring using paper chromatography.

This is the method used.

1. Put a spot of food colouring **X** on the start line.
2. Put spots of three separate dyes, **A**, **B** and **C**, on the start line.
3. Place the bottom of the paper in water and leave it for several minutes.

(a) **Figure 1** shows the apparatus the student used.

**Figure 1**



Give **two** mistakes the student made in setting up the experiment.

Tick **two** boxes.

The lid was on the beaker.

The paper did not touch the bottom of the beaker.

The spots were too small.

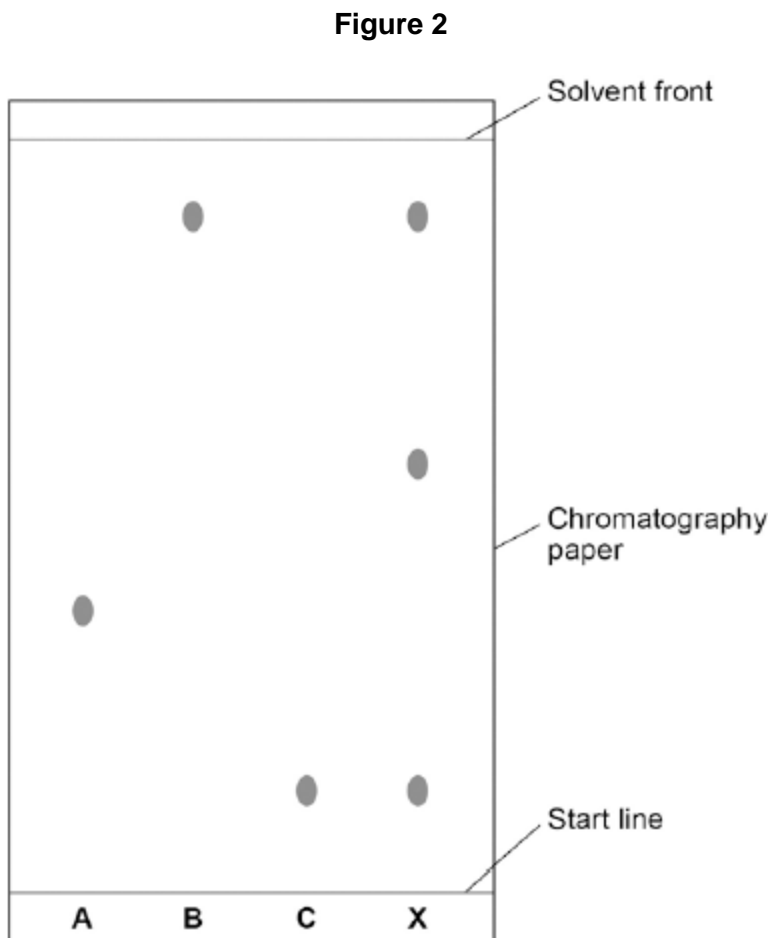
The start line was drawn in ink.

The water level was above the spots.

(2)

(b) Another student set the experiment up correctly.

**Figure 2** shows the student's results.



How many dyes were in **X**?

Tick **one** box.

1	<input type="checkbox"/>
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3	<input type="checkbox"/>
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4	<input type="checkbox"/>
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6	<input type="checkbox"/>
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(1)

(c) Which dye, **A**, **B** or **C**, is **not** in **X**?

Write your answer in the box.

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(1)

(d) Use **Figure 2** to complete the table below.

Calculate the value for  $R_f$  for dye **A**.

	Distance in mm
Distance moved by dye <b>A</b>	_____
Distance from start line to solvent front	_____

Use the equation:

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

Give your answer to two significant figures.

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

(5)  
(Total 9 marks)

3.

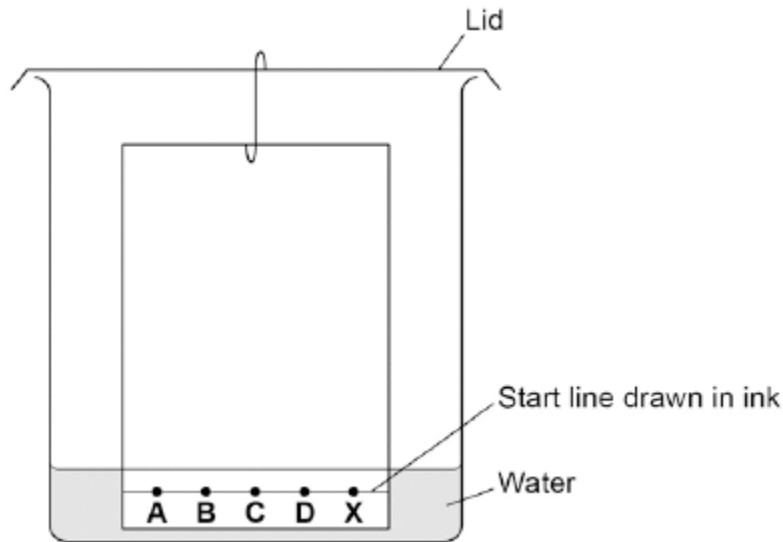
A student investigated food dyes using paper chromatography.

This is the method used.

1. Put a spot of food colouring **X** on the start line.
2. Put spots of four separate dyes, **A**, **B**, **C** and **D**, on the start line.
3. Place the bottom of the paper in water and leave it for several minutes.

**Figure 1** shows the apparatus the student used.

**Figure 1**



- (a) Write down **two** mistakes the student made in setting up the experiment and explain what problems one of the mistakes would cause.

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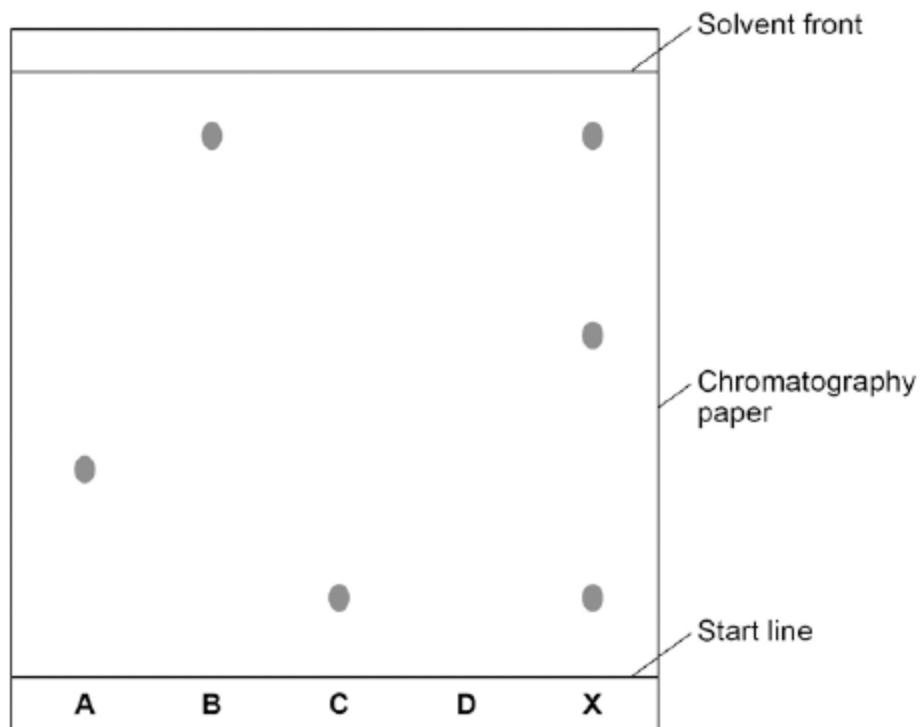
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(2)

(b) Another student set up the apparatus correctly.

Figure 2 shows the student's results. The result for dye D is not shown.

Figure 2



Calculate the  $R_f$  value of dye A

Give your answer to two significant figures.

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

(3)

(c) Dye D has an  $R_f$  value of 0.80. Calculate the distance that dye D moved on the chromatography paper.

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Distance moved by dye D = \_\_\_\_\_

(1)

(d) Explain how the different dyes in **X** are separated by paper chromatography.

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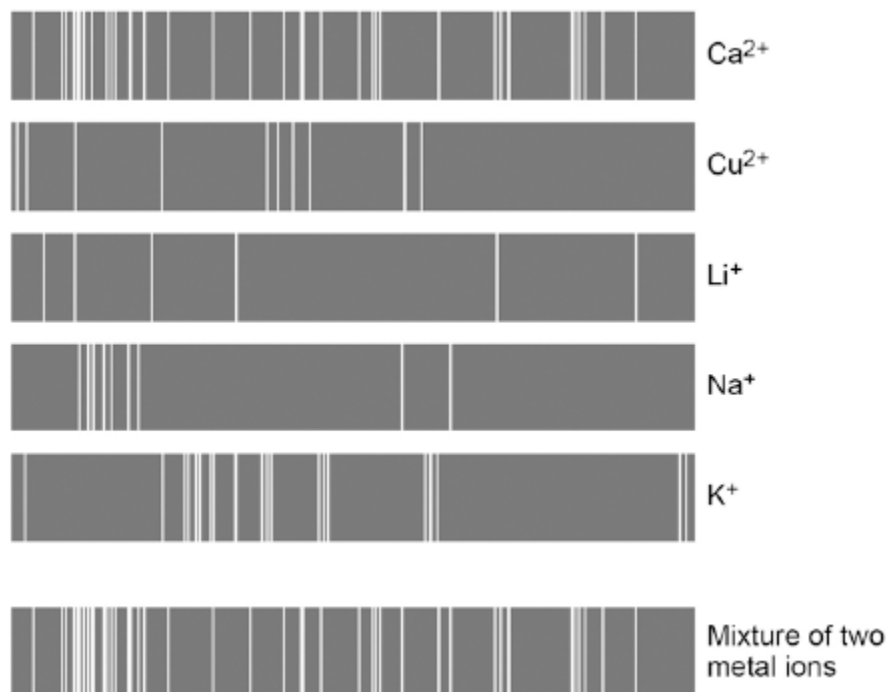
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(4)

(e) Flame emission spectroscopy can be used to analyse metal ions in solution.

**Figure 3** gives the flame emission spectra of five metal ions, and of a mixture of two metal ions.

**Figure 3**



Use the spectra to identify the **two** metal ions in the mixture.

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(2)

(f) Explain why a flame test could **not** be used to identify the two metal ions in the mixture.

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(2)

(g) Two students tested a green compound **X**.  
The students added water to compound **X**.  
Compound **X** did not dissolve.

The students then added a solution of ethanoic acid to compound **X**.  
A gas was produced which turned limewater milky.

Student **A** concluded that compound **X** was sodium carbonate.  
Student **B** concluded that compound **X** was copper chloride.

Which student, if any, was correct?

Explain your reasoning.

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(4)

(Total 18 marks)

4.

This question is about chemical tests.

- (a) Solutions of copper(II) ions and iron(III) ions produce coloured precipitates with sodium hydroxide solution.

Draw **one** line from each metal ion to the colour of the precipitate it produces.

Metal ion	Colour of precipitate
Copper(II) ( $\text{Cu}^{2+}$ )	Blue
	Brown
	Green
Iron(III) ( $\text{Fe}^{3+}$ )	White

(2)

- (b) Sodium hydroxide solution was added to a solution containing ions of a metal.

A white precipitate was produced. The white precipitate dissolved in excess sodium hydroxide solution.

Use the correct answer from the box to complete the sentence.

aluminium      magnesium      potassium

The ions in the solution were ions of \_\_\_\_\_ .

(1)

(c) Low sodium salt contains sodium chloride and potassium chloride.

A student used a flame test on low sodium salt.

(i) What is the colour produced by sodium ions in a flame test?

\_\_\_\_\_

(1)

(ii) What is the colour produced by potassium ions in a flame test?

\_\_\_\_\_

(1)

(iii) Why is it **not** possible to tell from the flame test that both ions are present in low sodium salt?

\_\_\_\_\_

\_\_\_\_\_

(1)

(Total 6 marks)

5.

This question is about atoms.

Atoms contain electrons, neutrons and protons.

(a) (i) Which of these particles has a positive charge?

Tick (✓) **one** box.

Electron

Neutron

Proton

(1)

(ii) Which of these particles does **not** have an electrical charge?

Tick (✓) **one** box.

Electron

Neutron

Proton

(1)

(b) How are the elements in the periodic table arranged?

Tick (✓) **one** box.

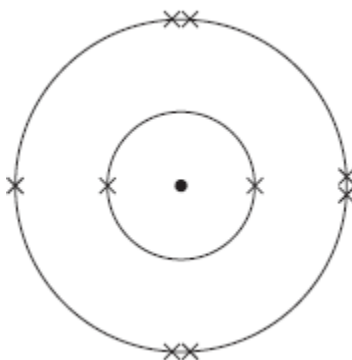
In order of increasing atomic number

In order of increasing mass number

In order of increasing reactivity

(1)

(c) The diagram shows the arrangement of the electrons in an atom of fluorine.



(i) How many protons are in an atom of fluorine?

Tick (✓) **one** box.

2

7

9

(1)

(ii) The boiling point of fluorine is  $-188\text{ }^{\circ}\text{C}$ .

What is the state of fluorine at room temperature?

Tick (✓) **one** box.

Solid

Liquid

Gas

(1)

- (d) Fluorine reacts with copper to form an ionic compound.
- (i) Explain, in terms of electrons and electronic structure, what happens to a fluorine atom when it reacts with copper.

Use the figure above to help you to answer this question.

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(2)

- (ii) Describe a chemical test which would show that a solution contains copper(II) ions.

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(2)

(Total 9 marks)

6.

This question is about chemical analysis.

- (a) A student has solutions of three compounds, **X**, **Y** and **Z**.

The student uses tests to identify the ions in the three compounds.

The student records the results of the tests in the table.

Compound	Test			
	Flame test	Add sodium hydroxide solution	Add hydrochloric acid and barium chloride solution	Add nitric acid and silver nitrate solution
<b>X</b>	no colour	green precipitate	white precipitate	no reaction
<b>Y</b>	yellow flame	no reaction	no reaction	yellow precipitate
<b>Z</b>	no colour	brown precipitate	no reaction	cream precipitate



7.

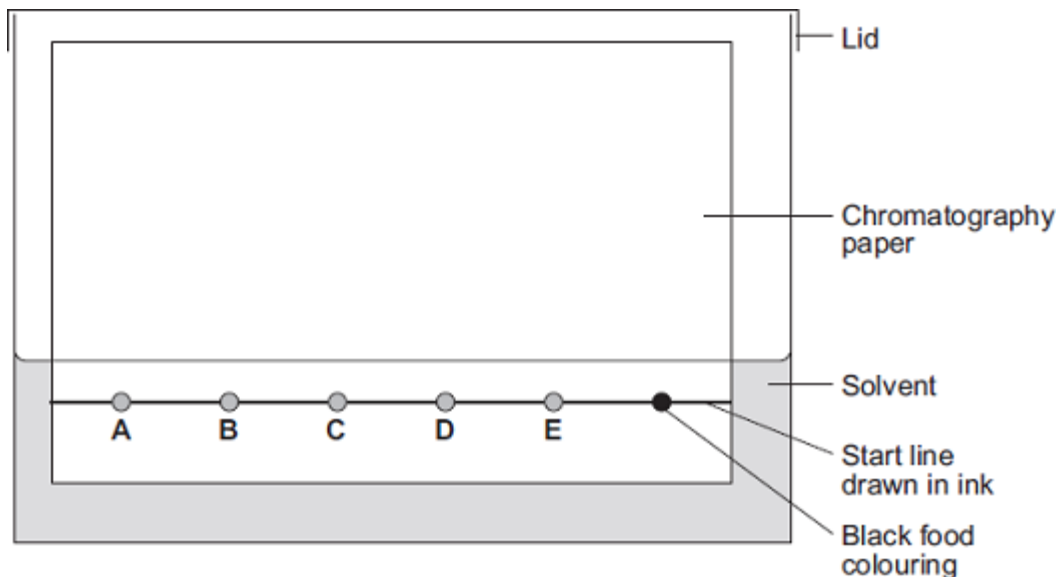
Chromatography can be used to separate components of a mixture.

(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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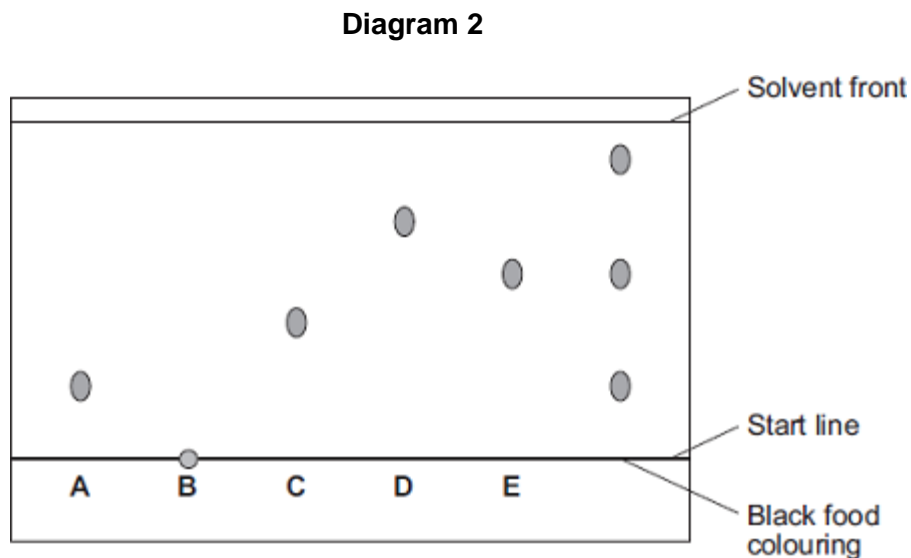
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(4)

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

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



(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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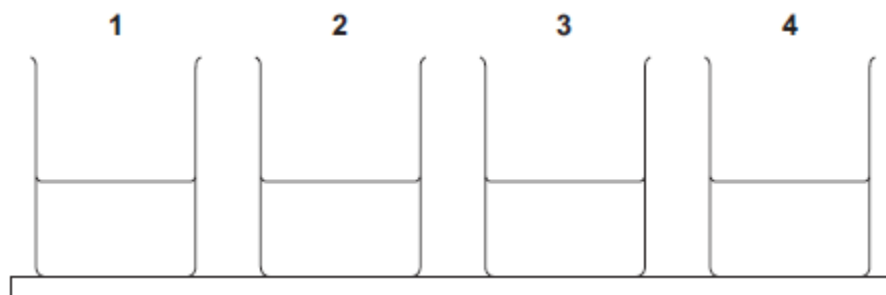
(1)

(Total 12 marks)

8.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

A group of students had four different colourless solutions in beakers **1**, **2**, **3** and **4**, shown in the figure below.



The students knew that the solutions were

- sodium chloride
- sodium iodide
- sodium carbonate
- potassium carbonate

but did **not** know which solution was in each beaker.

The teacher asked the class to plan a method that could be used to identify each solution.

She gave the students the following reagents to use:

- dilute nitric acid
- silver nitrate solution.



## Mark schemes

- 1.** (a)  $\frac{125}{8}$  1
- = 15.6(25) (g) 1
- an answer of 15.6(25) (g) scores 2 marks*
- (b) copper (ions) 1
- allow in either order*
- sulfate (ions) 1
- (c) flame test 1
- yellow (flame) 1
- (d) add dilute acid 1
- allow named acid*
- (bubble gas produced through) limewater 1
- (turns) cloudy / milky 1
- allow forms white precipitate* 1
- [9]**
- 2.** (a) The start line was drawn in ink 1
- The water level was above the spots 1
- (b) 3 1
- (c) **A** 1
- (d) (*distance moved by dye A*) 38 (mm) 1
- allow values in range 36-40*
- (*distance from start line to solvent front*) 102 (mm) 1
- allow values in range 101-103*

$$\frac{38}{102}$$

*allow ecf from Table 1*

1

0.37254 ...

*allow values in range 0.35 – 0.39*

1

0.37

*accept 0.37 with no working shown for 5 marks*

1

[9]

3.

(a) water level above the start line

**and**

start line drawn in ink

*allow water level too high*

1

*water level*

food colours would dissolve into water

**or**

*start line*

the ink would 'run' on the paper

1

(b) (distance moved by **A**) 2.8cm **and** 8.2 cm (distance moved by solvent)

*allow values in range 2.7 – 2.9 cm and 8.1 – 8.3 cm*

1

$$\frac{2.8}{8.2}$$

1

0.34

*allow 0.33 or 0.35*

*allow ecf from incorrect measurement to final answer for 2 marks if given to 2 significant figures*

*accept 0.34 without working shown for 3 marks*

1

(c) 6.6 cm

*allow values between 6.48 and 6.64 cm*

1

(d) solvent moves through paper

1

different dyes have different solubilities in solvent

1

and different attractions for the paper

1

and so are carried different distances

1

(e) calcium ions

*allow Ca<sup>2+</sup>*

1

sodium ions

*allow Na<sup>+</sup>*

1

(f) two different colours

**or**

Ca<sup>2+</sup> / one is orange-red and Na<sup>+</sup> / the other is yellow

*allow brick red for Ca<sup>2+</sup> and / or orange for Na<sup>+</sup>*

*allow incorrect colours if consistent with answer to 7.5*

1

(so) colours mix

**or**

(so) one colour masks the other

1

(g) (Student **A** was incorrect)

because sodium compounds are white not green

**or**

because sodium carbonate is soluble

1

so can't contain sodium ions

1

(Student **B** was incorrect)

because adding acid to carbonate produces carbon dioxide

1

so must contain carbonate not chloride ions

1

[18]

4.

(a) copper (II) → blue

iron (III) → brown

*more than one line from any box negates the mark*

1

1

(b) aluminium

*allow correct answer shown in box if answer line blank*

1

- (c) (i) yellow  
*allow orange* 1
- (ii) lilac  
*allow purple* 1
- (iii) one colour masks the other  
*allow colours mixed* 1

[6]

5.

- (a) (i) Proton 1
- (ii) Neutron 1
- (b) In order of increasing atomic number 1
- (c) (i) 9 1
- (ii) Gas 1
- (d) (i) gains (one) electron 1
- (to gain a) full outer energy level **or** noble gas configuration  
*allow because it has seven outer electrons* 1
- (ii) add sodium hydroxide (solution)  
*allow ammonia (solution) or ammonium hydroxide or any other soluble hydroxide or flame test* 1
- (forms a) blue precipitate  
*second mark dependent on suitable reagent being added*  
*allow blue-green / blue / green if flame test given* 1

[9]

6.

- (a) **X:**  
Fe<sup>2+</sup> / iron(II), SO<sub>4</sub><sup>2-</sup> / sulfate  
*allow iron(II) sulfate*  
**or** FeSO<sub>4</sub> 1

**Y:**

Na<sup>+</sup> / sodium, I<sup>-</sup> / iodide

*allow sodium iodide*

**or** NaI

1

**Z:**

Fe<sup>3+</sup> / iron(III), Br<sup>-</sup> / bromide

*allow iron(III) bromide*

**or** FeBr<sub>3</sub>

*correct identification of any two ions = one mark*

*correct identification of any four ions = two marks*

1

(b) any **five** from:

*allow converse arguments*

method 1

- weighing is accurate
- not all barium sulfate may be precipitated
- precipitate may be lost
- precipitate may not be dry
- takes longer
- requires energy

*allow not all the barium hydroxide has reacted*

method 2

- accurate
- works for low concentrations

*allow reliable / precise*

5

**[8]**

**7.**

(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

*allow any value from 45 to 46*

1

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]

8.

Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

**0 marks**

No relevant content

**Level 1 (1 – 2 marks)**

Any description of a method used and / or a result given

**Level 2 (3 – 4 marks)**

Description of workable methods used, with results to identify positive **or** negative ions

**Level 3 (5 – 6 marks)**

Description of methods used to identify both positive **and** negative ions, with relevant results

**examples of the points made in the response**

*extra information*

**Test:** add (platinum / nichrome) wire (for the flame test)

*accept any method of introducing the solution into the flame, eg a splint soaked in the solution or sprayed from a bottle*

**Result:** the sodium compounds result in a yellow / orange / gold flame **or** the potassium compound results in a lilac / purple / mauve flame

*student could state that potassium carbonate gives a different colour to the three sodium compounds as long as it is clear that the flame test colour comes from Na<sup>+</sup> or K<sup>+</sup>*

**Test:** add dilute nitric acid to all four solutions

*allow any acid*

**Result:** sodium carbonate and potassium carbonate will effervesce **or** sodium chloride and sodium iodide will not effervesce

**Test:** add dilute nitric acid followed by silver nitrate

**Result:** sodium chloride and sodium iodide produce a precipitate **or** sodium chloride produces a white precipitate and sodium iodide produces a yellow precipitate

*accept sodium carbonate and potassium carbonate do not produce a precipitate*

**[6]**