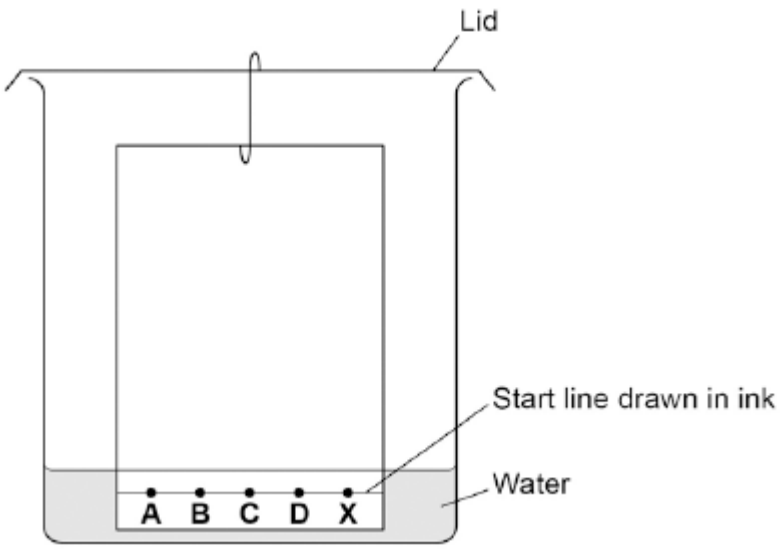
Q1.A student investigated food dyes using paper chromatography.

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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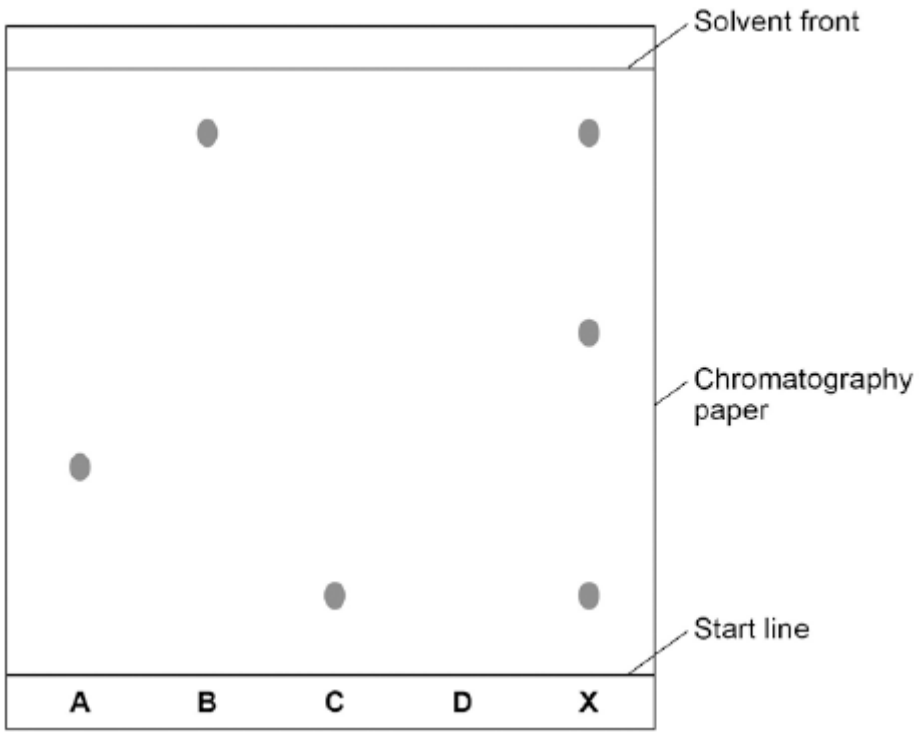
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(2)

(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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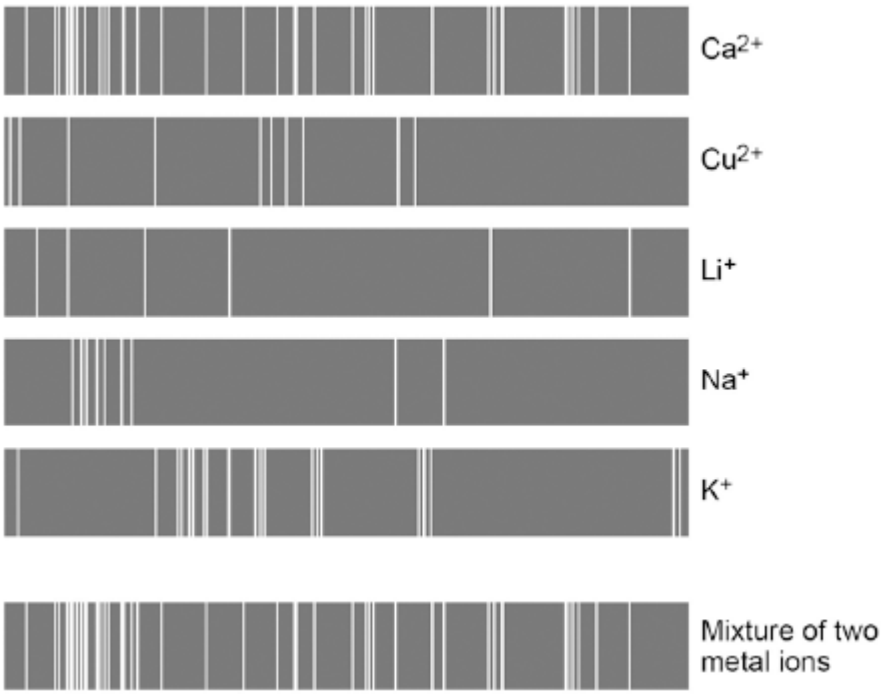
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(4)

(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)

Q2. 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.

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

Identify the **two** ions present in each compound, **X, Y** and **Z**.

X .....

Y .....

Z .....

(3)

(b) A chemist needs to find the concentration of a solution of barium hydroxide.
Barium hydroxide solution is an alkali.

The chemist could find the concentration of the barium hydroxide solution using two different methods.

Method 1

- An excess of sodium sulfate solution is added to 25 cm^3 of the barium hydroxide solution. A precipitate of barium sulfate is formed.

- The precipitate of barium sulfate is filtered, dried and weighed.

- The concentration of the barium hydroxide solution is calculated from the mass of barium sulfate produced.

Method 2

- 25 cm^3 of the barium hydroxide solution is titrated with hydrochloric acid of known concentration.

- The concentration of the barium hydroxide solution is calculated from the result of the titration.

Compare the advantages and disadvantages of the two methods.

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(5)
(Total 8 marks)

Q3.A student was investigating a magnesium salt, **X**.

The student found that **X**:

- has a high melting point
- does not conduct electricity
- dissolves in water and the solution conducts electricity.

(a) (i) What is the type of bonding in magnesium salt **X**?

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(1)

(ii) Explain why solid **X** does **not** conduct electricity but a solution of **X** does conduct electricity.

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(2)

(b) The student dissolved **X** in water.

The student added dilute nitric acid and silver nitrate solution to the solution of **X**.

A white precipitate was formed.

Salt **X** contains chloride ions.

Explain why a white precipitate was formed.

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(2)

(c) The student dissolved **X** in water.

The student added a few drops of sodium hydroxide solution to the solution of **X**.

A white precipitate was formed.

(i) Salt **X** contains magnesium ions.

Name **two** other metal ions that would give a white precipitate when a few drops of sodium hydroxide solution are added.

1 .....

2 .....

(2)

(ii) Describe the **two** further tests the student would have to do to show that salt **X** contains magnesium ions, and **not** the two metal ions you identified in part **(c) (i)**.

Give the expected results of each test.

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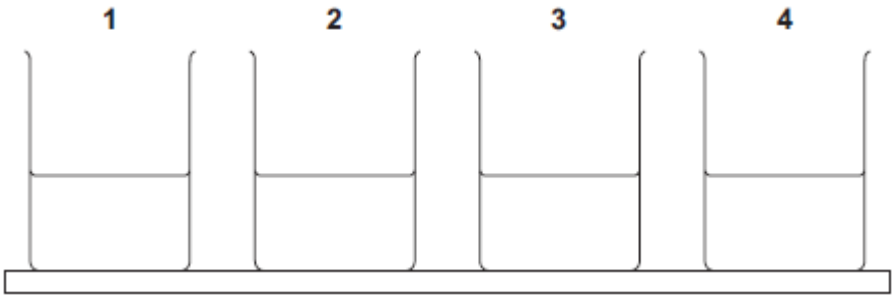
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(4)

(Total 11 marks)

Q4.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.

The teacher suggested using a flame test to identify the positive ions.

Outline a method the students could use to identify the four solutions.

You should include the results of the tests you describe.

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Extra space .....

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(Total 6 marks)

Q5. The colours of fireworks are produced by chemicals.



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(a) Information about four chemicals is given in the table.

Complete the table below.

Chemical	**Colour produced in firework**
barium chloride	green
..... carbonate	crimson
sodium nitrate	.....
calcium sulfate	red

(2)

(b) Describe a test to show that barium chloride solution contains chloride ions.

Give the result of the test.

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(2)

(c) A student did two tests on a solution of compound **X**.

Test 1
Sodium hydroxide solution was added.
A blue precipitate was formed.

Test 2
Dilute hydrochloric acid was added.
Barium chloride solution was then added.
A white precipitate was formed.

The student concluded that compound **X** is iron(II) sulfate.

Is the student's conclusion correct?

Explain your answer.

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(3)
(Total 7 marks)

Q6. Four bottles of chemicals made in the 1880s were found recently in a cupboard during a Health and Safety inspection at Lovell Laboratories.



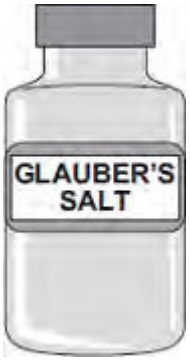
Sodium carbonate



Sodium chloride



Sodium nitrate



Sodium sulfate

The chemical names are shown below each bottle.

(a) You are provided with the following reagents:

- aluminium powder
- barium chloride solution acidified with dilute hydrochloric acid
- dilute hydrochloric acid
- silver nitrate solution acidified with dilute nitric acid
- sodium hydroxide solution.
- limewater
- red litmus paper

(i) Describe tests that you could use to show that these chemicals are correctly named.

In each case give the reagent(s) you would use **and** state the result.

Test and result for carbonate ions:

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Test and result for chloride ions:

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Test and result for nitrate ions:

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Test and result for sulfate ions:

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(4)

(ii) Suggest why a flame test would **not** distinguish between these four chemicals.

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(1)

(b) Instrumental methods of analysis linked to computers can be used to identify chemicals.

Give **two** advantages of using instrumental methods of analysis.

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(2)
(Total 7 marks)