All questions are for separate science students only

Q1.

Potash alum is a chemical compound.

Potash alum contains potassium ions, aluminium ions and sulfate ions.

(a) Which **two** methods can be used to identify the presence of potassium ions in potash alum solution?

Tick (✓) **two** boxes.

Flame emission spectroscopy	☐
Flame test	☐
Measuring boiling point of solution	☐
Paper chromatography	☐
Using litmus paper	☐

(2)

(b) Sodium hydroxide solution is used to test for some metal ions.

Sodium hydroxide solution is added to a solution of potash alum until a precipitate forms.

Complete the sentence.

Choose the answer from the box.

blue	**brown**	**green**	**white**

The colour of the precipitate formed is _____.

(1)

(c) Complete the sentence.

Choose the answer from the box.

barium chloride solution	**limewater**
red litmus paper	**silver nitrate solution**

Sulfate ions can be identified using dilute hydrochloric acid

and _____.

(1)

(d) A solution of potash alum has a concentration of 258 g/dm^3

Calculate the mass of potash alum needed to make 800 cm^3 of a solution of potash alum with a concentration of 258 g/dm^3

Give your answer to 3 significant figures.

_____

_____

_____

_____

_____

_____

_____

Mass (3 significant figures) = _____ g

(4)

(Total 8 marks)

Q2.

Potash alum is a chemical compound.

The formula of potash alum is $KAl(SO_4)_2$

(a) Give a test to identify the Group 1 metal ion in potash alum.

You should include the result of the test.

Test _____

_____

Result _____

_____

(2)

(b) Name **one** instrumental method that could identify the Group 1 metal ion **and** show the concentration of the ion in a solution of potash alum.

_____

_____

(1)

A student identifies the other metal ion in potash alum.

The student tests a solution of potash alum by adding sodium hydroxide solution until a change is seen.

(c) Give the result of this test.

_____

_____

(1)

(d) This test gives the same result for several metal ions.

What additional step is needed so that the other metal ion in potash alum can be identified?

Give the result of this additional step.

Additional step _____

_____

Result _____

_____

(2)

(e) Describe a test to identify the presence of sulfate ions in a solution of potash alum.

Give the result of the test.

Test _____

_____

_____

Result _____

_____

_____

(3)

(Total 9 marks)

Q3.

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.

(a) What flame colour is produced by copper sulfate solution?

_____

(1)

(b) 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)

(c) The student added sodium hydroxide solution to:

- copper sulfate solution
- calcium iodide solution.

Give the results of the tests.

Copper sulfate solution _____

_____

Calcium iodide solution _____

_____

(2)

(d) 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)

(e) 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.

Solution _____

Result _____

_____

(2)

(Total 8 marks)

Q4.

This question is about drinking water.

There are two main steps in producing drinking water from fresh water.

(a) Draw **one** line from each step to the reason for the step.

Step	Reason for step
	Desalination
Filtration	Improve taste
	Increase pH
Sterilisation	Kill bacteria
	Remove solids

(2)

(b) Which **two** substances are used to sterilise fresh water?

Tick (✓) **two** boxes.

Ammonia ☐

Chlorine ☐

Hydrogen	☐
Nitrogen	☐
Ozone	☐

(2)

A large amount of aluminium sulfate was accidentally added to the drinking water supply at a water treatment works.

(c) Scientists tested a sample of the drinking water to show that it contained dissolved solids.

Which **two** methods show the presence of dissolved solids in the sample of drinking water?

Tick (✓) **two** boxes.

Add damp litmus paper to the sample.	☐
Evaporate all water from the sample.	☐
Measure the sample's boiling point.	☐
Test the sample with a glowing splint.	☐

(2)

(d) Scientists tested two water samples from the drinking water supply.

The scientists tested one sample for aluminium ions and the other sample for sulfate ions.

Draw **one** line from each ion to the compound needed to identify the ion.

Ion	Compound needed to identify ion
	Barium chloride
Aluminium ion	Copper sulfate
	Silver nitrate
Sulfate ion	Sodium hydroxide
	Sulfuric acid

(2)

(e) How could pure water be produced from drinking water that contained dissolved solids?

Tick (✓) **one** boxes.

- Chromatography ☐
- Cracking ☐
- Distillation ☐
- Sedimentation ☐

(1)

(Total 9 marks)

Q5.

This question is about lithium carbonate.

Lithium carbonate is used in medicines.

The figure shows a tablet containing lithium carbonate.

(a) Lithium carbonate contains lithium ions and carbonate ions.

A student tested the tablet for lithium ions and for carbonate ions.

The student used:

- a metal wire
- dilute hydrochloric acid
- limewater.

Plan an investigation to show the presence of lithium ions and of carbonate ions in the tablet.

You should include the results of the tests for the ions.

(6)

(b) The tablet also contains other substances.

The substances in tablets are present in fixed amounts.

What name is given to mixtures like tablets?

_____

(1)

(c) The tablet has a mass of 1.20 g and contains 700 mg of lithium carbonate.

Calculate the percentage by mass of lithium carbonate in this tablet.

_____

_____

_____

_____

Percentage by mass of lithium carbonate = _____%

(3)

(Total 10 marks)

Q6.

A large amount of aluminium sulfate was accidentally added to the drinking water supply at a water treatment works.

(a) Describe a test to show that the drinking water contained aluminium ions.

Give the result of the test.

Test _____

_____

Result _____

_____

_____

_____

(3)

(b) Describe a test to show that the drinking water contained sulfate ions.

Give the result of the test.

Test

_____

_____

Result _____

_____

(2)

(c) Plan an investigation to find the total mass of dissolved solids in a 100 cm^3 sample of the drinking water.

Your investigation should produce valid results.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 9 marks)

Q7.

This question is about chemicals in fireworks.

Coloured flames are produced because of the metal ions in the fireworks.

(a) What colour flame would sodium ions produce?

_____

(1)

(b) Name a metal ion that would produce a green flame.

_____

(1)

(c) Some fireworks contain a mixture of metal ions.

Why is it difficult to identify the metal ions from the colour of the flame?

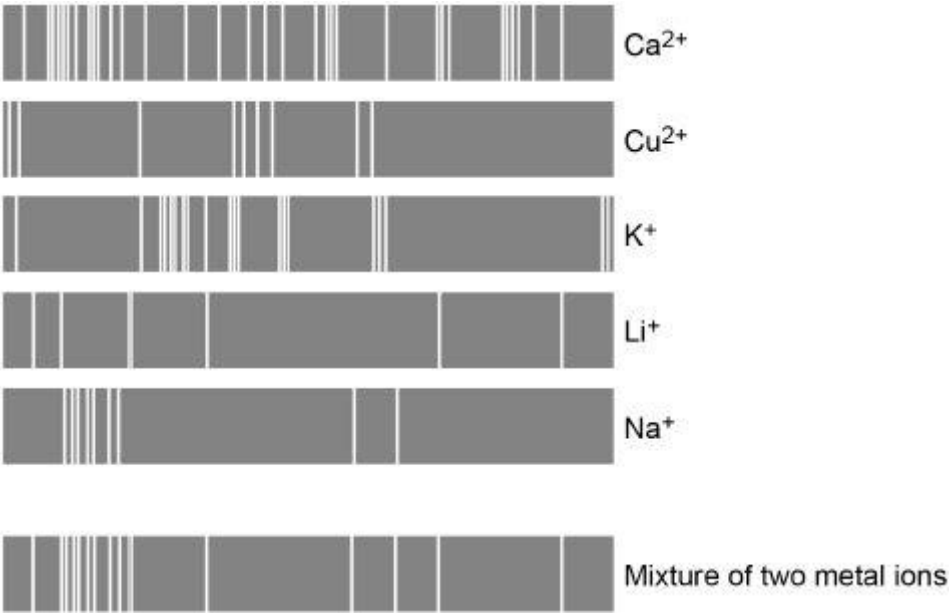
_____

(1)

(d) Flame emission spectroscopy is used to identify metal ions in a firework.

The diagram below shows:

- the flame emission spectra of five individual metal ions
- a flame emission spectrum for a mixture of two metal ions.



Which **two** metal ions are in the mixture?

Tick **two** boxes.

Ca^{2+} ☐

Cu^{2+} ☐

K^+ ☐

Li^+ ☐

Na^+ ☐

(2)

The compounds in fireworks also contain non-metal ions.

A scientist tests a solution of the chemicals used in a firework.

(e) Silver nitrate solution and dilute nitric acid are added to the solution.

A cream precipitate forms

Which ion is shown to be present by the cream precipitate?

_____

(1)

(f) Describe a test to show the presence of sulfate ions in the solution.

Give the result of the test if there are sulfate ions in the solution.

Test _____

_____

_____

_____

Result _____

_____

(3)

(Total 9 marks)

Q8.

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**.

_____

_____

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.

bromide	**chloride**	**copper**
iron(II)	**iron(III)**	**sulfate**

_____ 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.

_____

_____

_____

_____

(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.

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

Q9.

This question is about mixtures and analysis.

(a) Which **two** substances are mixtures?

Tick **two** boxes.

Air ☐

Carbon dioxide ☐

Graphite ☐

Sodium Chloride ☐

Steel ☐

(2)

(b) Draw **one** line from each context to the correct meaning.

Context	Meaning
	A substance that has had nothing added to it
Pure substance in chemistry	A single element or a single compound
	A substance containing only atoms which have different numbers of protons
Pure substance in everyday life	A substance that can be separated by filtration
	A useful product made by mixing substances

(2)

(c) What is the test for chlorine gas?

Tick **one** box.

A glowing splint relights ☐

A lighted splint gives a pop ☐

Damp litmus paper turns white ☐

Limewater turns milky ☐

(1)

(d) A student tested a metal chloride solution with sodium hydroxide solution.

A brown precipitate formed.

What was the metal ion in the metal chloride solution?

Tick **one** box.

Calcium ☐

Copper(II) ☐

Iron(II) ☐

Iron(III) ☐

(1)

(Total 6 marks)

Q10.

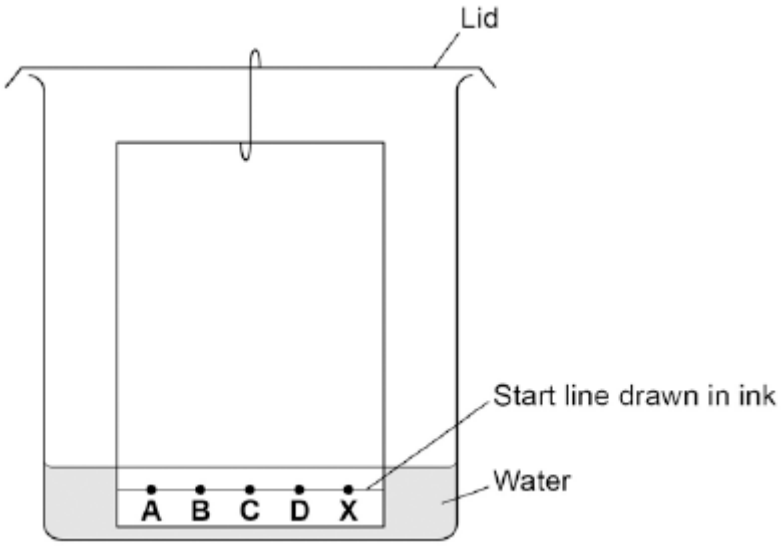
A student investigated food dyes using paper chromatography.

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.

_____

_____

_____

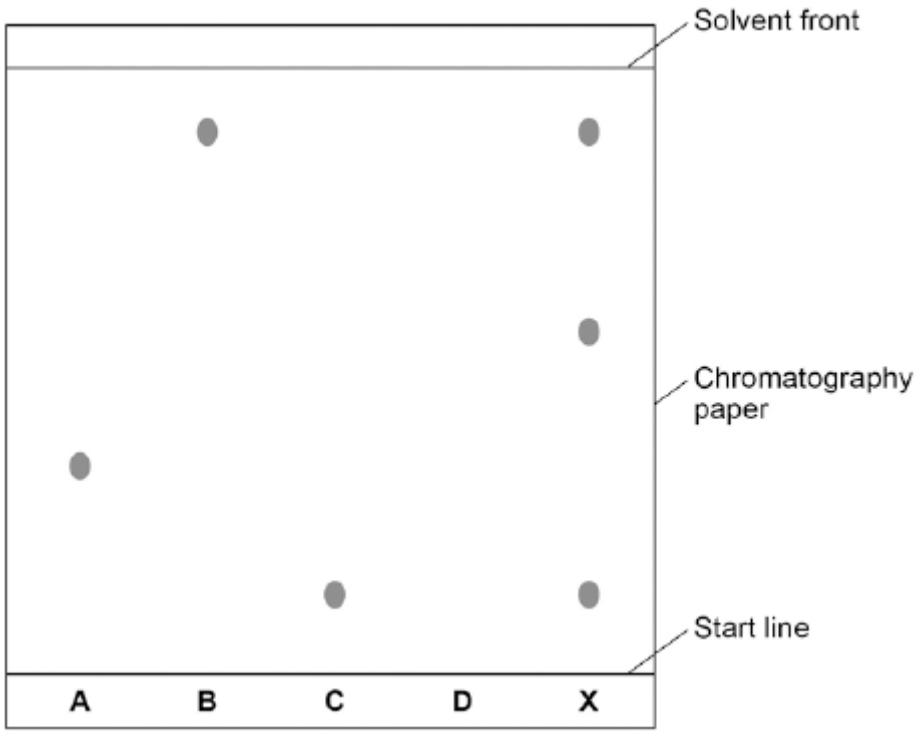
_____

(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.

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.

Distance moved by dye **D** = _____

(1)

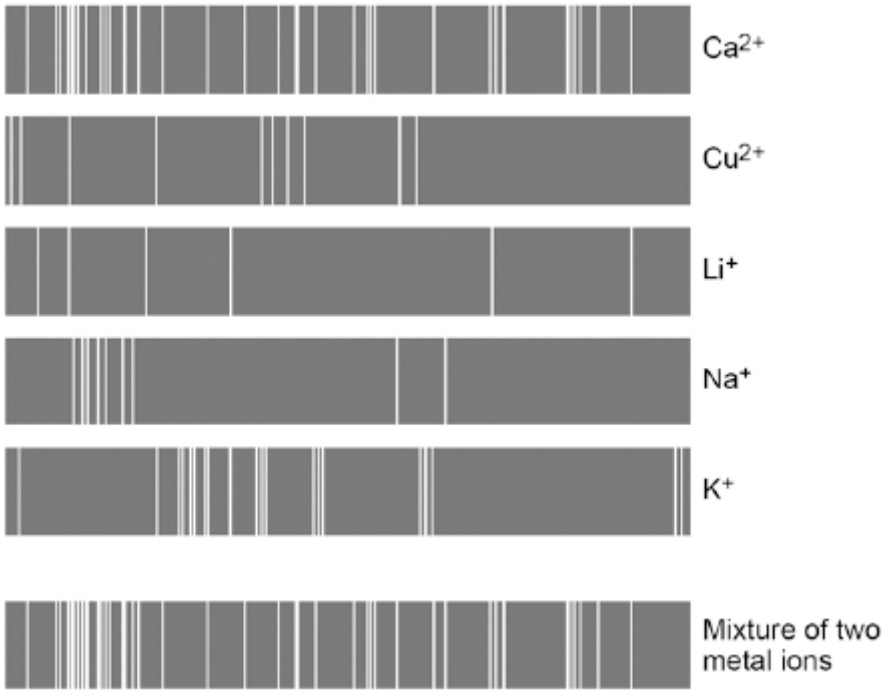
(d) Explain how the different dyes in **X** are separated by paper chromatography.

(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.

(2)

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

_____

(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.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

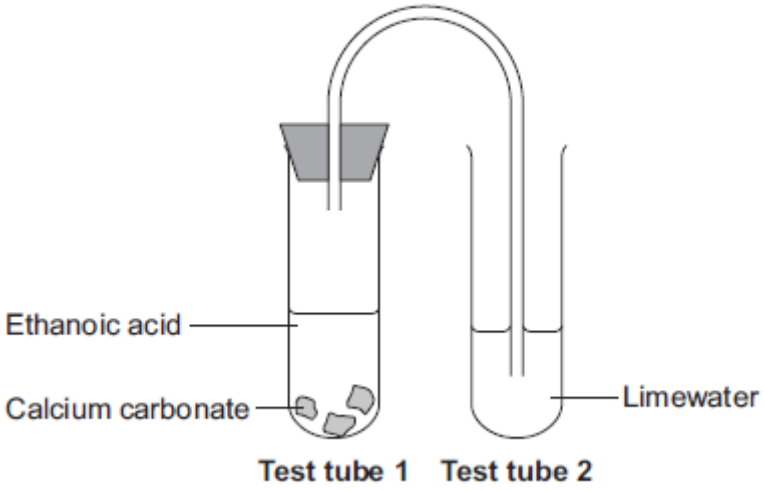
(Total 18 marks)

Q11.

This question is about reactions of ethanoic acid and the analysis of salts.

(a) **Figure 1** shows the apparatus used to investigate the reaction of ethanoic acid with calcium carbonate.

Figure 1



(i) Describe a change that would be seen in each test tube.

Give a reason for each change.

Test tube 1 _____

_____

_____

_____

Test tube 2 _____

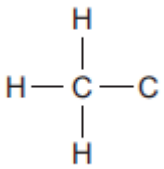
_____

_____

_____

(4)

(ii) Complete the displayed structure of ethanoic acid.



(1)

(iii) Ethanoic acid is a carboxylic acid.
Complete the sentence.

Carboxylic acids react with alcohols in the presence of an

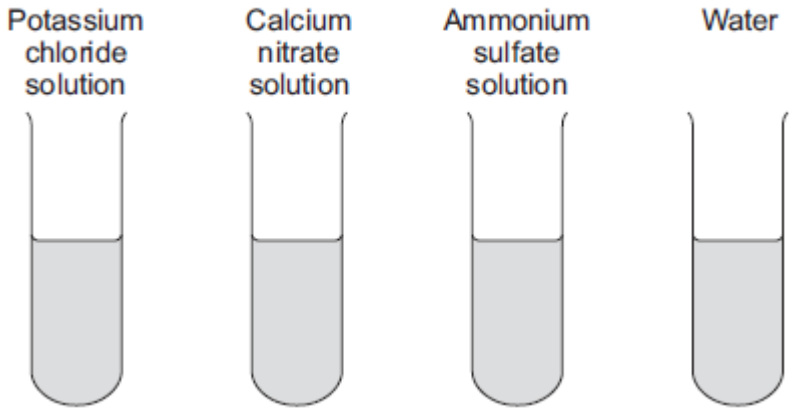
_____ catalyst to produce pleasant-smelling compounds

called _____ .

(2)

(b) **Figure 2** shows four test tubes containing three different salt solutions and water.

Figure 2



Each solution and the water was tested with:

- silver nitrate in the presence of dilute nitric acid
- barium chloride in the presence of dilute hydrochloric acid.

Complete the table of results.

	Potassium chloride solution	**Calcium nitrate solution**	**Ammonium sulfate solution**	**Water**
Test with silver nitrate in the presence of dilute nitric acid			no change	no change
Test with barium chloride in the presence of dilute hydrochloric acid		no change	white precipitate	

(2)

(c) Flame tests can be used to identify metal ions.

(i) Complete the following sentences.

The flame colour for potassium ions is _____ .

The flame colour for calcium ions is _____ .

(2)

(ii) Give **one** reason why a flame test would **not** show the presence of both potassium ions and calcium ions in a mixture.

_____

_____

_____

(1)

(Total 12 marks)