

(Flame tests and tests for metal cations (Na^+ , K^+ , Ca^{2+} , Cu^{2+} , etc.))

Q1. (2018)

This question is about chemicals in fireworks.

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

What colour flame would sodium ions produce?

[1 mark]

Q2. (2018)

Name a metal ion that would produce a green flame.

[1 mark]

Q3. (2018)

Some fireworks contain a mixture of metal ions.

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

[1 mark]

Q4. a). (2019)

This question is about lithium carbonate.

Lithium carbonate is used in medicines.

Figure 2 shows a tablet containing lithium carbonate.

Figure 2



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 marks]

Q4. b). (2019)

The tablet also contains other substances.

The substances in tablets are present in fixed amounts.

What name is given to mixtures like tablets?

[1 mark]

Q4. c). (2019)

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.

[3 marks]

Percentage by mass of lithium carbonate = _____ %

Q5. a). (2019)

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

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

Give the result of the test.

[3 marks]

Test _____

Result _____

Q5. b). (2019)

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

Give the result of the test.

[2 marks]

Test _____

Result _____

Q5. c). (2019)

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 marks]

Q6. a). (2020)

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.

What flame colour is produced by copper sulfate solution?

[1 mark]

Q6. b). (2020)

Calcium compounds produce an orange-red flame colour.

The student left out an important step before reusing the metal wire.

The student's method did **not** produce a distinct orange-red flame colour using calcium iodide solution.

Explain why.

[2 marks]

Q6. c). (2020)

The student added sodium hydroxide solution to:

- copper sulfate solution
- calcium iodide solution.

Give the results of the tests.

[2 marks]

Copper sulfate solution _____

Calcium iodide solution _____

Q6. d) (2020)

To test for sulfate ions the student added dilute hydrochloric acid to copper sulfate solution.

Name the solution that would show the presence of sulfate ions when added to this mixture.

[1 mark]

Q6. e). (2020)

To test for iodide ions the student added dilute nitric acid to calcium iodide solution.

Name the solution that would show the presence of iodide ions when added to this mixture.

Give the result of the test.

[2 marks]

Solution _____

Result _____

Q7. (2021)

Potash alum is a chemical compound.

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

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

You should include the result of the test.

[2 marks]

Test _____

Result _____

Q8. a). (2021)

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.

Give the result of this test.

[1 mark]

Q8. b). (2021)

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.

[2 marks]

Additional step _____

Result _____

Q9. (2022)

Copper sulfate is a compound of copper.

Copper sulfate solution contains copper(II) ions and sulfate ions.

A solution can be added to copper sulfate solution to show the presence of copper(II) ions.

Name the solution added.

Give the result of the test.

[2 marks]

Name of solution added _____

Result _____

Q10. a). (2023)

This question is about chemical analysis.

Potassium bromide is used in medicine.

A scientist tested a sample of medicine to show the presence of potassium ions and of bromide ions.

The sample is soluble in water.

Plan a method the scientist could use to show that the sample of medicine contains potassium ions **and** bromide ions.

The scientist has:

- a Bunsen burner
- a metal wire
- test tubes
- a dropping pipette
- distilled water
- dilute nitric acid
- silver nitrate solution.

You should give the results of the tests.

[6 marks]

Q10. b). (2023)

The scientist could also use an instrumental method to show the presence of potassium ions in the medicine.

Which instrumental method could be used to show the presence of potassium ions in the medicine?

[1 mark]

Q10. c). (2023)

Give **one** advantage of using this instrumental method instead of a chemical test.

[1 mark]

Q11. (2023)

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

Give the result of the test.

[2 marks]

Test

Result

Q12. a). (2024)

A student investigated an aqueous solution of a salt.

The student identified that the salt solution contained only sodium ions and chloride ions.

Describe a test to identify sodium ions.

Give the result of the test.

[2 marks]

Test for sodium ions _____

Result _____

Q12. b). (2024)

Describe a test to identify chloride ions.

Give the result of the test.

[2 marks]

Test for chloride ions _____

Result _____

Q12. c). (2024)

The student determined the concentration of sodium chloride in the salt solution.

This is the method used.

1. Weigh an empty evaporating dish.
2. Add 25.0 cm^3 of the salt solution into the evaporating dish.
3. Heat the evaporating dish and contents.
4. Weigh the evaporating dish and contents.
5. Repeat steps 3 to 4 until there is no further change in mass.
6. Repeat steps 1 to 5 three more times.

Why did the student heat the evaporating dish and contents until the mass did not change?

[1 mark]

Q12. d). (2024)

How did the student calculate the mass of solid sodium chloride remaining after steps 1 to 5?

[1 mark]

Tick (✓) **one** box.

Mass of 25 cm^3 of salt solution + mass of empty evaporating dish

☐

Mass of 25 cm^3 of salt solution – mass of empty evaporating dish

☐

Mass of evaporating dish and dry contents + mass of empty evaporating dish

☐

Mass of evaporating dish and dry contents – mass of empty evaporating dish

☐

Q12. e). (2024)

The student calculated the concentration of sodium chloride in the salt solution.

Table 1 shows the results.

Table 1

Concentration of sodium chloride in g/dm ³			
Trial 1	Trial 2	Trial 3	Trial 4
35.2	34.6	36.4	33.8

The percentage by mass of sodium ions in sodium chloride is 39.3%.

Calculate the mean concentration of sodium ions in the salt solution.

[4 marks]

Mean concentration = _____ g/dm³