Atmosphere part 3 AQA Triple Chemistry

Name: _____

Class: _____

Date: _____

Time: **70 minutes**

Marks: **69 marks**

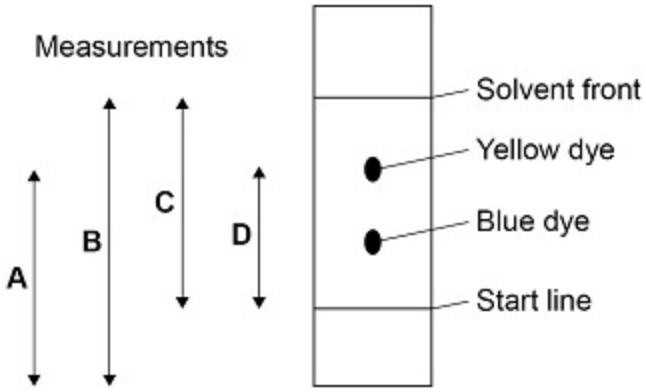
Comments:

1. This question is about ink.

A student investigated green ink using paper chromatography in a beaker.

The diagram below shows:

- the results the student obtained
- measurements **A**, **B**, **C** and **D** the student could make.



(a) The student calculated the R_f value of the blue dye.

The student measured:

- the distance moved by the blue dye = 2.7 cm
- the distance moved by the solvent = 9.0 cm

Calculate the R_f value of the blue dye.

Use the equation:

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

_____

_____

_____

R_f = _____

(2)

(b) Which measurements on the diagram above are needed to calculate the R_f value of the yellow dye?

Tick (✓) **one** box.

A and **B** ☐

A and **C** ☐

B and **D** ☐

C and **D** ☐

(1)

(c) Paper chromatography has a stationary phase and a mobile phase.

Draw **one** line from each phase to the identity of that phase in the student's investigation.

Phase	**Identity**
	Beaker
Mobile phase	Ink
	Paper
Stationary phase	Solvent
	Start line

(2)

The green ink contains 85% yellow dye and 15% blue dye.

(d) Determine the simplest whole number ratio of yellow dye : blue dye in the green ink.

_____

_____

Yellow dye : Blue dye = _____ **:** _____

(1)

(e) Which word correctly describes the green ink?

Tick (✓) **one** box.

Compound ☐

Element ☐

Formulation ☐

Solvent ☐

(1)

(f) The student repeated the investigation using green ink containing 75% yellow dye and 25% blue dye.

What would happen to the R_f value of the yellow dye?

Tick (✓) **one** box.

The R_f value would decrease. ☐

The R_f value would increase. ☐

The R_f value would stay the same. ☐

(1)

(Total 8 marks)

2. 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)

3. 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)

4. 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)

5. 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)

6. A student investigated the colours in three different flowers, **A**, **B** and **C**, using paper chromatography.

The colours are soluble in ethanol but are insoluble in water.

This is the method used.

1. Place ethanol in a beaker.
2. Add the flower.
3. Stir until the colours dissolve in the ethanol.
4. Filter the mixture.
5. Put spots of the coloured filtrate on the chromatography paper.

(a) The filtrate was a very pale coloured solution.

How could the student obtain a darker coloured solution?

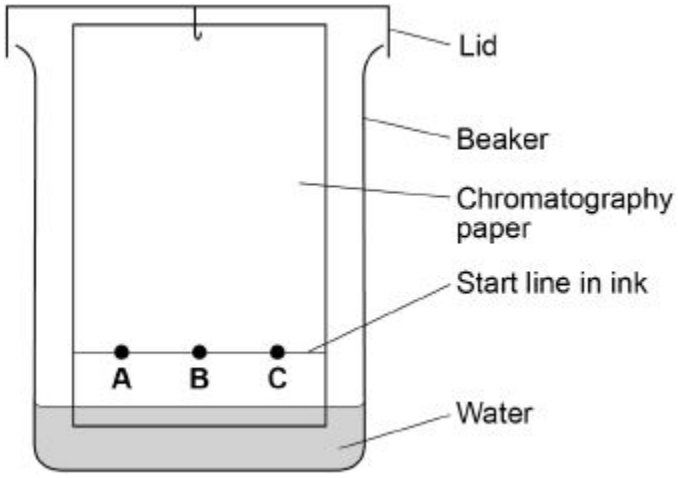
Tick **two** boxes.

- Crush the flower ☐
- Filter the mixture three times ☐
- Use a larger beaker ☐
- Use more ethanol ☐
- Use more flowers ☐

(2)

(b) **Figure 1** shows the apparatus used.

Figure 1



What **two** mistakes did the student make in setting up the apparatus?

Tick **two** boxes.

The paper does not touch the beaker ☐

The start line is drawn in ink ☐

The water level is below the start line ☐

Uses a lid on the beaker ☐

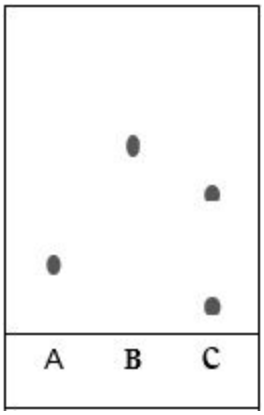
Uses water as the solvent ☐

(2)

(c) Another student sets up the apparatus correctly.

Figure 2 represents the student's results.

Figure 2



What **two** conclusions can be made from **Figure 2**?

Tick **two** boxes.

Flower **A** contains a single pure colour ☐

Flowers **A** and **B** contain the same colours ☐

The colour in flower **C** is a mixture ☐

The colour in flower **B** was the least soluble ☐

Two of the colours have the same R_f value ☐

(2)

(d) The student records some measurements.

The measurements are:

- the colour from flower **B** moves 7.2 cm
- the solvent moves 9.0 cm

Calculate the R_f value for the colour from flower **B**.

Use the equation:

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

_____

_____

(2)

(Total 8 marks)

7. 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?

_____

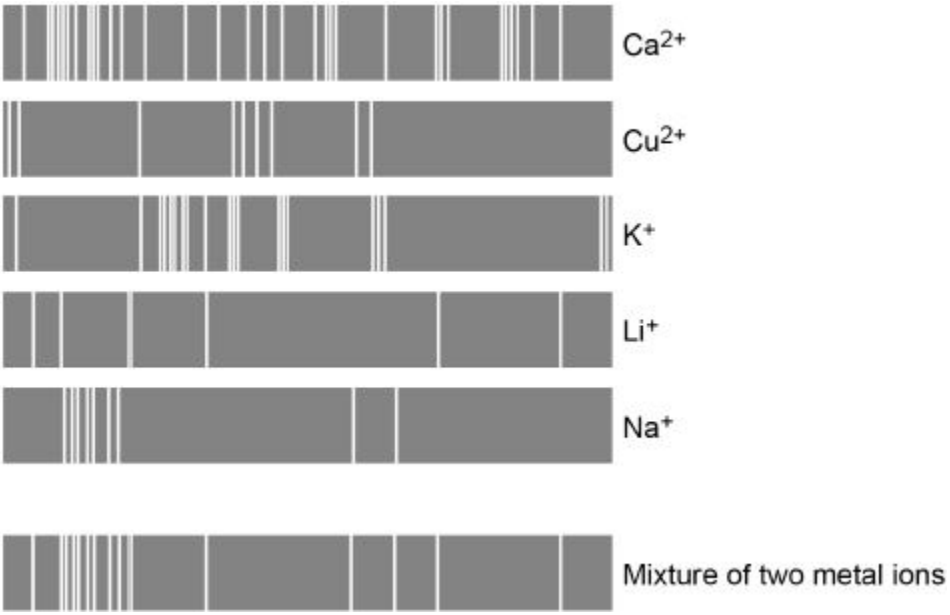
_____

(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)

8. A student investigated the colours in three different flowers, **A**, **B** and **C**.

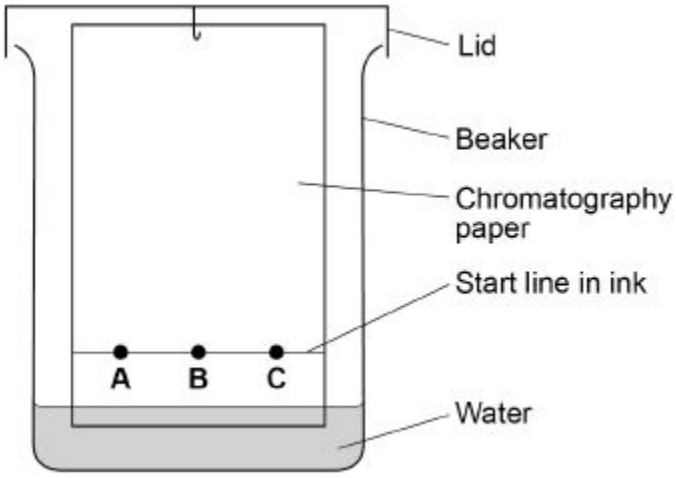
The colours are soluble in ethanol but are insoluble in water.

This is the method used.

1. Crush flower **A**.
2. Add ethanol to flower **A**.
3. Filter the mixture.
4. Put spots of the coloured filtrate on to the chromatography paper.
5. Repeat steps 1-4 with flowers **B** and **C**.

Figure 1 shows the apparatus used.

Figure 1



(a) The student made **two** mistakes in setting up the apparatus.

Give **one** problem caused by each mistake.

Mistake 1 _____

Problem caused _____

_____

Mistake 2 _____

Problem caused _____

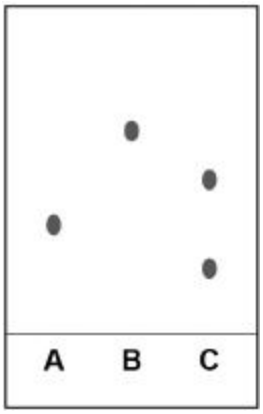
_____

(4)

(b) Another student set up the apparatus correctly.

Figure 2 represents the student's results.

Figure 2



Give **two** conclusions you can make from **Figure 2**.

1. _____

_____

2. _____

_____

(2)

(c) Colour **A** has an R_f value of 0.65

Colour **A** moves 3.2 cm

Calculate the distance moved by the solvent.

_____

_____

Distance moved by the solvent = _____ cm

(2)

(Total 8 marks)

1. (a) $\frac{2.7}{9.0}$

1

= 0.3

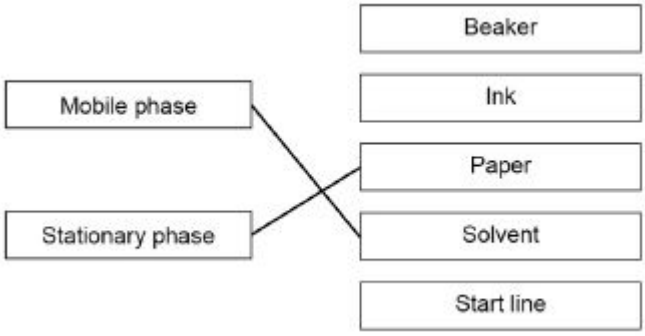
ignore units

1

(b) **C** and **D**

1

(c)



1

additional line from a box on the left negates the mark for that box

1

(d) 17 : 3

1

(e) formulation

1

(f) the R_f value would stay the same

1

[8]

2. (a) green

allow blue-green

1

(b) did not clean the metal wire (between tests)
or
copper sulfate (solution) is still present

1

(so) colours are mixed / blended / masked

1

(c) (copper sulfate solution) blue precipitate

allow blue solid

1

(calcium iodide solution) white precipitate

allow white solid

1

(d) barium chloride (solution)

allow barium nitrate (solution)

1

(e) silver nitrate (solution)

1

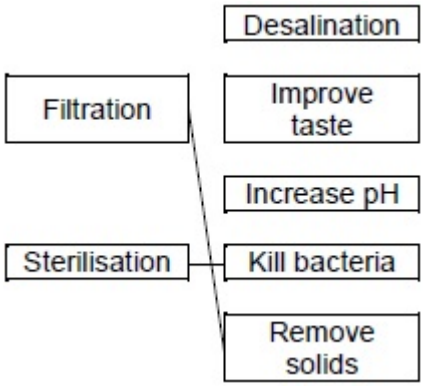
yellow precipitate

allow yellow solid
allow pale yellow precipitate / solid

1

[8]

3. (a)



an extra line from a step to a reason for that step negates that mark

2

(b) chlorine

1

ozone

1

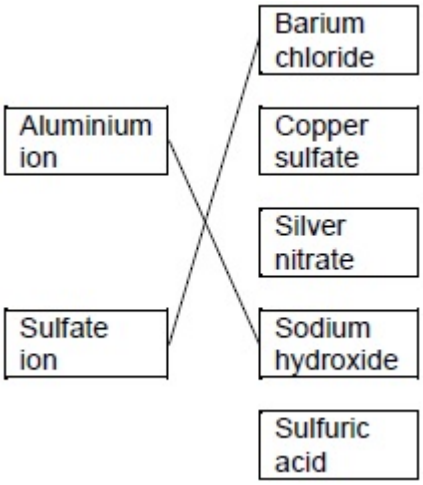
(c) evaporate all water from the sample

1

measure the sample's boiling point

1

(d)



an extra line from an ion to a compound needed negates that mark

2

(e) distillation

1

[9]

4. (a) **Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.

3–4

Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

lithium:
- crush tablets or dissolve tablet (in water or acid)
- clean wire
- place on wire
- place in (roaring / blue / non-luminous) flame
- observe flame colour
- crimson flame

carbonate:
- add hydrochloric acid
- effervescence / fizzing
- bubble gas through limewater
- limewater becomes cloudy

(b) formulation(s)

1

(c)

*an answer of 58.3333333 (%) correctly rounded to at least 2 significant figures scores **3** marks*

1.20 g = 1200 mg
or
700 mg = 0.700 g

1

$\frac{700}{1200} \times 100$ **or** $\frac{0.700}{1.20} \times 100$

allow correct use of incorrectly or not converted values from step1

1

= 58.3 (%)

allow 58.3333333 (%) correctly rounded to at least 2 significant figures

1

[10]

5. (a) add sodium hydroxide (solution to water sample)

1

white precipitate (forms)

dependent on correct test in MP1

1

(precipitate which is) soluble in excess (NaOH)

dependent on correct test in MP1

1

(b) add barium chloride (solution) **and** (dilute) hydrochloric acid (to water sample)

allow barium nitrate (solution)
allow (dilute) nitric acid

1

white precipitate (forms)

dependent on addition of barium chloride / nitrate (solution) in MP1

1

(c) **Level 2**: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

3–4

Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

- weigh (evaporating) basin / dish
- add measured volume of water
- weigh (evaporating) basin / dish and water
- heat to evaporate water
- reweigh
- repeat heating until constant mass obtained
- subtract mass of (evaporating) basin / dish from mass
- repeat and calculate a mean, discarding anomalous results
- calculate the mass in 100 cm^3 water if necessary

[9]

6.

(a) crush the flower

1

use more flowers

1

(b) the start line is drawn in ink

1

uses water as the solvent

1

(c) flower A contains a single pure colour

1

the colour in flower C is a mixture

1

(d) $\frac{7.2}{9.0}$

1

= 0.8

1

*an answer of 0.8 scores **2** marks*
ignore units

[8]

7.

(a) yellow

allow orange
allow orange-yellow

1

(b) copper (ion)

allow Cu^{2+}
allow copper (II)
allow barium (ion)
allow Ba^{2+}

1

(c) (flame) colours are masked

allow (flame) colours mix / blend
allow only see one colour
allow cannot see two colours at once
ignore hard to distinguish

1

(d) Li^+

1

Na^+

1

(e) bromide (ion)

allow Br^-
ignore bromine

1

(f) add barium chloride (solution)

allow barium nitrate (solution)

1

add hydrochloric acid

allow nitric acid
allow acidified
*do **not** accept sulfuric acid*

1

white precipitate produced

dependent on use of a barium compound

1

[9]

8.

(a) start line drawn in ink

allow start line should have been drawn in pencil

1

(so) ink dissolves

(as) pencil does not dissolve

or

ink runs in solvent / water

or

pencil does not run in solvent / water

1

water used (as solvent)

allow ethanol not used

or

water in beaker

1

(so) colours will not dissolve / move

1

(b) any **two** from:

- the flowers have no colours in common

  allow the flowers are not the same colour

- A / B contain one colour

- C contains two colours

  allow C is a mixture of colours

- (the colour in) B is most soluble

  allow (the colour in) B has the highest R_f value
  allow one of the colours in C is the least soluble

2

(c) $\text{(distance moved =)}\frac{3.2}{0.65}$

1

(distance moved) = 4.9 (cm)

allow 4.923076923 (cm) correctly rounded

1

*an answer of 4.9 (cm) scores **2** marks*

[8]