All questions are for both separate science and combined science students

Q1.

This question is about paper chromatography.

A food colouring contains a dye.

(a) Plan an investigation to determine the Rf value for the dye in this food colouring.

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

Your plan should include the use of:

- a beaker
- a solvent
- chromatography paper.

_____

_____

_____

_____

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_____

(6)

(b) Two students investigated a dye in a food colouring using paper chromatography.

Each student did the investigation differently.

The Rf values they determined for the same dye were different.

How did the students' investigations differ?

Tick (✓) one box.

Different length of paper used ☐

Different period of time used ☐

Different size of beaker used ☐

Different solvent used ☐

(1)

(c) Paper chromatography involves a stationary phase.

What is the stationary phase in paper chromatography?

Tick (✓) one box.

Beaker ☐

Dye ☐

Paper ☐

Solvent ☐

(1)

(Total 8 marks)

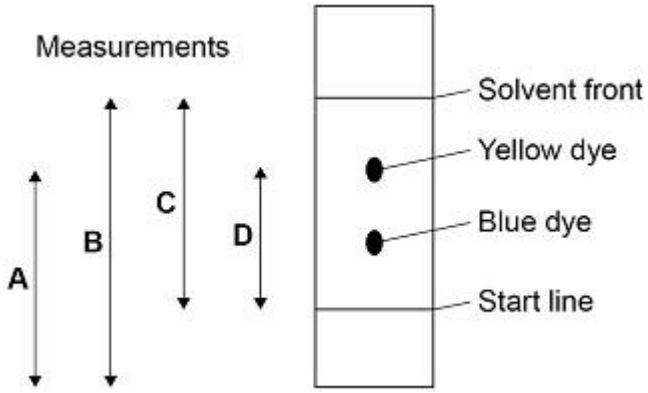
Q2.

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 Rf 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 Rf value of the blue dye.

Use the equation:

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

_____

_____

_____

Rf = _____

(2)

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

Tick (✓) one box.

The Rf value would decrease. ☐

The Rf value would increase. ☐

The Rf value would stay the same. ☐

(1)

(Total 8 marks)

Q3.

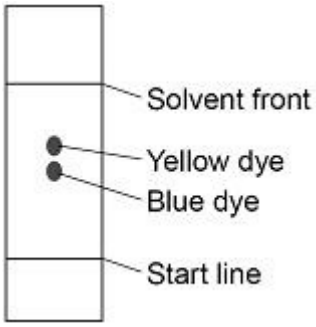
This question is about ink.

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

The student used water as the solvent.

The diagram below shows the chromatogram obtained.

Diagram not to scale



(a) The Rf value of the yellow dye = 0.60 The distance moved by the yellow dye = 5.7 cm

Calculate the distance moved by the solvent.

_____

_____

_____

_____

_____

Distance moved by the solvent = _____cm

(3)

(b) The green ink contains more than two compounds.

Suggest one reason why only two spots are seen on the diagram above.

_____

_____

(1)

(c) On the student's chromatogram, the yellow and blue spots are very close together.

Which two ways could increase the distance between the spots?

Tick (✓) two boxes.

Allow the solvent front to travel further.	☐
Dry the chromatogram more slowly.	☐
Use a different solvent.	☐
Use a larger beaker.	☐
Use a larger spot of green ink.	☐

(2)

(d) The manufacturers of the green ink always use the same proportions of yellow dye and blue dye.

Suggest one reason why.

_____

_____

(1)

(e) The Rf value of a dye depends on:

- the solubility of the dye in the solvent
- the attraction of the dye to the paper.

Which will definitely produce a smaller Rf value if the solvent and paper are both changed?

Tick (✓) one box.

The dye is less soluble in the new solvent and less attracted to the new paper.	☐
The dye is less soluble in the new solvent and more attracted to the new paper.	☐
The dye is more soluble in the new solvent and less attracted to the new paper.	☐
The dye is more soluble in the new solvent and more attracted to the new paper.	☐

(1)

(Total 8 marks)

Q4.

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	☐

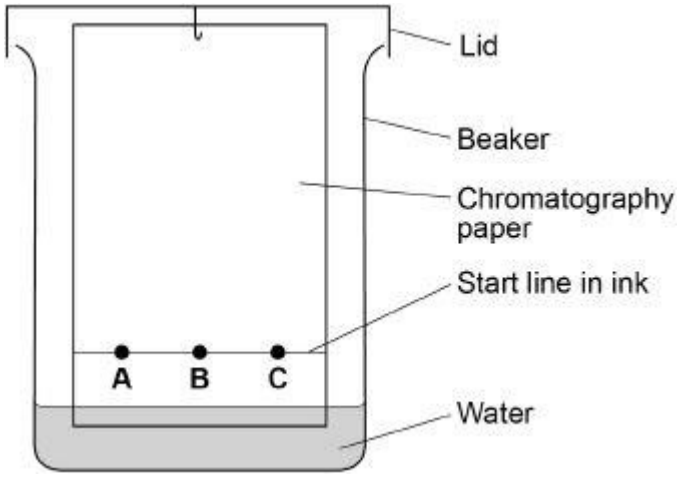
Use more ethanol ☐

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 ☐

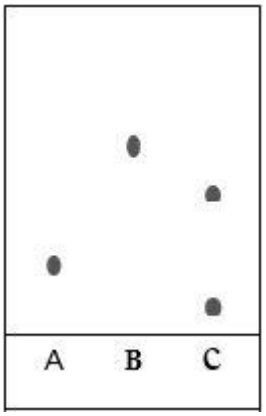
Uses water as the solvent ☐

(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 Rf 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 Rf 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)

Q5.

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

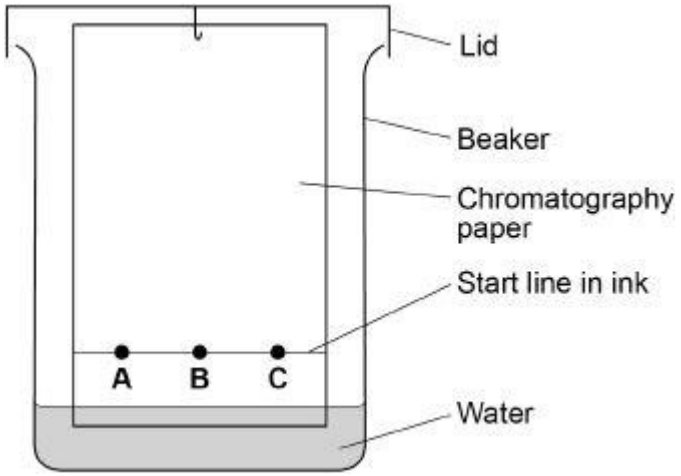
The colours are soluble in ethanol but are insoluble in water.

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 _____

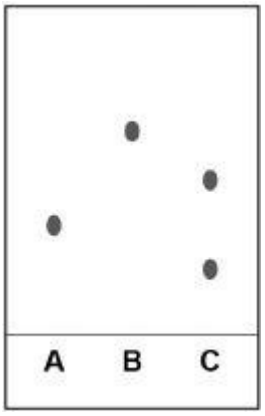
_____

(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 Rf 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)

Q6.

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)

Q7.

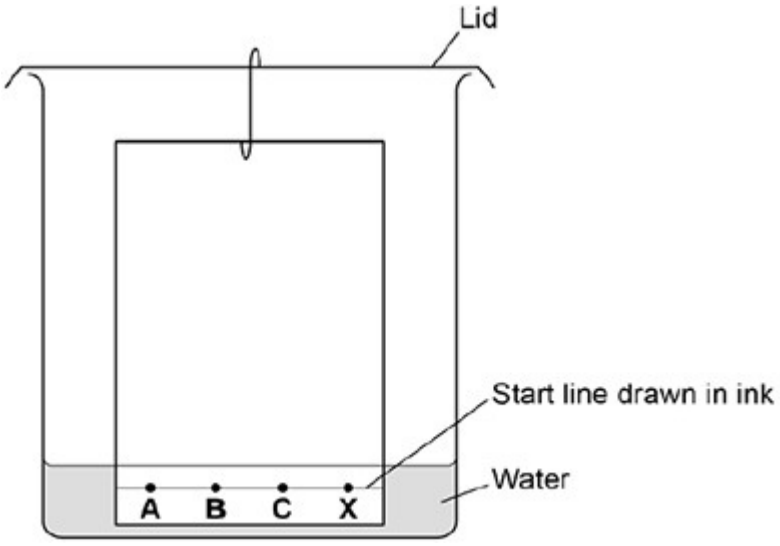
A student investigated a food colouring using paper chromatography.

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. ☐

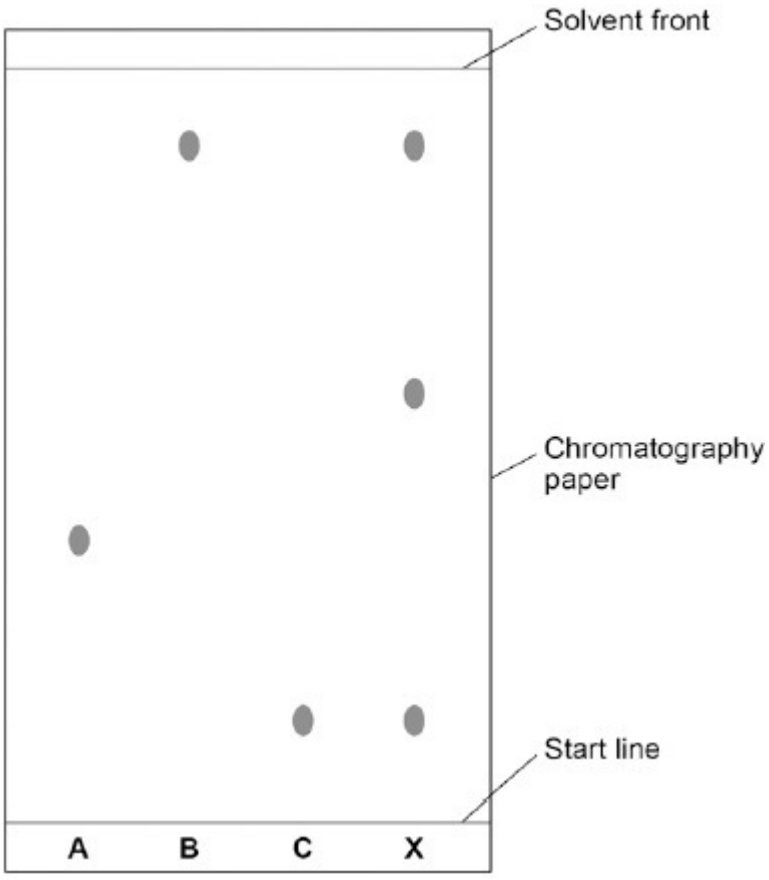
The water level was above the spots. ☐

(2)

(b) Another student set the experiment up correctly.

Figure 2 shows the student's results.

Figure 2



How many dyes were in X?

Tick one box.

1 ☐ 3 ☐ 4 ☐ 6 ☐

(1)

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

Write your answer in the box. ☐

(1)

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

Calculate the value for Rf for dye A.

	Distance in mm
Distance moved by dye A	_____
Distance from start line to solvent front	_____

Use the equation:

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

Give your answer to two significant figures.

_____

_____

_____

Rf value = _____

(5)

(Total 9 marks)

Q8.

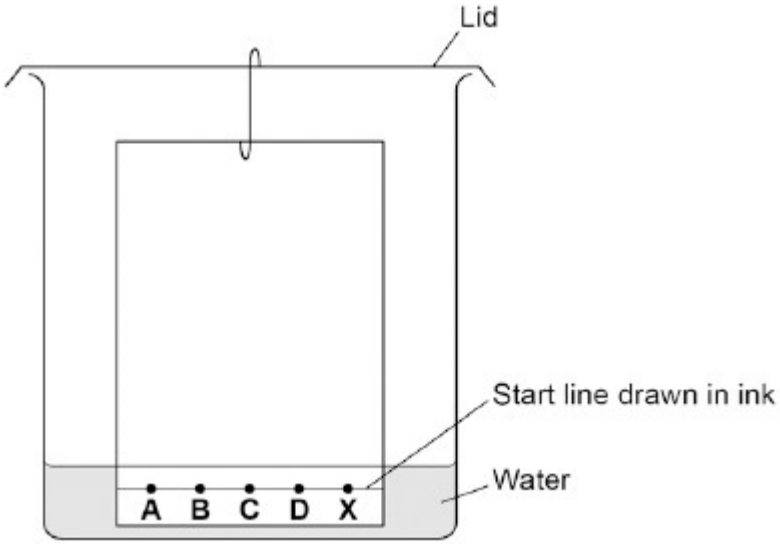
A student investigated food dyes using paper chromatography.

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.

_____

_____

_____

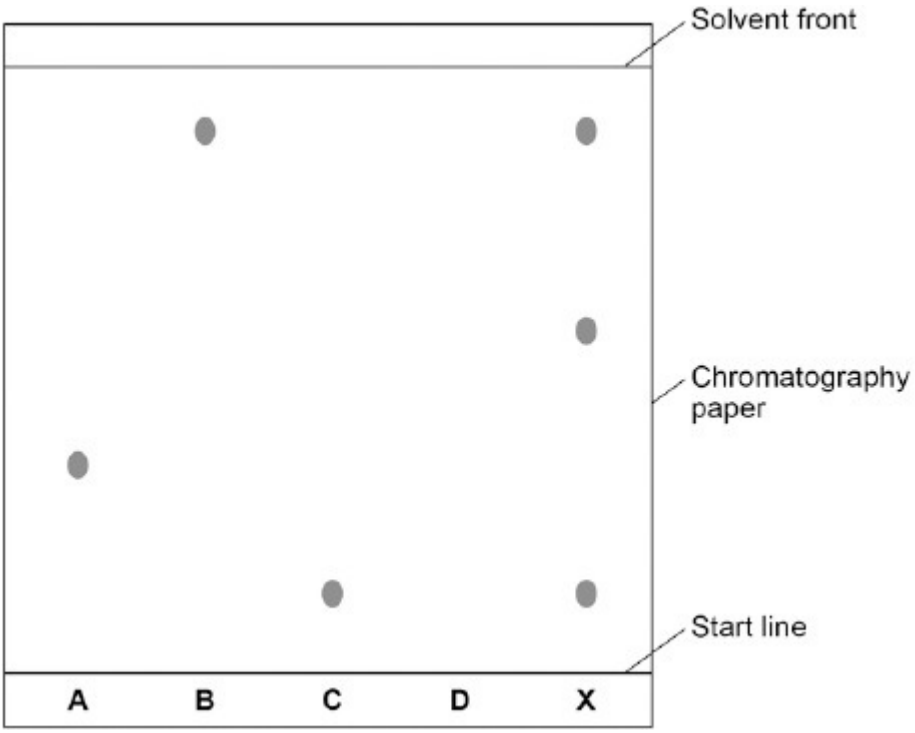
_____

(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 Rf value of dye A Give your answer to two significant figures.

_____

_____

_____

_____

Rf value = _____

(3)

(c) Dye D has an Rf 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.

_____

_____

_____

_____

_____

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_____

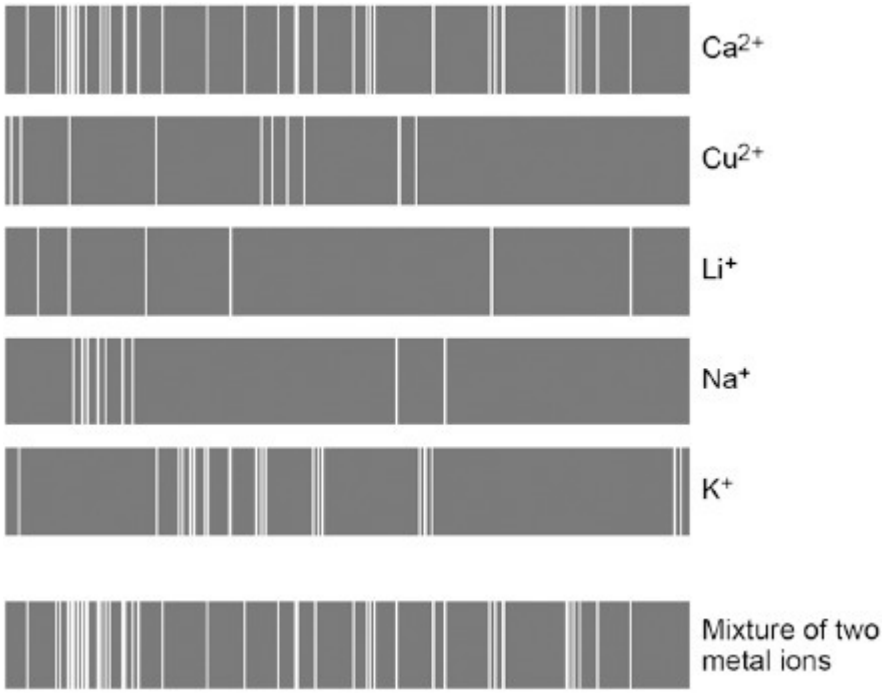
_____

(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.

_____

_____

(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)