Questions are for both separate science and combined science students unless indicated in the question

Q1.

This question is about paper chromatography.

A food colouring contains a dye.

(a) Plan an investigation to determine the R_f 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.

(6)

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

Each student did the investigation differently.

The R_f 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)

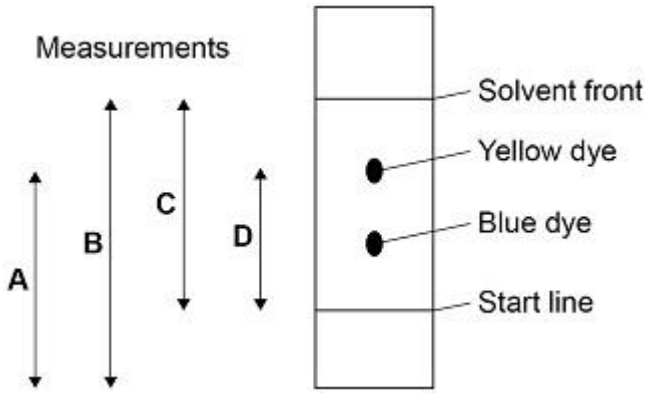
Q2.

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 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)

Q3.

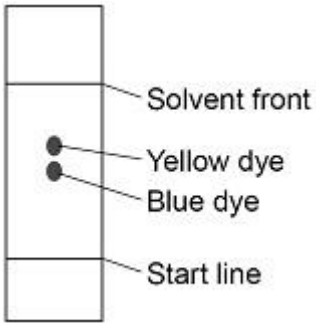
This question is about ink.

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 R_f 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 R_f 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 R_f 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	☐

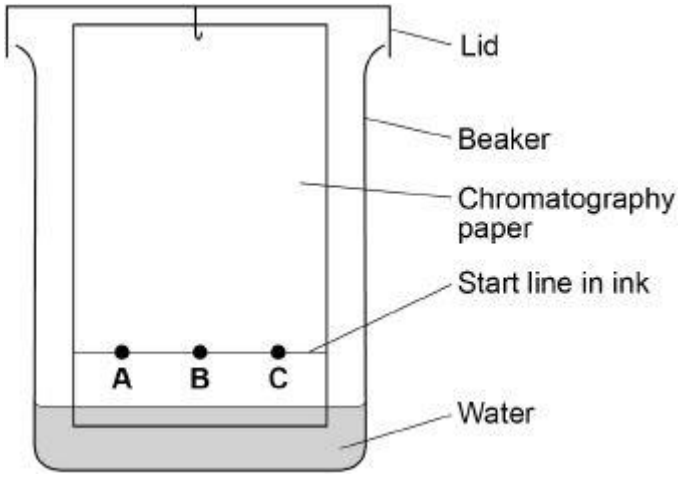
Use more ethanol ☐

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 ☐

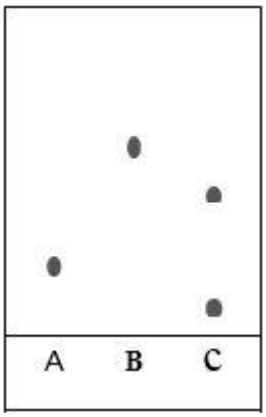
Uses water as the solvent ☐

(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 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)

Q5.

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

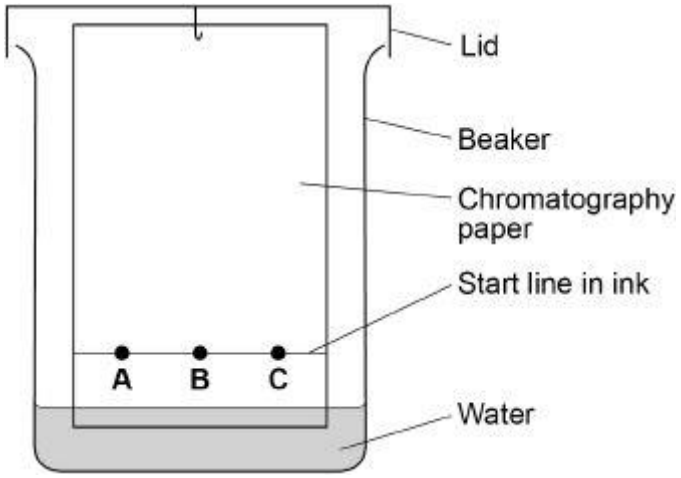
The colours are soluble in ethanol but are insoluble in water.

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 _____

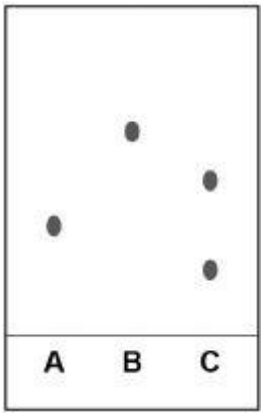
_____

(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 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)

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. **(separate only)**

Calcium ☐

Copper(II) ☐

Iron(II) ☐

Iron(III) ☐

(1)

(Total 6 marks)

Q7.

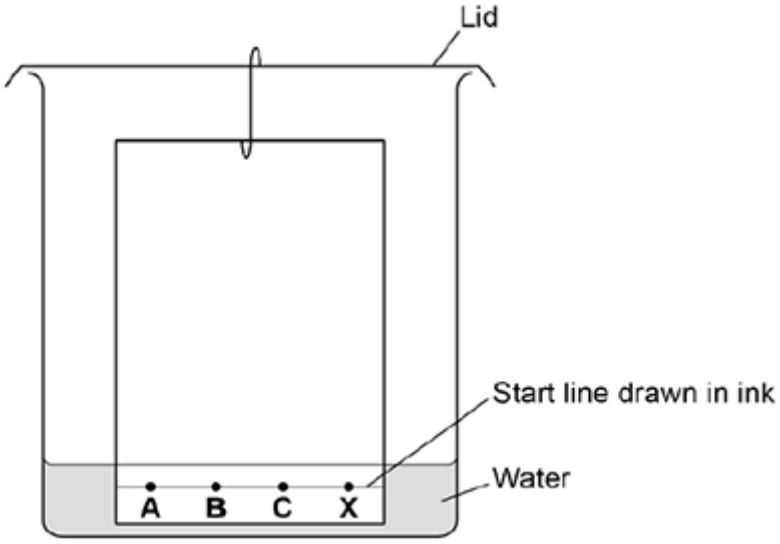
A student investigated a food colouring using paper chromatography.

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. ☐

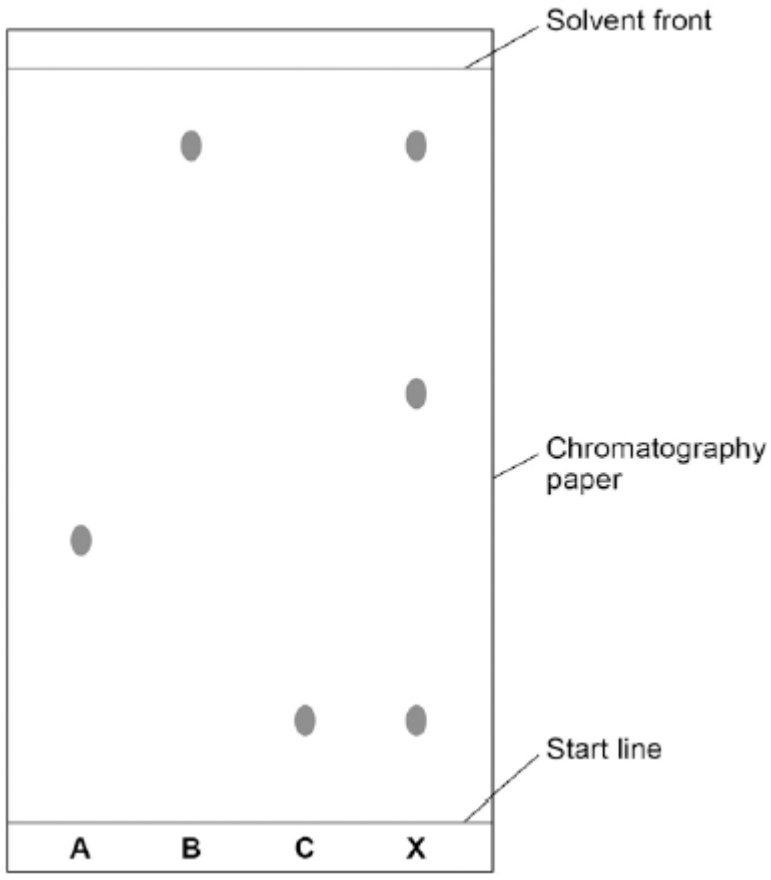
The water level was above the spots. ☐

(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 R_f 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.

_____

_____

_____

R_f value = _____

(5)

(Total 9 marks)

Q8.

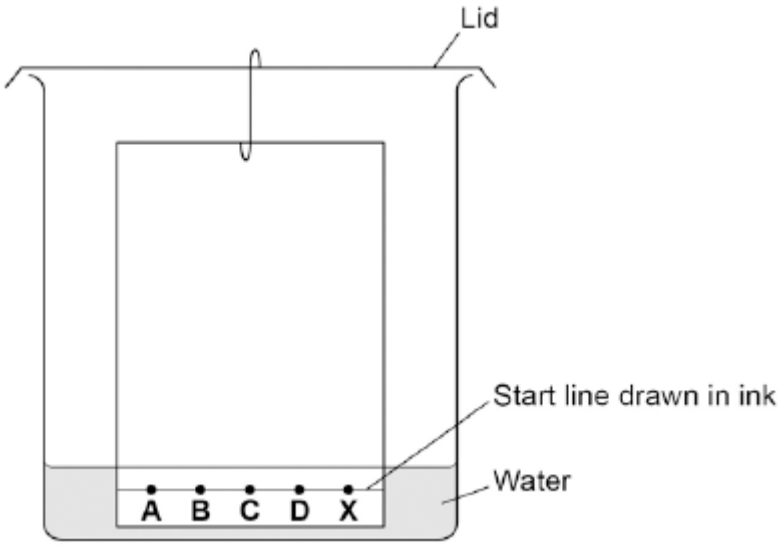
A student investigated food dyes using paper chromatography.

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.

_____

_____

_____

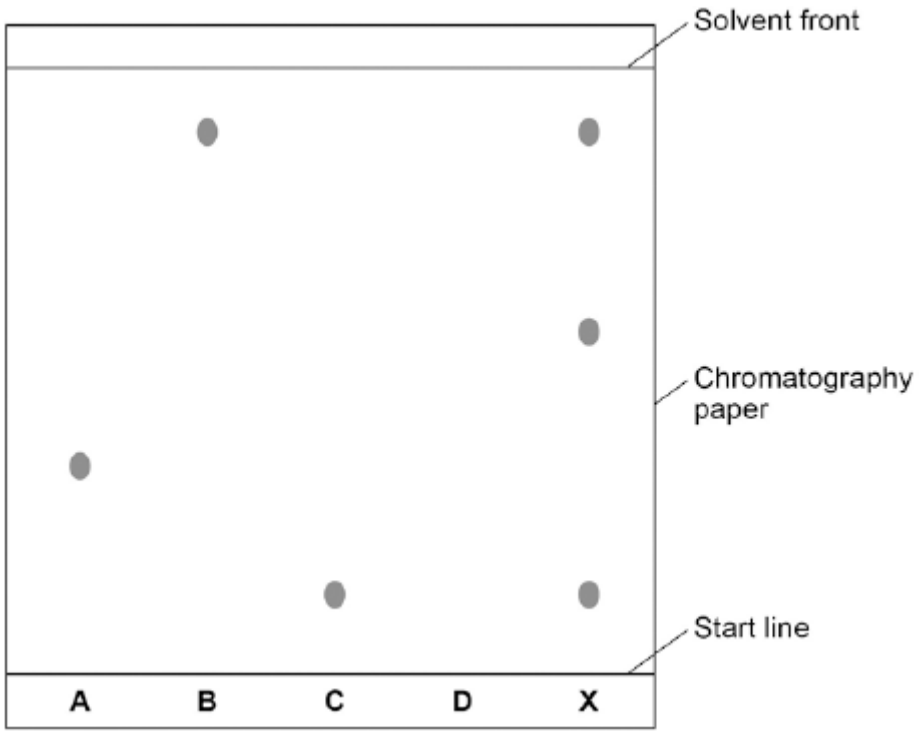
_____

(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 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)

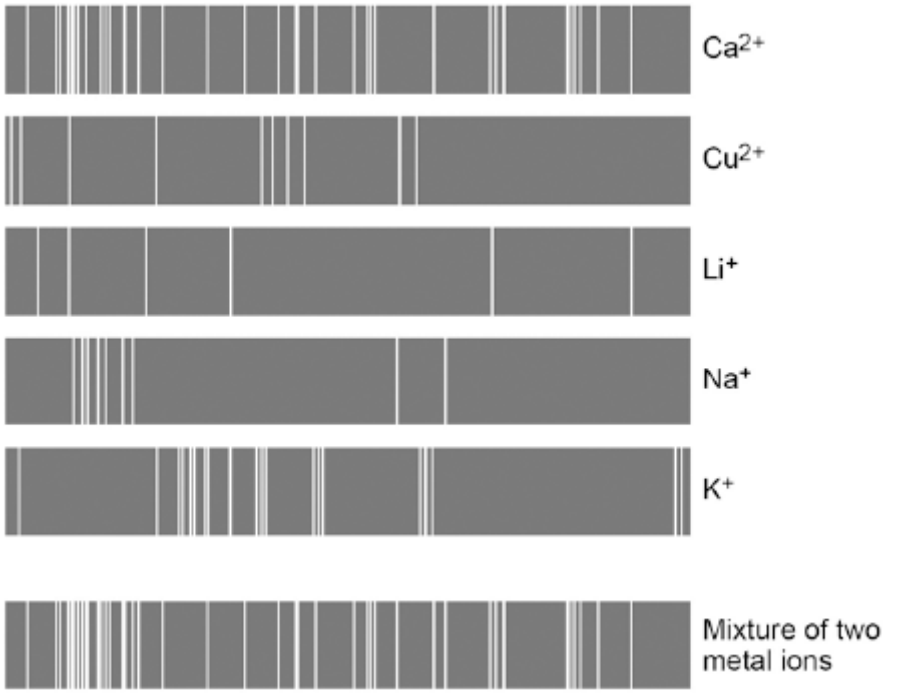
(d) Explain how the different dyes in **X** are separated by paper chromatography.

(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. **(separate only)**

(2)

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

_____

(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. **(separate only)**

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 18 marks)