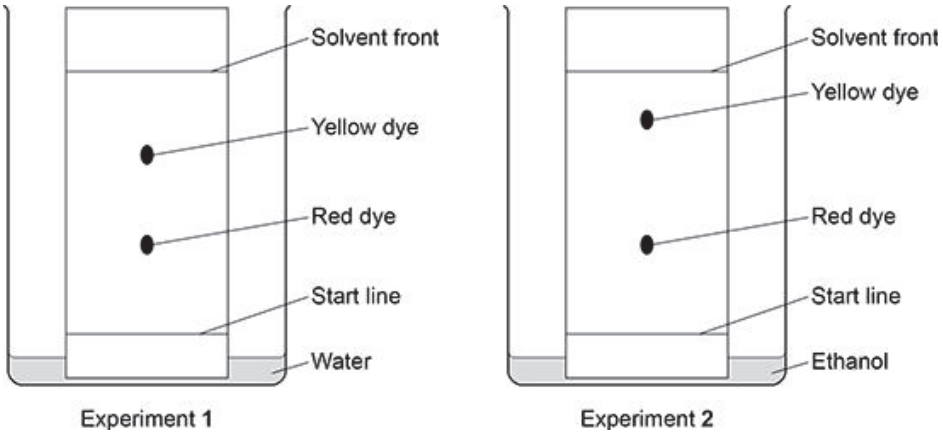
All questions are for both separate science and combined science students

Q1.

A student investigated an orange dye (**A**) using paper chromatography.

Figure 1 shows the results of Experiment **1** and Experiment **2** using orange dye **A**.

Figure 1



(a) Explain why the yellow dye and red dye travel different distances in Experiment **1**.

Refer to forces of attraction between the dyes and the chromatography paper in your answer.

The yellow dye travels further as this dye has a weaker attraction to the chromatography paper

(2)

(b) The student used the same type of chromatography paper in Experiment **1** and in Experiment **2**.

Explain why the yellow dye is in different positions in Experiment **1** and in Experiment **2**.

Use **Figure 1**.

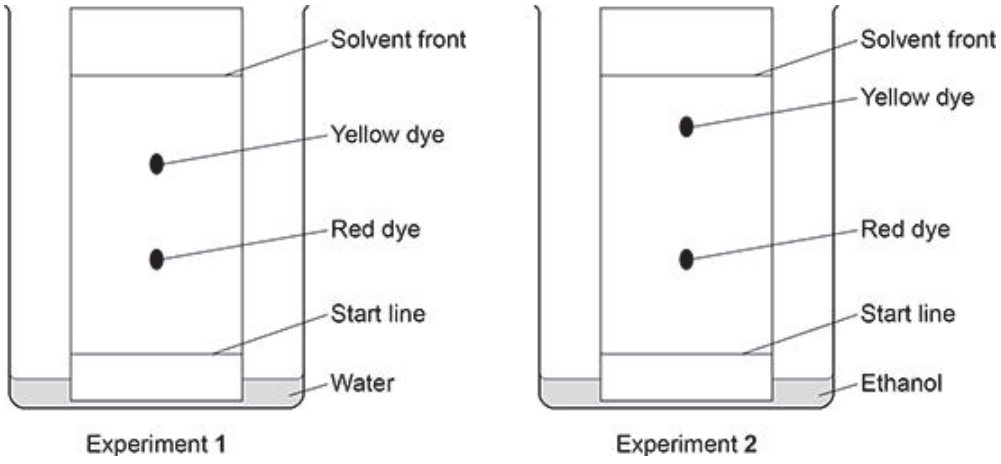
The yellow dye travels further than previously because the solvents are different.
The yellow dye is more soluble in ethanol than water

(3)

Figure 1 is repeated below.

Figure 1 shows the results of Experiment **1** and Experiment **2** using orange dye **A**.

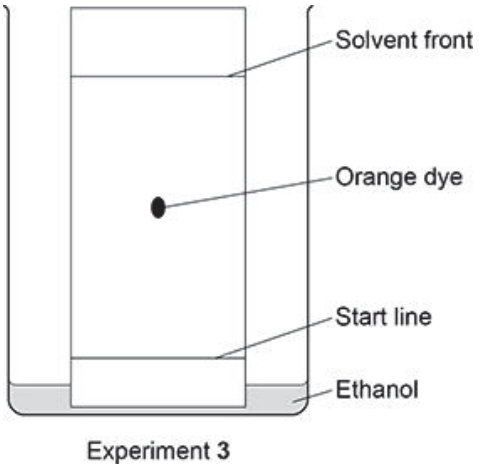
Figure 1



The student investigated a different orange dye (**B**).

Figure 2 shows the results of Experiment **3** using orange dye **B**.

Figure 2



(c) Compare the purity of the orange dyes **A** and **B**.

Give reasons for your answer.

Use **Figure 1** and **Figure 2**.

A is an impure substance as there are two components.
B is a pure substance as there is only one component.

(2)

R_f = distance moved by solute / distance moved by solvent

(d) The student calculated that the R_f value of the orange dye in the experiment shown in **Figure 2** was 0.48

Calculate the distance moved by the solvent front when the orange dye had moved 5.4 cm.

distance moved by solvent = distance moved by solute / R_f

distance moved by solvent = 5.4 / 0.48 = 11.25

Distance moved by solvent front = 11.25 cm

(3)

(e) Why is the R_f value of a dye **not** affected by how far the solvent front is allowed to travel?

The ratio of spot distance moved to solvent distance moved is constant.

(1)

(f) Another type of chromatography is called gas chromatography.

Gas chromatography is an instrumental method of chemical analysis.

Scientists tested the orange dyes using gas chromatography.

Suggest **two** advantages of using the instrumental method of gas chromatography rather than paper chromatography.

1 More sensitive and accurate

2 Faster analysis.

(2)

(Total 13 marks)

Q2.

This question is about chromatography.

A student investigated an orange food colouring using two different types of chromatography paper.

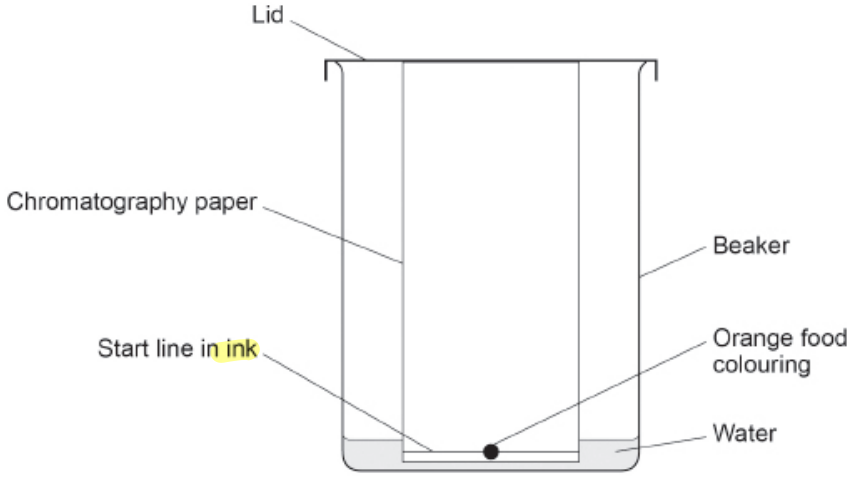
The food colouring:

- contained a mixture of red and yellow dyes
- was soluble in water.

This is the method used.

1. Draw a start line on a piece of type **A** chromatography paper.
2. Put a spot of orange food colouring on the line.
3. Put the paper into a beaker containing water as a solvent.
4. Wait for the water to travel up the paper.
5. Measure the distance above the start line moved by the red and yellow dyes and the water.
6. Repeat steps 1 to 5 using type **B** chromatography paper.

The figure below shows how the student set up the apparatus.



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

Give **two** mistakes the student made.

1 The start line is drawn in ink

2 The start line is below the water level

(2)

Another student set up the apparatus correctly.

The table below shows the results.

	Type A chromatography paper		Type B chromatography paper	
	Red dye	**Yellow dye**	**Red dye**	**Yellow dye**
Distance moved by dye in cm	4.8	6.6	5.4	**X**
Distance moved by water in cm	12.0	12.0	12.0	12.0
R_f value	0.40	0.55	0.45	0.60

(b) Determine value **X** in the table above.

R_f = distance moved by solute / distance moved by solvent

$0.6 = \frac{X}{12.0}$ $\quad X = 0.6 \times 12.0$

$= 7.2$ cm

X = 7.2 cm

(3)

Changing the type of chromatography paper resulted in different R_f values for the red dye.

(c) Explain why the R_f values for the red dye are different using the two types of chromatography paper.

Use the table above.

The Rf value is smaller for Paper A, because the red dye is more attracted to Paper A than to Paper B. So the red dye spends a greater proportion of the time distributed in Paper A.

(3)

(d) What other change to the investigation could result in a different R_f value for the red dye?

Use a different solvent.

(1)

(Total 9 marks)