AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.8.1 PURITY, FORMULATIONS AND CHROMATOGRAPHY (PACK 1)

SCORE	PERCENTAGE
/170	%

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Q1.

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.

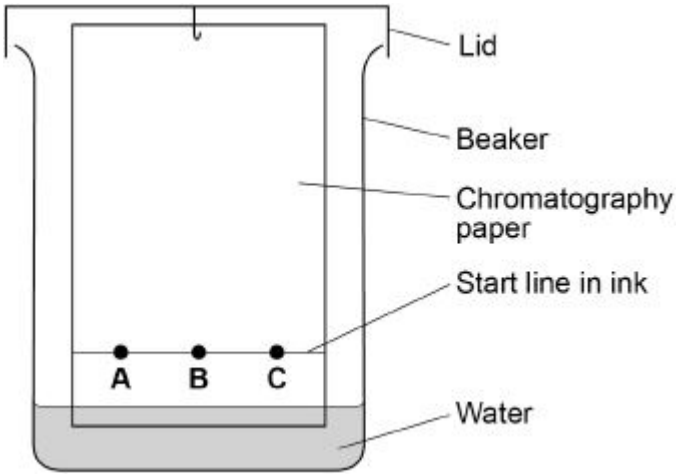
Crush the flower	☐
Filter the mixture three times	☐
Use a larger beaker	☐
Use more ethanol	☐
Use more flowers	☐

(2)

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

Figure 1

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

Tick **two** boxes.

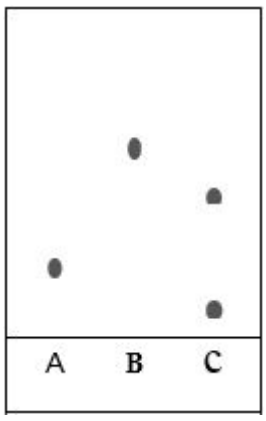
The paper does not touch the beaker	☐
The start line is drawn in ink	☐
The water level is below the start line	☐
Uses a lid on the beaker	☐
Uses water as the solvent	☐

(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**?

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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)

Q2.

Methylated spirit is a useful product made from a mixture of substances.

The table below shows the mass of the substances in a sample of methylated spirit.

Substance	**Mass in grams**
Ethanol	265.5
Methanol	23.3
Pyridine	3.0
Methyl violet	1.5

(a) What name is given to a useful product such as methylated spirit?

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_____

(1)

(b) Calculate the percentage by mass of methanol in methylated spirit.

Use the table above.

_____

_____

_____

_____

Percentage = _____ %

(2)

Methylated spirit contains ethanol and is available cheaply.

Methylated spirit also contains:

- pyridine which has a very unpleasant smell
- methyl violet which makes the mixture purple.

(c) Suggest why pyridine and methyl violet are added to ethanol to make methylated spirit.

_____

_____

(1)

(d) Suggest **one** use of methylated spirit.

_____

(1)

(e) Describe how ethanol is produced from sugar solution.

Give the name of this process.

_____

_____

_____

_____

_____

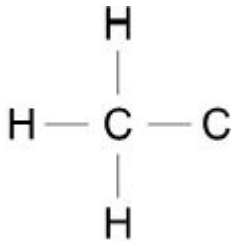
_____

(3)

(f) The diagram below shows part of the displayed formula for ethanol.

Complete the diagram.

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(1)

(g) Name the gas produced when sodium is added to ethanol.

_____

(1)

(h) Methanol is used to produce methanoic acid.

What type of substance reacts with methanol to produce methanoic acid?

_____

(1)

(Total 11 marks)

Q3.

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

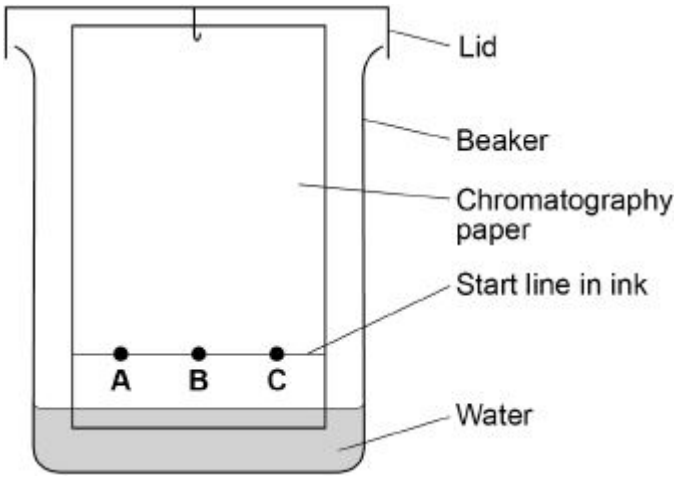
The colours are soluble in ethanol but are insoluble in water.

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.

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

Mistake 1 _____

Problem caused _____

_____

Mistake 2 _____

Problem caused _____

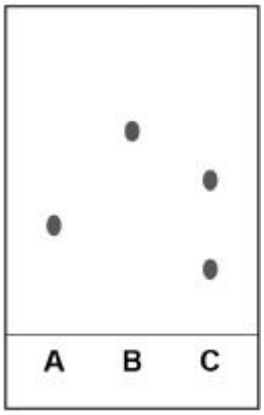
_____

(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)

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(Total 8 marks)

Q4.

Potable water is water that is safe to drink.

Seawater can be changed into potable water by desalination.

(a) Name the substance removed from seawater by desalination.

_____

(1)

(b) Desalination requires large amounts of energy.

Desalination is only used when there is no other source of potable water.

Give **one** reason why.

_____

_____

(1)

Water from lakes and rivers can be treated to make it potable.

(c) The first stage is to filter the water from lakes and rivers.

Why is the water filtered?

_____

_____

(1)

(d) Chlorine gas is then added to the filtered water.

Why is chlorine gas used to treat water?

_____

_____

(1)

(e) Describe a test for chlorine gas.

Give the result of the test if chlorine is present.

Test _____

Result _____

(2)

Some students investigated different water samples.

The table shows some of their results.

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Water	pH	Mass of dissolved solid in g / dm^3
Tap water	6.5	0.5
Seawater	8.1	35.0
Pure water		

(f) Complete the table above to show the expected results for pure water.

(2)

(g) What mass of dissolved solid is present in 100 cm^3 of the sample of tap water?

Tick (✔) **one** box.

0.05 g ☐

0.5 g ☐

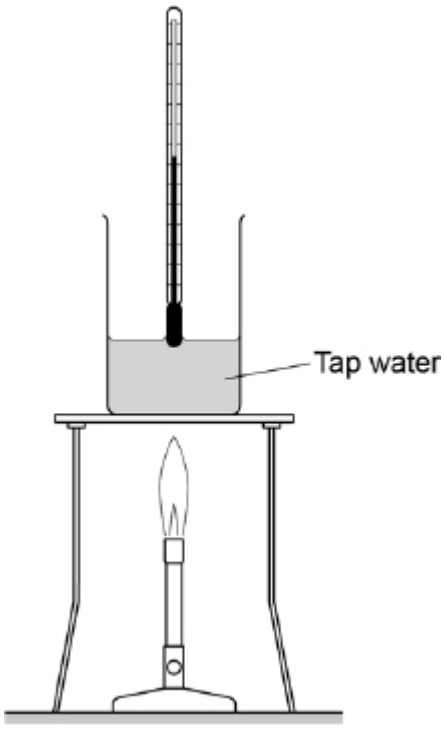
5 g ☐

50 g ☐

(1)

(h) Boiling points can be used to show whether substances are pure.

The diagram shows the apparatus the students used to find the boiling point of tap water.



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The students made a mistake setting up the apparatus.

What mistake did the students make?

_____

_____

(1)

(Total 10 marks)

Q5.

Burgundy Mixture is a formulation used to kill fungi on grapevines.

It is made by mixing two compounds, **A** and **B**.

The ratio by mass of **A** : **B** in the mixture is 1 : 8

(a) Calculate the mass of A needed in a mixture containing 125 g of **B**.

_____

_____

Mass of **A** = _____ g

(2)

Scientists test a solution of compound **A**.

The table shows their results.

Test	**Result**
Add sodium hydroxide solution	Blue precipitate
Add dilute hydrochloric acid and barium chloride solution	White precipitate

(b) Which **two** ions are in compound **A**?

Choose the answers from the box.

bromide	**chloride**	**copper**
iron(II)	**iron(III)**	**sulfate**

_____ ions and _____ ions

(2)

(c) The scientists think that compound **B** is sodium carbonate.

Describe how the scientists can test a solution of **B** to see if sodium ions are present.

Give the result of the test if sodium ions are present.

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_____

_____

_____

_____

(2)

(d) Describe how the scientists can test a solution of **B** to see if carbonate ions are present.

Give the result of the test if carbonate ions are present.

_____

_____

_____

_____

_____

_____

(3)

(Total 9 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

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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)

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(Total 6 marks)

Q7.

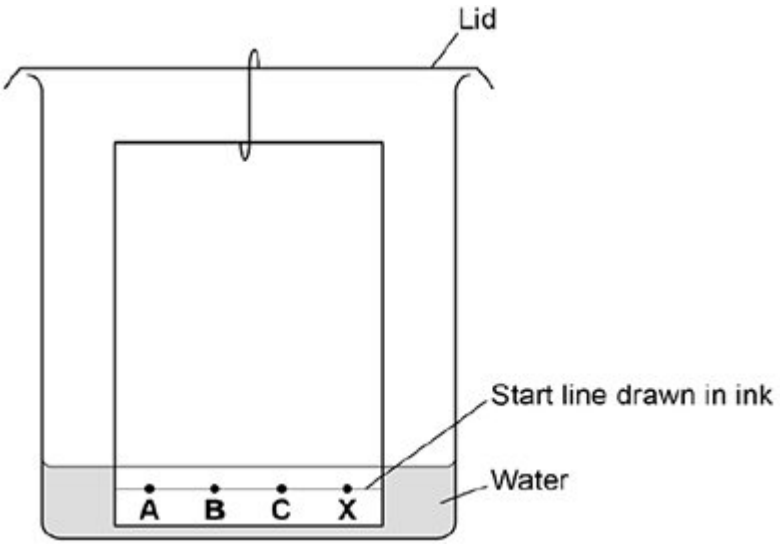
A student investigated a food colouring using paper chromatography.

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. ☐

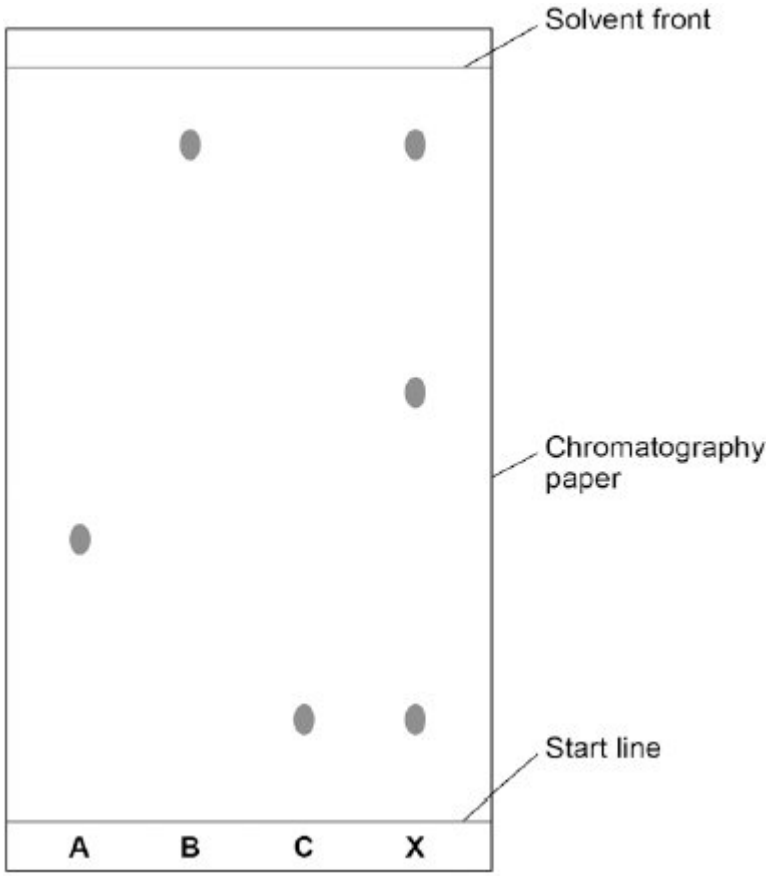
(2)

(b) Another student set the experiment up correctly.

Figure 2 shows the student's results.

Figure 2

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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:

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

Give your answer to two significant figures.

_____

_____

_____

R_f value = _____

(5)

(Total 9 marks)

Q8.

Water from a lake in the UK is used to produce drinking water.

(a) What are the two main steps used to treat water from lakes?

Give a reason for each step.

Step 1 _____

Reason _____

Step 2 _____

Reason _____

(2)

(b) Explain why it is more difficult to produce drinking water from waste water than from water in lakes.

_____

_____

_____

_____

_____

_____

(3)

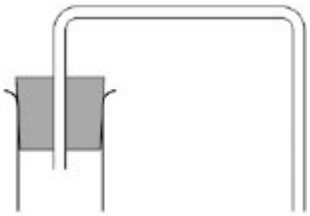
(c) Some countries make drinking water from sea water.

Complete the figure below to show how you can distil salt solution to produce and collect pure water.

Label the following:

- pure water
- salt solution

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(3)

(d) How could the water be tested to show it is pure?

Give the expected result of the test for pure water.

_____

_____

_____

_____

_____

(2)

(e) Why is producing drinking water from sea water expensive?

_____

_____

(1)

(Total 11 marks)

Q9.

A student investigated food dyes using paper chromatography.

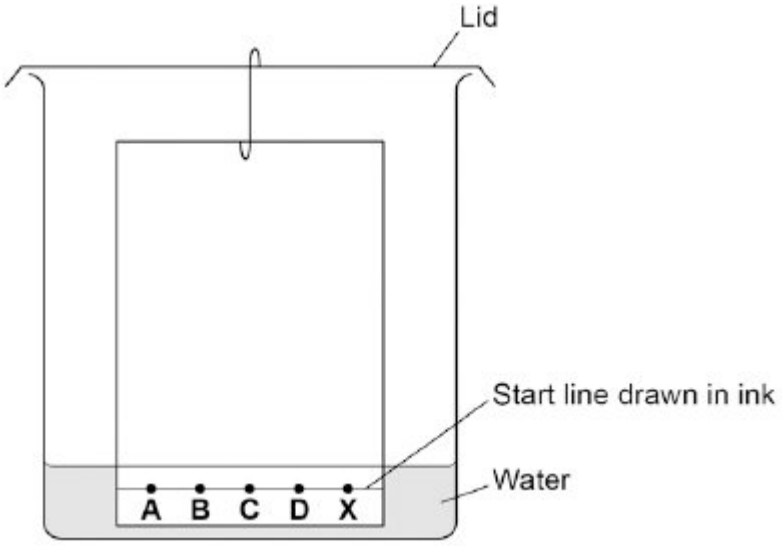
This is the method used.

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

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(a) Write down **two** mistakes the student made in setting up the experiment and explain what problems one of the mistakes would cause.

_____

_____

_____

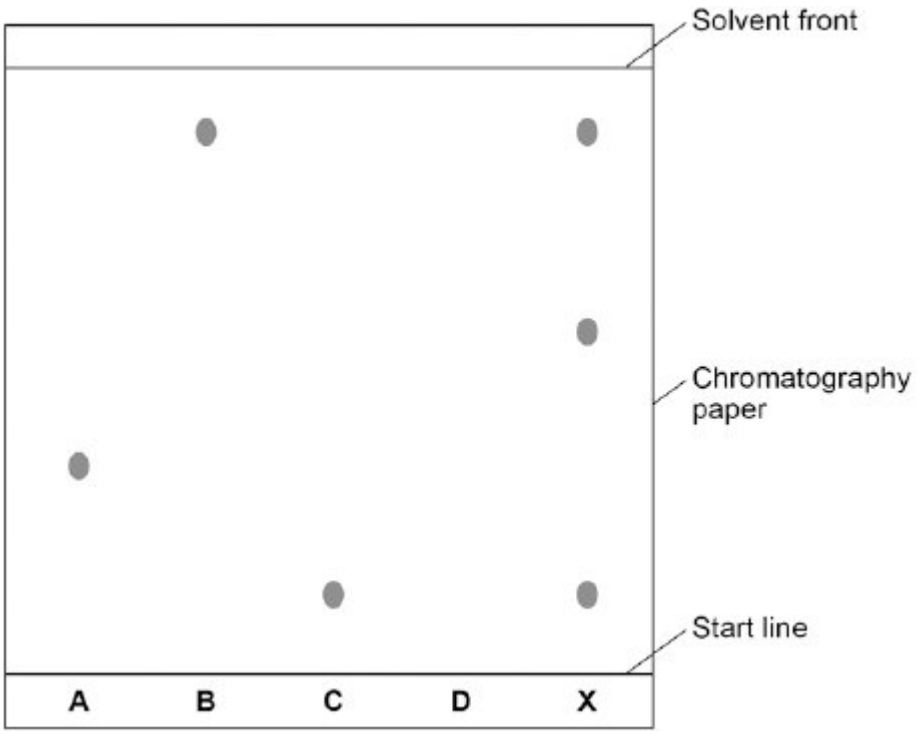
_____

(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



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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.

_____

_____

_____

_____

_____

_____

_____

_____

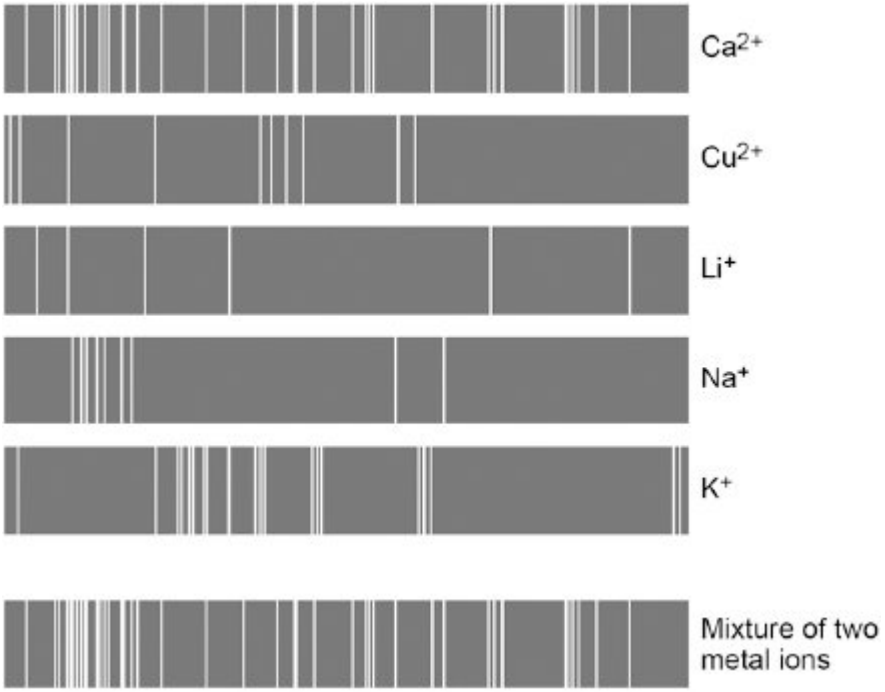
(4)

(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

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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.

_____

_____

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_____

_____

_____

_____

_____

_____

(4)

(Total 18 marks)

Q10.

Fertilisers are used to improve agricultural productivity.

(a) Ammonium nitrate is used in fertilisers.

Name the **two** compounds used to manufacture ammonium nitrate.

_____

_____

(1)

(b) A fertiliser contains the following information on the label:

NPK value = 14 : 11 : 11

Explain why this information is useful to farmers.

_____

_____

_____

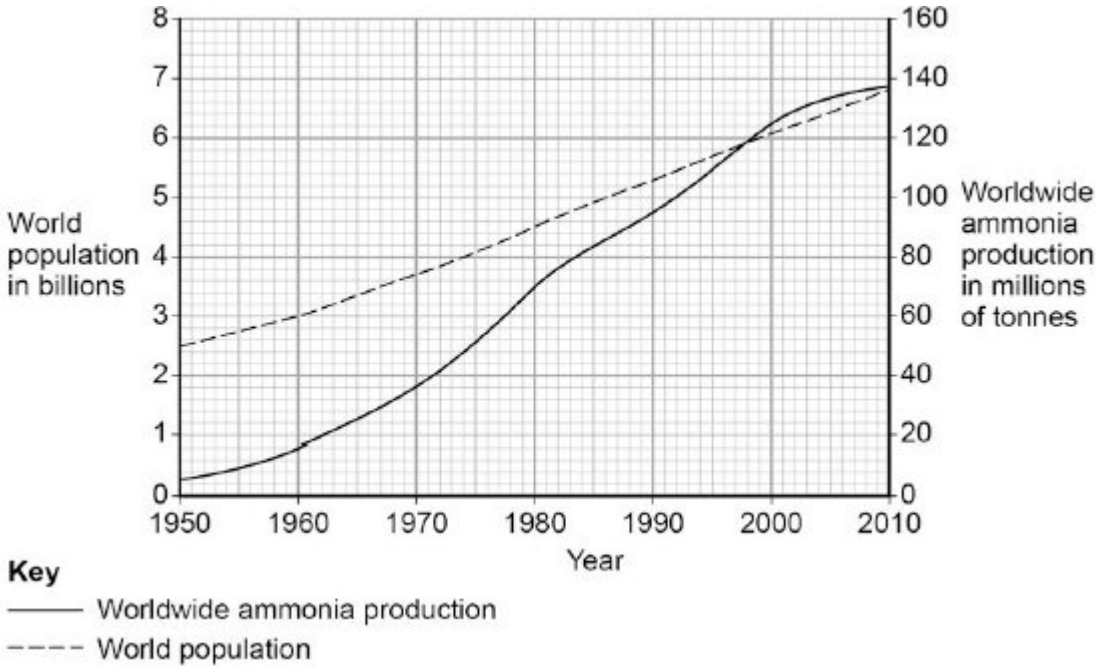
_____

_____

(2)

(c) The figure below shows worldwide ammonia production and world population from 1950 to 2010.

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Use the figure above and your knowledge to explain the relationship between ammonia production and world population.

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q11.

Chromatography can be used to separate components of a mixture.

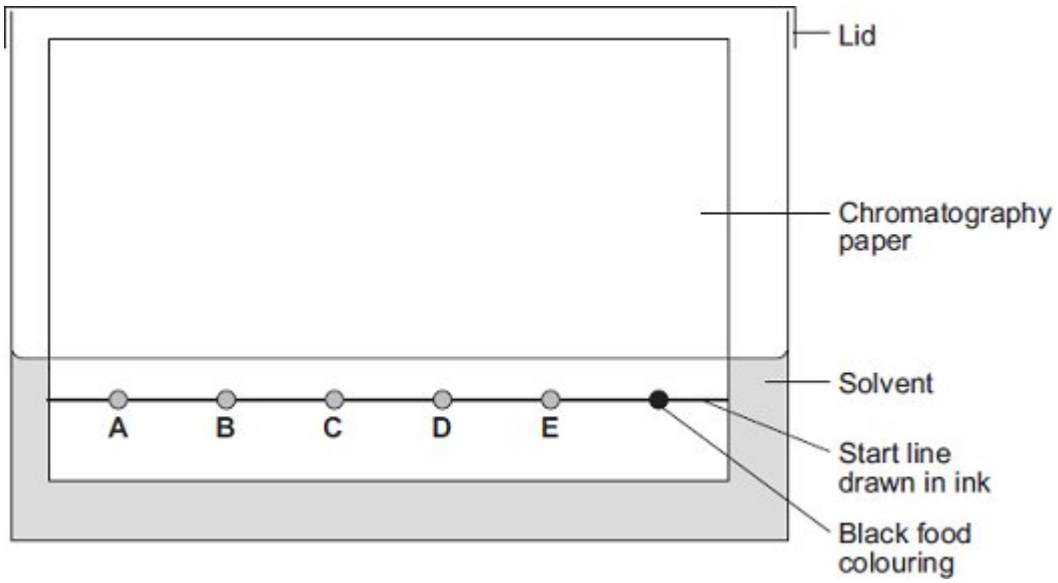
(a) A student used paper chromatography to analyse a black food colouring.

The student placed spots of known food colours, **A**, **B**, **C**, **D** and **E**, and the black food colouring on a sheet of chromatography paper.

The student set up the apparatus as shown in **Diagram 1**.

Diagram 1

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The student made **two** errors in setting up the apparatus.
Identify the **two** errors and describe the problem each error would cause.

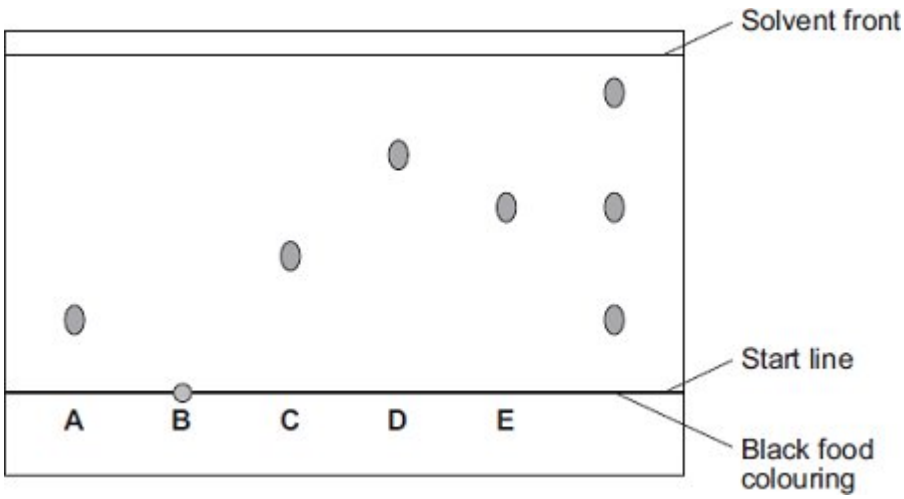
(4)

(b) A different student set up the apparatus without making any errors.

The chromatogram in **Diagram 2** shows the student's results.

Diagram 2

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(i) What do the results tell you about the composition of the black food colouring?

_____

_____

_____

(2)

(ii) Use **Diagram 2** to complete **Table 1**.

Table 1

	Distance in mm
Distance from start line to solvent front	_____
Distance moved by food colour **C**	_____

(2)

(iii) Use your answers in part **(b) (ii)** to calculate the R_f value for food colour **C**.

_____

_____

R_f value = _____

(1)

(c) **Table 2** gives the results of chromatography experiments that were carried out on some known food colours, using the same solvent as the students.

Table 2

Name of food colour	**Distance from start line to solvent front in mm**	**Distance moved by food colour in mm**	**R_f value**
Ponceau 4R	62	59	0.95

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Carmoisine	74	45	0.61
Fast red	67	27	0.40
Erythrosine	58	17	0.29

Which of the food colours in **Table 2** could be food colour **C** from the chromatogram?

Give the reason for your answer.

_____

_____

_____

(2)

(d) Two types of chromatography are gas chromatography and paper chromatography.

Give **one** advantage of gas chromatography compared with paper chromatography.

_____

_____

(1)

(Total 12 marks)

Q12.

The label shows the ingredients in a drink called Cola.

Cola

Ingredients:

Carbonated water
Sugar
Colouring
Phosphoric acid
Flavouring
Caffeine

(a) (i) The pH of carbonated water is 4.5.

The pH of Cola is 2.9.

Name the ingredient on the label that lowers the pH of Cola to 2.9.

_____

(1)

(ii) Which ion causes the pH to be 2.9?

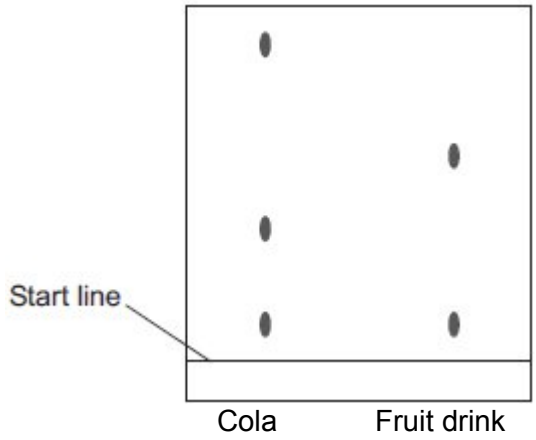
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_____

(1)

(b) A student investigated the food colouring in Cola and in a fruit drink using paper chromatography.

The chromatogram in the figure below shows the student's results.



(i) Complete the sentence.

The start line should be drawn with a ruler and _____ .

Give a reason for your answer.

_____

_____

(2)

(ii) Suggest **three** conclusions you can make from the student's results.

_____

_____

_____

_____

_____

_____

(3)

(c) Caffeine can be separated from the other compounds in the drink by gas chromatography.

Why do different compounds separate in a gas chromatography column?

_____

_____

(1)

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(d) Caffeine is a stimulant.

Large amounts of caffeine can be harmful.

(i) Only **one** of the questions in the table **can** be answered by science alone.

Tick (✓) **one** question.

Question	Tick (✓)
Should caffeine be an ingredient in drinks?	
Is there caffeine in a certain brand of drink?	
How much caffeine should people drink?	

(1)

(ii) Give **two** reasons why the other questions **cannot** be answered by science alone.

Reason 1 _____

_____

Reason 2 _____

_____

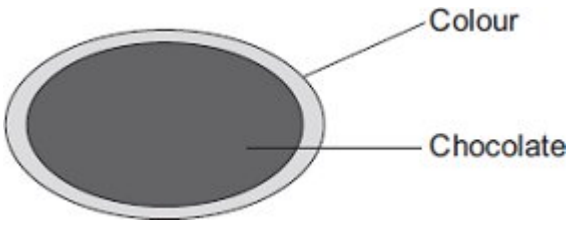
(2)

(Total 11 marks)

Q13.

Colours are used to coat some chocolate sweets.

Some of these colours are given E-numbers.



(a) Use the correct word from the box to complete the sentence.

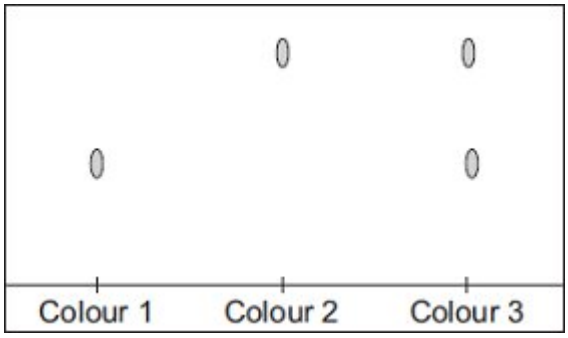
additive	element	fuel

An E-number is used to identify a permitted food _____

(1)

(b) Chromatography was used to compare three of the colours used to coat the chocolate sweets.

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What do these results tell you about these three colours?

_____

_____

_____

_____

_____

_____

(3)

(Total 4 marks)

Q14.

This is part of an article about food additives.

THE PERIL OF FOOD ADDITIVES

Some orange drinks contain the additives E102 (Tartrazine), E104 (Quinoline Yellow) and E110 (Sunset Yellow).These three coloured additives are thought to cause hyperactivity in children.

(a) State **two** reasons that a manufacturer might give to justify the use of these additives.

1. _____

_____

2. _____

_____

(2)

(b) Some scientists asked 4000 twelve-year-old children to help them investigate if there is a link between these three coloured additives and hyperactivity.

How would the scientists use these 4000 children to investigate if there is a link between these three coloured additives and hyperactivity in children?

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(4)

(c) A manufacturer used an independent scientist to show that their orange drink did not contain these three coloured additives.

(i) Suggest why the manufacturer would use a scientist who was independent instead of using their own scientist.

_____

_____

(1)

(ii) The scientist had samples of E102, E104 and E110 and the orange drink. The scientist used paper chromatography for the test.

Describe how the scientist could use the results to show if the orange drink contained any of these three coloured additives.

You may include a diagram of the paper chromatography results.

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(2)

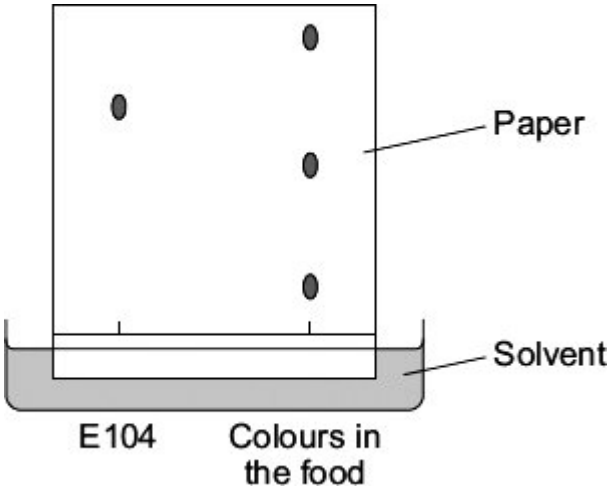
(Total 9 marks)

Q15.

An article began:

> # Ban yellow additives
>
> Quinoline yellow (E104) is suspected of causing hyperactivity, asthma and rashes in children.

(a) A student tested a food to find out if it contained quinoline yellow (E104).
The student's results are shown below.



(i) Draw a ring around the correct answer to complete the sentence.

This method of detecting and identifying colours is called

chromatography.
distillation.
electrolysis.

(1)

(ii) Using the student's results, how many different colours are in the food? ___

(1)

(iii) Using the student's results, how can you tell that the food does **not** contain quinoline yellow (E104)?

_____

_____

(1)

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(b) Quinoline yellow (E104) is used in foods such as sweets, drinks and ice cream.

(i) Give **one** reason why quinoline yellow (E104) is added to foods.

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_____

(1)

(ii) Suggest what should be done to decide if quinoline yellow (E104) should be banned.

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(1)

(Total 5 marks)

Q16.

Icing on cakes is tested to check that safe colours were used when they were made.

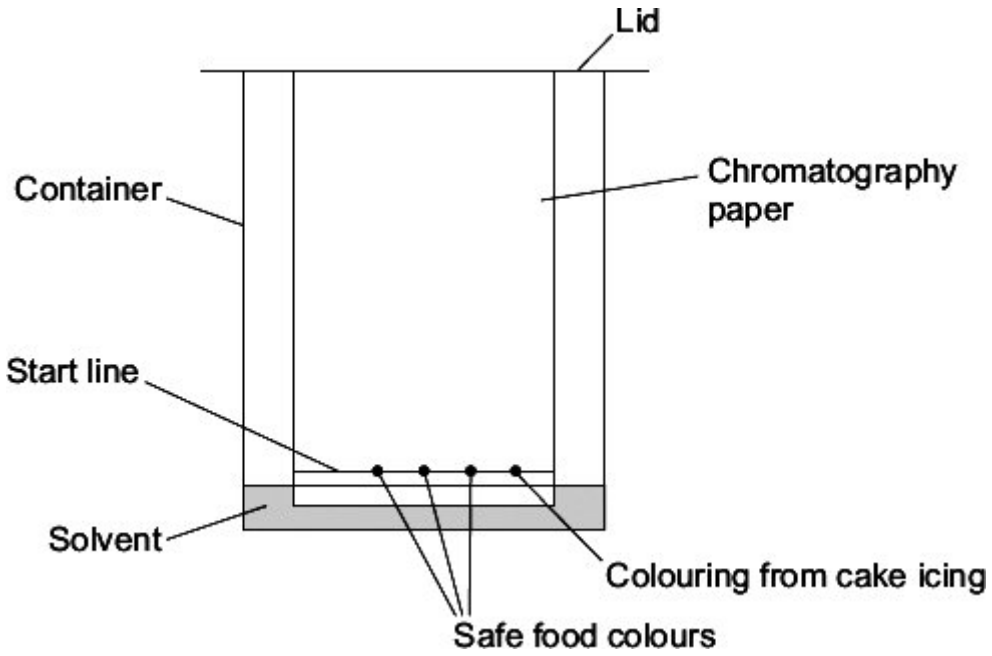


By Megan Chromik [CC-BY-SA-2.0], via Wikimedia Commons

Paper chromatography is one method of testing which colours are in cake icing.

(a) The diagram shows an experiment a student did.

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(i) Suggest why there is a lid on the container.

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_____

(1)

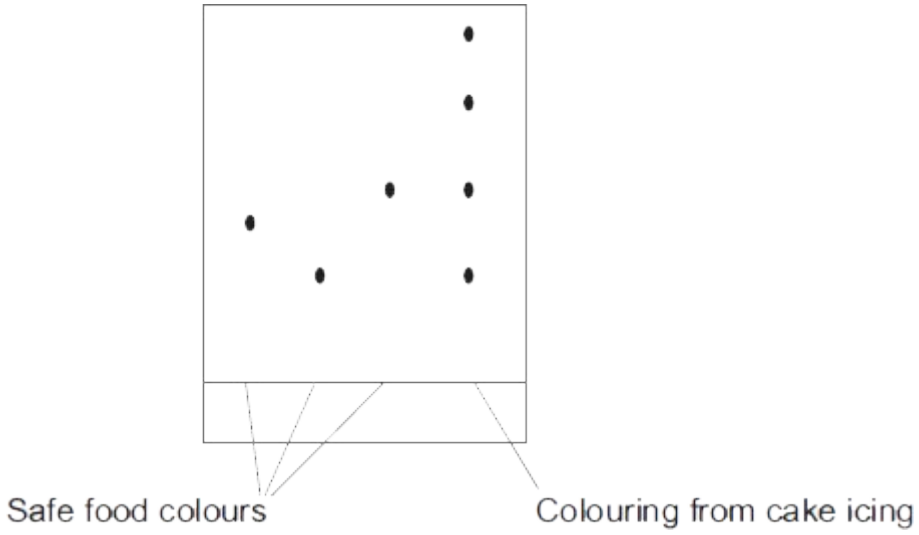
(ii) The start line should be drawn in pencil **not** in ink.
Suggest why.

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(1)

(b) The diagram shows the results of the paper chromatography experiment.



(i) How many different food colours were used in the colouring from the cake icing?

_____

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(1)

(ii) Is the cake icing safe to eat?

Give a reason for your answer.

_____

_____

(1)

(c) Gas chromatography linked to mass spectroscopy is an example of an instrumental method. This method was used on a mixture of solvents.

(i) Give **two** advantages of gas chromatography compared with paper chromatography.

_____

_____

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_____

(2)

(ii) What does gas chromatography do to the mixture of solvents?

_____

_____

(1)

(iii) What information does mass spectroscopy give?

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(1)

(Total 8 marks)

Q17.

Read the article.

Problem food colourings

Scientists say they have evidence that some food colourings cause hyperactive behaviour in young children.

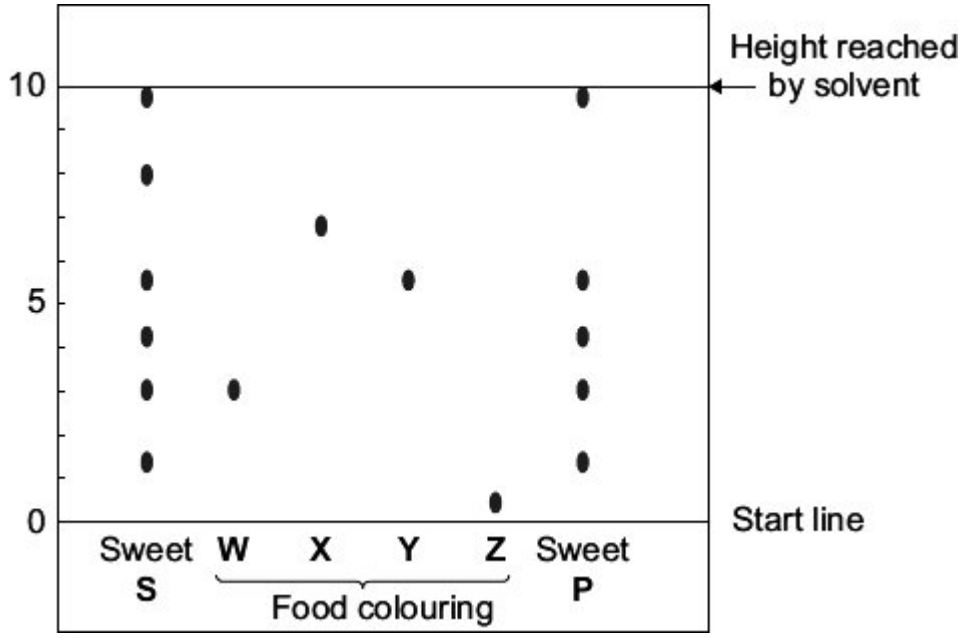
These food colourings are added to some sweets.

W, **X**, **Y** and **Z** are food colourings that may cause hyperactive behaviour in young children.

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A scientist used chromatography to see if these food colourings were used in two sweets, **S** and **P**.

The results are shown on the chromatogram.



(a) Food colourings, such as **W**, **X**, **Y** and **Z**, are added to some sweets.

Suggest **one** reason why.

_____

_____

(1)

(b) In chromatography, the R_f value = $\frac{\text{distance moved by the colouring}}{\text{distance moved by the solvent}}$

Use the scale on the chromatogram to help you to answer this question.

Which food colouring, **W**, **X**, **Y** or **Z**, has an R_f value of 0.7?

(1)

(c) From the chromatogram, what conclusions can the scientist make about the colourings in sweets **S** and **P**?

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(3)

(Total 5 marks)

Q18.

This is part of an article about food additives.

THE PERIL OF FOOD ADDITIVES

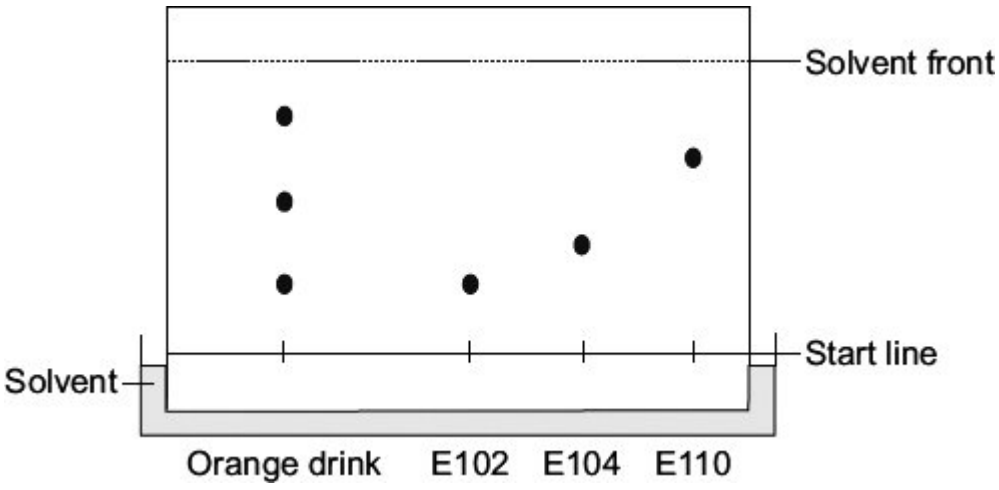
Some orange drinks contain the additives E102 (Tartrazine), E104 (Quinoline Yellow) and E110 (Sunset Yellow).
These three additives are thought to cause hyperactivity in children.

(a) Tick (✓) **two** reasons why a manufacturer of orange drinks uses these additives.

Reason	Tick (✓)
to make the drink healthier	
to improve the appearance of the drink	
because they are permitted colours	
because they are expensive	

(2)

(b) A scientist tested an orange drink to find out if it contained these additives.
The result of the test is shown.



(i) Draw a ring around the correct answer to complete the sentence.

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The test that the scientist did is called

chromatography.
cracking.
distillation.

(1)

(ii) How many coloured additives are there in the orange drink? _____

(1)

(iii) The scientist concluded that the orange drink contained only **one** of the additives E102, E104 and E110.

Explain why.

_____

_____

_____

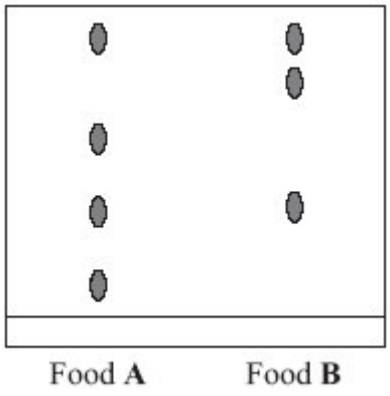
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(2)

(Total 6 marks)

Q19.

The result of a process used to detect and identify the colours in two foods, **A** and **B**, is shown.



(i) Describe the differences between the colours used in food **A** and food **B**.

_____

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(2)

(ii) Tick (✓) the name of the process used to detect and identify colours in food.

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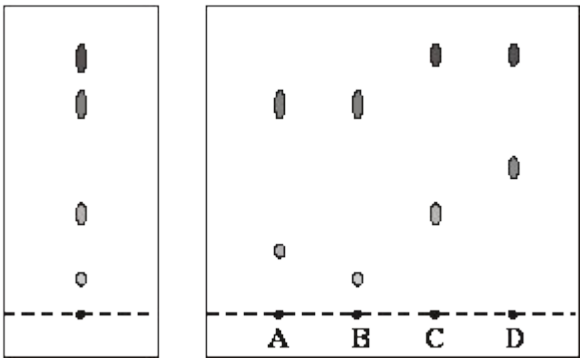
Process	(✓)
chromatography	
extraction	
hardening	

(1)

(Total 3 marks)

Q20.

Chromatography was carried out on a sample of soft drinks to check that they contained only colours that were safe. This is the result.



Safe colours Colours from the soft drinks

What conclusions about the safety of the colours in the soft drinks **A, B, C** and **D** can be made from the results shown by chromatography?

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(Total 2 marks)

Q21.

Some farmed salmon have a coloured additive in the food that they are given. This is a permitted additive that improves the colour of the fish meat.

A sample of the colour is extracted from a salmon.

Explain how paper chromatography could be used to confirm that this is the permitted additive.

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(Total 3 marks)

Q22.

Why blue sweets are turning white

A recent study identified a possible harmful effect on children's nervous systems by some artificial colours. Two of these colours are Brilliant Blue (E133) and Quinoline Yellow (E104). Both are artificial colours because they are made from coal. The company is to stop producing the blue sweets because it is removing all artificial colours and there is no natural blue alternative.

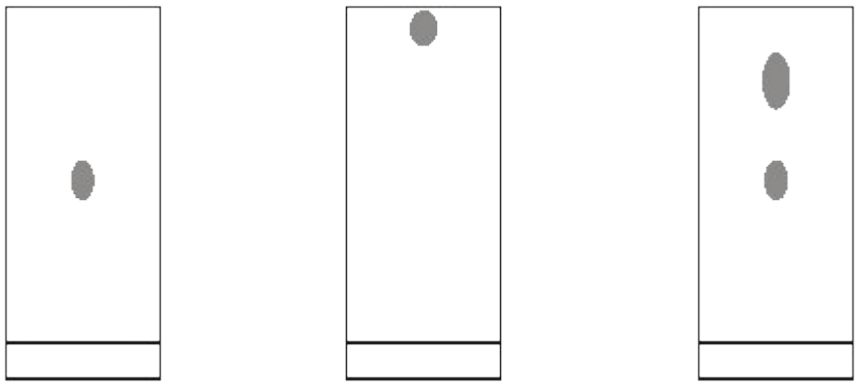
(a) Suggest why it is important to be able to identify the colour additives in food.

_____

_____

(1)

(b) A brown colour used in sweets was analysed using chromatography. The results were compared with those from E104 and E133.



What do the results tell you about the brown colour and its suitability for use in sweets?

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_____

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(3)

(c) Once all the unsuitable colours are removed, the company claims that its sweets are now ‘free from artificial colours’.

Does this mean that the sweets contain no additives? Explain your answer.

_____

_____

_____

_____

(2)

(Total 6 marks)

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