OCR
Oxford Cambridge and RSA

Monday 11 January 2016 – Afternoon

LEVEL 2 CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R075/02 How scientific data is used

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **50**.
- The quality of written communication is assessed in questions marked with a pencil (✎).
- This document consists of **20** pages. Any blank pages are indicated.

Answer **all** the questions.

1 Tom works for the World Anti-Doping Agency.

He tests blood specimens taken from athletes to see if they have used any banned drugs.

He receives blood specimens from all the athletes attending a sporting event.

There are male and female athletes from a number of different countries.

(a) (i) Tom cannot test all the blood specimens so he samples them.

Describe how he picks a **representative** sample from the blood specimens.

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..... **[2]**

(ii) Suggest **two** things that the people sending the blood specimens to Tom should do to make sure that the specimens are not contaminated.

1 .....

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2 .....

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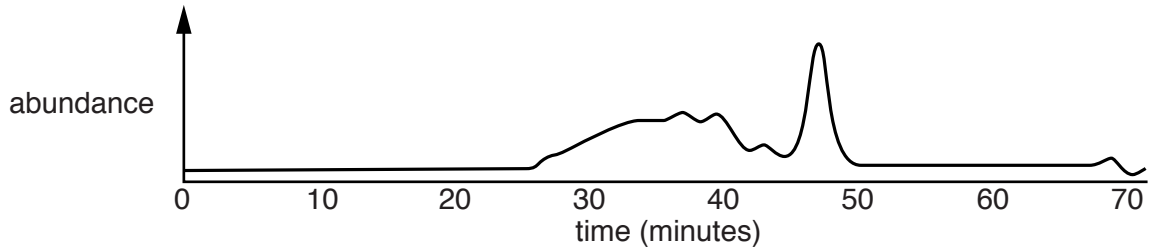
[2]

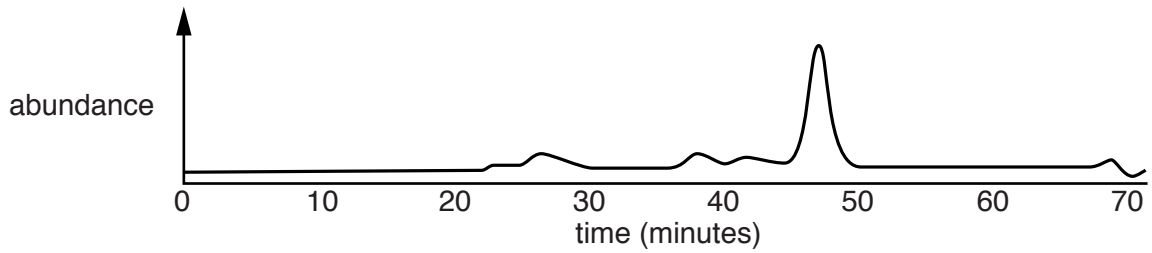
(b) Tom uses a high performance liquid chromatography (HPLC) technique to analyse two of the blood specimens, **A** and **B**.

These are his results.

Specimen A

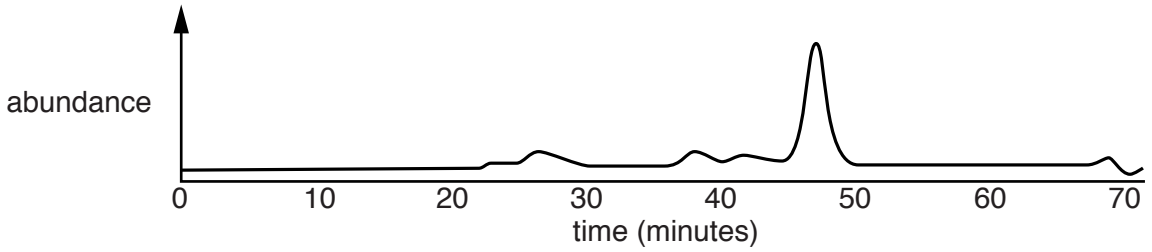


Specimen B



Tom uses the data below to help him interpret his results.

Blood specimen – no drugs



Tom concludes that **specimen A** contains a drug but **specimen B** does not.

(i) Refer to the data to explain why he makes these conclusions.

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..... **[2]**

(ii) Describe how Tom can identify the drug in **specimen A**.

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.....

..... **[2]**

(iii) Tom repeats his tests.

What else can he do to make his conclusions secure?

.....

..... **[1]**

2 Ella works for a company making medicines.

She uses a titration to find the concentration of an acid.

She uses 25.0 cm^3 of the acid for each titration.

She does a rough trial and then repeats the titration several times.

Here are her results.

	Rough trial	**Titration 1**	**Titration 2**	**Titration 3**	**Titration 4**	**Mean**
Volume of alkali added (cm^3)	28.2	27.6	27.4	25.7	27.5	27.5

(a) Describe how Ella calculated the mean volume of alkali added.

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.....

..... **[2]**

(b) The concentration of the alkali is 0.20 mol/dm^3.

Use this formula to calculate the concentration of the acid:

$$\text{concentration of acid} = \frac{\text{concentration of alkali} \times \text{mean volume of alkali added}}{\text{volume of acid}}$$

Show your working.

concentration of acid = ... mol/dm^3 **[2]**

3 Jack and Adam work in a research laboratory.

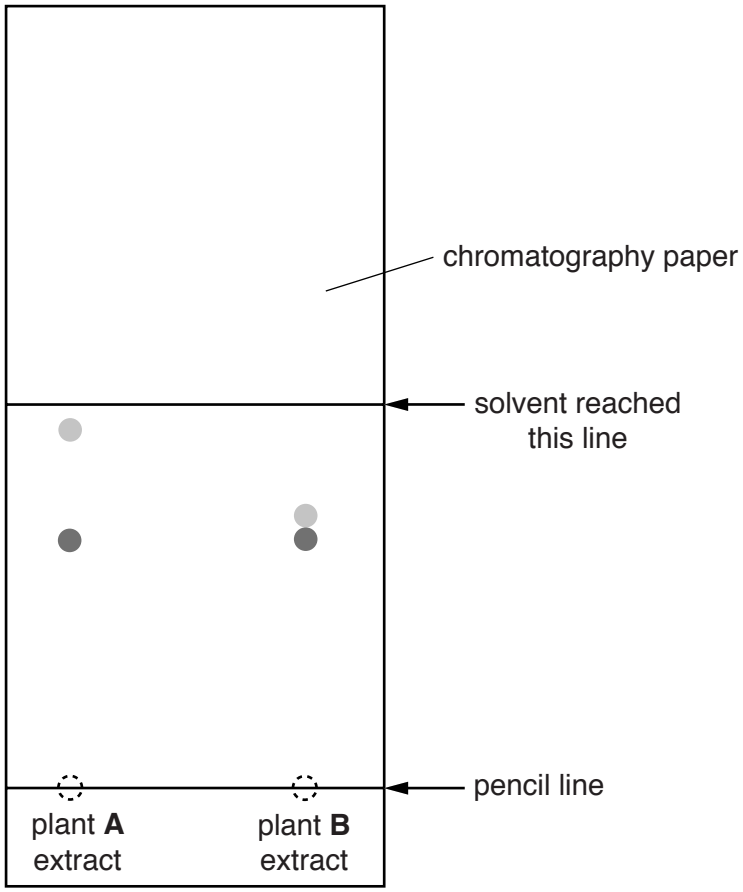
Plants are coloured because they contain a mixture of pigments.

(a) Jack is investigating which pigments are in plants **A** and **B**.

He crushes parts of each plant and dissolves them in a solvent to make plant extracts.

He uses chromatography to identify the pigments in the two plants.

Here is Jack's chromatogram.



Jack sees two spots for each extract; the lower spots are blue-green and the higher spots are yellow.

He uses this data table to help him identify the pigments in the plants.

Pigment	**Colour**
Carotene	bright yellow
Phaeophytin	yellow-grey
Xanthophyll	yellow-brown
Chlorophyll-a	blue-green
Chlorophyll-b	green

(i) Are Jack's observations **qualitative** or **quantitative**?

Explain your answer.

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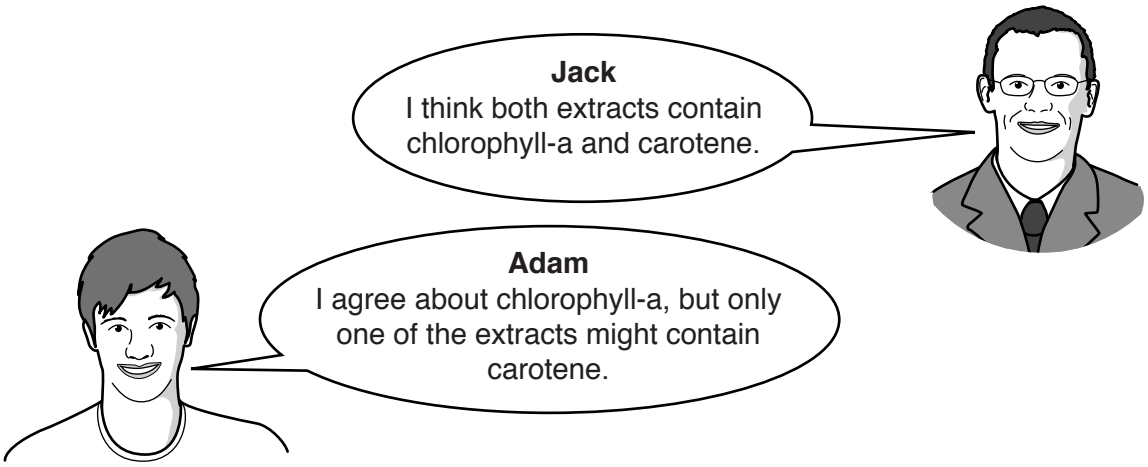
..... **[1]**

(ii) Jack discusses his conclusions with Adam.



Explain how the data supports Adam's conclusion.

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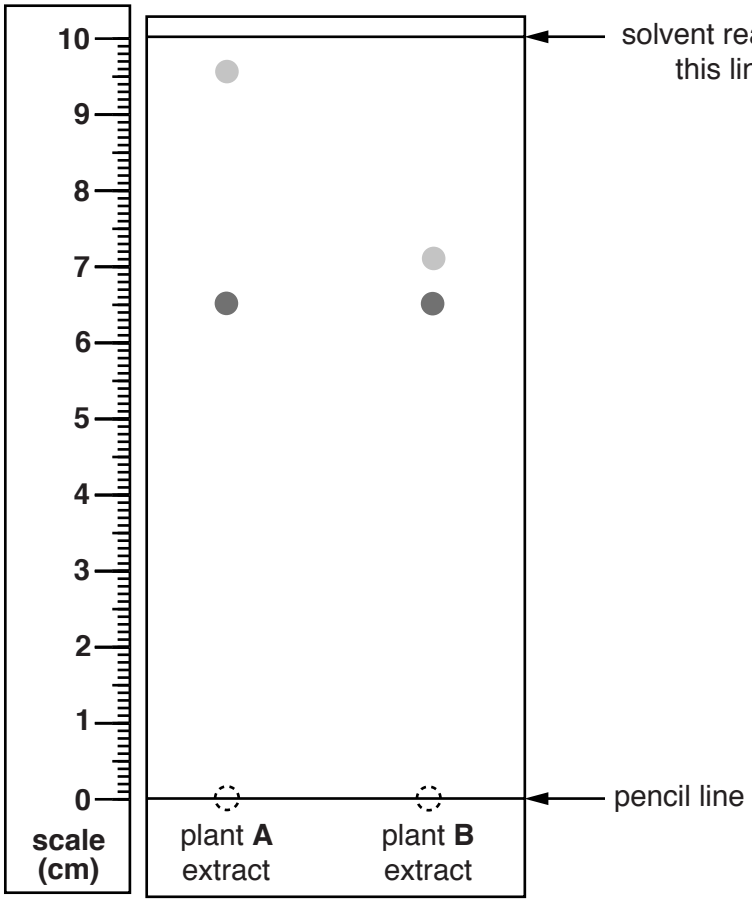
..... **[3]**

(b) Adam does a chromatograph using the same extracts.

Here is Adam's chromatogram.



They use this table of data and Adam's chromatogram to identify the pigments.

Pigment	R_f
Carotene	0.96
Phaeophytin	0.83
Xanthophyll	0.71
Chlorophyll-a	0.65
Chlorophyll-b	0.45

(i) How does the pencil line help to make the value accurate?

.....

..... **[1]**

(ii) The R_f value for a spot is calculated by using the formula:

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

Use the **scale** next to Adam's chromatogram to calculate the R_f value for the **higher** spot for plant **A** extract.

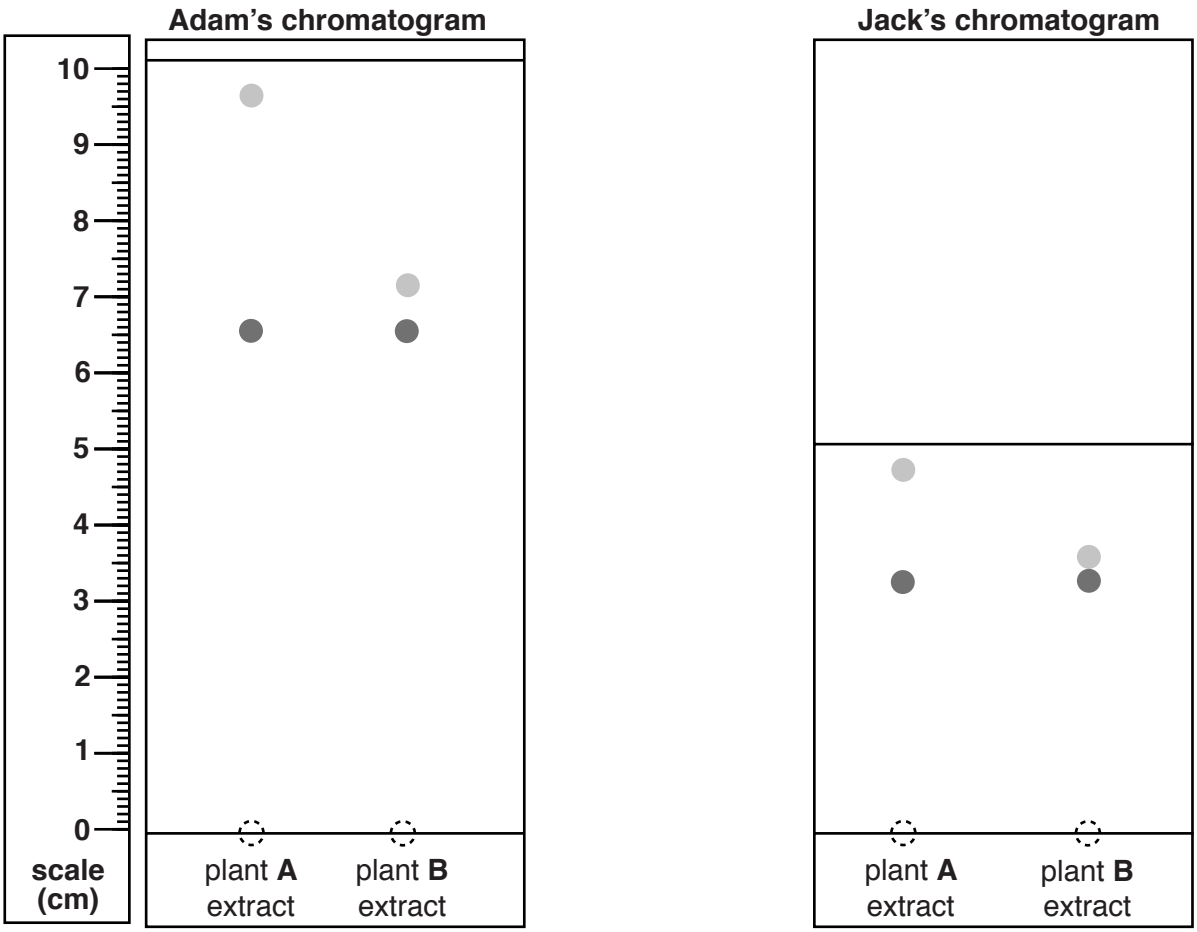
Show your working.

R_f value = ... **[2]**

(iii) Use your value in part **(b)(ii)** and the table on the opposite page to identify the pigment that produces the **higher** spot for plant **A** extract.

..... **[1]**

(c) Adam compares his chromatogram with Jack's.



Explain why Adam's chromatogram gives more accurate values than Jack's.

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..... **[1]**

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Question 3(d) begins on page 12

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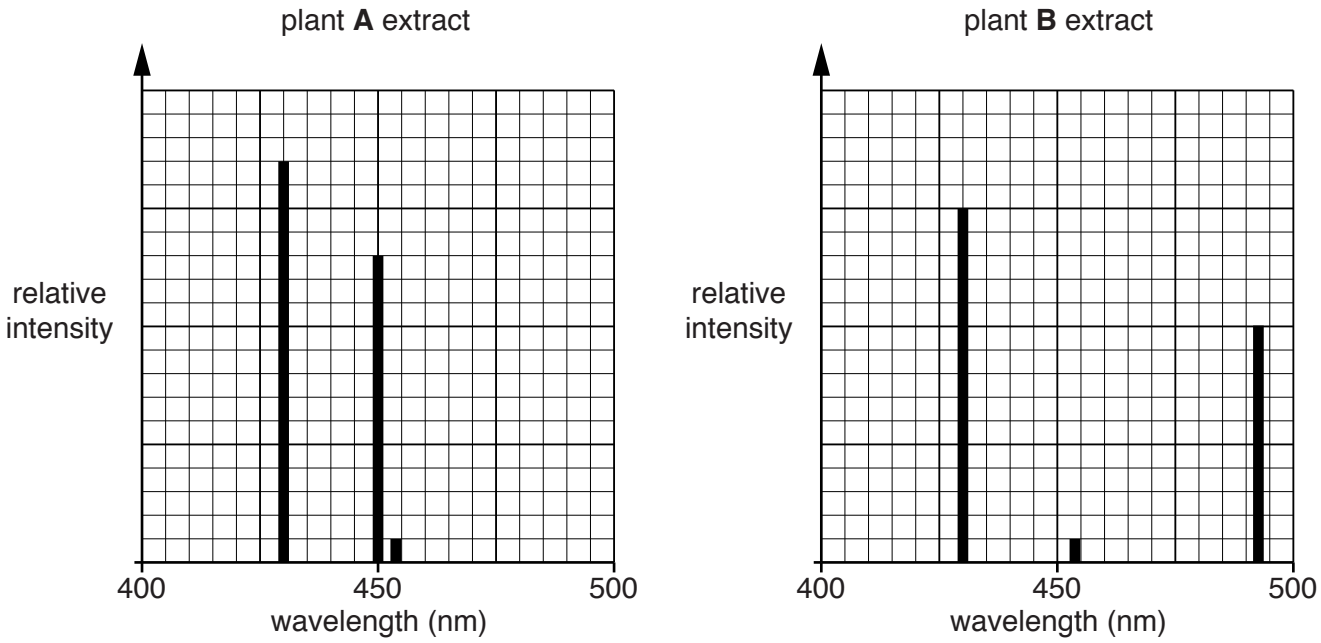
(d) Jack and Adam use an absorbance spectrophotometer to test extracts from plants **A** and **B**.

Here are their results.



This is the data they use to interpret their results.

Pigment	**Wavelength (nm)**
Carotene	450
Phaeophytin	410
Xanthophyll	493
Chlorophyll-a	430
Chlorophyll-b	453

From the results of the chromatograms Jack and Adam concluded that there were two pigments in each plant.

Describe the conclusions that you can make from the absorbance spectrophotometer data and suggest reasons why these are different from the conclusions made using the chromatogram results alone.

Give reasons for your answer.

The quality of written communication will be assessed in your answer.

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..... **[6]**

4 Lucy, Matt and Amy monitor the quality of water for an environmental organisation.

(a) Lucy tests the pH of water at various locations using a pH meter.

(i) Give **one** advantage and **one** disadvantage of using a pH meter compared with using Universal Indicator paper.

advantage .....

.....

disadvantage .....

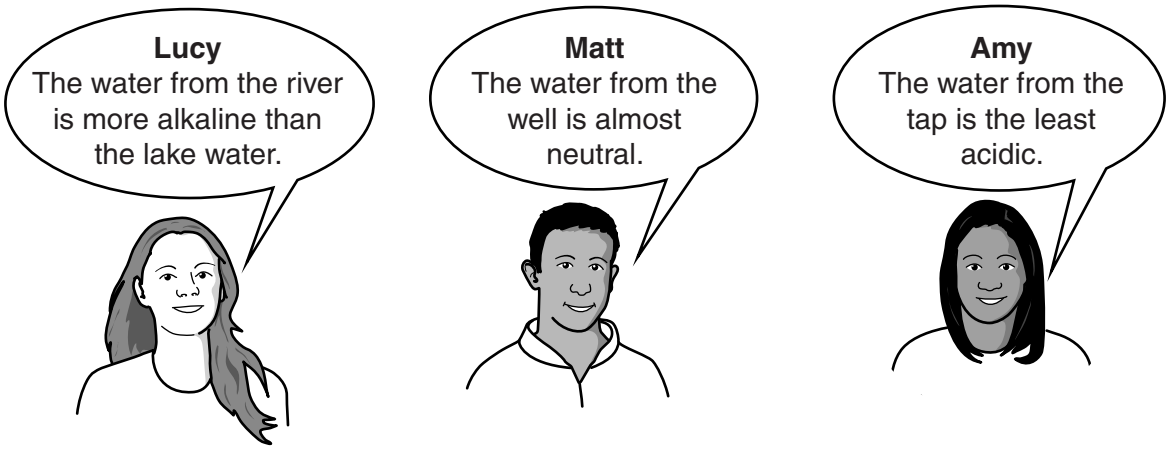
.....

[2]

Here are Lucy's results.

Location	pH	
	mean	range
Lake	8.1	0.2
River	8.7	0.3
Tap	6.6	0.2
Well	6.9	0.3

(ii) Lucy, Matt and Amy give their conclusions from these results.



Do you agree with their conclusions?

Use the results above to support your answers.

Lucy .....

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Matt .....

.....

Amy .....

.....

[4]

(b) Matt tests for ions in the tap water.

He puts some tap water in a beaker and leaves it until all of the liquid has evaporated.

He uses a flame test to test the solid residue left in the beaker.

Matt follows this procedure:

Step 1 – Dip a wire loop in concentrated acid.

Step 2 – Put wire loop in a Bunsen burner flame.

Step 3 – Dip wire loop in solid residue.

Step 4 – Put wire loop in a Bunsen burner flame.

(i) Why does Matt do steps **1** and **2**?

Put a tick (✓) next to the correct answer.

to make the solid residue stick to the wire	☐
to find out what colour the acid gives	☐
to make the colour stronger	☐
to clean the wire	☐

[1]

(ii) The flame test gives a very strong, bright yellow-orange colour.

What metal ion is in the solid residue?

Put a (ring) around the correct answer.

calcium **lithium** **potassium** **sodium** **[1]**

(iii) Amy thinks there might be more than one type of metal ion in the tap water.

Suggest why the flame test only identifies one type of metal ion.

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..... **[1]**

(iv) Amy tests the solid residue using the same procedure and gets the same result.

Explain why doing this shows that the results are reproducible.

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..... **[1]**

(v) What can Amy do to find out if there is more than one type of metal ion in the solid residue?

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..... **[1]**

(c) Matt decides to do further tests to identify the anions in the solid residue.

He dissolves the solid residue in distilled water to make a solution for the tests.

(i) Explain why it is important that he uses distilled water rather than tap water to make the solution.

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..... **[1]**

(ii) Matt divides the solution of the solid residue between two test tubes, **X** and **Y**.

He adds a test solution to each test tube.

Here are his results.

Test tube	Test solution added	Result
X	silver nitrate	no effect
Y	barium nitrate	white precipitate

What conclusions can be made from these results?

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..... **[2]**

(iii) Matt also tests for carbonate ions.

When he adds acid to the solid residue, bubbles of gas are produced.

He tests the gas given off and finds that it is carbon dioxide.

What is used to test for carbon dioxide and what result do you see?

Test .....

Result .....

[2]

(d) Amy tests the water from a well for pH, nitrates and total dissolved solids.

This is the summary of her results.

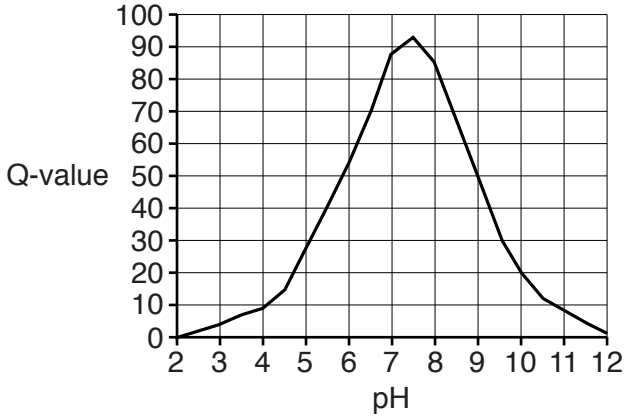
pH		Nitrates (mg/litre)		Total dissolved solids (mg/litre)	
mean	**range**	**mean**	**range**	**mean**	**range**
6.7	6.4–7.0	5	4–8	225	200–250

Water quality is measured by its total **Q-value**.

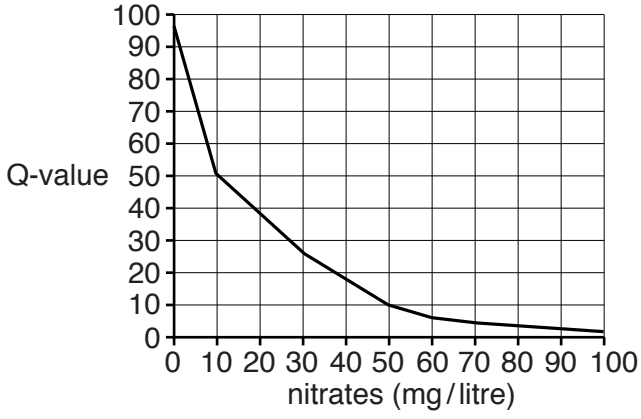
The total **Q-value** is found by calculating the mean of individual Q-values for the pH, nitrates and total dissolved solids in the water, and adding them together.

Amy uses her results and these Q-value graphs to work out the Q-value for the pH, nitrates and total dissolved solids in the water she tested.

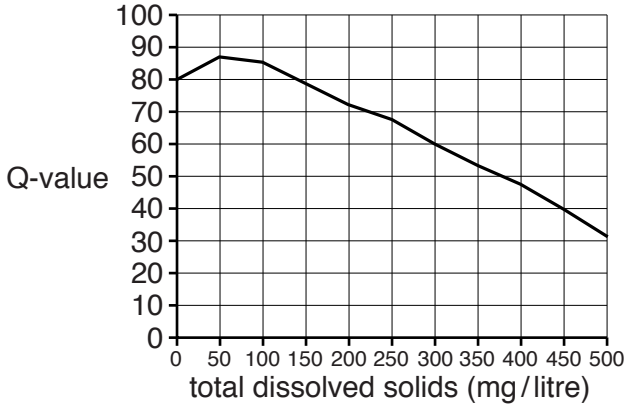
pH Q-value graph



Nitrates Q-value graph



Total dissolved solids Q-value graph



The table shows how the total **Q-value** is used to judge the quality of the water.

Total Q-value	Quality
300–271	excellent
270–209	good
210–151	medium
150–76	fair
75–0	poor

Use Amy's results and the Q-value graphs to work out the Q-value for the water, and use the data to judge what the quality of the water is.

Show your working and give reasons for your answer.

The quality of written communication will be assessed in your answer.

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..... **[6]**

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page. The question number(s) must be clearly shown in the margin.