OCR
Oxford Cambridge and RSA

Friday 12 June 2015 – 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

R075/02

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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. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- 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 Maria works for a drinks company.

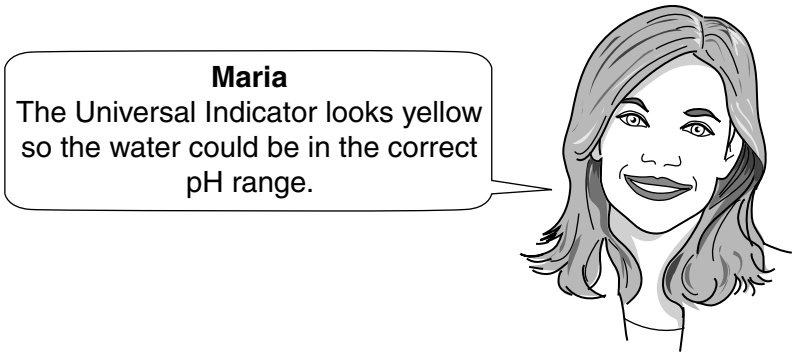
She tests the water used to make the drinks.

The water needs to have a pH value in the range from 5.8 to 6.2.

(a) She uses Universal Indicator to test the pH of the water.

Here is the colour chart she uses.

4	5	6	7	8	9
red	orange	yellow	green	green-blue	blue



(i) Explain why Maria **cannot be certain** that the water's pH value is between 5.8 and 6.2.

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

(ii) Maria then uses a **pH meter** to test the water.

Give **two** advantages of using a pH meter instead of Universal Indicator for this test.

Advantage 1 .....

.....

Advantage 2 .....

.....

[2]

(b) The water to make the drinks may contain ions.

Maria tests the water for ions.

Here are some of her results.

Test solution used	Result
Barium nitrate	No effect
Silver nitrate	White precipitate formed
Sodium hydroxide	Blue precipitate formed

Which ions do these tests show are in the water?

Put a (ring) around each of the **two** correct answers.

carbonate **chloride** **copper** **potassium** **sodium** **[2]**

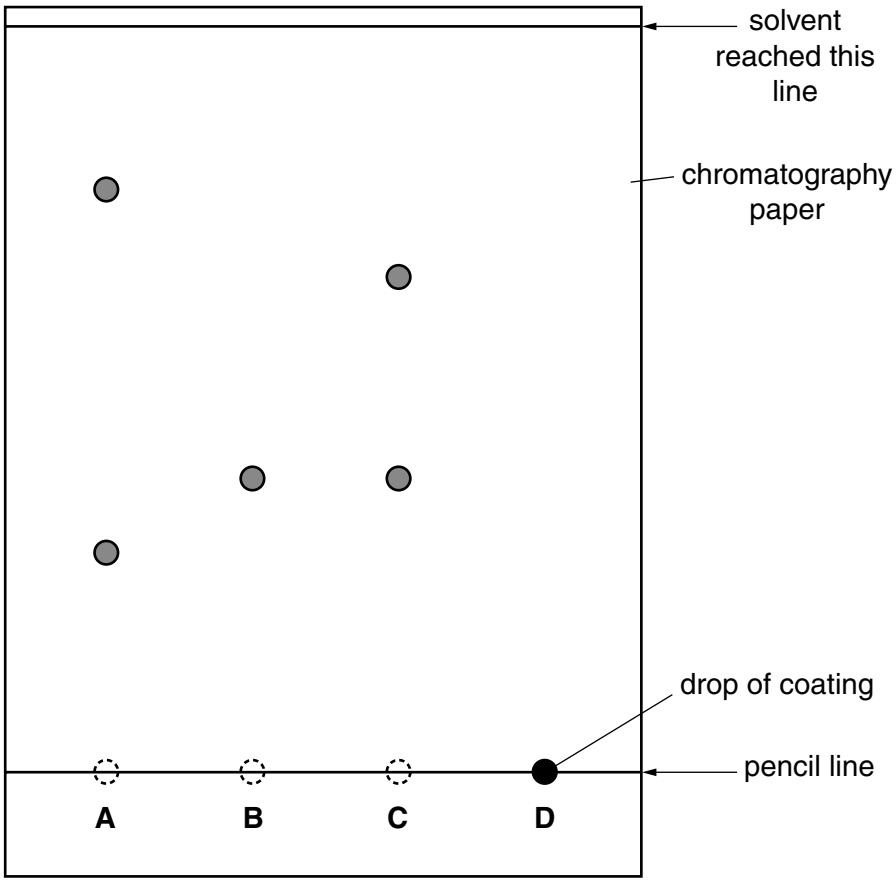
[Total: 6]

2 Peter works for a sweet manufacturer.

The sweet manufacturer makes sweets with coloured coatings. The coatings contain a mixture of different food dyes.

Peter uses chromatography to test four sweet coatings **A**, **B**, **C** and **D**.

This is the chromatogram he produces.



(a) What are the mobile and stationary phases for Peter's chromatogram?

Draw **one** straight line from each phase to its component.

Phase	Component
	chromatography paper
mobile	drop of coating
stationary	pencil line
	solvent

[2]

Use the chromatogram results to answer these questions.

(b) What conclusions can you make about the food dyes in coatings **B** and **C**?

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

(c) **(i)** Peter thinks that coating **D** contains food dyes that are insoluble in the solvent.

How does the chromatogram support his conclusion?

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

(ii) Peter does another chromatogram to show all the food dyes in coating **D**.

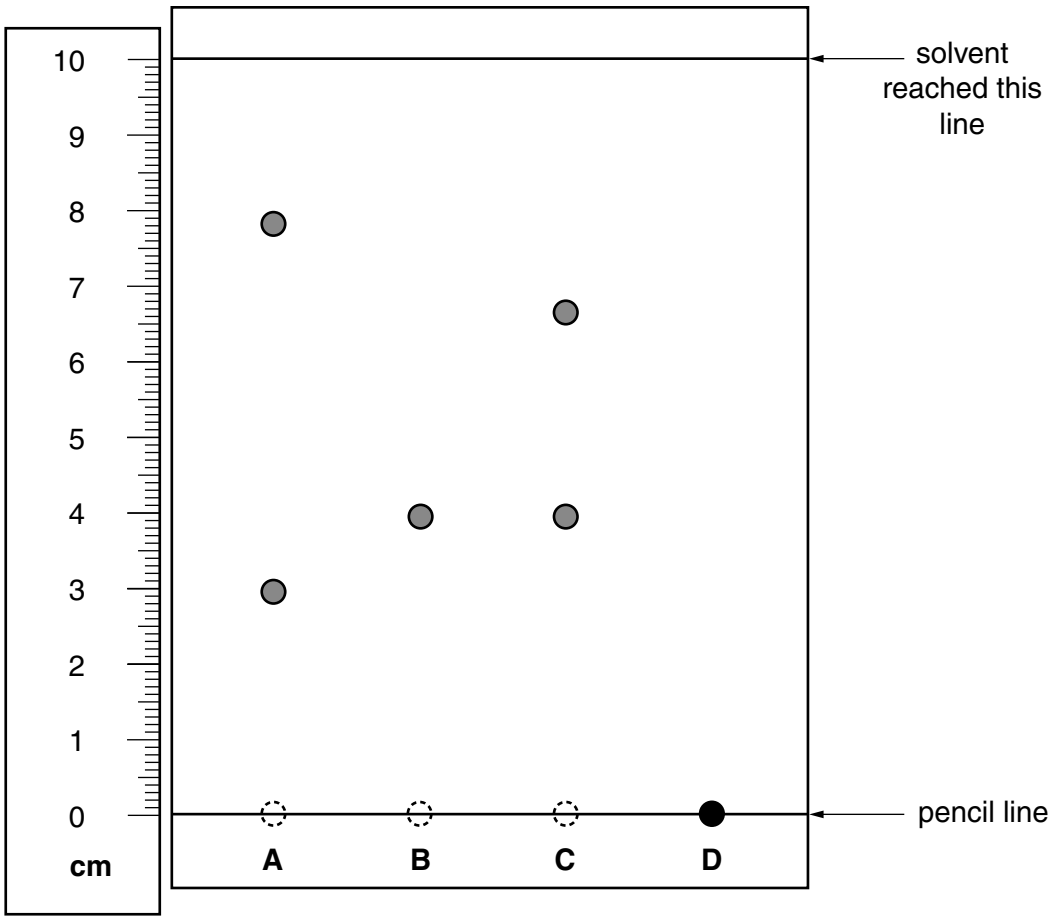
Which of these changes could separate all the food dyes in coating **D**?

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

Use a different solvent.	☐
Put a larger drop of coating on the pencil line.	☐
Use a longer piece of chromatography paper.	☐
Use more of the same solvent.	☐

[1]

(d) Peter places a scale marked in cm alongside the chromatogram.



The R_f value for each spot can be calculated by using the formula:

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

(i) Use the scale next to the chromatogram to calculate the R_f value for the **higher** spot of coating **A**.

Show your working.

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

(ii) Peter uses this table from a book to identify the dyes in coating **A**.

Name of food dye	**R_f value**
Allura red	0.30
Brilliant blue	0.77
Sky blue	0.80
Fast green	0.82

He thinks that coating **A** contains **allura red** and **brilliant blue**.

Use the chromatogram and your answer to part **(d)(i)** to evaluate his conclusion.

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

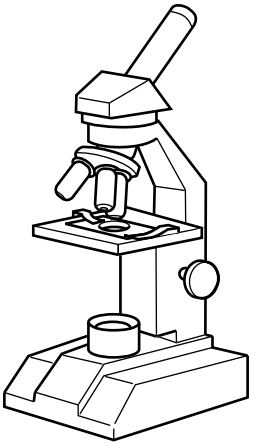
[Total: 12]

3 Matt works in a laboratory that monitors pollen in the air.

Sticky strips of tape are left outside to collect pollen grains from the air.

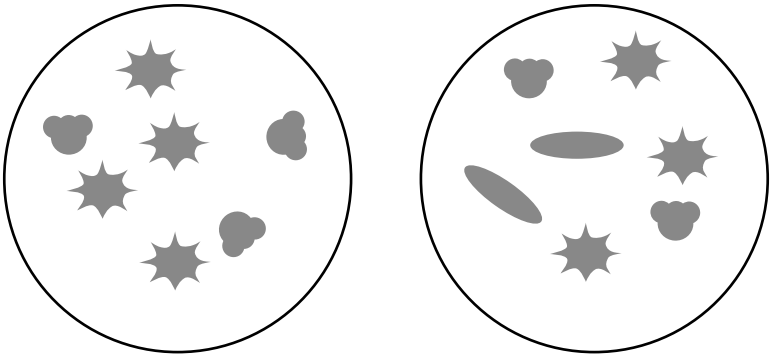
Matt puts each strip of tape on a microscope slide.

He uses a light microscope to look at the slides.



He looks at two strips, **A** and **B**.

This is what he sees.



A **B**

(a) What do you conclude about the **types** of pollen on strip **B** compared with those on strip **A**?

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

(b) Matt uses a higher magnification to focus on one of the pollen grains.

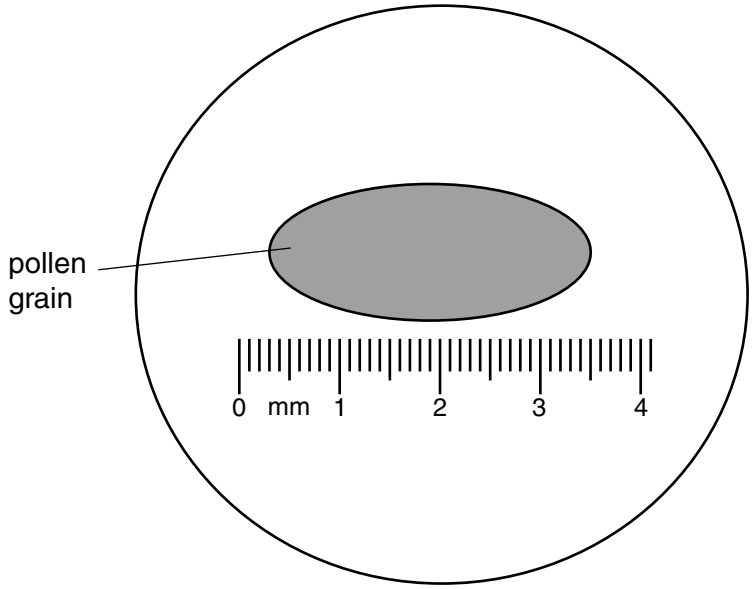
(i) How does he change the magnification?

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

He increases the intensity of the light.	☐
He moves the stage nearer the objective lens.	☐
He pulls the eyepiece lens out further.	☐
He selects a different objective lens.	☐

[1]

(ii) The microscope has a scale built into it. The scale measures in mm.



Use the scale to measure the longer length of the image of the pollen grain.

Matt uses a magnification of ×500.

Calculate the actual length of the pollen grain.

Show your working.

actual length of pollen grain = ... mm **[2]**

(iii) Explain what Matt would have to do to find the mean length of this type of pollen grain.

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

(c) Matt takes a sample of pollen grains from the air.

He wants to count the number of pollen grains, compare their shapes and examine their outer surface.

He can use an electron microscope to do this.

Explain the **advantages** and **limitations** of using an electron microscope.

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

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

[Total: 12]

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Turn over for the next question

4 Lucy works in the department of an art gallery that restores painted pictures.

Her job is to test paint to identify which compounds are present.

She removes a very small sample of paint.

(a) How can Lucy avoid contamination of the sample?

.....

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

(b) Paint used on pictures contains metal compounds.

Lucy does a flame test on the sample, but she cannot see any colours, even though she knows there are metal compounds present.

Suggest a reason why the flame test does not give a result.

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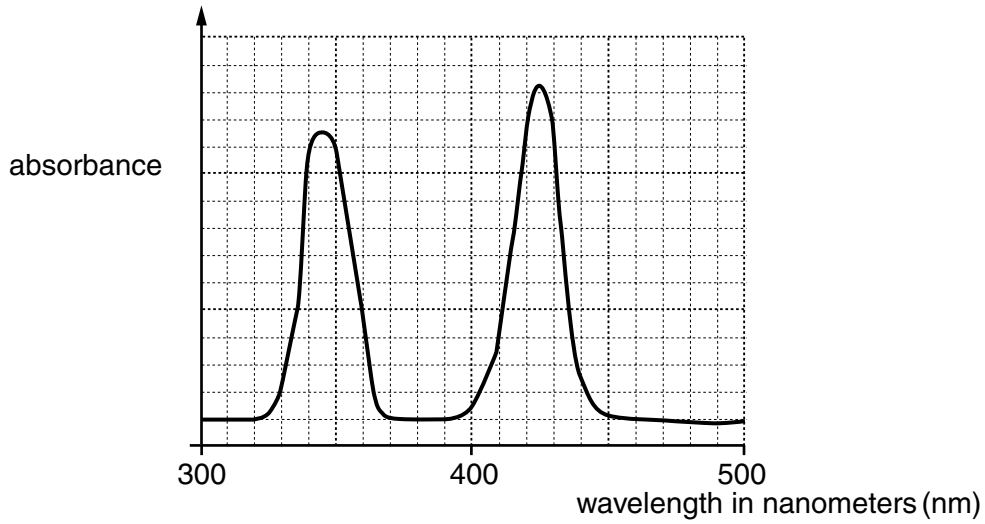
..... **[1]**

(c) Lucy then uses an absorption spectrophotometer to analyse the sample.

The graph shows her results.



She uses this data table to interpret the graph.

Metal	Wavelength in nanometers (nm)
Calcium	422
Cobalt	327
Copper	345
Lead	405
Titanium	400

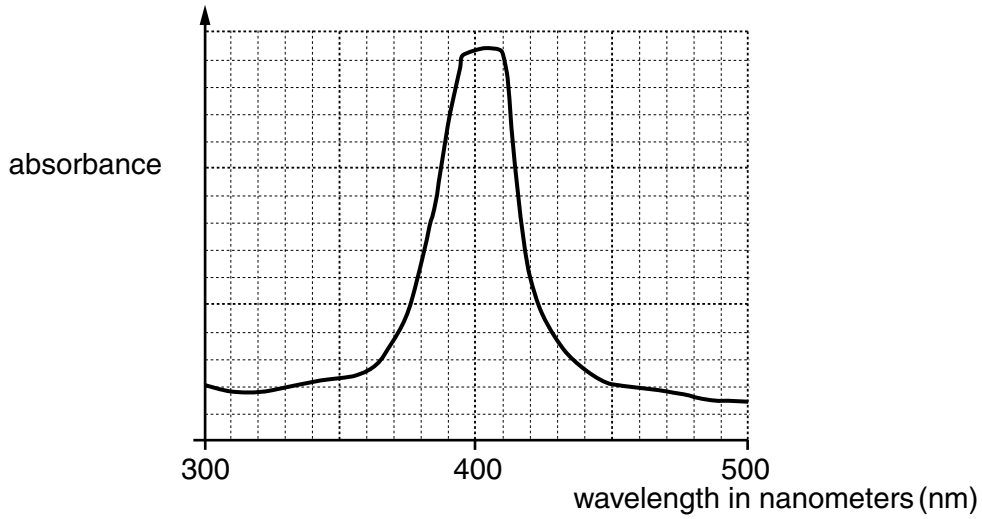
Which metals are in the sample?

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

(d) Lucy also uses spectrophotometer results to estimate how old pictures are.

White paint taken from pictures painted before 1900 contains lead. However, the white paint in pictures painted after 1900 contains titanium.

She uses a spectrophotometer to test some white paint from a picture.



Lucy thinks the picture was painted before 1900 but she is not certain.

Use the graph above and the data table in part **(c)** to explain why it is difficult for Lucy to make a conclusion.

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

(e) One of the advantages of using the spectrophotometer compared with a flame test is that the results are quantitative, whereas the results from the flame test are qualitative.

(i) Explain why the results from a flame test are qualitative.

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

(ii) Give another advantage of using a spectrophotometer.

.....

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

[Total: 7]

5 **(a)** Jai works in a factory which makes coloured dyes for textiles.

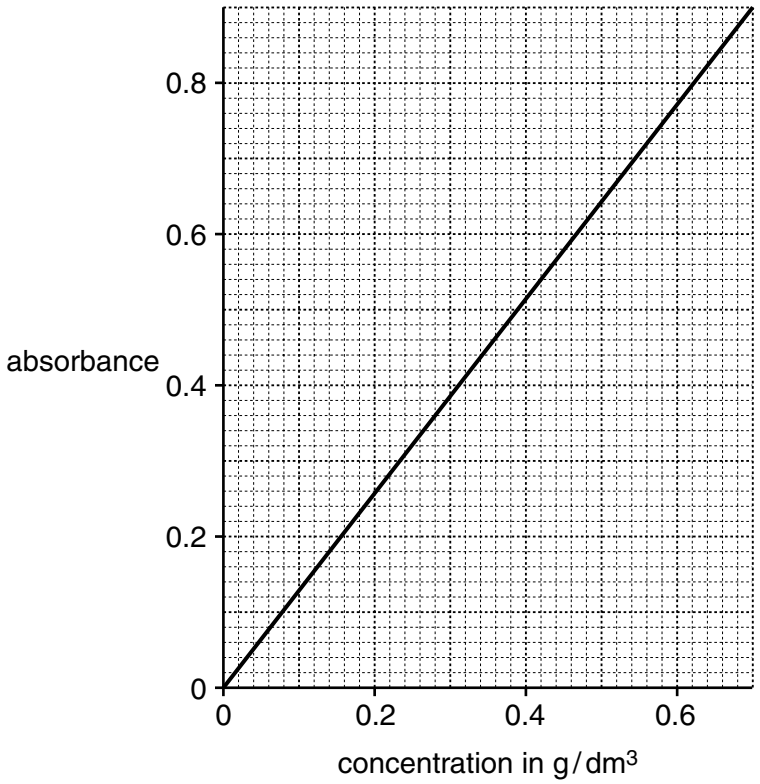
He uses a colorimeter to measure the concentration of dyes.

For each dye he does the test four times.

Here are his results for one dye.

Test	Absorbance
1	0.53
2	0.55
3	0.58
4	0.50

He uses this calibration graph to interpret his results.



The dye can only be used if its concentration is $0.40 \pm 0.02\,g/dm^3$.

Use the table and graph to decide if this dye can be used.

Show all your working and explain your decision.

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

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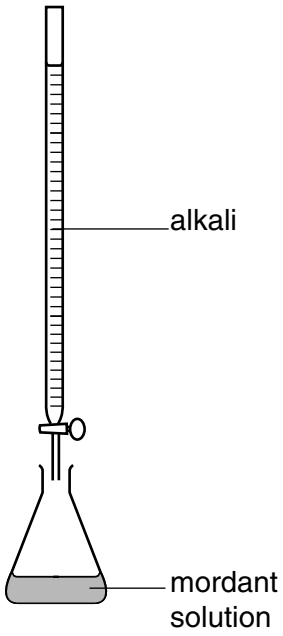
..... **[6]**

(b) A mordant solution is used to help bind the dye to a textile.

A mordant solution contains an acid.

Jai uses a titration to find the amount of acid in a mordant solution.



Jai tests two different mordant solutions, **A** and **B**.

He uses 25.0 cm^3 of the mordant solution for each titration.

He does four titrations for each mordant solution.

Here are his results.

Mordant solution	**Volume of alkali added in cm^3**			
	Titration 1	**Titration 2**	**Titration 3**	**Titration 4**
A	42.1	42.3	41.9	42.1
B	40.3	40.5	48.4	40.1

(i) In the table below, is each of the quantities a **Control variable**, **Dependent variable**, **Independent variable**, or **Not a variable**?

Put a tick (✓) in **one** box in **each** row.

Quantity	**Control variable**	**Dependent variable**	**Independent variable**	**Not a variable**
Volume of alkali added				
25.0 cm^3 of mordant solution used in each titration				

[2]

(ii) Calculate the mean volume of alkali added for each mordant solution.

Explain your method.

Mean: Mordant **A** ..... cm^3 Mordant **B** ..... cm^3

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

(c) (i) The burette that Jai uses has an error value printed on it of +/–0.05 cm^3.

The percentage error in a reading is calculated by:

$$\frac{2 \times \text{burette error}}{\text{reading}} \times 100\%$$

Calculate the percentage error for a reading of 41.0 cm^3.

Show your working.

percentage error ..... % **[2]**

(ii) Suggest a reason why the burette error is multiplied by 2 in part **(i)**.

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

[Total: 13]

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