OCR
RECOGNISING ACHIEVEMENT

SPECIMEN L2

Level 1/2 Cambridge National Certificate in SCIENCE IN THE WORKPLACE

R075/02

R075: How scientific data is used (Level 2)

Candidates answer on the question paper

OCR Supplied Materials:
- None

Other Materials Required:
- Pencil, ruler
- Calculator

Duration: 1 hour

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES
- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES
- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks for each question is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **50**.
- This document consists of **12** pages. Any blank pages are indicated.

Answer **all** questions.

1 Julia works for a forensics laboratory.

She needs to find out where a sample of soil found on a shoe comes from.

It could be from any one of five fields.

(a) Julia gets a sample of soil from each field.

Explain how the samples could be obtained and transported to the laboratory without contamination.

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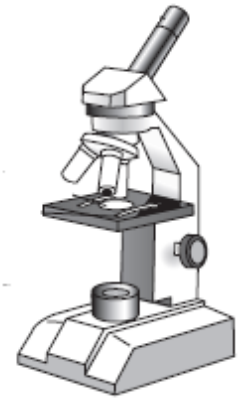
.....**[3]**

(b) Julia studies the soil samples with a microscope.

She sees this image of the soil from the shoe.



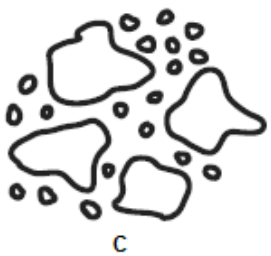
soil sample from shoe

Here are the images of the six soil samples **A**, **B**, **C**, **D**, **E** and **F** from the fields.

All images have the same magnification.

A

B



C

D

E

F

Julia concludes that the soil sample on the shoe came from field **D**.
Is she correct? Justify your answer.

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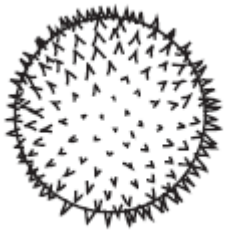
.....**[2]**

(c) A pollen grain is found in the soil sample from the shoe.
Here is the full size image of the pollen grain seen through the microscope.
The microscope has a magnification of x500.



Julia finds this data about the pollen from four different plants P, Q, R and S.

plant	range of pollen size in mm
P	0.15 - 0.10
Q	0.06 - 0.04
R	0.05 - 0.02
S	0.09 - 0.05

Which plant is the pollen most likely to have come from?
Justify your answer with calculations.

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.....**[4]**

[Total: 9 Marks]

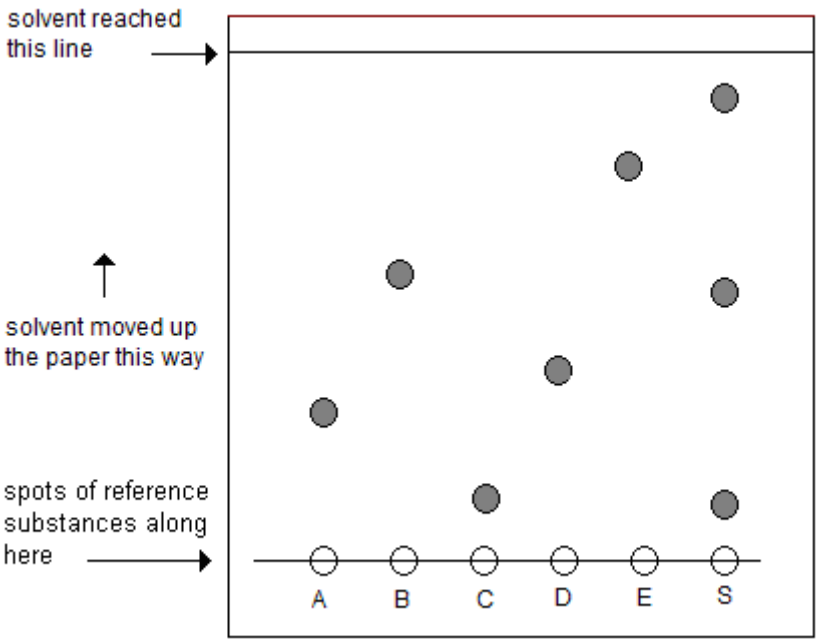
2 Jason works in a laboratory.

He uses chromatography to find the food colourings in a hard sweet.

Jason dissolves the sweet in water

He places a drop of the dissolved sweet on chromatography paper

(a) Here is the chromatogram obtained by Jason.



The five different reference substances are labelled **A**, **B**, **C**, **D** and **E**.

The sweet is labelled **S**.

One of the colourings in the sweet is **not** one of the five reference substances.

Jason decides to calculate the R_F value of this extra colouring.

(i) Use the chromatogram to calculate the R_F value of the extra colour.

$$R_F = \frac{\text{distance moved by sample}}{\text{distance moved by solvent}}$$

R_F = ... **[2]**

(ii) Suggest how Jason could use the R_F value of the extra colour to identify it.

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

(b) Paper chromatography has some limitations.

(i) Suggest an alternative technique that Jason could use to find the food colourings in the sweet.

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

(ii) How would the results be better from this technique?

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

[Total: 7 Marks]

3 Titration of sodium hydroxide solution with hydrochloric acid can be used to measure the concentration of the sodium hydroxide solution.

(a) Describe the steps you would take when carrying out this titration to obtain an **accurate** value.

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

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

(b) A student titrates 50 ml of a sodium hydroxide solution with a hydrochloric acid solution of concentration 2.0 mol/dm^3. The volume of acid required to neutralise the sodium hydroxide solution is 32 ml. Calculate the concentration of the sodium hydroxide solution.
1.0 mol of hydrochloric acid reacts with 1.0 mol of sodium hydroxide.

concentration = ...mol/dm^3 **[3]**

[Total: 9 Marks]

4 Sheena is learning about food science.

She wants to know the concentration of a food colouring in a fruit drink.

She uses a colorimeter.

(a) Explain how Sheena should eliminate systematic errors in the colorimeter before taking her readings.

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

(b) Sheena prepares a number of reference solutions to make a calibration graph.

Here are the instructions for making one of these solutions.

step 1	Place a dry measuring cylinder on the scales.
step 2	Zero the scales.
step 3	Add dry colouring until the scales read 0.25 g.
step 4	Place the measuring cylinder on the bench.
step 5	Add some distilled water and stir to dissolve the food colouring.
step 6	Add distilled water to the 50 ml mark.

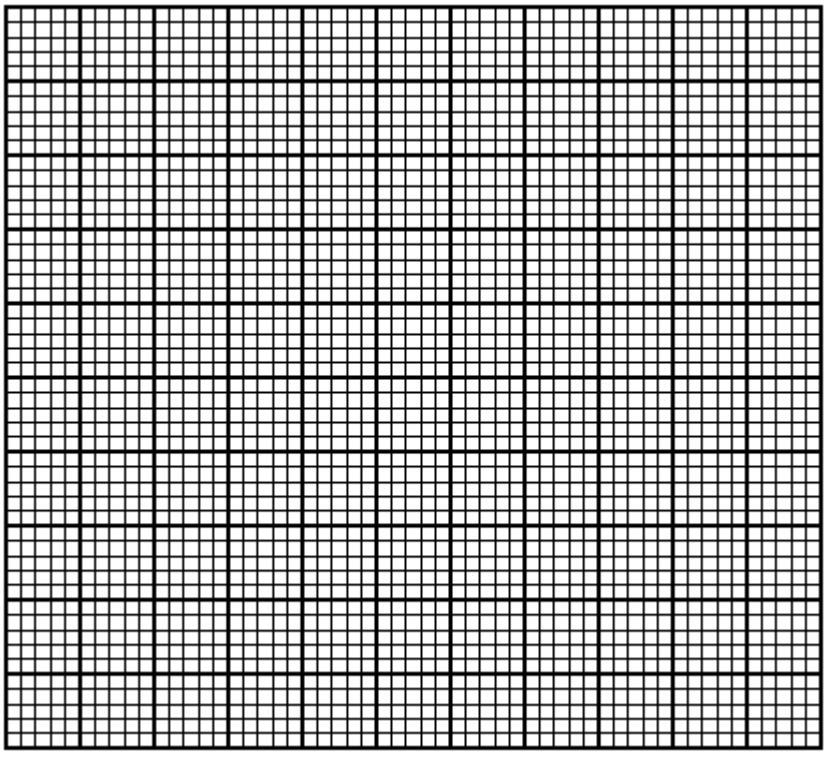
Calculate the concentration of the reference solution in g/dm^3 made by this technique.

concentration = ... g/dm^3 **[2]**

(c) Sheena makes six different reference solutions and places them in the colorimeter. Here are the results.

reference solution	concentration in g/dm^3	absorbance
A	1.0	0.06
B	2.0	0.12
C	3.0	0.19
D	4.0	0.23
E	6.0	0.36
F	7.0	0.42

(i) Use the results to plot a calibration graph on the grid below.



[3]

(ii) When Sheena tested the fruit drink it had an absorbance of 0.21.
What is the concentration of food colouring in the drink?

concentration = ... g/dm^3 **[1]**

[Total: 8 Marks]

5 Nina works in a laboratory.

She finds a bottle without a label. It contains a white powder.

(a) Nina uses a flame test to find out the metal cation in the powder.

Here are the steps she takes.

step 1	Heat a nichrome wire in a bunsen flame.
step 2	Dip the wire in hydrochloric acid.
step 3	Collect some of the powder on the end of the wire.
step 4	Hold the end of the wire in the flame and observe the colour.

(i) Explain the reason for step 2.

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

(ii) The flame glows **lilac** when the powder enters it.

Put a ring around the metal present in the powder.

calcium **copper** **potassium** **sodium**

[1]

(b) Nina decides to confirm this result by using a spectrophotometer to analyse the light from the flame.

State the advantages of using this instrument for the flame test.

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

(c) Nina performs three tests on the powder to determine the anions in it.
Here are the results.

test	**result**
Add silver nitrate to a solution of the powder.	white precipitate
Add barium chloride to a solution of the powder.	no reaction
Add hydrochloric acid to the dry powder.	fizzing

Here are some possible conclusions from the tests.
Put a tick (✓) in the boxes next to **two** correct conclusions.

The powder may contain a carbonate.	
The powder does not contain a chloride.	
The powder definitely contains a carbonate.	
The powder contains only two different anions.	
The powder contains at least two different anions.	

[2]

[Total: 7 Marks]

6 Liz owns a farm.

Her crops do not grow well.

She thinks that this may be because there isn't enough calcium in the soil.

(a) Liz sends three samples of soil from each of fields **A**, **B**, **C** and **D** to a laboratory for testing.

The laboratory carries out one test on each sample.

Here are the results.

field	**level of calcium in mg per kg.**		
	first sample	**second sample**	**third sample**
A	105	129	154
B	430	250	720
C	245	375	305
D	98	47	77

Liz is concerned about the validity of the results of the tests shown in the table.

Explain why Liz is concerned.

Use ideas about **repeatability** and **reproducibility** in your answer.

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

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

(b) Liz decides to consult some **secondary** sources to find out about calcium levels in soil used to grow crops.

(i) How can she be confident that the secondary data she collects about calcium levels is valid?

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

(ii) Explain how Liz could use this secondary data.

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

[Total: 10 Marks]

END OF QUESTION PAPER

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SPECIMEN L2

R075/02

Level 1/2 Cambridge National Certificate in
SCIENCE IN THE WORKPLACE

R075: How scientific data is used (Level 2)

MARK SCHEME

Duration: 1 hour

MAXIMUM MARK 50

This document consists of 9 pages

Question			Answer	Mark	Guidance
1	(a)		place sample in new plastic bag; label and seal bag; use a new spatula/tool to collect each sample	3	
	(b)		No; (no mark) D contains a different proportion of large to small particles compared to C; D contains larger particles than C	2	

	(c)		diameter of image = 25 mm;
			diameter of pollen = 25/500 = 0.05 mm;
			in middle of range for Q;
			only at edge of range of R and S
				4	**accept** 24 mm or 26 mm
					accept ecf on incorrect diameter

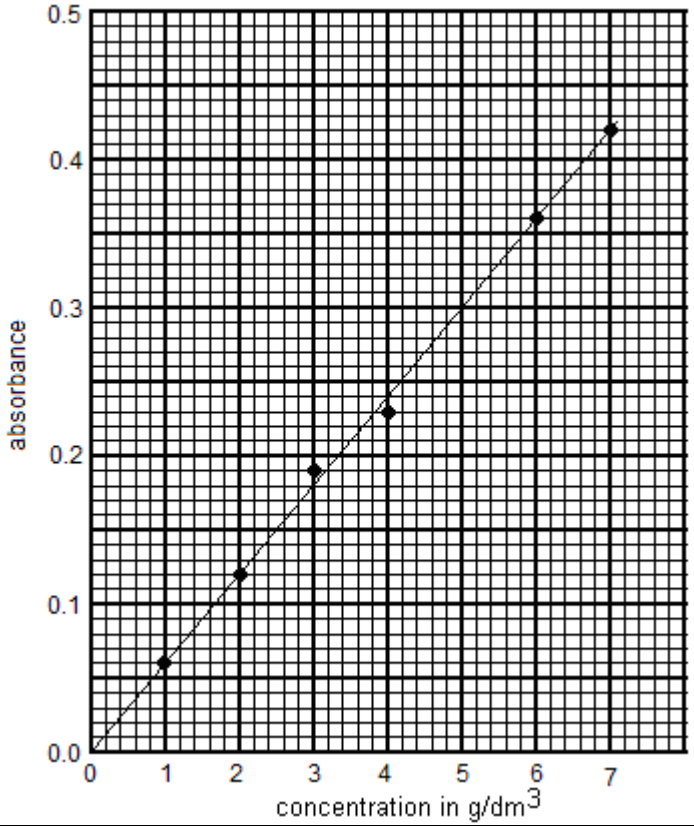
Question			Answer	Mark	Guidance
2	(a)	(i)	61 mm / 67 mm; 0.9(1)	2	**accept** error of 1 mm in each measurement
		(ii)	look in data book / internet; to find another colour with the same R_F value	2	
	(b)	(i)	gas chromatography (GC) / high performance liquid chromatography (HPLC) / mass spectrometer	1	
		(ii)	any two from (1 mark each) idea of improved separation / easier to read results; enhanced accuracy; greater sensitivity; tells you the (relative) amount of each colour; could identify the unknown colouring;	2	

Question			Answer	Mark	Guidance
3	(a) ✎		**[Level 3]** Includes majority of relevant points, presenting an appropriate procedure identifying steps which enhance accuracy. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Describes procedure, mentions need to measure accurately and repeat, but does not give details of how to measure and repeat. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Describes most of the procedure, but does not make reference to accuracy. Mentions all apparatus but provides insufficient detail for the procedure to be carried out. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**Relevant points include:** • fill burette with acid • of known concentration • note initial volume of acid in burette • measure volumes accurately, to nearest 0.5 cm^3 • to put known volume of alkali in beaker • measuring with pipette • select appropriate indicator (bromothymol) with a sharp colour change • slowly add acid with stirring • until (blue) colour just disappears • note final volume of acid in burette • carry out rough titre first • repeat (three times), adding acid drop by drop close to change point • take average value of fine results

Question			Answer	Mark	Guidance

3	(b)		quantity of acid = (32/1000) x 2.0 = 0.064 mol;
			conc of base = 0.064/(50/1000);
			= 1.3 mol/dm3;
				3	**allow** ecf for quantity of acid (0.064)
					allow ecf for calculation mark
					correct answer with no working shown (3)

Question			Answer	Mark	Guidance
4	(a)		to set the zero on the meter; by adding a sample of distilled water to the colorimeter;	2	
	(b)		(0.25/50) x 1000; 5(.0)	2	appreciation that 1 dm^3 = 1000 cm^3 (1) correct answer with no working shown (2)

Question			Answer	Mark	Guidance
4	(c)	(i)		3	scales and labels on both axes [1] correct plotting to within one square for [1] either best fit line or best fit curve through all points for [1]
		(ii)	3.5 g/dm^3	1	accept 3.4 or 3.6

Question			Answer	Mark	Guidance
5	(a)	(i)	to clean the wire; so that no contamination of sample	2	
		(ii)	potassium	1	
	(b)		more sensitive; quantitative result	2	
	(c)		... may contain a carbonate; ... contains at least two different anions	2	

Question			Answer	Mark	Guidance
6	(a)		**[Level 3]** Correct use of ideas of *repeatability* and *reproducibility*. Uses data from the table to demonstrate poor repeatability. Identifies lack of reproducibility from the process followed. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Correct use of ideas of *repeatability* and *reproducibility*. Does not use data from the table to exemplify poor repeatability. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Correct use of idea of *repeatability* or *reproducibility*. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**Relevant points include:** Liz is concerned due to poor/low repeatability and lack of evidence of reproducibility. Repeatability • samples from any one field have a large range of values • example from table e.g. B has from 250 to 720 • results don't show if results are single test or mean of several tests • variation between fields not an indication of poor repeatability • could process results to show mean / range / % variation and comment on relationship between values Reproducibility • send samples to a different laboratory • same laboratory could repeat the tests a few times, but must use different equipment / testers • compare results between labs to see how they varied

Question			Answer	Mark	Guidance
	(b)	(i)	use multiple sources (ora); choose reputable sources	2	
		(ii)	compare her test results with (secondary) sources to; decide if her soil has too much / little calcium to suit her crops	2	

ASSESSMENT GRID					
Question no. (and part)	Learning Outcomes				Total
	LO1	LO2	LO3	LO4	
1(a)	3				3
1(b)			2		2
1(c)		2	2		4
2(a)(i)		2			2
2(a)(ii)			2		2
2(b)(i)	1				1
2(b)(ii)	2				2
3(a)	4			2	6
3(b)		3			3
4(a)	2				2
4(b)		2			2
4(c)(i)		3			3
4(c)(ii)			1		1
5(a)(i)	1	1			2
5(a)(ii)	1				1
5(b)	2				2
5(c)			2		2
6(a)			4	2	6
6(b)(i)			2		2
6(b)(ii)			2		2
Totals	16	13	17	4	50

