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0973/06

For Examination from 2019

SPECIMEN PAPER

1 hour 30 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **18** printed pages.



CAMBRIDGE
International Examinations

- 1 A student is investigating what happens when a celery stalk is placed in coloured water.

The celery stalk is left in the coloured water for 10 minutes and then the stalk is cut as shown in Fig. 1.1.

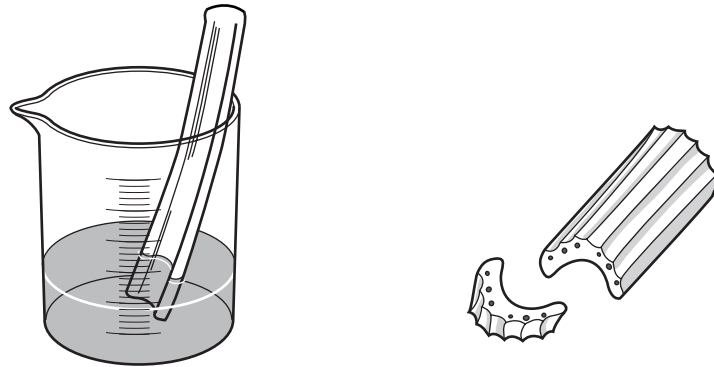
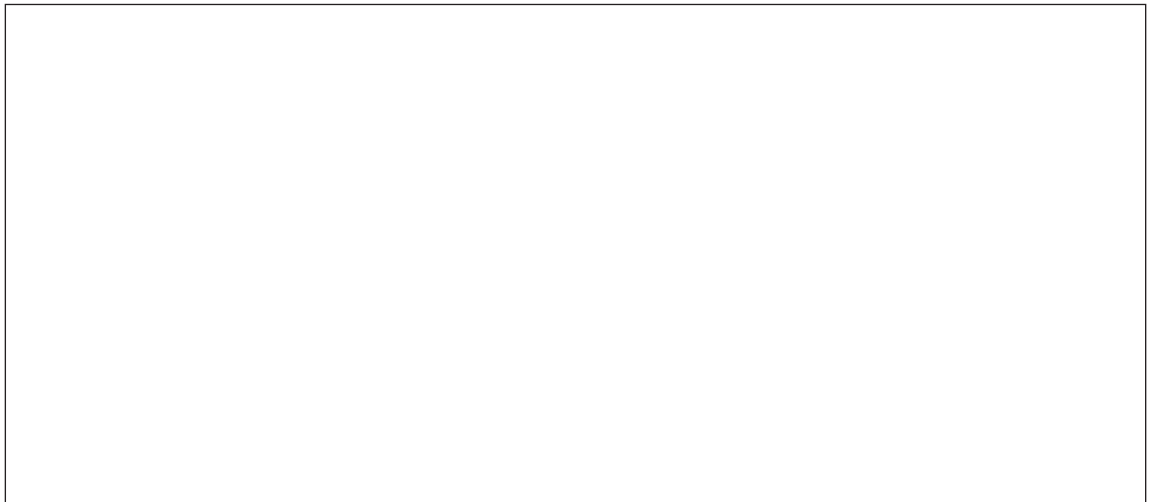


Fig. 1.1

- (a) (i) In the space below, make a large, accurate drawing of the cross-section (cut-end) of the celery stalk.



[3]

- (ii) On your drawing in (a)(i) label one of the areas which has taken up the stain with a label line and the letter **S**. [1]
- (iii) Name the tissue that has become stained and state what can be concluded about its function.

name

function

[2]

- (b) A student uses pieces of celery stalk and coloured water to investigate the effect of temperature on the speed of movement of the coloured water.

The student records the time taken for the coloured water to reach the top of the stalks at different temperatures.

- (i) Suggest suitable values of temperature for this investigation.

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

- (ii) State **two** variables that should be kept constant in this investigation.

1
2 [2]

- (c) State **one** safety precaution the student would take when carrying out this procedure.

..... [1]

[Total: 11]

- 2 A student is investigating the vitamin C content of a fruit juice.

DCPIP is a dark blue chemical that is decolourised by vitamin C.

A solution containing a higher concentration of vitamin C will take fewer drops to decolourise DCPIP.

The student is provided with a set of four solutions containing different concentrations of vitamin C and a fruit juice of an unknown vitamin C concentration.

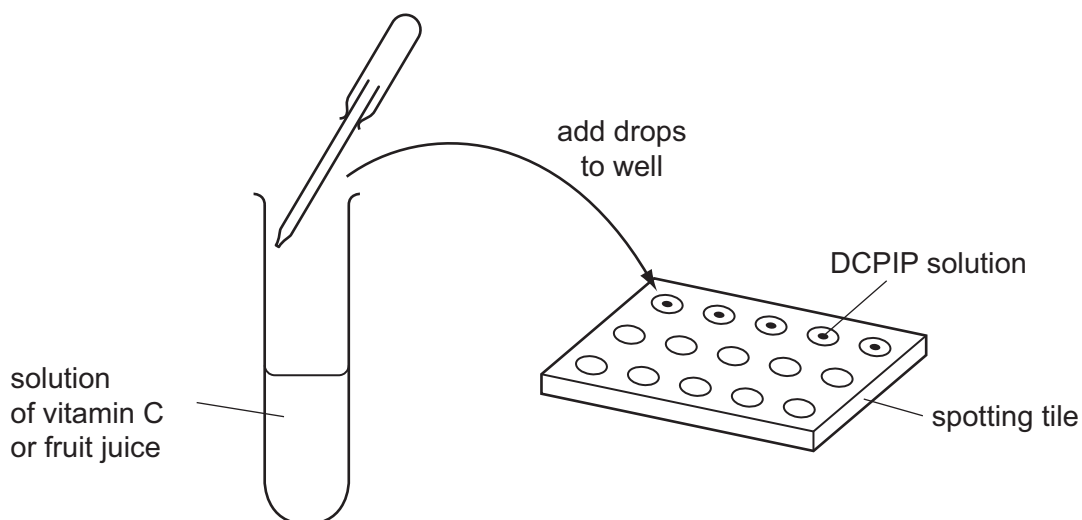


Fig. 2.1 (not to scale)

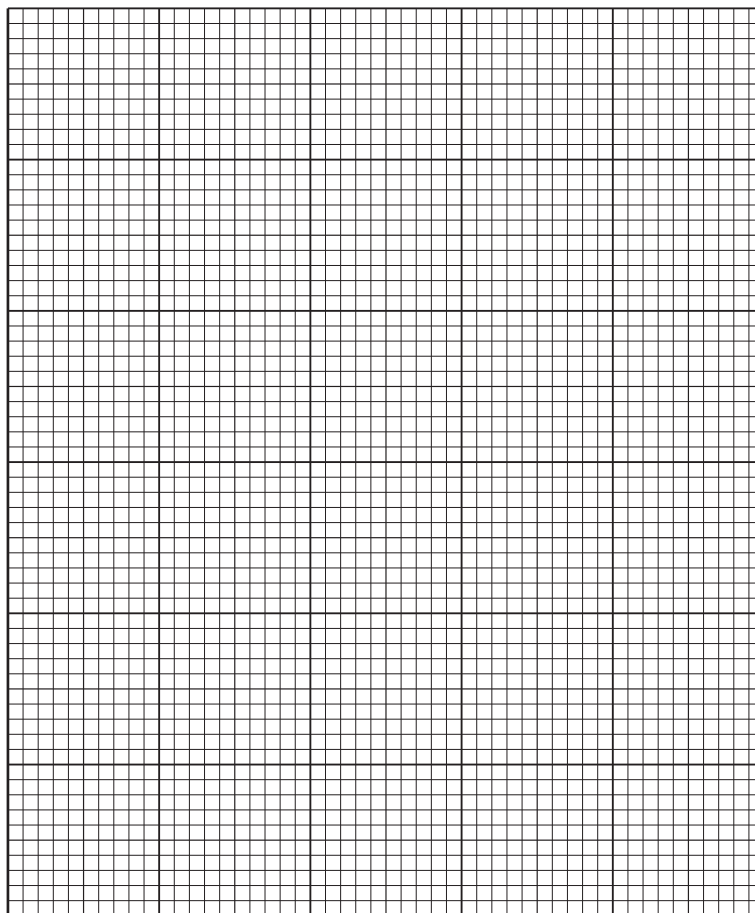
- Using a dropping pipette, the student places two drops of DCPIP into each of five wells of a white spotting tile.
- She adds drops of the 0.25% vitamin C solution into one of the wells as shown in Fig. 2.1. She counts the number of drops needed to decolourise the DCPIP.
- She repeats the process for the remaining vitamin C solutions and the fruit juice.

The results are shown in Table 2.1.

Table 2.1

percentage concentration of vitamin C	number of drops needed to decolourise DCPIP
0.25%	20
0.50%	17
0.75%	10
1.00%	5
fruit juice	12

- (a) (i) On the grid provided, use the data from Table 2.1 to plot a graph of the number of drops needed to decolourise DCPIP against percentage concentration of vitamin C on the x-axis.



[2]

- (ii) Draw the best-fit straight line.

[1]

- (b) Use your graph to estimate the percentage concentration of vitamin C in the fruit juice.

Mark on the graph to show how you worked this out.

percentage concentration of vitamin C =% [2]

- (c) The student suggested that drops of distilled water are added to two drops of DCPIP in another well.

Give **one** reason why this further test should be used.

.....

..... [1]

(d) Suggest **two** ways in which the experiment may be changed to give more accurate results.

1

.....

2

.....

[2]

(e) Suggest **one** way to improve the reliability of this experiment.

.....

..... [1]

[Total: 9]

Question 3 starts on page 8

3 A student has two metal oxides, **J** and **K**.

(a) The student carries out a series of experiments to investigate the identities of **J** and **K**.

Experiment to identify **J**.

- Place one large spatula load of solid **J** into a small beaker and add approximately 25 cm³ distilled water.
- Stir well for 30 seconds.
- Record any observations.
- Add a few drops of full range Universal Indicator and record any observations.
- Bubble carbon dioxide through the liquid and record any observations.

The student's observations are shown in Fig. 3.1.

When I mixed solid **J** with the distilled water it dissolved in the water.

The liquid went a purple- blue colour when Universal Indicator solution was added.

When carbon dioxide is bubbled through the liquid it becomes cloudy which must mean it is calcium hydroxide solution.

Fig. 3.1

(i) What can you conclude from the student's observation that the Universal Indicator becomes a purple-blue colour?

..... [1]

(ii) What colour would you expect the Universal Indicator to become if it was added to distilled water?

..... [1]

(iii) Use all the information in Fig. 3.1 to suggest the identity of **J**.

J is [1]

(iv) Using the student's observation in (a)(i), classify the metallic oxide **J**.

classification of oxide **J** [1]

(b) The student continues with the investigation to find out the identity of **K**.

Experiment to identify **K**.

- Place one large spatula load of solid **K** into a beaker. Add 25 cm³ dilute nitric acid and stir the mixture.
- Heat gently.
- Transfer the liquid into two large test-tubes, **A** and **B**, so that each is one-third full.
- Add sodium hydroxide solution to test-tube **A** until nearly full. Use red litmus to check that the mixture is alkaline.
- Stir carefully and record any observations.
- Add ammonia solution slowly to test-tube **B** until there is no further change. Record any observations.

The student's observations are shown in Table 3.1.

Table 3.1

test-tube A with sodium hydroxide	test-tube B with ammonia solution
A blue precipitate forms.	A blue precipitate forms in the test-tube but this dissolves and forms a blue solution.

(i) Use the observations in Table 3.1 to identify the cation present in **K**.

cation present in **K** is [1]

(ii) Explain why **K** is heated with the dilute nitric acid.

..... [1]

(iii) State **one** safety precaution that the student should take when carrying out this investigation.

..... [1]

[Total: 7]

4 A student is investigating how much thermal energy (heat) is given out in the reaction between solid **L** and solution **N**.

- He places 25 cm³ of solution **N** in a plastic cup.
- He measures the temperature.
- He adds a sample of solid **L** to solution **N** and starts the stopclock.
- He measures the temperature of the mixture every half minute for seven minutes, stirring throughout.

His results are shown in Table 4.1.

Table 4.1

time / min	temperature / °C
0	
0.5	52.0
1.0	52.0
1.5	50.0
2.0	49.0
2.5	
3.0	46.0
3.5	44.5
4.0	
4.5	42.5
5.0	41.5
5.5	40.5
6.0	39.5
6.5	38.5
7.0	38.0

(a) Read the thermometers in Fig. 4.1, which show the temperature of the mixture at 0 minutes, 2.5 minutes and 4.0 minutes, and record the temperatures in Table 4.1. [3]

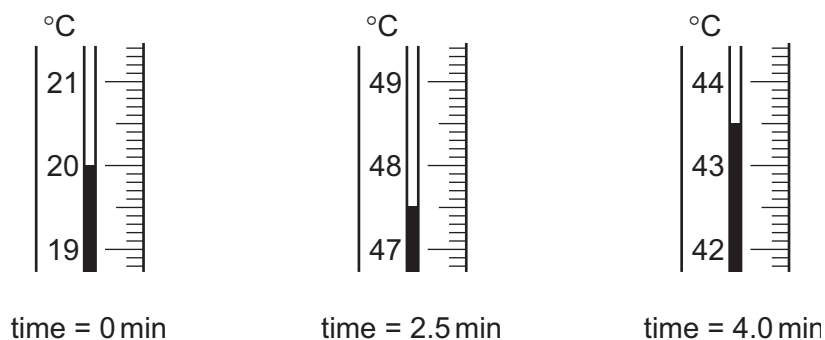


Fig. 4.1

- (b) (i) Using the data in Table 4.1, calculate the maximum temperature rise, ΔT , in this reaction.

$$\Delta T = \dots\dots\dots\text{ }^{\circ}\text{C} \text{ [1]}$$

- (ii) Calculate the thermal energy, E , given out by the reaction using the formula shown.

$$E = \text{volume of solution } \mathbf{N} \times 4.2 \times \Delta T$$

Give your answer to two significant figures.

$$E = \dots\dots\dots\text{ J [1]}$$

- (c) During the experiment, thermal energy is transferred to the surroundings so the temperatures recorded are not as high as they should be.

Suggest two modifications to the apparatus (**not** the chemicals) that will mean that less thermal energy is transferred to the surroundings during the experiment.

modification 1

.....

modification 2

.....

[2]

[Total: 7]

5 A student is investigating the reaction between magnesium ribbon and hydrochloric acid.

He finds out that the reaction produces soluble magnesium chloride and hydrogen gas.

He wants to find out what happens to the speed of the reaction if he changes the concentration of hydrochloric acid.

Plan an investigation to find out how the concentration of hydrochloric acid affects the rate of this reaction.

In your answer, include:

- the apparatus needed, including a labelled diagram if you wish
- a brief description of the method, including how you will control variables and any safety precautions
- the measurements you will make
- how you will process your results
- how you will use your results to draw a conclusion.

..... [6

Question 6 starts on page 14

- 6 The spring constant, k , of a spring is a measure of how stiff the spring is.

A student is carrying out an investigation to find out the spring constant, k , of a spring.

The apparatus is set up as shown in Fig. 6.1.

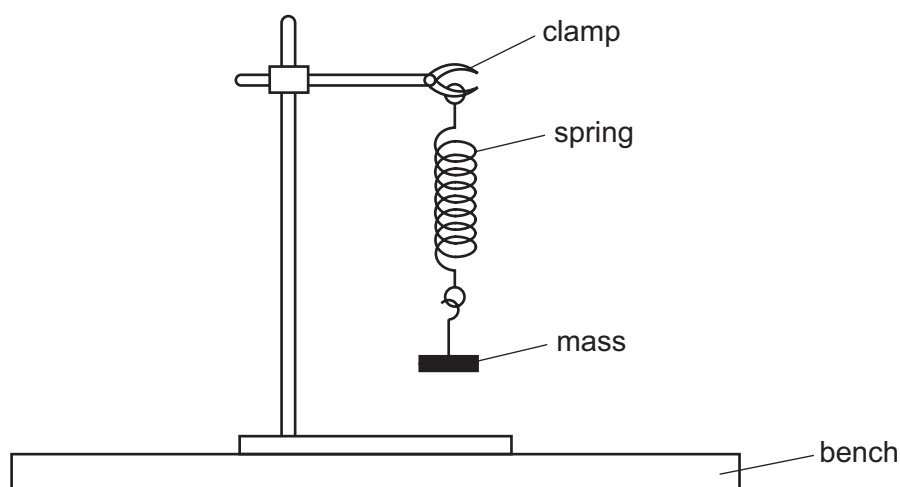


Fig. 6.1

The student pulls the mass down a small distance and releases it. In **one** complete oscillation the mass moves from its lowest position to its highest position and then back to its lowest position.

The student measures the time taken t for five complete oscillations.

He does this for masses of 0.20 kg, 0.30 kg, 0.40 kg and 0.50 kg.

His results are shown in Table 6.1.

Table 6.1

mass m / kg	time for five complete oscillations t / s	period T / s	T^2 / s ²
0.20	3.25		
0.30	3.75		
0.40	4.25		
0.50	4.75		

- (a) (i) Use the values for five complete oscillations to calculate T , the period (the time for one complete oscillation) for each of the masses.

Record these values for T to the nearest 0.1 s in Table 6.1. [1]

- (ii) Calculate the values of T^2 .

Record these values for T^2 to the nearest 0.01 s² in Table 6.1. [2]

- (b) The value of the spring constant k can be calculated using the equation shown.

$$k = \frac{39.5 \times m}{T^2}$$

- (i) Calculate the value of k using the data in the table for a mass of 0.20 kg.

$k =$ [1]

- (ii) Calculate the value of k using the data in the table for a mass of 0.50 kg.

$k =$ [1]

- (iii) Suggest how **all** of the results in Table 6.1 could be used to determine the value of the spring constant k .

..... [1]

- (c) Suggest **two** modifications that could be made to the experiment to give a more accurate value for the spring constant k of the spring.

1

.....

2

.....

[2]

[Total: 8]

- 7 A student is carrying out an experiment to find out the density of modelling clay. She has a piece of clay that she has shaped into a rough cube. The cube is shown in Fig. 7.1.

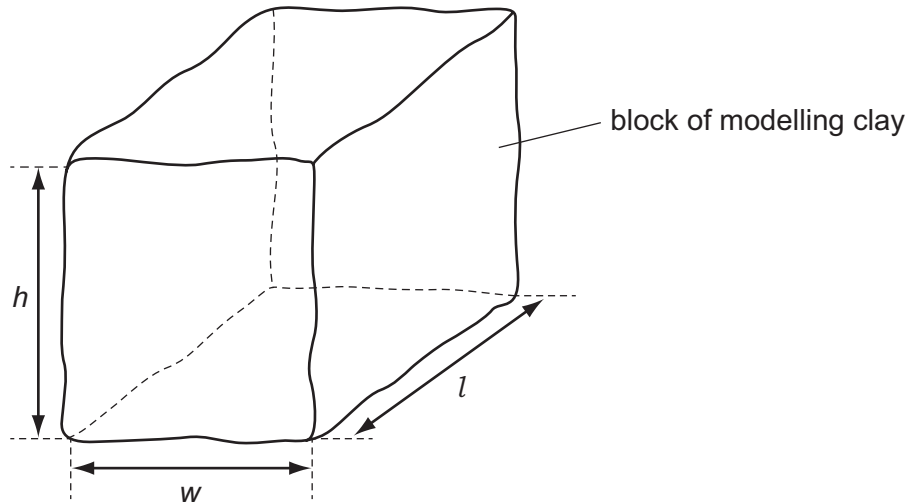


Fig. 7.1

- (a) (i) Measure and record the length l , width w , and height h , of the cube to the nearest 0.1 cm.

$l =$ cm

$w =$ cm

$h =$ cm
[2]

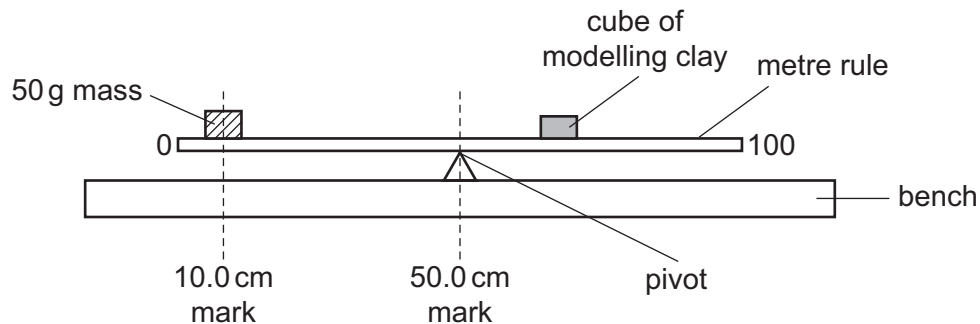
- (ii) Calculate the volume, V , of the cube using the equation shown.

$$V = l \times w \times h$$

$V =$ cm³ [1]

- (b) The student sets up a balance as shown in Fig. 7.2.

A 50 g mass is placed onto the metre rule with its centre over the 10.0 cm mark.



Not to scale

Fig. 7.2 (not to scale)

The student places the cube of modelling clay on the metre rule and adjusts its position until the rule is just balanced.

- (i) The student needs to accurately measure the distance of the cube from the pivot that results in the rule being balanced.

Show the measurement the student should take by drawing a line on Fig. 7.2.

Label this line x .

[2]

- (ii) The student records a measurement, x , of 19.8 cm.

Calculate the mass, m , of the cube of modelling clay using the equation shown.

$$m = \frac{2000}{x}$$

$$m = \dots\dots\dots \text{ g [1]}$$

- (iii) Calculate the density, d , of the modelling clay using the equation shown.

$$d = \frac{m}{V}$$

Record your answer to an appropriate number of significant figures.

State the unit.

$$d = \dots\dots\dots \text{ unit} = \dots\dots\dots \text{ [3]}$$

- (c) (i) Describe **one** source of uncertainty in the procedure or limitation of the procedure for this experiment.

.....
 [1]

- (ii) Suggest **one** improvement that could be made to this experiment to overcome your stated uncertainty or limitation in (c)(i).

.....
 [1]

- (d) The experiment is repeated but this time the modelling clay is made into a long thin cylinder instead of a cube.

Suggest and explain what effect this would have on the density of the modelling clay.

effect

explanation [1]

[Total: 12]