Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | | CANDIDATE NUMBER | | | | |

9663375953

COMBINED SCIENCE **0653/61**

Paper 6 Alternative to Practical **October/November 2018**

1 hour

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 **19** printed pages and **1** blank page.

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1 A student investigates a leaf.

Fig. 1.1 shows the leaf.

Fig. 1.1

(a) **(i)** In the box provided, make an enlarged detailed pencil drawing of the leaf shown in Fig. 1.1.

[3]

(ii) Draw a line on the leaf in Fig. 1.1 to join the points labelled **A** and **B**.

Measure **and** record the length of this line **A**–**B**, in millimetres, to the nearest millimetre.

length of line **A**–**B** in Fig. 1.1 ....mm [1]

(iii) Draw the equivalent line **A**–**B** on your drawing.

Measure **and** record the length of this line, in millimetres, to the nearest millimetre.

length of line **A**–**B** in drawing ....mm [1]

(iv) Use your measurements in **(a)(ii)** and **(a)(iii)** to calculate the magnification of your drawing.

magnification = ...[1]

(b) (i) Describe in detail the steps involved to test the leaf for the presence of starch.

....

....

....[3]

(ii) State the observation for a positive result.

....[1]

2 A student investigates the temperature changes when solid **H** reacts with solution **J**.

(a) He uses a thermometer to measure the temperature *T* of solution **J** to the nearest 0.5 °C. He records this in Table 2.1 for time = 0 min.

He records in Table 2.2 the appearance of solid **H** and solution **J** before the reaction.

- He places a sample of solid **H** into a plastic cup.
- He adds 25 cm^3 of solution **J** to solid **H** in the plastic cup.
- He starts the stopclock and stirs the mixture thoroughly.
- He continues stirring and measures the temperature of the mixture every half minute for four minutes.
- He records in Table 2.1 the values to the nearest 0.5 °C.
- After the final reading, he records in Table 2.2 the appearance of the solid and the solution.

Table 2.1

time / min	temperature *T* / °C
0	20.5
0.5	56.0
1.0	55.0
1.5	49.5
2.0	45.0
2.5	41.5
3.0	38.0
3.5	36.0
4.0	35.0

Table 2.2

observations	solid	solution
before the reaction	grey	blue
after the reaction	brown	colourless

(i) The thermometer readings are taken to the nearest 0.5 °C.
State the value of one division on the thermometer that makes this possible.

one division = ... °C [1]

(ii) Use the data in Table 2.1 to calculate the maximum rise in temperature ΔT of the mixture during the reaction.

ΔT ....°C [1]

(iii) Explain why the value in **(a)(ii)** can only be regarded as an estimate.

....

....[1]

(iv) Suggest what could have been done to achieve a more accurate value for the rise in temperature for this experiment.

....

....[1]

(b) **(i)** Calculate the energy E released in this reaction. Use the equation shown.

E = volume of solution **J** × 4.2 × ΔT

Give your answer to 2 significant figures.

E = ... joules [2]

(ii) Your value of E in **(b)(i)** is less than the actual amount of thermal energy released by the reaction.

Suggest an improvement to the **apparatus** (not the chemicals) that would result in a higher value of E.

Explain why your improvement would result in a higher value of E.

improvement ....

....

explanation ....

....
[2]

(c) Using the observations in Table 2.2, the student concludes that solution **J** contains the copper(II) ion, Cu^{2+}.

Describe a test that the student could use to confirm that solution **J** contains the copper(II) ion, Cu^{2+}.

Include the observations for a positive test.

test ....

....

observations ....

....
[2]

3 A student measures the acceleration of free fall g using a spring.

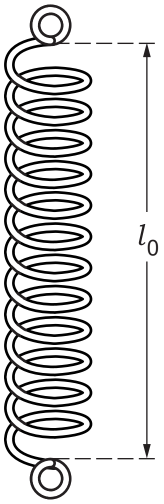


Fig. 3.1

(a) Measure and record the unstretched length l_0 of the spring shown in Fig. 3.1 to the nearest millimetre.

l_0 = ...mm [1]

(b) The student attaches the spring to a clamp as shown in Fig. 3.2 and suspends a 200 g mass on the spring.

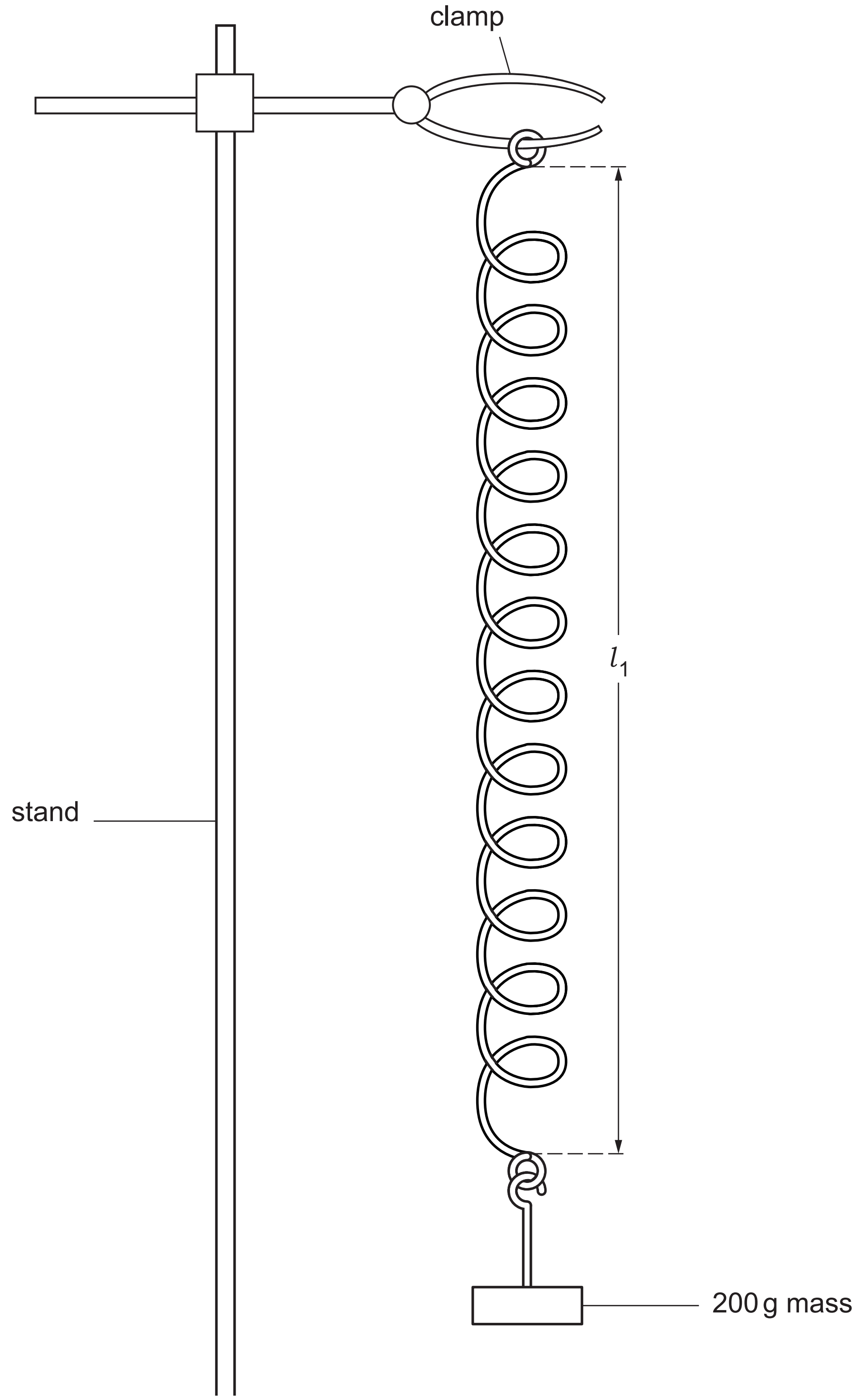


Fig. 3.2

Measure the stretched length l_1 of the spring.

l_1 = ...mm

Calculate the extension e of the spring produced by the mass. Use the equation shown.

$$e = l_1 - l_0$$

Record your value in Table 3.1. [1]

Table 3.1

mass m / g	extension e / mm	time t taken for 20 oscillations / s	period T / s	T^2 / s^2
200		11.22	0.561	0.31
300	118	13.34	0.667	
400	160	15.81	0.791	0.63
500	202	17.87	0.894	0.80

(c) The student pulls the mass down a small distance and releases it. The mass oscillates up and down. The period T of the oscillations is the time taken for **one** oscillation.

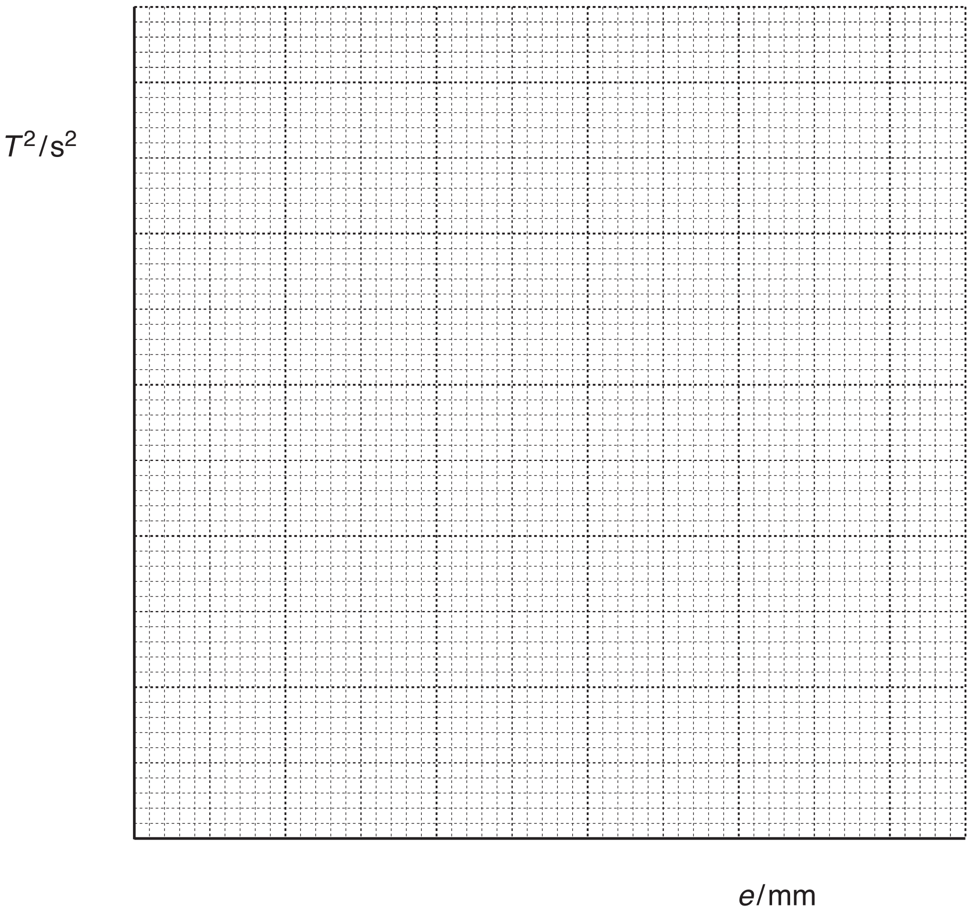
- She measures the time t taken for 20 oscillations and records this time in Table 3.1.
- She repeats the procedure for masses of 300 g, 400 g and 500 g.

Her results are shown in Table 3.1.

Calculate the missing value of T^2.

Record your answer in Table 3.1. [1]

(d) **(i)** On the grid provided, plot a graph of T^2 (vertical axis) against e. Start your axes at (0,0).



[2]

(ii) Draw the best-fit straight line. [1]

(iii) Calculate the gradient of your line.

Show all working and indicate on your graph the values you chose to enable an accurate value of the gradient to be calculated.

gradient = ...[2]

(iv) Use your answer to **(d)(iii)** and the equation shown, to determine a value for the acceleration of free fall g.

$$g = \frac{0.0395}{\text{gradient}}$$

g = ...m/s^2 [1]

(e) It is important to avoid line-of-sight (parallax) errors when measuring the length of a spring.

Describe how you would avoid this error.

....

....

....[1]

4 A student investigates oxygen consumption in respiring maggots.

(a) She sets up the apparatus shown in Fig. 4.1. The soda lime removes any carbon dioxide in the test-tube.

- The student closes the clip. She reads and records the start position of the left hand edge of the coloured liquid.
- She leaves the apparatus for 30 minutes. The coloured liquid moves towards the maggots.
- She reads and records the end position of the left-hand edge of the coloured liquid.
- She opens the clip.

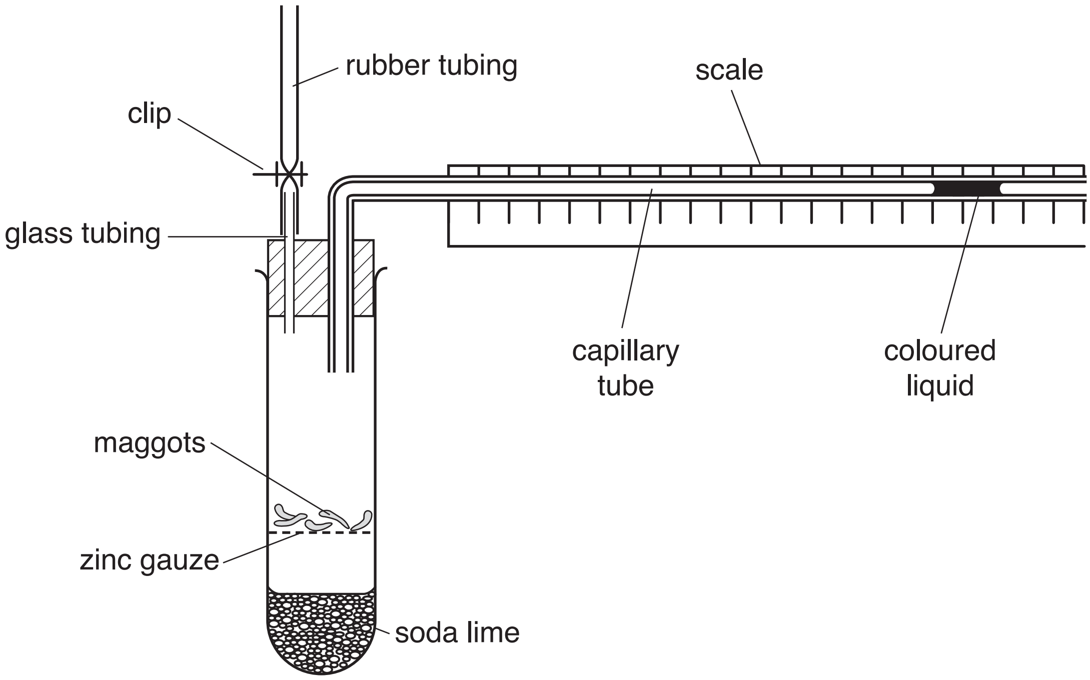


Fig. 4.1

Fig. 4.2 shows the positions of the left-hand edge of the coloured liquid at the start and at the end of the investigation.

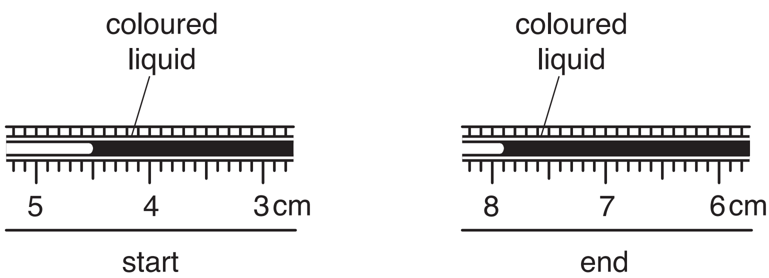


Fig. 4.2

(i) Use Fig. 4.2 to read the positions of the left-hand edge of the coloured liquid and record them in Table 4.1, in centimetres, to the nearest 0.1 cm. [2]

Table 4.1

start position / cm	end position / cm	total distance moved in 30 minutes / cm	rate of movement of the coloured liquid / cm per minute

(ii) Calculate the total distance moved by the coloured liquid in 30 minutes. Record your answer in Table 4.1.

[1]

(iii) Calculate the rate of movement of the coloured liquid in cm per minute. Record your answer in Table 4.1.

[1]

(b) During the investigation, the apparatus shown in Fig. 4.1 is airtight, and the maggots are respiring.

The word equation for respiration is shown.

glucose + oxygen → carbon dioxide + water

Explain why the coloured liquid moves towards the maggots during the investigation.

....

....

....[2]

(c) Suggest why the student needs to close the clip at the start of the investigation and open it at the end of the investigation.

close at start ....

....

open at end ....

.... [2]

(d) This experiment is repeated using the same apparatus.

State **two** variables that need to be kept constant.

variable 1 ....

variable 2 .... [2]

5 A student prepares a pure sample of blue copper sulfate crystals using black copper oxide powder and sulfuric acid.

He uses the following method.

Step **1**: Measure 25 cm^3 of sulfuric acid into a beaker.

Step **2**: Place the beaker of sulfuric acid onto a tripod and heat gently with a Bunsen burner.

Step **3**: Add copper oxide powder to the sulfuric acid a small amount at a time and stir with a glass rod. Keep adding the copper oxide until no more reacts. Be careful not to let the mixture boil.

Step **4**: Filter the mixture into an evaporating basin.

Step **5**: Gently heat the copper sulfate solution in the evaporating basin until about half of the water in the solution has evaporated.

Step **6**: Leave the basin to cool.

Step **7**: Filter off the crystals.

Step **8**: Wash the crystals with ice cold water.

Step **9**: Dry the crystals with filter paper.

(a) Name a piece of apparatus suitable for measuring the 25 cm^3 of sulfuric acid used in Step **1**.

....[1]

(b) Draw a labelled diagram of the apparatus used for Step **2**.

[2]

(c) State how the student knows when no more copper oxide will react with the sulfuric acid in Step **3**.

....[1]

(d) The apparatus used for Step **4** is shown in Fig. 5.1.

Fig. 5.1

Label **all** of the apparatus and **all** of the substances shown in Fig. 5.1. [2]

(e) Explain why only half of the water is evaporated in Step **5**.

....

....[1]

(f) Explain how the student makes sure that the crystals he produces are pure.

....

....[1]

(g) Suggest why the water in Step **8** is ice cold.

....

....[1]

(h) The student adds the crystals to a boiling tube and heats them gently until they form a white powder.

State the substance that could be added to the white powder to make the blue colour return.

....[1]

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6 A student investigates the alcohol content of wine.

- He places a 100 cm^3 measuring cylinder on a mass balance and zeroes the balance (so that the mass reads 0.00 g).
- He places between 95 cm^3 and 100 cm^3 of water into the measuring cylinder. This is 0% alcohol.
- He reads the mass balance, which is the mass of water. He records this mass in Table 6.1.
- He measures the volume of water and records this value, to the nearest 0.5 cm^3, in Table 6.1.
- He empties the measuring cylinder and repeats the procedure using 4%, 8%, 12%, 16% and 20% alcohol solutions.

Table 6.1

percentage of alcohol / %	volume / cm^3	mass / g	density / g per cm^3
0	99.0	99.0	1.000
4	98.5	97.8	0.993
8	99.5	97.7	0.982
12		94.6	0.980
16	97.0		0.975
20	96.0	93.0	0.969

(a) (i) Fig. 6.1 shows the volume in the measuring cylinder for the 12% alcohol solution.

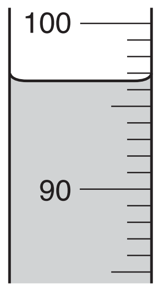


Fig. 6.1

Record this volume in Table 6.1. [1]

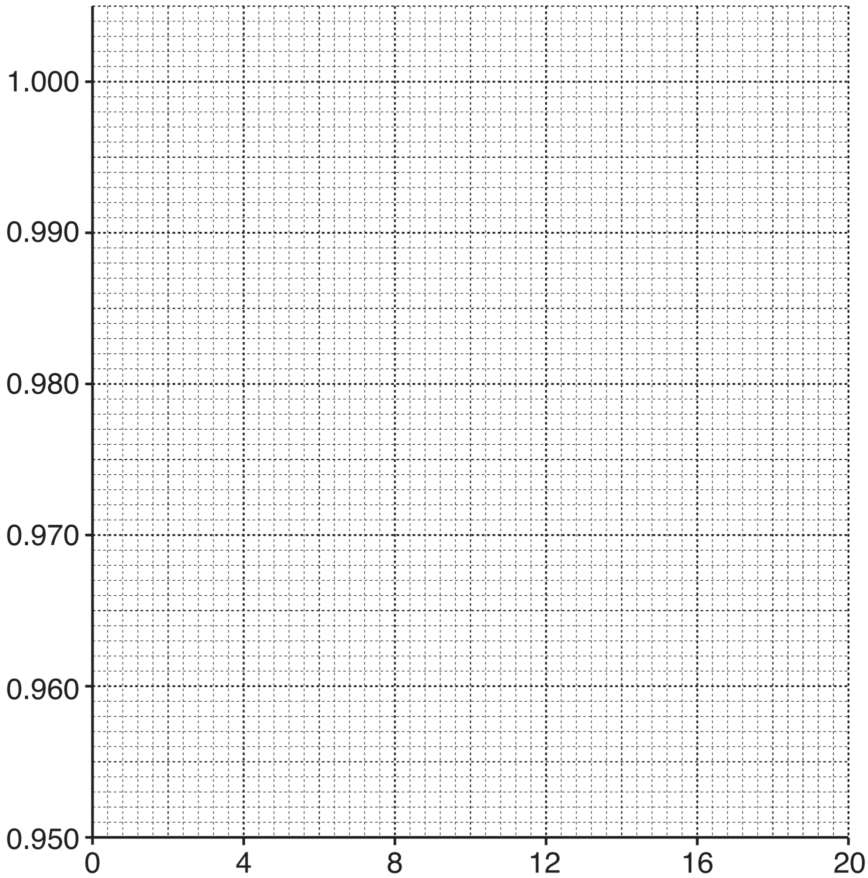
(ii) Fig. 6.2 shows the mass balance reading for the 16% alcohol solution.

Fig. 6.2

Record this mass in Table 6.1. [1]

(b) **(i)** On the grid provided, plot a graph of density (*vertical axis*) against percentage of alcohol.

Label the axes.



[2]

(ii) On your graph, circle the anomalous point. [1]

(iii) Draw the best-fit straight line. [1]

(c) Use your graph to determine the percentage alcohol content of a sample of wine of density 0.978 g per cm^3.

Show clearly on your graph how you arrived at your answer.

Percentage alcohol content of wine = ...% [1]

(d) Suggest how the student could minimise the effect of errors in this experiment.

....

....[1]

(e) The density of the alcohol solution is calculated using the formula shown.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Suggest **one** reason why the student added between 95 cm^3 and 100 cm^3 of the alcohol solution into the measuring cylinder rather than adding exactly 100 cm^3.

....

....[1]

(f) Some wines, for example Champagne, contain dissolved carbon dioxide which makes them fizzy.

Suggest **one** reason why the method in this experiment is **not** suitable for determining the alcohol content of Champagne.

....

....[1]