



CANDIDATE
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0654/63

October/November 2021

1 hour 30 minutes

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [].

This document has **20** pages. Any blank pages are indicated.

- 1 A student investigates the action of the enzyme amylase on starch.

Procedure

The student:

- step 1 adds 10 cm³ of starch solution into each of test-tubes **A** and **B**
- step 2 places the test-tubes in a warm water-bath at 35°C
- step 3 places a test-tube of amylase solution into the warm water-bath
- step 4 places a test-tube of distilled water into the warm water-bath
- step 5 labels five wells **A** and five wells **B** on a spotting tile
- step 6 adds two drops of iodine solution to each well as shown in Fig. 1.1

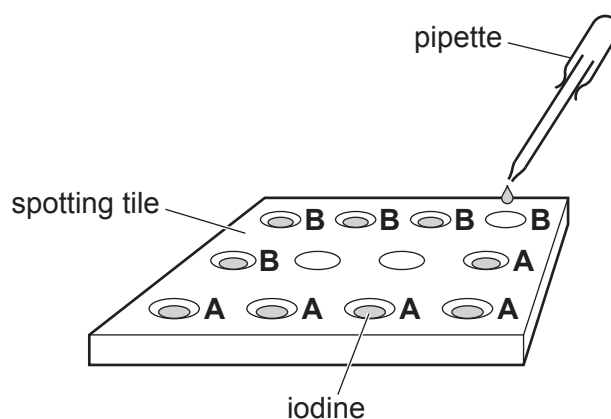


Fig. 1.1

- step 7 waits five minutes
- step 8 pours the amylase into the starch in test-tube **A**
- step 9 pours the distilled water into the starch in test-tube **B**
- step 10 replaces both test-tubes into the warm water-bath
- step 11 starts a stop-clock
- step 12 places two drops from the mixture in test-tube **A** into one of the wells labelled **A**
- step 13 places two drops from the mixture in test-tube **B** into one of the wells labelled **B**
- step 14 records in Table 1.1 the colour observed in both of these wells
- step 15 repeats steps 12–14 at one minute intervals for 4 minutes.

Table 1.1

time / minutes	colour observed	
	sample from test-tube A (starch and amylase)	sample from test-tube B (starch and distilled water)
0	<i>blue-black</i>	<i>blue-black</i>
1	<i>blue-black</i>	<i>blue-black</i>
2	<i>dark brown</i>	<i>blue-black</i>
3	<i>brown</i>	<i>blue-black</i>
4	<i>brown</i>	<i>blue-black</i>

- (a) Name a piece of apparatus suitable for measuring 10 cm³ of starch solution in step 1.

..... [1]

- (b) (i) State what can be concluded about the presence of starch in test-tubes **A** and **B** after 4 minutes.

test-tube **A**

test-tube **B**

[2]

- (ii) Suggest the effect the enzyme amylase has on starch.

.....

..... [1]

- (iii) Suggest why distilled water is used in test-tube **B**.

..... [1]

- (c) (i) Suggest why all the test-tubes are placed in the warm water-bath at the start of the investigation.

.....

..... [1]

- (ii) In steps 8 and 9 the student does **not** stir the mixture.

Suggest why stirring improves the procedure.

.....

..... [1]

- (d) The enzyme amylase works best at 35–40 °C.

The student repeats the procedure.

Fig. 1.2 shows the thermometer reading for the warm water-bath in this repeat.

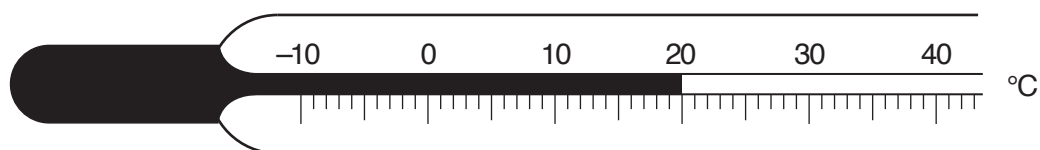


Fig. 1.2

- (i) Record the thermometer reading to the nearest 0.5 °C.

temperature = °C [1]

- (ii) Suggest how the results in the repeated procedure are different from the results in Table 1.1.

.....
 [1]

- (iii) Suggest how the temperature of the warm water-bath can be maintained at 35 °C.

.....
 [1]

- (e) Boiling amylase solution stops the enzyme working.

Predict the results expected if you repeat the procedure using boiled amylase.

.....
 [1]

- (f) The enzyme amylase is a protein.

Name the reagent used to test for the presence of protein. Give the observation for a positive result.

reagent

observation

[2]

[Total: 13]

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- 2 Washing powders remove stains from clothes by dissolving the stain.

Washing powder **X** contains enzymes, washing powder **Y** does **not** contain enzymes.

Plan an investigation to find out which washing powder, **X** or **Y**, is better at removing stains.

You are provided with:

- white cloth and scissors
- yellow egg solution which stains cloth
- samples of washing powders **X** and **Y**
- water
- any other common laboratory apparatus.

Include in your plan:

- any other apparatus you will need
- a brief description of the method including any safety precautions
- the measurements you will make, including how you ensure they are as accurate as possible
- the variables you will control
- how you will use your results to draw a conclusion.

You may include a labelled diagram if you wish.

You may include a results table if you wish. You are **not** required to include any results.

- 3 A student investigates the amount of energy given off by ethanol when it burns.

(a) Procedure

The student:

- step 1 puts 50 cm^3 of water into a 250 cm^3 beaker
- step 2 measures the initial temperature of the water and records it to the nearest 0.5°C in Table 3.1
- step 3 measures the initial mass of a spirit burner containing ethanol and records it in Table 3.1
- step 4 sets up the apparatus as shown in Fig. 3.1

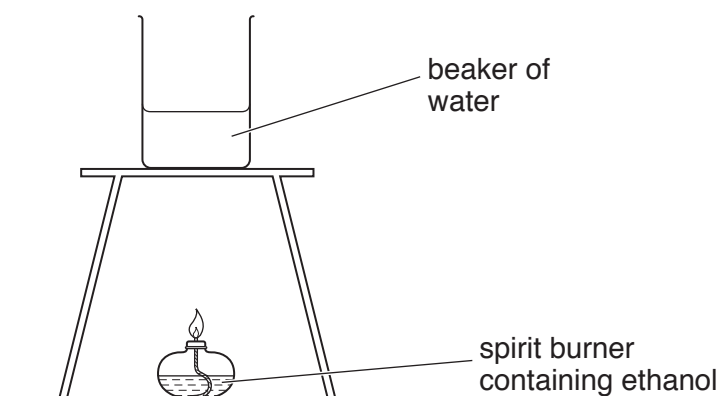


Fig. 3.1

- step 5 lights the spirit burner and heats the water for five minutes
- step 6 puts out the flame
- step 7 measures the final temperature of the water
- step 8 measures the final mass of the burner and remaining ethanol.

Table 3.1

initial mass/g	76.43
final mass/g	
change in mass $\Delta m/\text{g}$	
initial temperature/ $^\circ\text{C}$	21.5
final temperature/ $^\circ\text{C}$	
change in temperature $\Delta T/^\circ\text{C}$	

- (i) Fig. 3.2 shows the final mass reading on the balance and the final temperature reading on the thermometer.

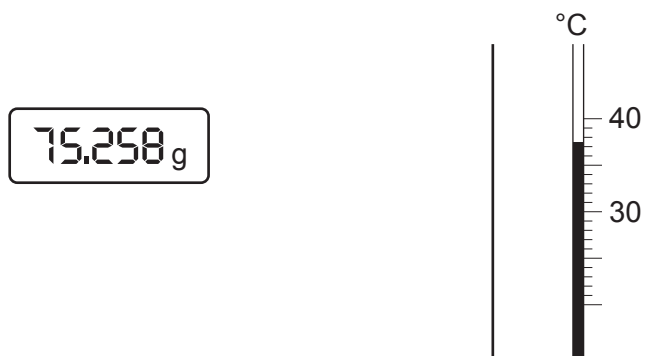


Fig. 3.2

Record these values in Table 3.1. [2]

- (ii) Calculate the change in mass of the ethanol, Δm . Record this value in Table 3.1. [1]
- (iii) Calculate the change in temperature ΔT . Record this value in Table 3.1. [1]
- (b) (i) Calculate the energy given off by the ethanol.
Use the equation shown.

$$\text{energy given off} = \frac{210 \times \Delta T}{\Delta m}$$

Give your answer to **three** significant figures.

energy given off = J/g [2]

- (ii) The value you calculate in (b)(i) is less than the expected value.

Suggest **an** improvement to the experiment which will make the value you calculated more accurate.

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

- (c) The student tests the gas made when the ethanol burns and finds it is carbon dioxide.

State the test which confirms the presence of carbon dioxide.

reagent

observation for a positive result

[1]

[Total: 8]

4 You are going to find a test to identify substance **X**.

(a) **Procedure**

A student:

- step 1 dissolves powder **X** in distilled water
- step 2 adds 2 cm depth of the solution of **X** to each of four test-tubes
- step 3 does the tests shown in Table 4.1
- step 4 records the observations in Table 4.1.

The student repeats the procedure with solid **Y** and records their observations in Table 4.1.

Table 4.1

tests	observations	
	with X	with Y
add a few drops of aqueous sodium hydroxide	blue precipitate	blue precipitate
add excess aqueous sodium hydroxide	blue precipitate	blue precipitate
flame test	green	green
add dilute nitric acid followed by aqueous barium nitrate	fizzes blue solution	white precipitate
add a few drops of aqueous ammonia	blue precipitate	blue precipitate
add excess aqueous ammonia	dark blue solution	blue precipitate

A student has an unknown powder.

Describe **two** tests which allow the student to confirm that the sample is powder **X** and **not** powder **Y**.

Include the observations in your answer.

Test 1

reagent

observation

Test 2

reagent

observation

[4]

(b) Describe how to do a flame test.

.....

.....

..... [2]

(c) A sample of an unknown blue solid is heated. The solid turns white.
When water is added to the white solid it turns blue.

Suggest the identity of the unknown solid.

..... [1]

[Total: 7]

- 5 Hydrogen gas can be made from magnesium ribbon and dilute hydrochloric acid.

The magnesium ribbon is placed in a conical flask and dilute hydrochloric acid is added.

The hydrogen is collected over water.

Fig 5.1 shows some pieces of apparatus.

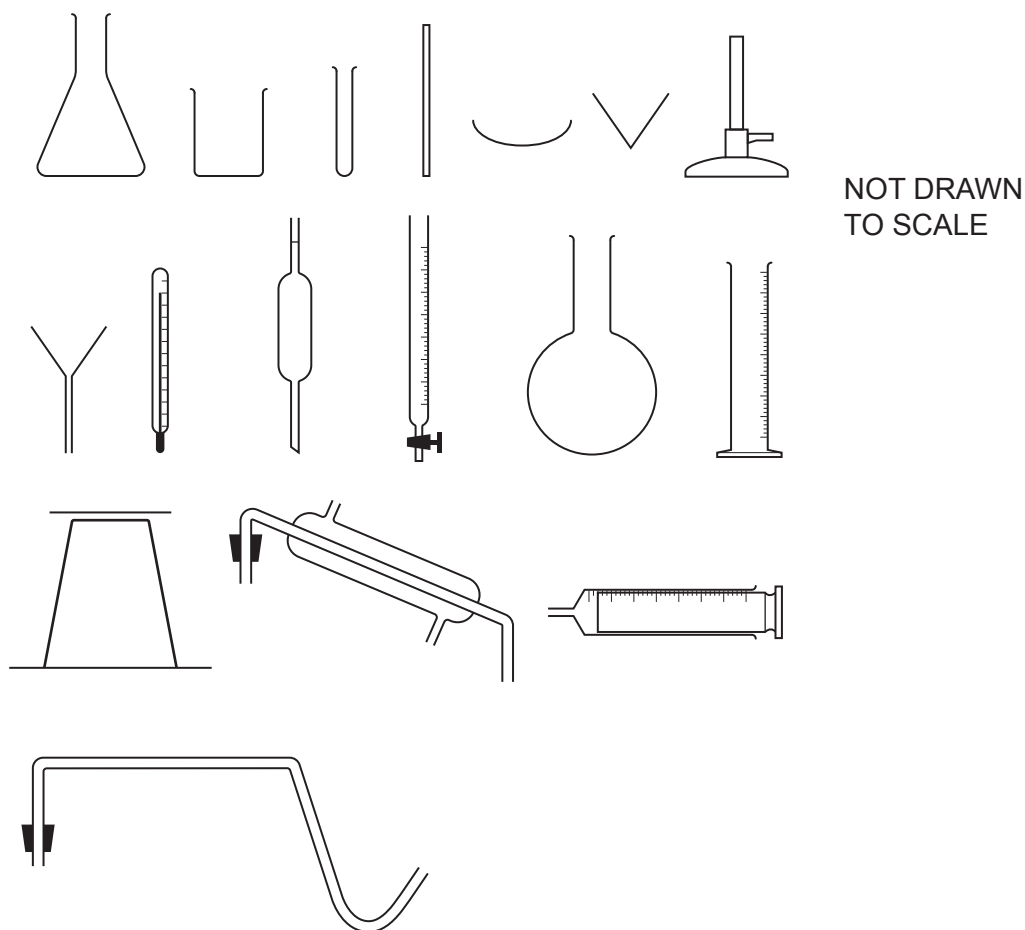


Fig. 5.1

- (a) Draw a labelled diagram of the assembled apparatus used for making, collecting and measuring the **volume** of hydrogen gas made in this experiment.

In your diagram include the following apparatus from Fig. 5.1:

- a conical flask
- a beaker
- a measuring cylinder
- a delivery tube
- any other apparatus necessary.

Also include the magnesium ribbon, dilute hydrochloric acid and water and label them.

[4]

(b) Dry hydrogen gas can be collected and measured without using water.

On Fig. 5.1 label the piece of apparatus suitable for collecting and measuring the volume of dry hydrogen gas.

[1]

[Total: 5]

- 6 A student determines the acceleration due to gravity g by measuring the period of a pendulum.

The period of a pendulum is the time for one complete to and fro swing (oscillation).

(a) The student:

- sets up the pendulum with its point of support a fixed distance D above the bench as shown in Fig. 6.1
- does **not** adjust this distance, or the position of the clamp.

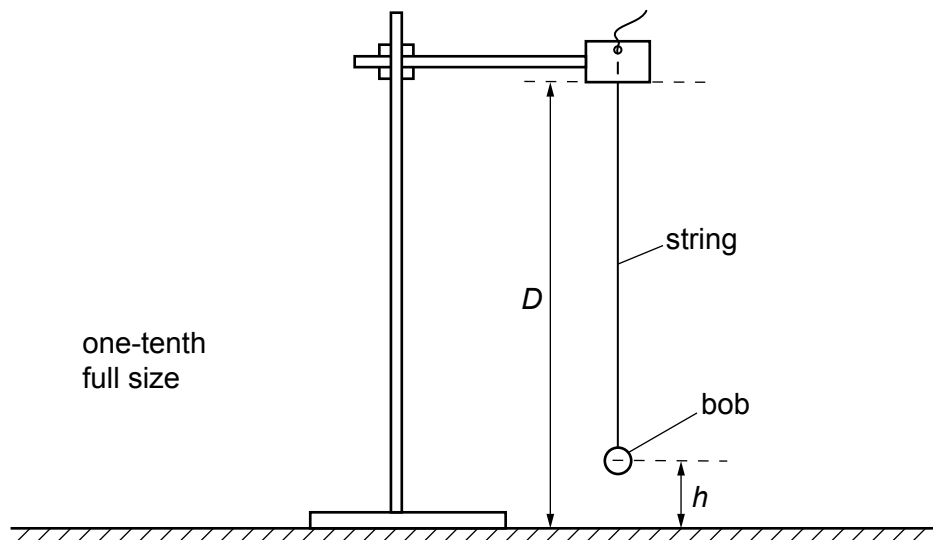


Fig. 6.1

Fig. 6.1 is drawn to a scale of one-tenth full size.

- (i) On Fig. 6.1 measure the distance D , the height of the point of support of the pendulum above the bench, in centimetres to the nearest millimetre.

$D =$ cm [1]

- (ii) Calculate the actual distance d of the point of support of the pendulum above the bench in centimetres.

$d =$ cm [1]

(b) The student:

- adjusts the length of the pendulum until the height h of the centre of the bob above the bench is 10.0 cm. Distance D is **not** changed.
- gives the bob a small sideways displacement and releases it
- measures the time taken for 20 oscillations of the pendulum.

The reading on the stop-watch is shown in Fig. 6.2.



Fig. 6.2

Read and record in Table 6.1 the time taken in seconds for 20 oscillations of the pendulum. [1]

Table 6.1

h/cm	time for 20 oscillations/s	period T/s	T^2/s^2
10.0			
20.0	25.4	1.27	1.6
25.0	23.8	1.19	1.4
30.0	20.2	1.10	1.2
40.0	18.0	0.90	0.81

(c) The student:

- repeats the procedure in (b) for heights h of 20.0 cm, 25.0 cm, 30.0 cm and 40.0 cm
- records the times for 20 oscillations in Table 6.1.

State how the student could check that the measured values of the time for 20 oscillations of the pendulum are reliable.

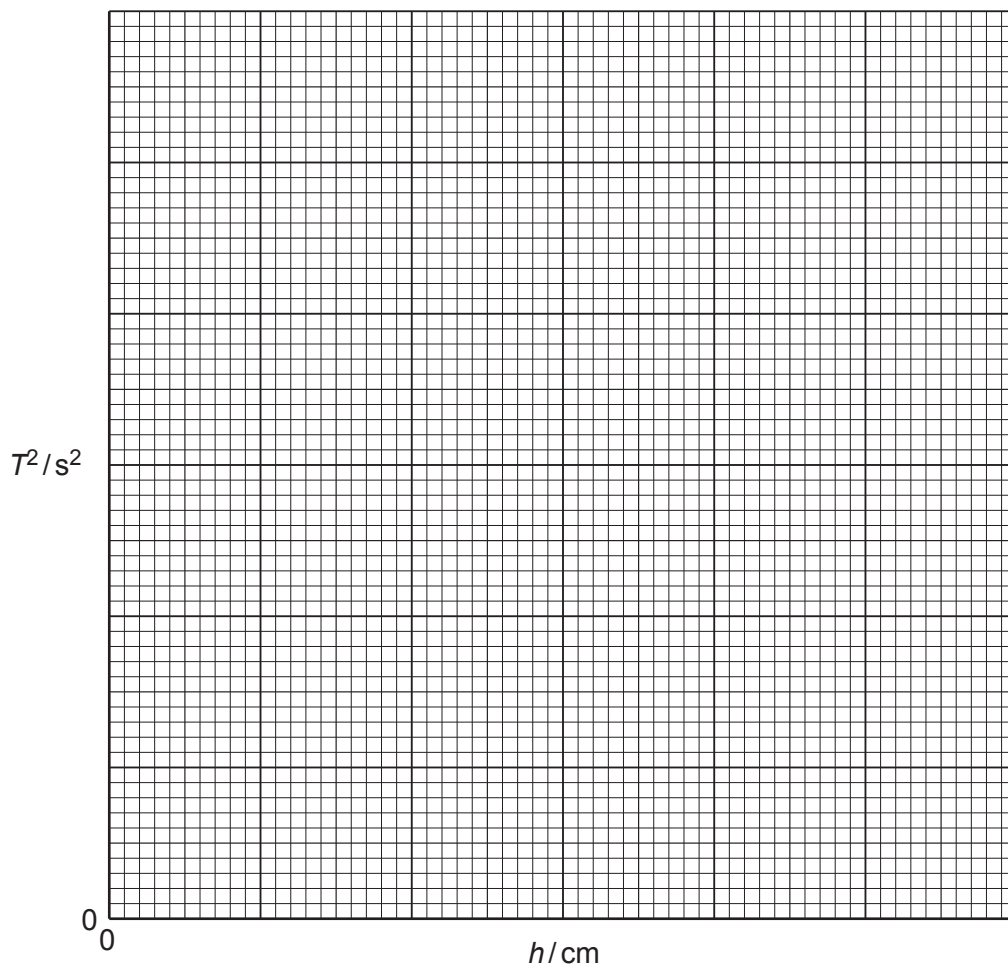
..... [1]

(d) (i) Use the result in (b) to calculate the period T of the pendulum for $h = 10.0$ cm. The period is the time for **one** complete oscillation.

Record your value in Table 6.1. [1]

(ii) Calculate the value of T^2 for $h = 10.0$ cm and enter your value in Table 6.1 to 1 decimal place. [1]

- (e) (i) On the grid provided, plot a graph of T^2 (vertical axis) against h . [2]



- (ii) Draw the best-fit straight line. [1]
- (f) Calculate the gradient of your line.

Indicate on your graph the values you chose to enable the gradient to be calculated.
Show all your working

gradient = [2]

- (g) Calculate the value of the acceleration due to gravity g .
Use the equation shown.

$$g = \frac{0.395}{\text{gradient}}$$

$g = \dots\dots\dots \text{ m/s}^2$ [1]

[Total: 12]

7 A student measures the energy stored in a spring when different loads L are added to it.

- The student sets up the spring in a clamp, as shown in Fig. 7.1.

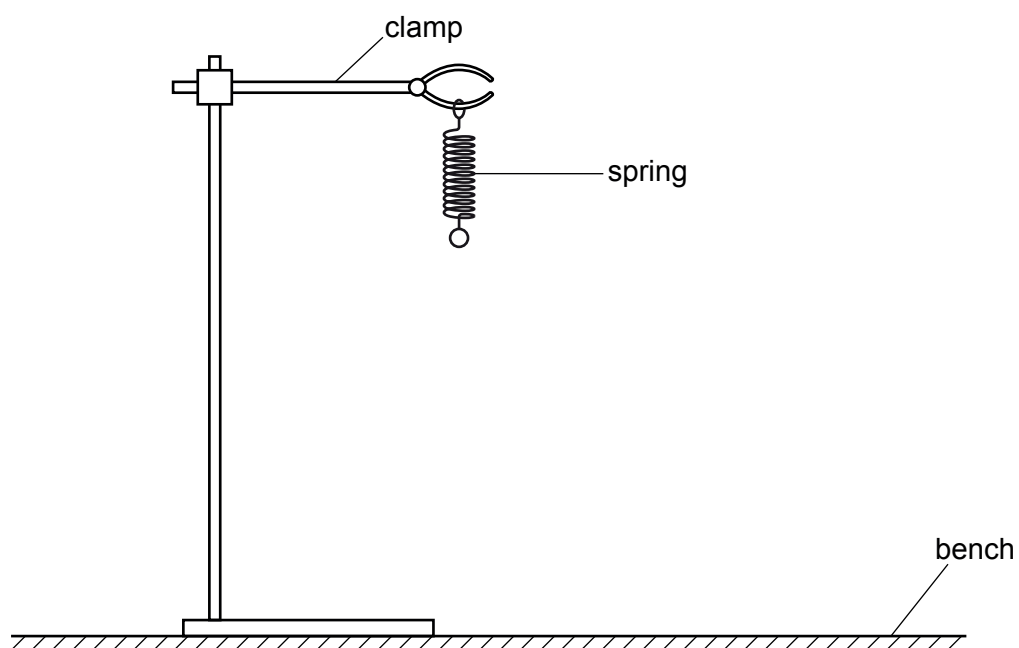


Fig. 7.1

- The student measures the length l_0 of the unstretched spring.

A full size diagram of the unstretched spring is shown in Fig. 7.2.

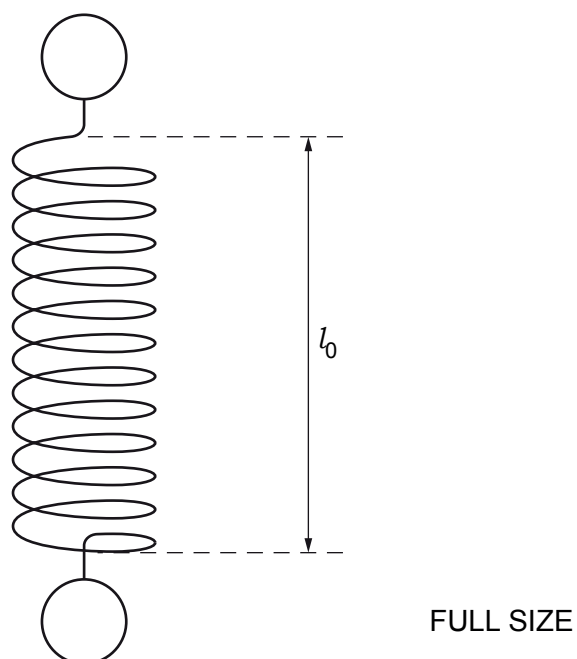


Fig. 7.2

- (a) Measure the unstretched length of the spring in centimetres to the nearest 0.1 cm.

$$l_0 = \dots\dots\dots [1]$$

(b) Procedure

The student:

- step 1 suspends a load of $L = 1.0\text{ N}$ on the spring
- step 2 measures the new length l of the spring in centimetres to the nearest 0.1 cm
- step 3 records the length l in Table 7.1
- step 4 repeats the procedure using a load of $L = 2.0\text{ N}$.

The results are shown in Table 7.1.

Table 7.1

load L/N	spring length l/cm	extension e/cm	energy stored E/J
1.0	9.6		
2.0	14.0		

- (i) Calculate the extension e of the spring for each load.
Use the equation shown.

$$e = l - l_0$$

Record these values in Table 7.1. [2]

- (ii) Calculate the energy stored E stored in the spring for loads of $L = 1.0\text{ N}$ and $L = 2.0\text{ N}$ using the equation:

$$E = 0.005 \times L \times e$$

Record these values in Table 7.1 to two significant figures. [2]

- (c) The teacher states that when the load on a spring doubles, the elastic energy stored E in the spring increases four times.

Use your values for E in Table 7.1 to state if the values support the teacher's statement within the limits of experimental accuracy. Give a reason for your answer.

statement

reason [1]

- (d) Suggest how the student can extend the investigation, to have more confidence in the answer in (c).

.....

..... [1]

- (e) Stretched springs are potentially dangerous.

State **one** safety precaution that is taken when working with stretched springs. Explain your answer.

safety precaution

explanation [1]

[Total: 8]

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