



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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COMBINED SCIENCE

0653/61

Paper 6 Alternative to Practical

May/June 2011

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 a soft pencil for any diagrams, graphs, tables or rough working.

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

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

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.

For Examiner's Use	
1	
2	
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Total	

This document consists of **18** printed pages and **2** blank pages.



- 1 (a) A student carried out experiments to investigate the composition of *inhaled* and *exhaled* air.

Analysis of **inhaled** air.

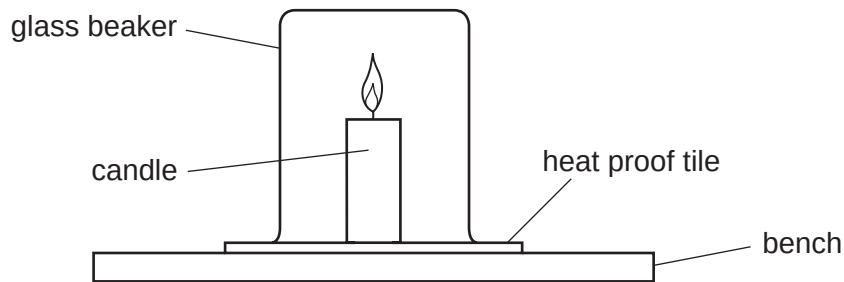


Fig. 1.1

- A student took a 500 cm³ glass beaker.
- A candle was lit and placed onto a heat proof tile.
- A timer was set to zero.
- The beaker was placed over the candle and the timer started (see Fig. 1.1).
- The timer was stopped when the flame went out.
- The experiment was then repeated.

Analysis of **exhaled** air.

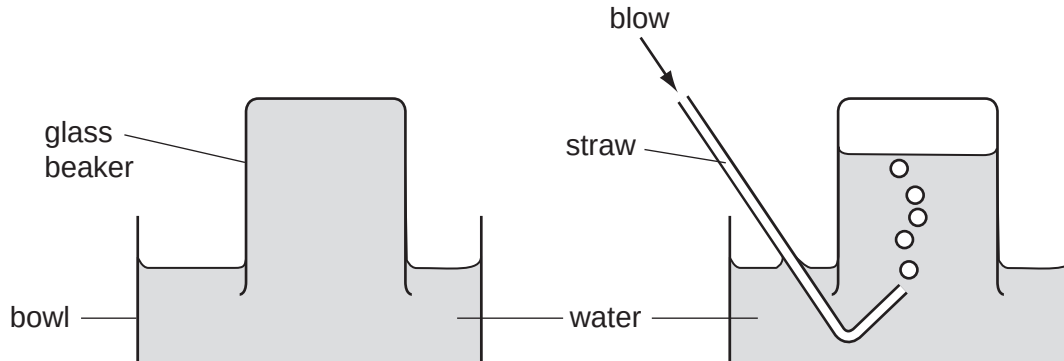


Fig. 1.2

- The 500 cm³ beaker was filled with water, inverted and placed into a bowl of water (see Fig. 1.2).
- The student blew through a tube until the beaker was full of exhaled air.
- He lit a candle and placed it onto a heat proof tile.
- The timer was set to zero.
- The beaker (of exhaled air) was placed over the candle and the timer started.
- The timer was stopped when the flame went out.
- He then repeated the experiment.

Fig. 1.3 shows the times for the flames to go out.

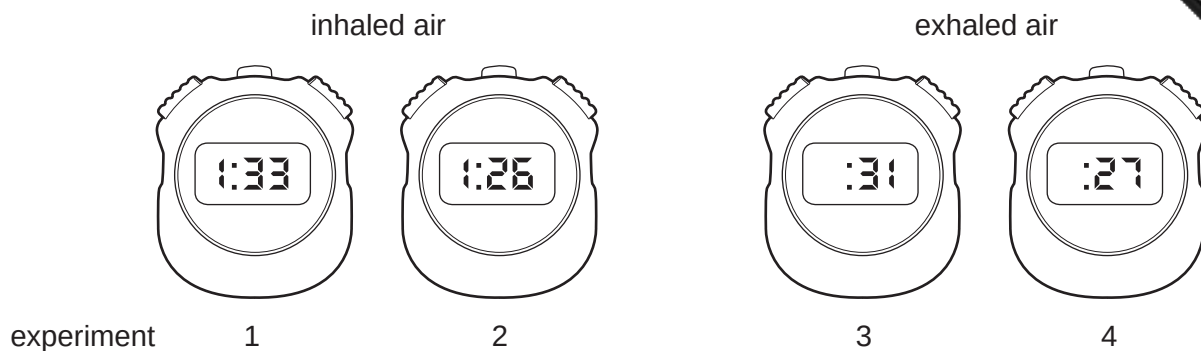


Fig. 1.3

- (i) Use Fig. 1.3 to record in Table 1.1, the times taken in seconds for the flame to go out in each experiment.

Table 1.1

	inhaled air		exhaled air	
experiment number	1	2	3	4
time taken/s				

[2]

- (ii) Is the data reliable? Explain your answer.

.....
 [1]

- (iii) Calculate the average times for the flame to go out in inhaled air and exhaled air.

Show your working.

average time taken for flame to go out in inhaled air = ... s

average time taken for flame to go out in exhaled air = ... s

[3]

- (iv) Describe and explain the difference between the results for inhaled and exhaled air.

.....

.....

.....

..... [2]

- (b) In a separate experiment inhaled air was bubbled through tube **A** containing limewater for 30 seconds and the appearance of the limewater recorded.

Exhaled air was bubbled through tube **B** containing limewater for 30 seconds. Fig. 1.4 shows the appearance of the limewater in tubes **A** and **B** after 30 seconds.

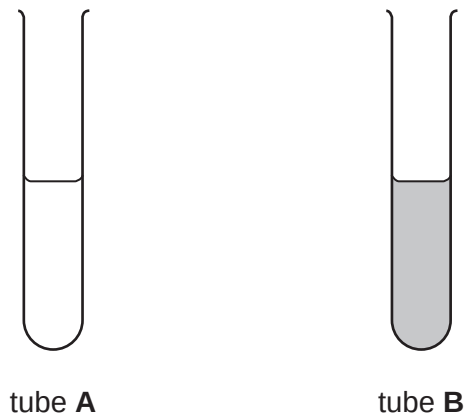


Fig. 1.4

Explain the difference between the appearance of the limewater in tube **A** and tube **B**.

.....

.....

.....

.....

..... [2]

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Please turn over for Question 2.

- 2 (a) A student is investigating how an elastic band stretches when different masses are hung on it.

The apparatus is set up as shown in Fig. 2.1.

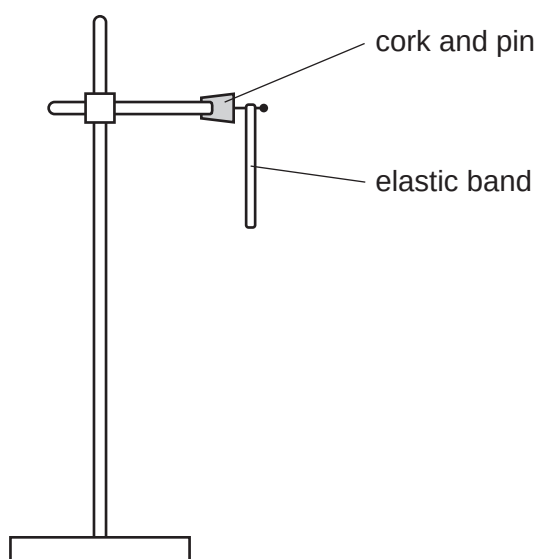


Fig. 2.1

The length of the elastic band is measured with a metre rule, and is recorded in Table 2.1.

A hanger of mass 100g is added to the elastic band and the new length is measured and recorded in Table 2.1. A 100g mass is added to the hanger and the new length of the elastic band is measured and recorded.

Table 2.1

total mass /g	force /N	length of elastic band /mm	total increase in length /mm
0	0	80	0
100	0.1	98	18
200		114	34
300		130	
400		148	
500	0.5	165	85

- (i) Complete column two of Table 2.1 to show the force in Newtons.

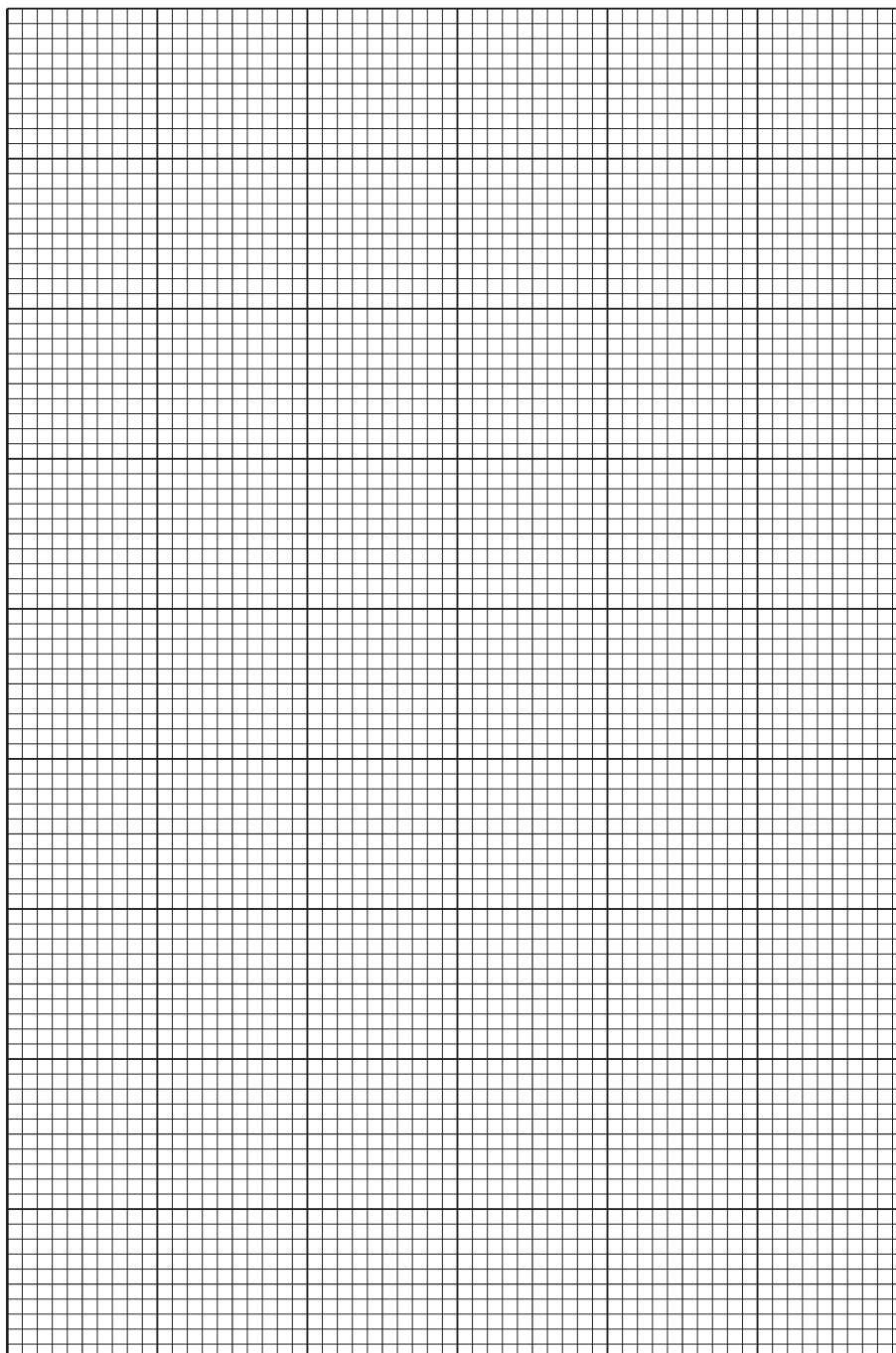
[1]

- (ii) Calculate the total increase in length of the elastic band for 300 g and 400 g.

Complete column four of Table 2.1.

[1]

- (iii) Plot a graph of total increase in length/mm (vertical axis) against force/N (horizontal axis). Draw the best fit straight line.



[3]

- (iv) Use your graph to describe and explain the relationship between the applied force and the total increase in length.

.....

.....

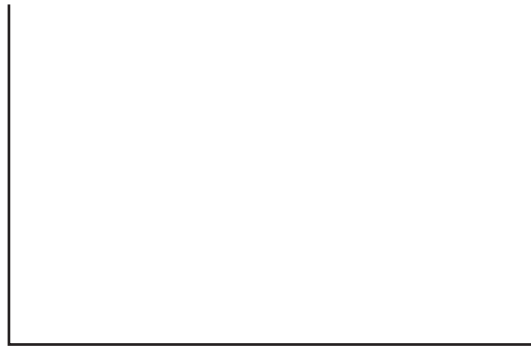
..... [2]

- (v) Use your graph to find the total increase in length produced by a mass of 250 g.

Show how you do this on the graph.

total increase in length = ... mm [2]

- (b) If masses were added beyond 500 g, the elastic band would eventually break. On the axes below, sketch the shape of graph that would be obtained.



[1]

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Please turn over for Question 3.

- 3 (a) A student is provided with a salt **Z** that contains two cations and one anion.

She places a sample of **Z** in a hard glass test-tube and heats strongly. There is an alkaline gas given off.

- (i) What test does she use and what observation is seen that proves the gas is alkaline?

test

observation [2]

- (ii) Suggest a name for the cation that produces this alkaline gas.

..... [1]

- (b) Another sample of **Z** is dissolved in water, and the solution is divided equally into three test-tubes.

- (i) In one test-tube aqueous sodium hydroxide is added drop by drop, until alkaline. A reddish-brown precipitate is produced.

Name the cation that causes this precipitate.

..... [1]

- (ii) In the second test-tube of solution **Z** she tests for chloride ions.

Describe how she does this, naming any chemicals used and the observations for a positive test and a negative test.

.....

.....

.....

.....

..... [3]

The test for chloride ions proved negative.

- (iii) In the third test-tube of solution **Z** she adds a few drops of hydrochloric acid, followed by a few drops of aqueous barium chloride. A white precipitate is produced.

Name the anion that produces this precipitate.

..... [1]

(iv) Why is hydrochloric acid added in the test in (b)(iii)?

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

(c) Using all the information from the positive tests, suggest a name for salt Z.

..... [1]

- 4 (a) A student was investigating the effect of temperature on the activity of yeast. Yeast is a micro-organism that uses enzymes during respiration to break down sugar. This process produces carbon dioxide. In bread the carbon dioxide is trapped as bubbles in the dough. These bubbles cause the bread to rise.

- The student made up some dough using flour, yeast, sugar and water.
- She divided the dough into six equal parts each of volume 25 cm^3 .
- She put the first part of the dough in a measuring cylinder, noted the volume and recorded it in Table 4.1. She took the volume reading where the dough touched the sides of the measuring cylinder.
- She put the remaining parts of the dough in five other measuring cylinders.
- She left each measuring cylinder at a different temperature for 30 minutes.
- The student recorded the final volume of dough in each measuring cylinder in Table 4.1.

Table 4.1

temperature/ $^{\circ}\text{C}$	total volume, v , of dough/ cm^3
10	
20	31
30	47
40	
50	54
60	25

- (i) Read the scales of the measuring cylinders in Fig. 4.1 at the line where the dough touches the side to find the missing volumes of dough. Enter the values of v for 10°C and 40°C in Table 4.1. [2]

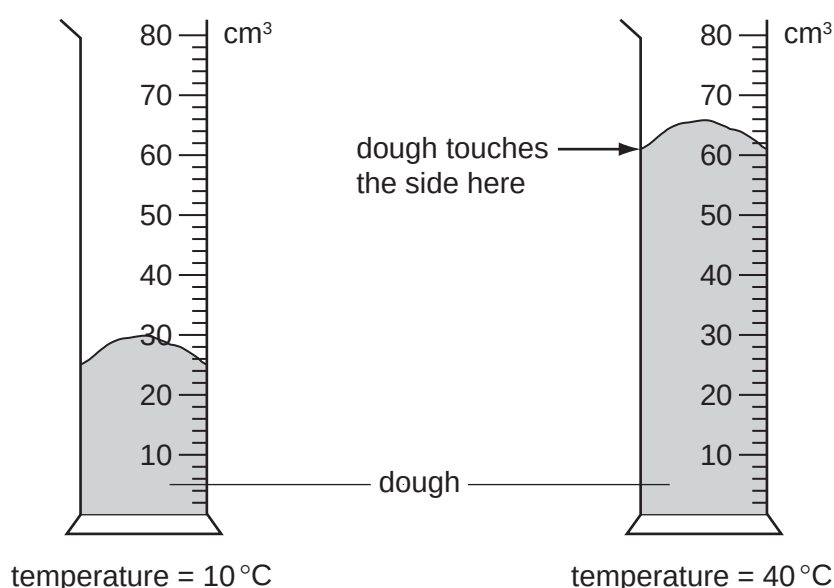


Fig. 4.1

- (ii) Calculate the increase in volume of dough for each temperature to complete column two of Table 4.2. For
ininer's

[2]

Table 4.2

temperature / °C	increase in volume, v , of dough $(v-25)/\text{cm}^3$	rate of increase in volume $\text{cm}^3/\text{min } (v-25)/30$
10		
20		
30		
40		
50		
60		

- (iii) Calculate the rate of increase in volume of dough for each temperature.

Enter these values in column three of Table 4.2.

[2]

- (b) At which temperature was the rate of increase in volume of dough greatest? This is the optimum temperature.

optimum temperature = ... °C [1]

- (c) Suggest the apparatus used to maintain the different temperatures for the meat cylinders containing the dough.

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

- (d) Using your knowledge of the activity of enzymes explain the difference between the results at

20 to 30 °C, ...
.....
40 to 60 °C.
..... [2]

- 5 A student has three gold-coloured bracelets, **A**, **B** and **C**. She believes that one, two or three may be different metals, painted gold.

To identify the metal in each bracelet she is going to find out the densities of each one.

To do this she has to find the mass and volume of each bracelet.

- (a) To find the volume, she pours exactly 50 cm^3 of water into a 100 cm^3 measuring cylinder.

She carefully drops bracelet **A** into the measuring cylinder and records the new volume in Table 5.1. She calculates the increase in volume. This increase is the volume of the bracelet.

Table 5.1

bracelet	A	B	C
volume of water / cm^3	50.0	50.0	50.0
new volume after / cm^3	54.4		
increase in volume / cm^3	4.4		

- (i) Use Fig. 5.1 to read the new volumes for the two bracelets, **B** and **C**. Record these values in Table 5.1. [2]

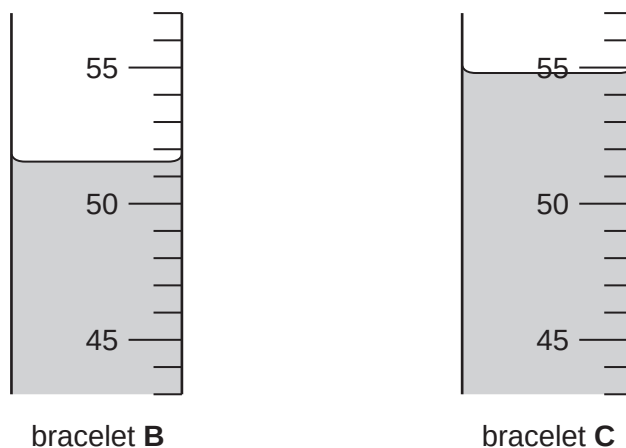


Fig. 5.1

- (ii) Calculate the increase in volume for bracelets **B** and **C** and complete Table 5.1. [2]

- (b) She now uses a balance to find the mass of bracelet **A**, and records this in Table 5.2

Table 5.2

bracelet	A	B	C
mass/g	49.8		

Use Fig. 5.2 to find the mass of bracelets **B** and **C** and record the results in Table 5.2. [2]

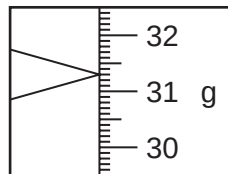
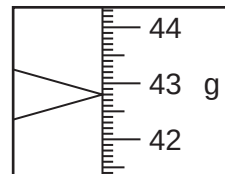
bracelet **B**bracelet **C**

Fig. 5.2

- (c) Calculate the density of each bracelet using the following equation.

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

density of bracelet **A** = ... g/cm³

density of bracelet **B** = ... g/cm³

density of bracelet **C** = ... g/cm³ [3]

(d) Use Table 5.3 to suggest what metal each bracelet was made of.

Table 5.3

density in g/cm ³	metal
2.7	aluminium
7.1	zinc
7.7	bronze
7.9	iron
8.9	copper
10.5	silver
11.3	lead
19.9	gold

bracelet **A**

bracelet **B**

bracelet **C**

[1]

- 6 (a) The decomposition of hydrogen peroxide into water and oxygen is shown in the equation.



The reaction is speeded up if a catalyst is present. The catalyst is not used up during this reaction.

A student is given samples of copper(II) oxide, manganese(IV) oxide and zinc oxide. He tests them to find the best catalyst.

He pours 25 cm³ of hydrogen peroxide into a conical flask and sets up the apparatus as in Fig 6.1.

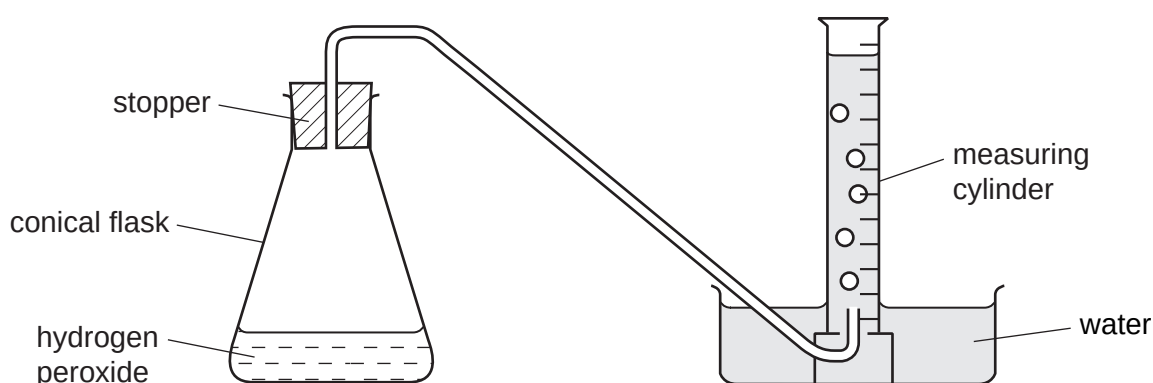


Fig. 6.1

His partner adds a spatula full of copper(II) oxide to the flask and quickly replaces the stopper.

The volume of oxygen gas formed, seen by the displacement of water in the measuring cylinder, is measured every 30 seconds. The results are shown in Table 6.1.

Table 6.1

time / s	volume of oxygen evolved / cm ³		
	copper(II) oxide	manganese(IV) oxide	zinc oxide
0	0	0	0
30	12	40	24
60	19		
90	24	92	50
120	28	100	59
150	30	100	66
180	32	100	70

- (i) He now repeats the experiment with the same volume of fresh hydrogen peroxide using manganese(IV) oxide instead of copper(II) oxide. The results are recorded in Table 6.1.

With another sample of hydrogen peroxide he uses zinc oxide. The results are recorded in Table 6.1.

Use Fig. 6.2, to read the volume of gas produced in each measuring cylinder after 60 seconds. Complete Table 6.1. [2]

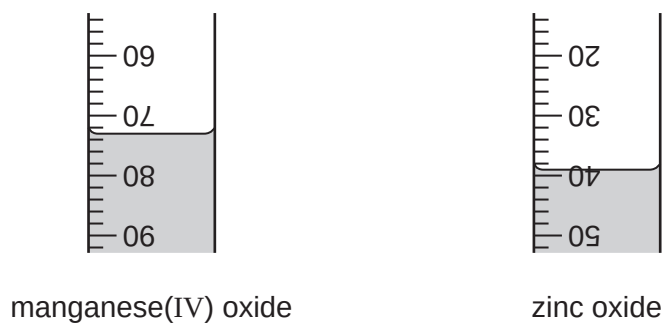
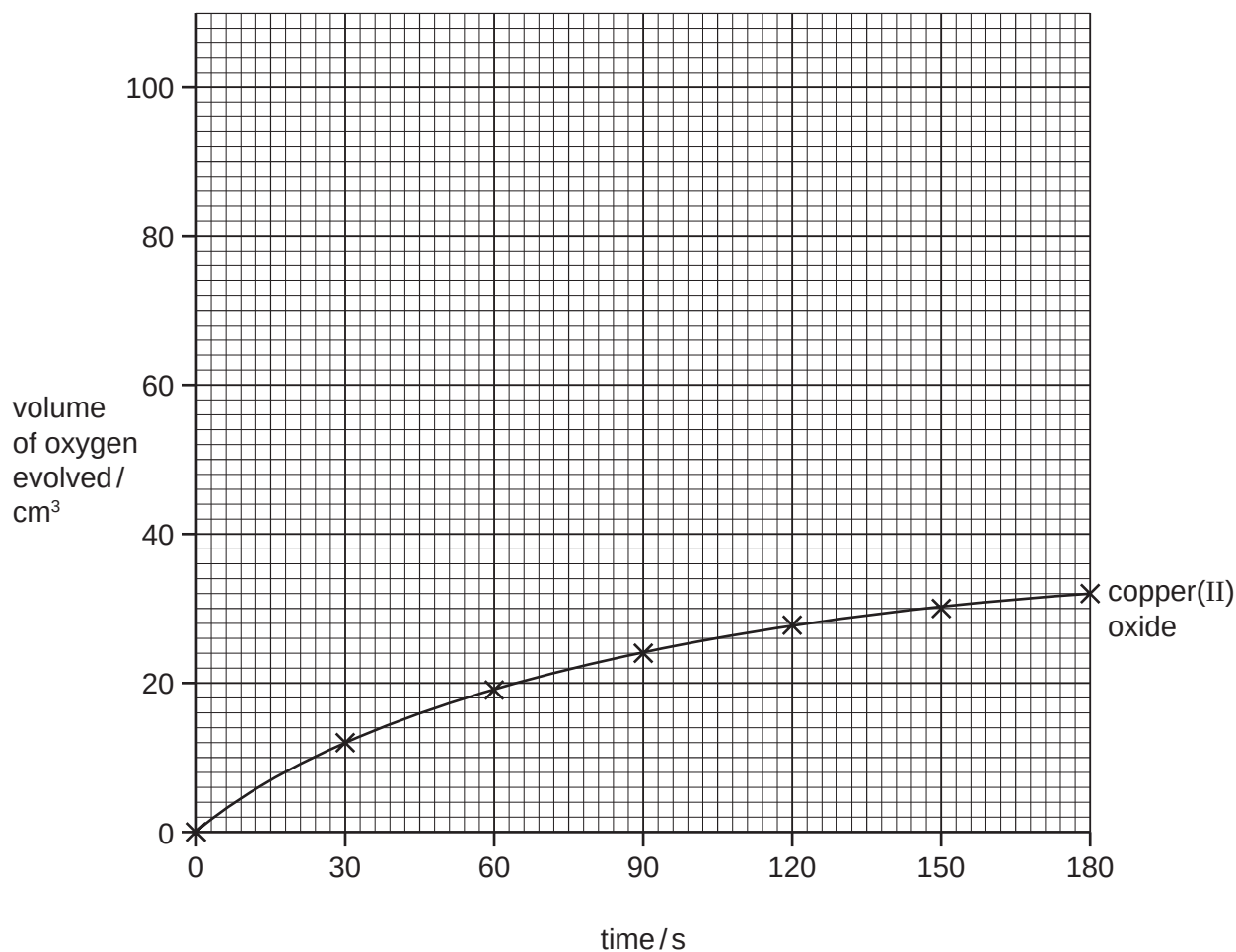


Fig. 6.2

- (ii) On the grid plot a graph of volume of oxygen evolved / cm^3 against time / s for manganese(IV) oxide and zinc oxide. Draw a smooth curve for each oxide and label them both clearly.



[4]

- (iii) Use your graph to suggest which metal oxide makes the best catalyst. Give your answer.

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

- (b) Suggest **one** source of error in the experiment.

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

- (c) How can you prove that the metal oxide you have named in (a)(iii) is a catalyst?

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



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COMBINED SCIENCE

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- 1 (a) (i) A student performed an experiment to investigate the energy content of bread.

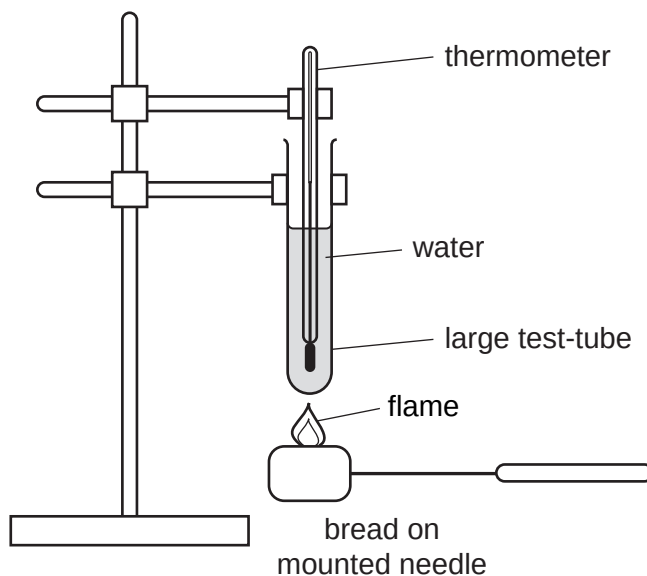


Fig. 1.1

- He placed 20cm^3 of water into a large test-tube and clamped it with a stand as shown in Fig. 1.1.
- He clamped a thermometer into the water.
- He measured the starting temperature of the water, t_s .
- He measured the mass of the bread, m_b , and recorded it in Table 1.1.
- Using a mounted needle, he picked up the bread and ignited it using a Bunsen burner.
- He quickly placed the burning bread under the large test-tube and heated the water.
- He measured the maximum temperature, t_m , that the water reached.

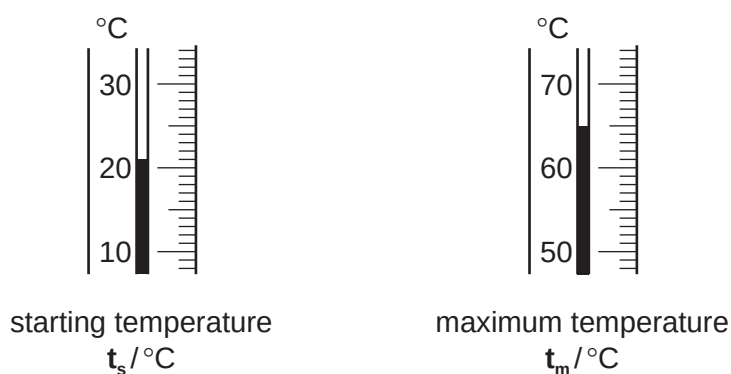


Fig. 1.2

- (i) Using Fig. 1.2, record t_s , the starting temperature, and t_m , the maximum temperature in Table 1.1. [2]

Table 1.1

starting temperature $t_s / ^\circ\text{C}$	maximum temperature $t_m / ^\circ\text{C}$	temperature rise $T = (t_m - t_s) / ^\circ\text{C}$	mass of bread m_b / g	mass of water m_w / g
			12.6	20

- (ii) Calculate T , the temperature rise of the water, using $T = t_m - t_s$.

Record it in Table 1.1.

[1]

- (iii) The energy content of the bread can be determined by using the formula

$$E = \frac{m_w \times T \times 4.2}{m_b \times 1000} \text{ kJ/g}$$

Calculate the energy content of the bread.

Show your working.

energy content of bread = ... kJ/g [2]

- (b) (i) The true energy content of bread is much higher than the value that you calculated. By reference to the experiment, suggest reasons for the difference.

.....

.....

.....

..... [2]

- (ii) Suggest **one** way in which the accuracy of the experiment could be improved.

.....

..... [1]

- (c) Suggest how the results will change if the experiment is repeated with bread covered with an equal mass of butter. Explain your answer.

.....

.....

.....

..... [2]

Please turn over for Question 2.

- 2 (a) A student is investigating three liquid fuels, **A**, **B** and **C** to find which one gives the largest temperature rise.

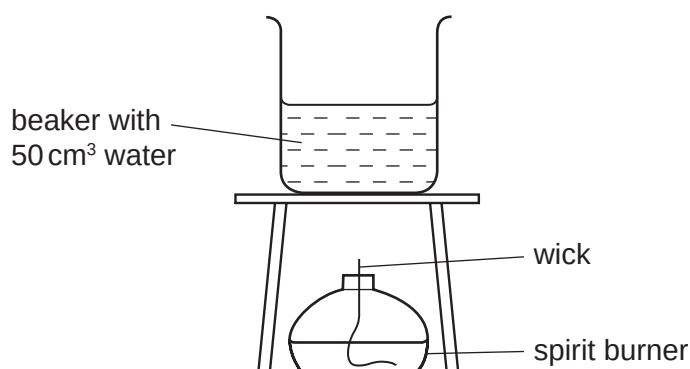
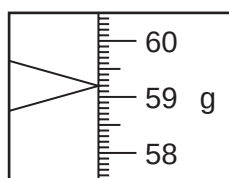


Fig. 2.1

- She fills a spirit burner with fuel **A**. Its mass is measured and recorded in Table 2.1.
- She places 50 cm³ of water in the beaker on the tripod above the spirit burner, as in Fig. 2.1. She measures the temperature of the water and records it in Table 2.2.
- She lights the wick and allows it to burn for 5 minutes, then extinguishes the flame.
- She measures the temperature of the water after heating and records it in Table 2.2.
- She measures the mass of the spirit burner again and records this in Table 2.1.
- Then she repeats all the steps using fuel **B** and then fuel **C**.

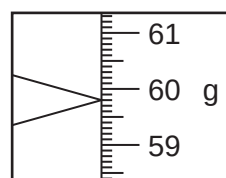
Table 2.1

	fuel A	fuel B	fuel C
mass of burner and fuel before burning /g	57.0		
mass of burner and fuel after burning /g	55.5	57.9	58.2
mass of fuel used /g	1.5		



fuel B

Fig. 2.2



fuel C

Fig. 2.3

- (i) Use Fig. 2.2 to find, and record in Table 2.1, the mass of the spirit burner and fuel **B**.

- (ii) Use Fig. 2.3 to find, and record in Table 2.1, the mass of the spirit burnt by fuel **C**.
- (iii) Calculate the mass of fuel used in each experiment and record it in Table 2.1. [1]

Table 2.2

	fuel A	fuel B	fuel C
temperature of water before heating / °C	15.5	15.5	15.5
temperature of water after heating / °C	56.8		
temperature rise / °C	41.3		

- (iv) The thermometers in Fig. 2.4 show the temperatures of the 50 cm³ of water after being heated for 5 minutes. Read the thermometers for each fuel and record the temperatures in Table 2.2. [2]

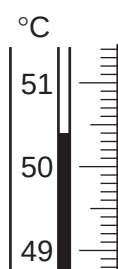
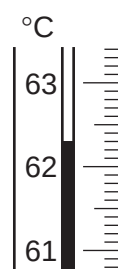
fuel **B**fuel **C**

Fig. 2.4

- (v) Use the data in Table 2.2 to calculate the temperature rise caused by fuels **B** and **C**.

Record these values in Table 2.2.

[1]

- (b) Not all the heat produced by the fuel is used to heat the water.

Suggest **one** improvement to the experiment so that more heat is used in heating the water.

.....

..... [1]

- (c) The temperature rise per gram, **T**, for fuel **A** is 27.5 °C/g.

Calculate the temperature rise per gram for fuels **B** and **C**.

Use the formula

$$T = \frac{\text{temperature rise}}{\text{mass of fuel}}$$

T for fuel **B** = ... °C/g

T for fuel **C** = ... °C/g [2]

- (d) The liquid with the highest value of **T** may not be suitable for use as a fuel in the home.

Suggest a property that could make this liquid unsuitable to use as a fuel.

.....
 [1]

- 3 (a) A student is finding the mass of a metre rule using the principle of moments.

He sets up the apparatus as in Fig. 3.1.

A pin to act as a pivot is pushed through the 100 mm mark of a metre rule into a cork clamped to the stand.

The rule is kept horizontal by a newton meter at the 900 mm mark.

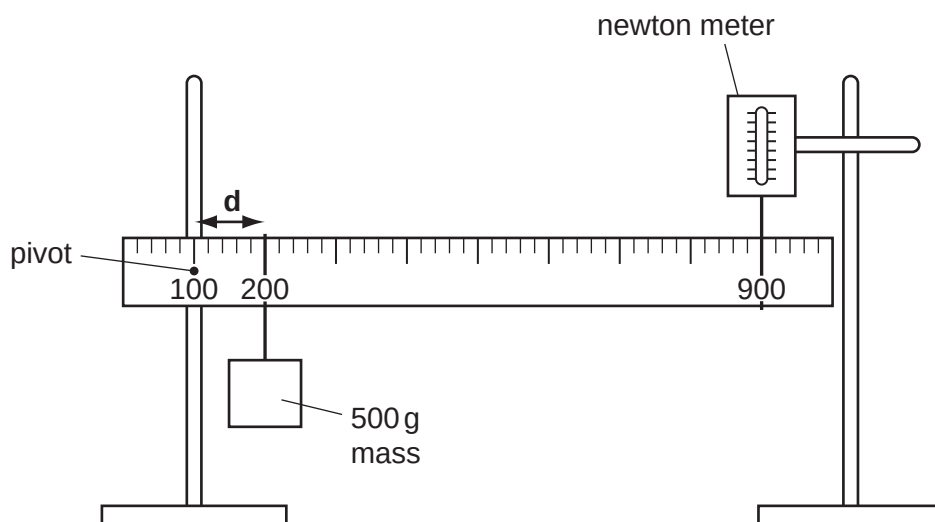


Fig. 3.1

A 500 g mass is hung at the 200 mm mark, 100 mm from the pivot, this is distance **d**.

The force on the newton meter required to keep the rule horizontal is measured and recorded in Table 3.1.

- (i) Read the newton meters in Fig. 3.2, for, **d** = 200 mm and **d** = 300 mm and record the values in Table 3.1. [2]

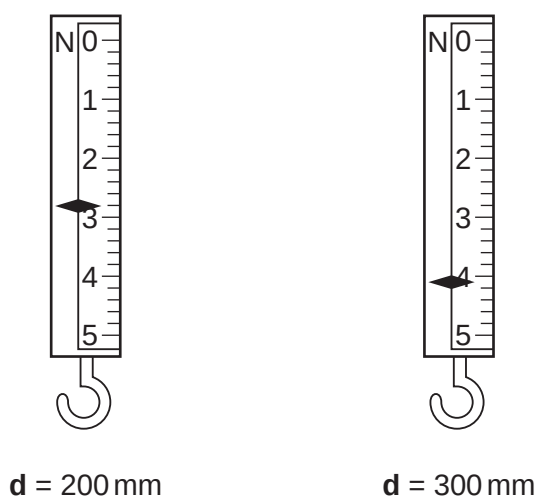


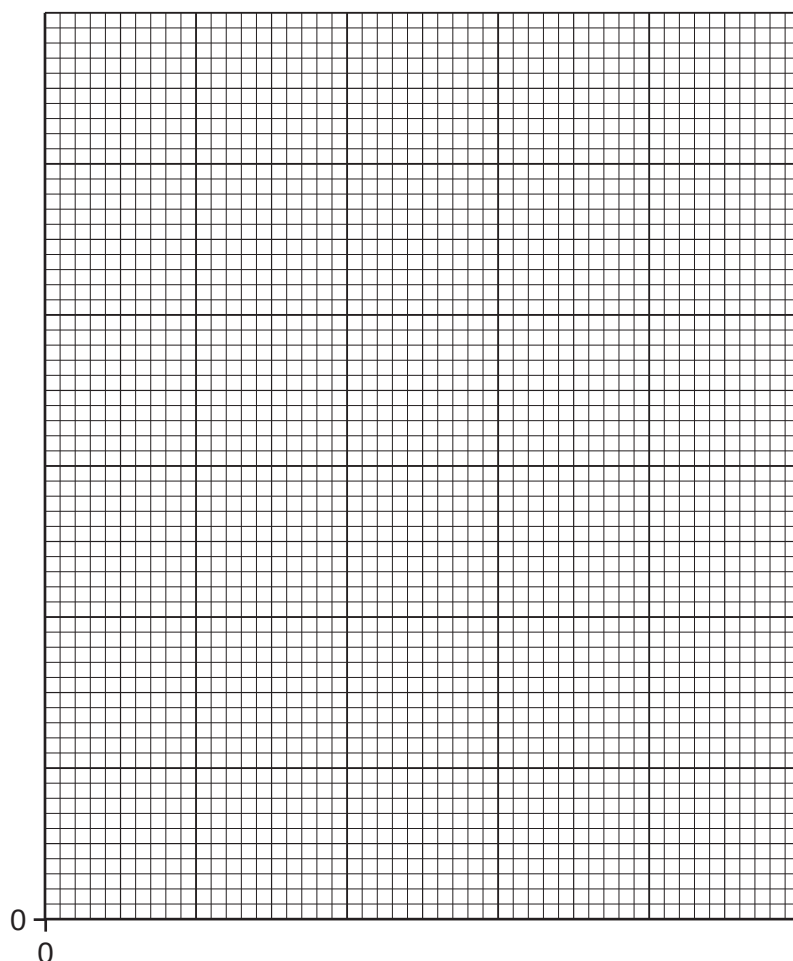
Fig. 3.2

Table 3.1

d/mm	force/N
100	1.8
150	2.3
200	
250	3.5
300	
350	4.6
400	5.2

(ii) On the grid below, plot a graph of force (vertical axis) against distance.

Draw the best straight line, it will not pass through the point (0,0).



- (iii) Extend the line you have drawn until it cuts the vertical axis.

Read off the value of the force when the distance $d = 0$.

force = ... N [1]

- (b) (i) Convert the force from (a)(iii) into a mass in grams. Remember that the force of gravity on 100g is 1 N.

mass = ... g [1]

- (ii) The mass of the metre rule is twice the value found in (b)(i).

Calculate the mass of the rule.

mass of rule = ... g [1]

- (c) The accuracy could be improved by making sure the rule is exactly horizontal when taking the measurements.

Suggest how the student can make sure the rule is horizontal.

.....

 [1]

- 4 A student was studying fruits. The photographs in Fig. 4.1 show each whole fruit and a section through the fruit to show the internal structures.

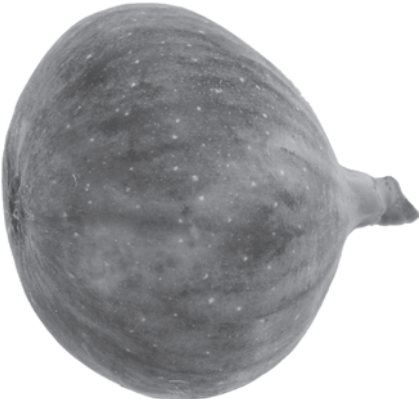
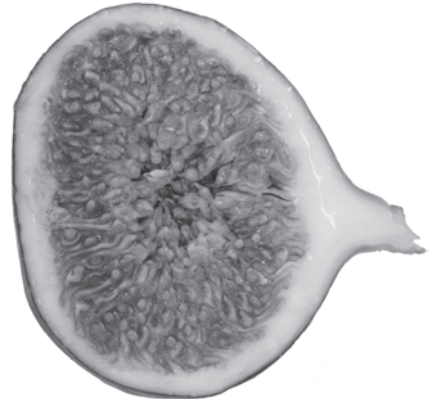
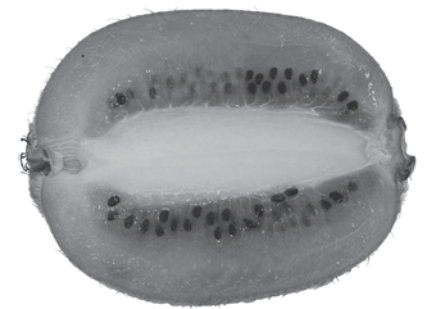
name of fruit	whole fruit	section through fruit
melon		
fig		
kiwifruit		
mango		

Fig. 4.1

- (a) Measure the maximum distance, **d**, as in Fig. 4.2 of each **whole fruit** photographs. Include all parts of the fruit including petioles (stalks) and enter distance **d** in Table 4.1.

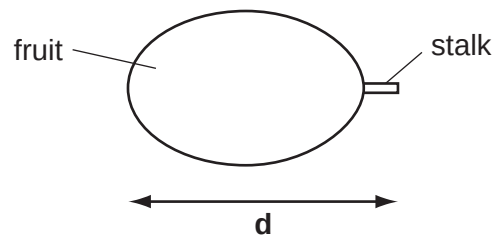


Fig. 4.2

Table 4.1

fruit	actual size of fruit / mm	distance d / mm	fraction of actual size
melon	120		
fig	58		
kiwifruit	77		
mango	125		

[2]

- (b) The photographs show the fruits to be of similar sizes. However the actual sizes of the fruits varied considerably.

Use your measurements for **d** to find how much each photograph was scaled down.

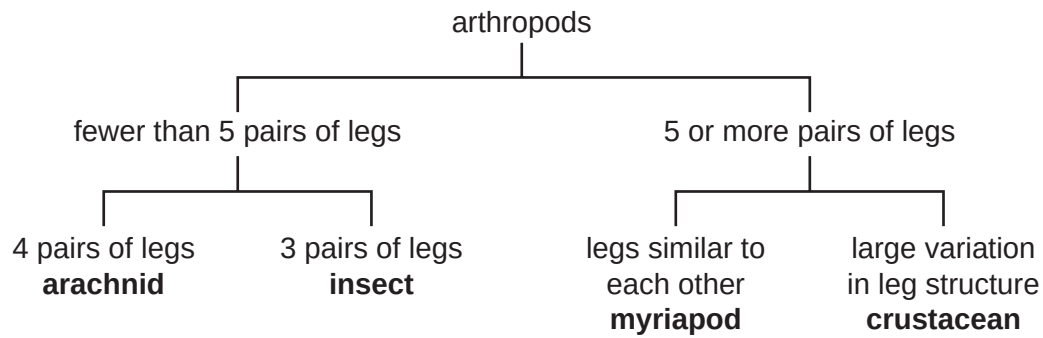
Use the following equation for each fruit and enter the values in Table 4.1.

$$\text{fraction of actual size} = \frac{\text{distance } d}{\text{actual size of fruit}}$$

[4]

(c) The student created a key for these fruits. A key is used to identify living organisms.

An example of a key to identify different arthropods is shown.



Using information from Fig. 4.1 and Table 4.1 construct a key for the fruits. Use the given example of a key to help you. Check that the key would enable all of the fruits to be identified.

- 5 (a) A student is trying to confirm Hooke's Law which states

"The extension of a spring is directly proportional to the force extending it."

The apparatus is set up as shown in Fig. 5.1.

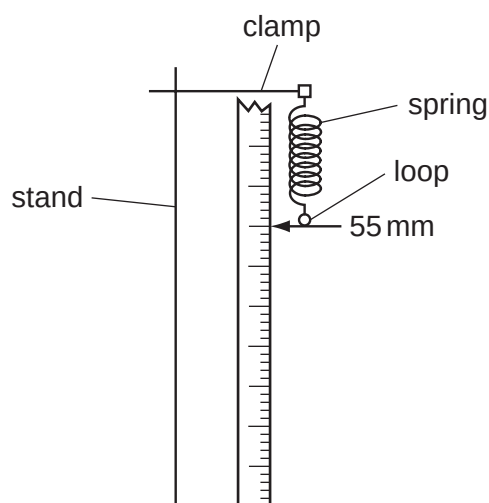


Fig. 5.1

He records in Table 5.1 the position of the pointer on the rule.

He now hangs a holder, weight 1 N, to the loop and reads the new position of the pointer. He calculates the extension. These measurements are placed in Table 5.1.

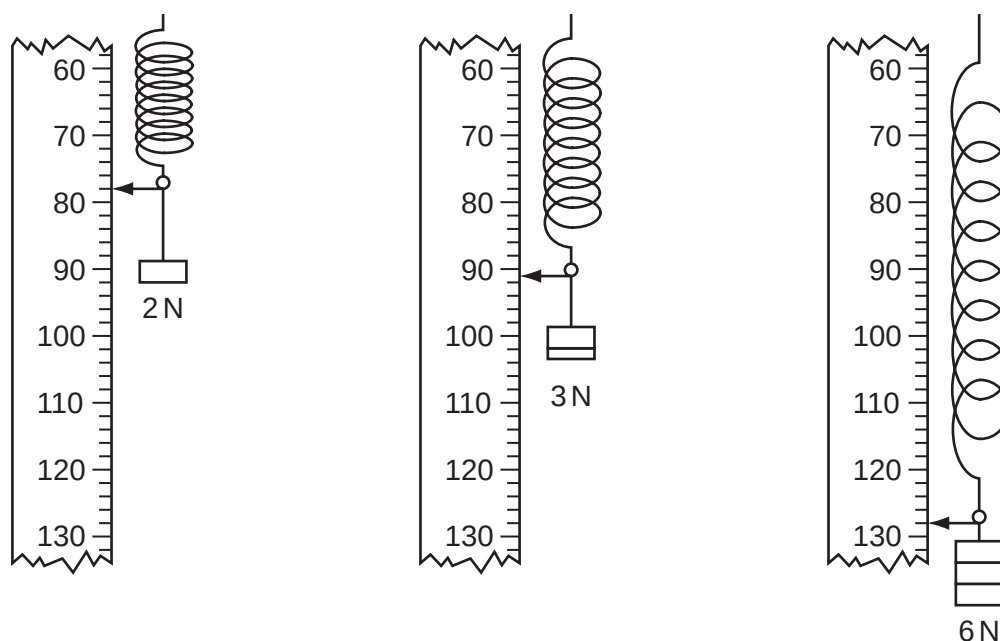


Fig. 5.2

- (i) Fig. 5.2 shows the springs with 2 N, 3 N and 6 N weights attached. Read off the position of the pointer each time, and record the values in Table 5.1. [3]

Table 5.1

weights / N	position of pointer, d / mm	total extension / mm
0	55	0
1	67	12
2		
3		
5	115	60
6		
9	165	110
10	235	180

- (ii) Calculate the missing extensions for weights 2 N, 3 N and 6 N and complete Table 5.1. [1]

- (b) (i) Plot a graph of total extension against weight. Draw the best line.

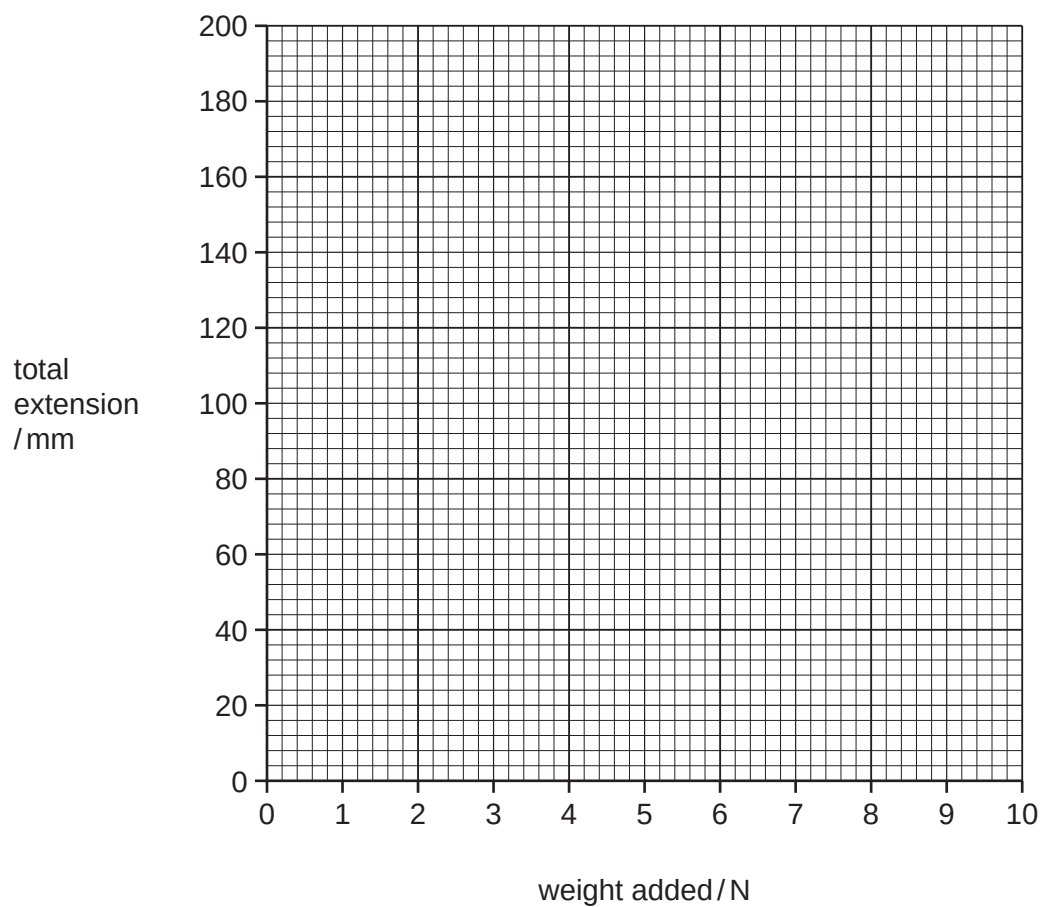


Fig. 5.3

[2]

- (ii) Does the graph confirm Hooke's Law?

Explain your answer.

.....

.....

.....

..... [3]

- (c) The student removes all the weights from the spring and observes that the pointer does not return to the 55 mm mark. Give a reason for this.

.....

.....

..... [1]

- 6 (a) Solid **X** is a mixture of two compounds, each containing different ions.

A student places solid **X** into a large test-tube, adds about 10 cm³ water, stoppers the tube and shakes it for a minute.

She filters the mixture, and saves the filtrate for part (b).

- (i) She scrapes the residue into a test-tube and adds 2 cm³ of hydrochloric acid. Bubbles of carbon dioxide gas are given off.

Describe the test for carbon dioxide.

test

.....

result

..... [2]

- (ii) Give the name of the anion that gives off carbon dioxide when hydrochloric acid is added.

..... [1]

- (iii) To the mixture from (a)(i) she adds aqueous sodium hydroxide, drop by drop, until no further reaction occurs.

She sees a white precipitate which dissolves to form a colourless solution.

Name the cation in the mixture.

..... [1]

(b) The filtrate from part (a) is a blue colour. She divides the filtrate into three test-tubes.

- To the first test-tube she adds aqueous sodium hydroxide, drop by drop until it is in excess.
- To the second test-tube she adds aqueous ammonia, again drop by drop until it is in excess.
- She determines that copper ions are present.

Describe the observations she sees.

observations with aqueous sodium hydroxide

.....

.....

.....

observations with aqueous ammonia

.....

.....

..... [4]

(c) (i) To the third test-tube of the filtrate, she adds a few drops of dilute hydrochloric acid followed by aqueous barium chloride.

A white precipitate is formed.

What anion causes this?

..... [1]

(ii) Why does hydrochloric acid need to be added in the test in (c)(i)?

..... [1]

