



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
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**CO-ORDINATED SCIENCES**

**0654/62**

Paper 6 Alternative to Practical

**October/November 2013**

**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 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 **20** printed pages.



- 1 In an experiment, four Petri dishes, **A**, **B**, **C** and **D**, were set up as shown in Fig. 1.1. The dishes contain a starch-agar mixture. This is a gel to which starch solution has been added.

For  
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Use

The experiment uses barley grains that were germinated for a few days. Some of the barley grains were then killed by being placed in boiling water. Groups of the barley grains were then placed on the starch-agar mixture in each of four dishes, and left for a few days.

- In dishes **A** and **B**, the barley grains were living.
- In dishes **C** and **D**, the barley grains were dead.

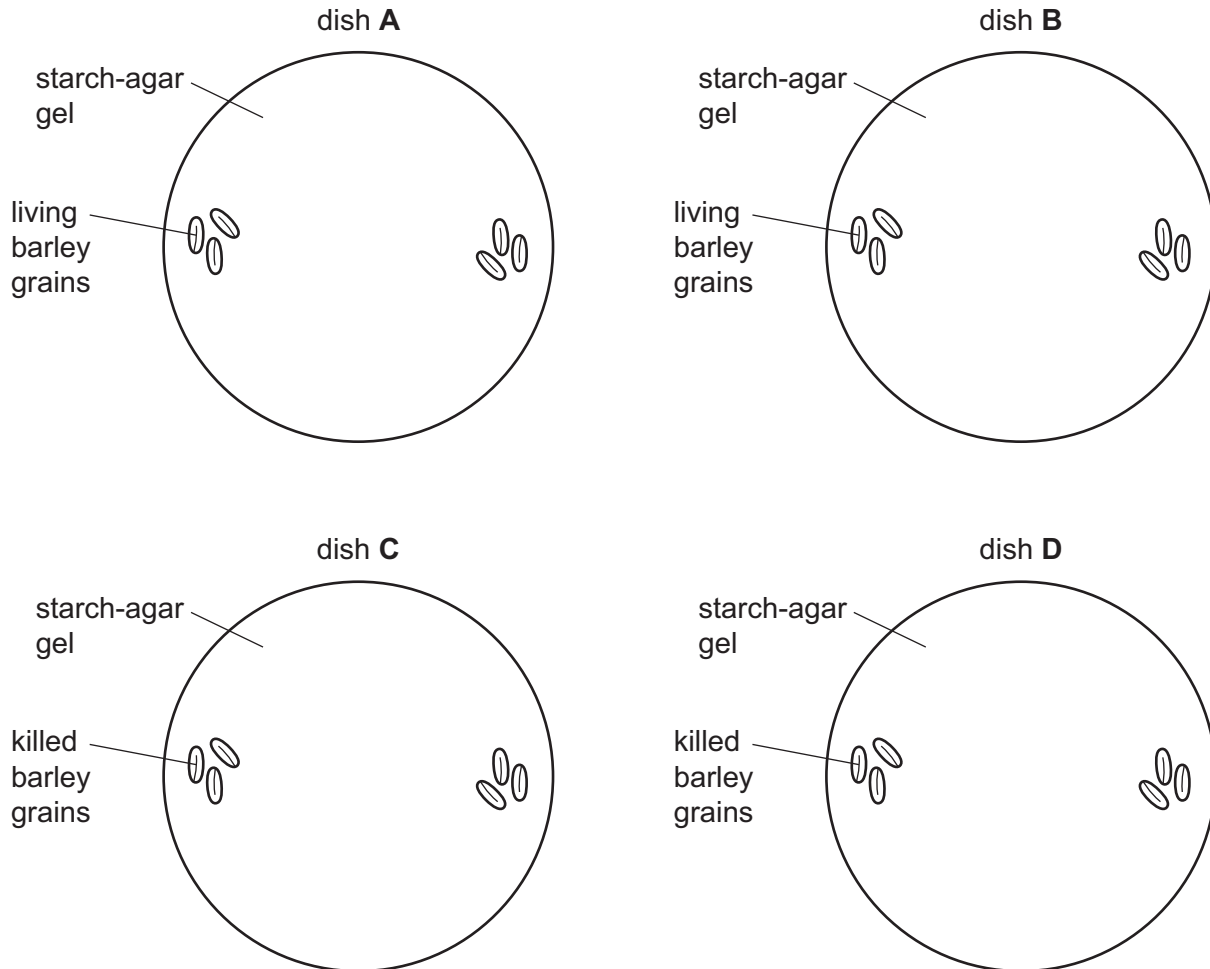


Fig. 1.1

(a) The barley grains were removed from dishes **A** and **C**. The gel in each of these dishes was then covered with iodine solution. The results are shown in Fig. 1.2.

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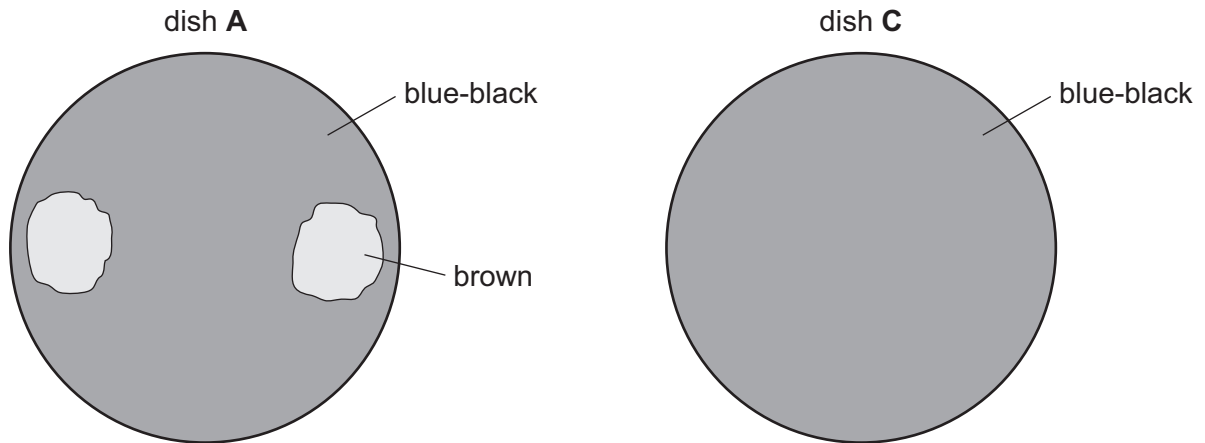


Fig. 1.2

(i) Describe the results in dish **A**.

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

(ii) Write a conclusion based on these results.

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

(iii) In dish **C**, dead barley grains were used. What is the purpose of dish **C**?

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

(b) The gel in each of dishes **B** and **D** was then tested as follows:

- A small piece of starch-agar gel was removed from underneath the barley grains in each dish. These pieces of gel were put into two separate test-tubes.
- Five drops of Benedict's solution were added to each test-tube.
- The test-tubes were placed in a hot water bath for three minutes.
- The results are shown in Table 1.1.

**Table 1.1**

	test-tube <b>B</b>	test-tube <b>D</b>
colour of Benedict's solution before heating	blue	blue
colour of Benedict's solution after heating	orange	blue

(i) Explain what the result in test-tube **B** shows.

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

(ii) Suggest a reason for this result.

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

(c) In these experiments, explain why several barley grains were used in each Petri dish, rather than just one.

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

(d) Suggest how the results in (a)(i) would have been different if

(i) the barley grains in the Petri dishes had been left for a longer period of time,

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

(ii) the Petri dishes had been kept at a lower temperature.

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

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Use

(e) Outline an experiment that you could do to compare the effect on starch-agar gel of two different varieties of seeds.

.....

.....

.....

.....

.....

..... [2]

- 2 A student is finding the mass and volume of a metre rule and then calculating the density of the material of which it is made.

The teacher has given him an unknown mass, **M**, to use in the experiment.

The apparatus is shown in Fig. 2.1.

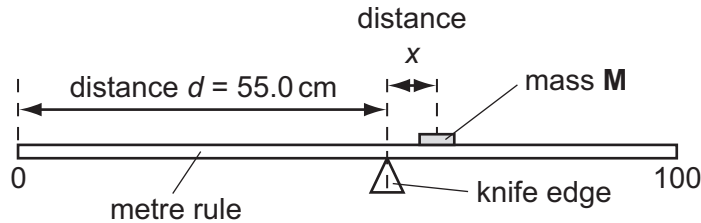


Fig. 2.1

- The student places the knife edge under the 55.0 cm mark of the rule so that distance  $d = 55.0$  cm.
- He places mass **M** on the right-hand side of the rule and adjusts its position until the rule is balanced.
- He records in Table 2.1 the position of mass **M** on the rule and calculates  $x$ , the distance between the knife edge and the centre of mass **M**.
- He adjusts the knife edge so that  $d = 60.0$  cm.
- He moves mass **M** until the rule is balanced again.
- He records the new position of mass **M**, then calculates and records the new value of  $x$ .
- He repeats the procedure for the other values of  $d$  shown in Table 2.1.

- (a) (i) Fig. 2.2 shows the positions of **M** when  $d = 60.0$  cm and  $70.0$  cm.

For each knife edge position, read the rule and record, in Table 2.1, the position of the centre of **M**. [2]

- (ii) Calculate the missing values of  $x$ , the distance from the knife edge to the centre of **M**, and record them in Table 2.1.

[2]

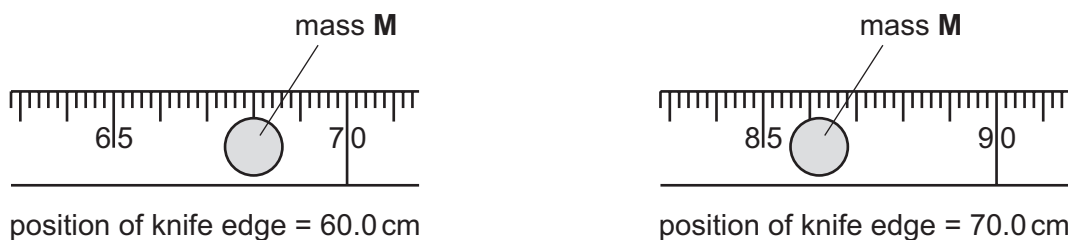


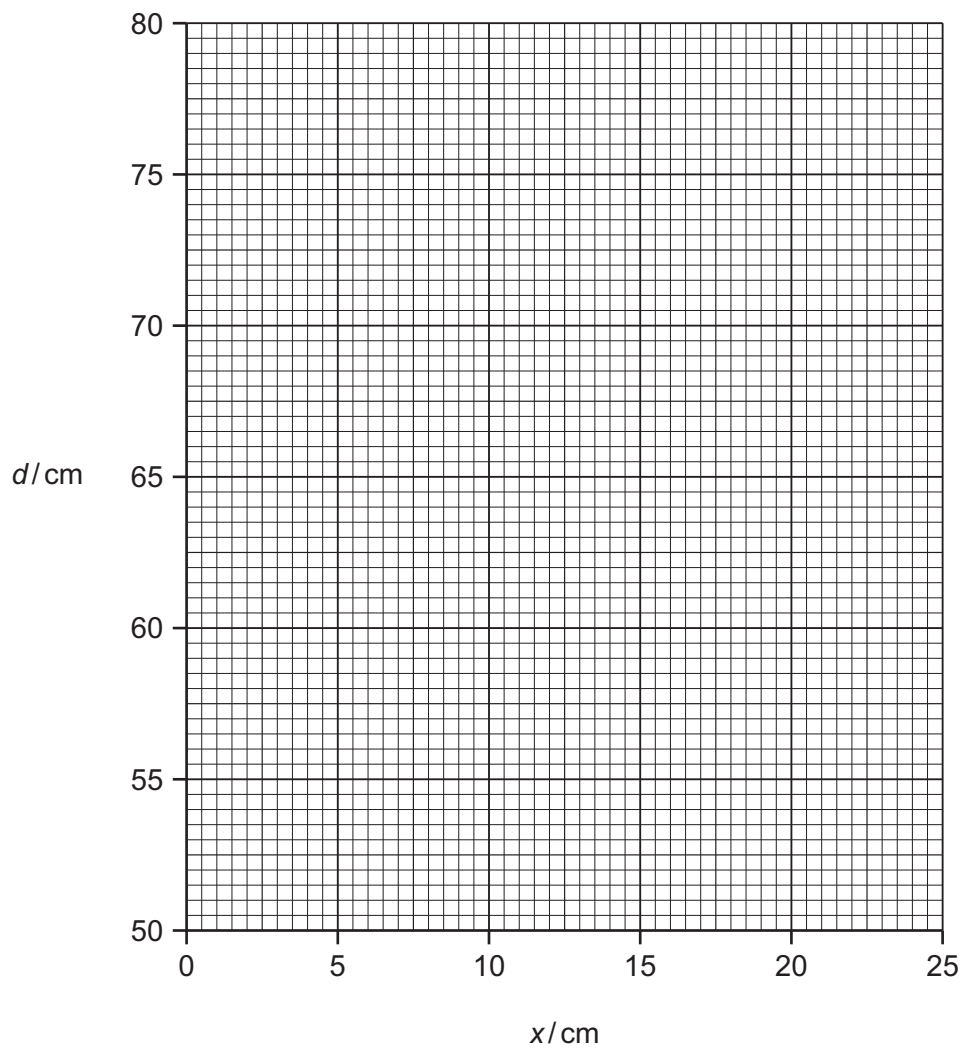
Fig. 2.2

Table 2.1

distance $d$ /cm	position of mass $M$ /cm	distance $x$ /cm
55.0	58.8	3.8
60.0		
65.0	77.1	12.1
70.0		
75.0	94.4	19.9

For  
Examiner's  
Use

(b) (i) On the grid provided, plot a graph of  $d$  against  $x$ . Draw the best straight line.



[2]

- (ii) Find the gradient of the line. Show on your graph the values that you use to calculate the gradient.

For  
Examiner's  
Use

gradient = ..... [2]

- (c) The teacher says that the mass of the metre rule,  $m$ , is given by the equation

$$\text{mass of rule, } m = \frac{150}{\text{gradient}}$$

Use this equation to calculate the mass of the rule.

$m = \dots\dots\dots$ g [1]

- (d) The student measures the dimensions of the metre rule, shown in Fig. 2.3. He wants to use the mass and volume of the rule to determine the density of the material.

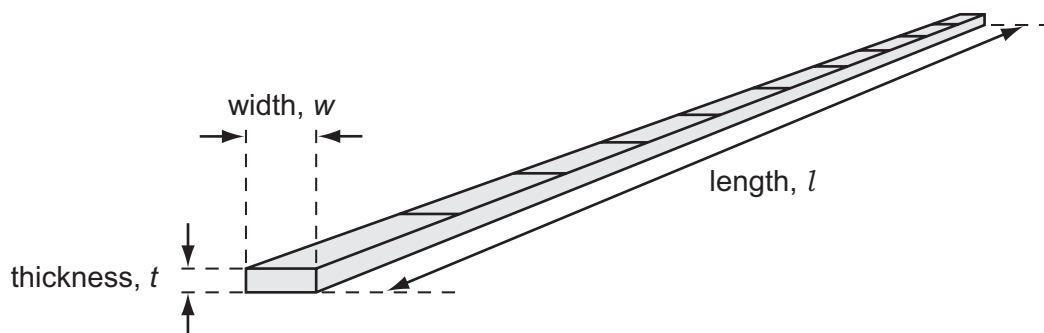


Fig. 2.3

Use the symbols  $l$ ,  $w$ ,  $t$  and  $m$  to write a formula that the student can use to find the density.

density of the material =

[1]



**Please turn over for Question 3.**

3 A student is carrying out tests to identify the ions present in solution **X**.

Table 3.1 shows the tests, observations and conclusions that he has made. Complete Table 3.1.

For  
Examiner's  
Use

**Table 3.1**

	test	observation	conclusion
<b>(a) (i)</b>	To a spatula load of solid <b>X</b> , slowly add dilute nitric acid, with shaking, until the solid has dissolved. Divide the solution into two parts, for use in <b>(a)(iii)</b> and <b>(b)(i)</b> .	Some ..... [1] are seen rising in the solution.  A green solution is formed.	A gas is given off.  Solid <b>X</b> contains ions of metals known as ..... [1] .....
<b>(ii)</b>	Test the gas given off from <b>(a)(i)</b> using limewater.	The limewater turns ..... [1]	Solid <b>X</b> contains carbonate ions.
<b>(iii)</b>	To the first part of the solution from <b>(a)(i)</b> add an equal volume of aqueous silver nitrate.	A ..... [1] ..... is formed.	Solid <b>X</b> contains chloride ions.
<b>(b) (i)</b>	To the second part of the solution from <b>(a)(i)</b> add ammonia solution, with shaking, until it is in excess. Filter the mixture.	A brown precipitate and a dark blue filtrate are obtained.	The brown precipitate is iron(III) ..... ..... [1]

	test	observation	conclusion
<b>(ii)</b>	To a sample of the filtrate from <b>(b)(i)</b> add dilute sulfuric acid until the mixture is just acid. Test with ..... [1] paper to show that the mixture is acid.	The colour of the mixture of the filtrate with dilute sulfuric acid is ..... [1]	The filtrate contains copper(II) ions.
<b>(iii)</b>	To a sample of the residue from <b>(b)(i)</b> add hydrochloric acid and shake until it has dissolved.	The colour of the solution is ..... [1]	The residue contains iron(III) ions.

For  
Examiner's  
Use

- (c)** The student has concluded that solution **X** contains copper(II), iron(III), chloride and sulfate ions.

Write the name and formula of two salts that could have been used to make solution **X**.

name of salt 1 .....

formula .....

name of salt 2 .....

formula .....

[2]

- 4 A student carried out an experiment to investigate the extension of a piece of artery. She set up the apparatus shown in Fig. 4.1.

For  
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Use

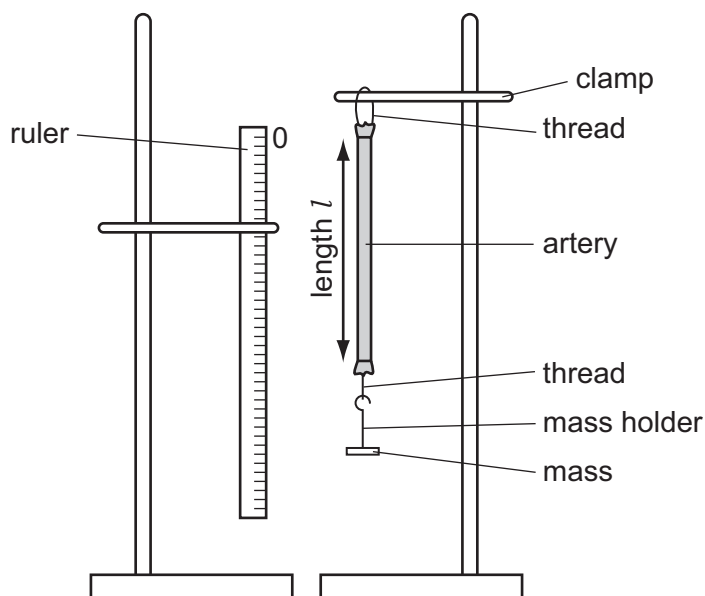


Fig. 4.1

- The student cut a length of artery and tied it firmly at each end.
- She suspended one end of the artery from a clamp.
- She measured the length  $l$  as shown in Fig. 4.1.
- The student then added masses 20 g at a time to the mass holder and measured the value of  $l$  after each addition.

At the end of the experiment the student removed the masses and the artery recoiled (sprang back) to its original length.

The results are shown in Table 4.1.

Table 4.1

mass/g	length $l$ /cm
0	10.0
20	10.9
40	
60	12.5
80	13.0
100	13.5
120	13.7
140	
160	14.1
180	14.1
200	14.1

- (a) (i) Read the scales of the rulers shown in Fig. 4.2. Enter the values for  $l$  in Table 4.1. [2]

For  
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Use

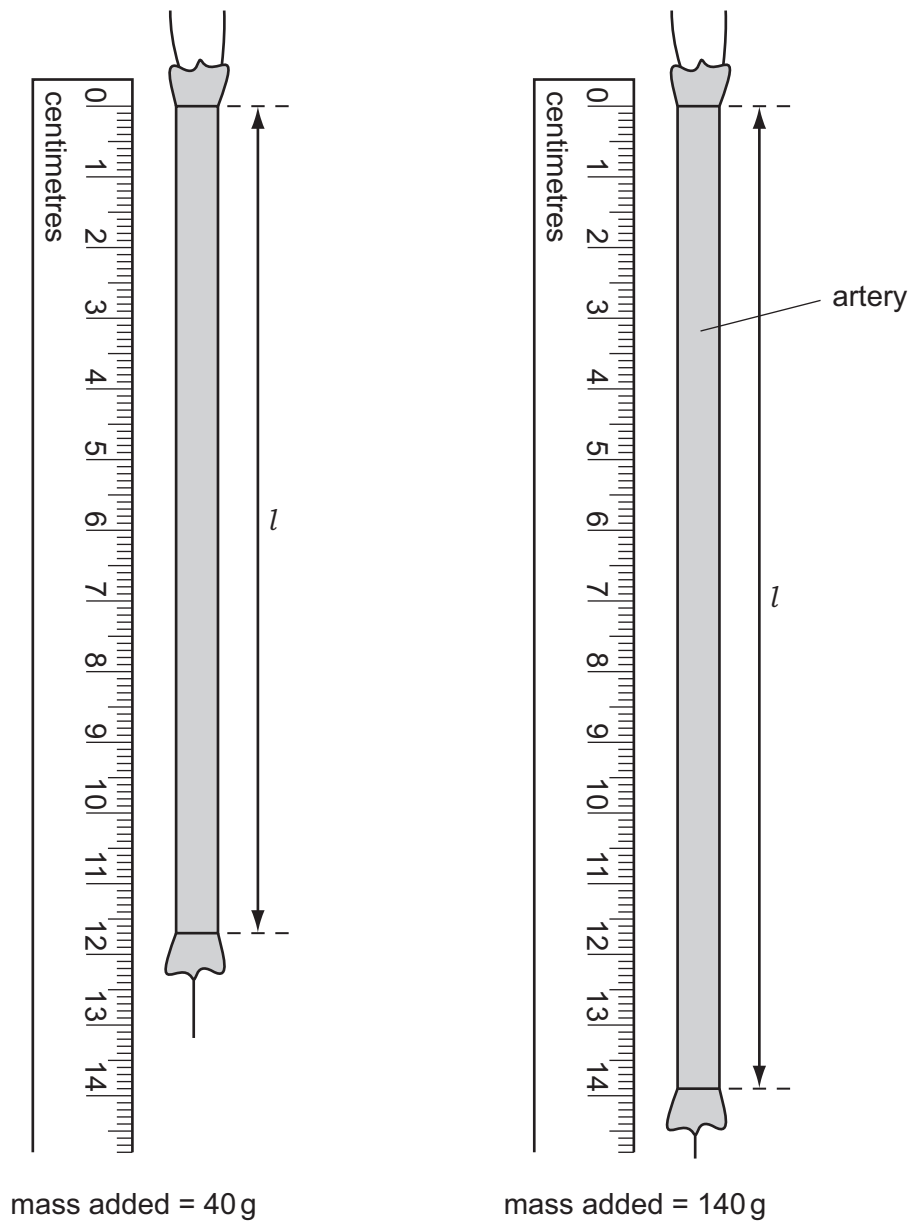


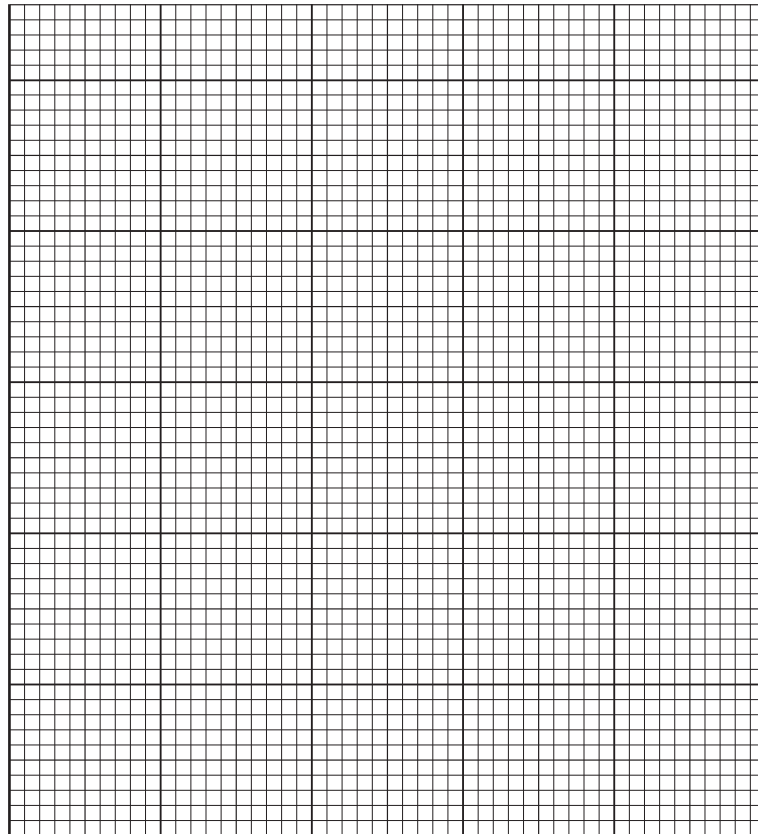
Fig. 4.2

(ii) Plot a graph of length  $l$  against mass. Draw a smooth curve.

[3]

For  
Examiner's  
Use

length  
 $l$  / cm



(iii) Calculate the average extension of the artery per gram of mass added from 0 to 60g,

average extension = ..... cm/g

from 100 to 160g.

average extension = ..... cm/g

[2]

(b) (i) The experiment was carried out on a piece of aorta. This is the artery that comes straight from the heart.

Suggest an advantage to the animal of the ability of the walls of the aorta to stretch and recoil.

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

(ii) Explain why it is important for the artery to be able to cope with large forces as shown in Table 4.1.

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

(c) The student carried out a similar investigation on a piece of vein of the same length.

State **one** other factor she should keep the same to make it a fair test.

..... [1]

- 5 A student is comparing three colourless samples of vinegar, **A**, **B** and **C**. He wants to find out how much acid is in each sample by titrating with aqueous sodium hydroxide.
- He measures out  $50\text{ cm}^3$  of sample **A** and places it in a conical flask.
  - He adds 3 drops of an indicator.
  - He fills a burette to the  $0.0\text{ cm}^3$  mark with aqueous sodium hydroxide and adds it drop by drop to the conical flask until the indicator changes colour.
  - He reads the burette scale and records the volume in Table 5.1.
  - He repeats the procedure using samples **B** and **C**.

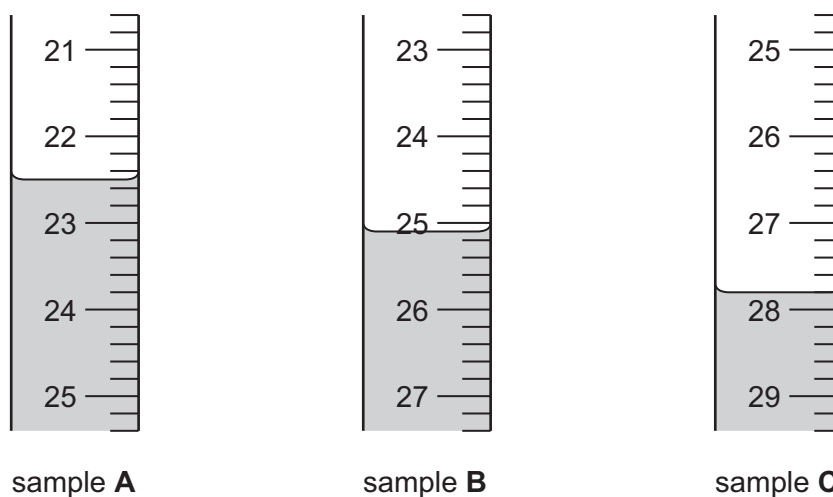
For  
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**Table 5.1**

sample	<b>A</b>	<b>B</b>	<b>C</b>
volume of aqueous sodium hydroxide used / $\text{cm}^3$			

- (a) (i) Fig. 5.1 shows the burette scales for samples **A**, **B** and **C**.

Read the scales and enter the volumes in Table 5.1.



**Fig. 5.1**

[3]

- (ii) Complete the sentence.

..... is the most concentrated sample and  
 ..... is the least concentrated sample of vinegar. [1]



- (b) (i) Vinegar contains ethanoic acid. During the reaction between vinegar and aqueous sodium hydroxide, a salt, sodium ethanoate, is formed.

Complete the word equation for the reaction between ethanoic acid and sodium hydroxide to form sodium ethanoate.



- (ii) Vinegar is a weak acid.

Suggest what colour Universal Indicator (full-range indicator) will turn if it is added to vinegar.

..... [1]

- (c) The student wants to make a sample of sodium ethanoate.

Describe carefully how he can use the results of this experiment to prepare pure dry crystals of sodium ethanoate.

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

- 6 The science class is studying waves made by a vibrating spring.

A piece of spring steel about 25 cm long has a pen fixed at one end. The other end is firmly clamped. When the spring is pulled to one side and then released, it vibrates for a few seconds. The pen makes a mark on a piece of paper that is pulled along while the spring is vibrating.

This is shown in Fig. 6.1.

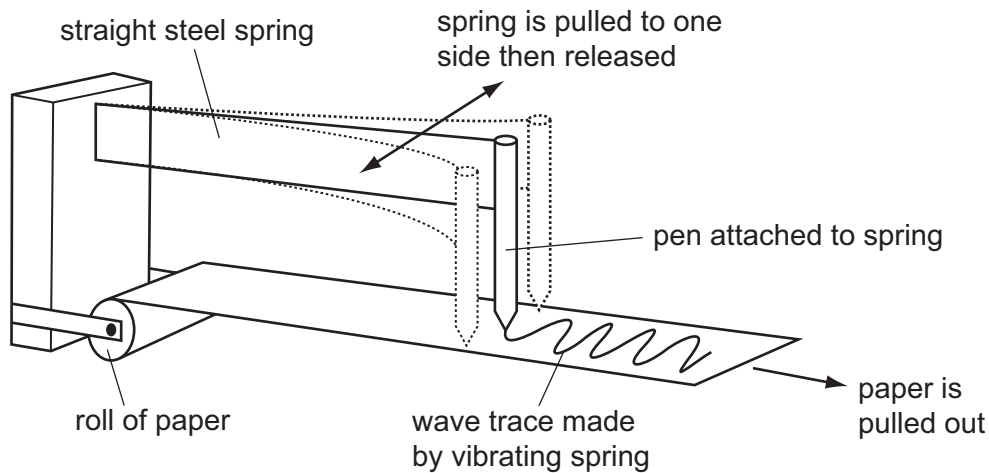


Fig. 6.1

The paper is pulled along at a constant speed. Fig. 6.2 shows the wave drawn by the pen. A student has numbered the waves.

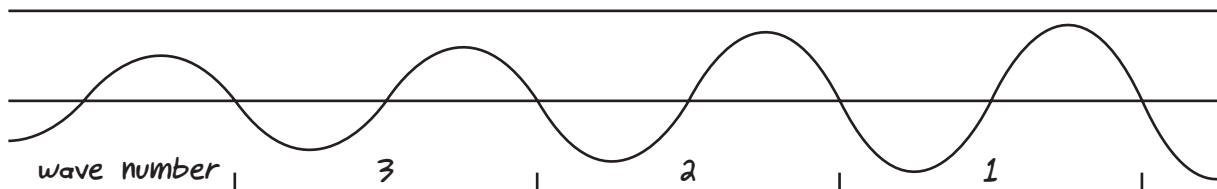


Fig. 6.2

- (a) (i) Describe how the amplitude of the wave changes from **wave 1** to **wave 3**.

..... [1]

- (ii) Use a ruler to measure to the nearest 0.1 cm the wavelength of one of the waves in Fig. 6.2. Use the marks that the student has made.

wavelength = ..... cm [1]

- (iii) The paper moved at a constant speed of 10 cm/s. Use the equation  $speed = frequency \times wavelength$  and your answer to part (ii) to calculate the frequency of the waves caused by the vibration of the steel spring.

frequency = ..... Hz [2]

For  
Examiner's  
Use

The apparatus shown in Fig. 6.1 is then used to find the acceleration of a trolley moving down a slope. This is shown in Fig. 6.3.

For  
Examiner's  
Use

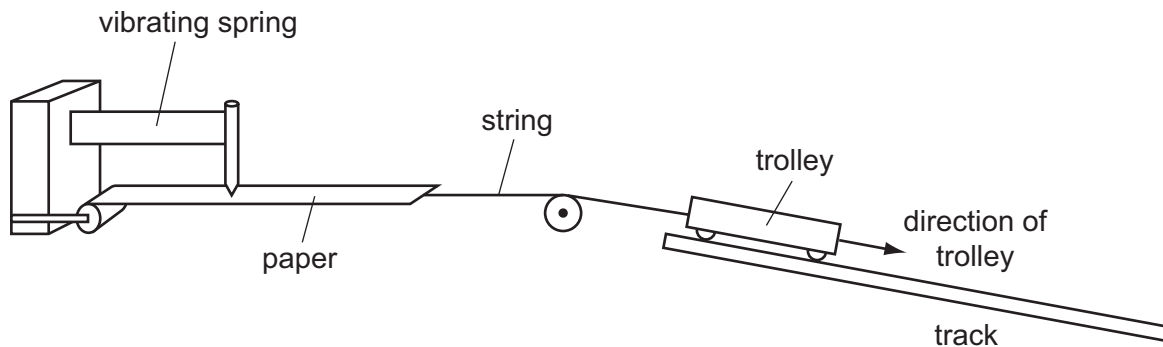


Fig. 6.3

The spring is adjusted so that it vibrates 4 times every second. One complete wave takes 0.25 s.

The trace made by the pen as the trolley moves down the slope is shown in Fig. 6.4. A student has numbered **waves 1 – 9** on the trace.

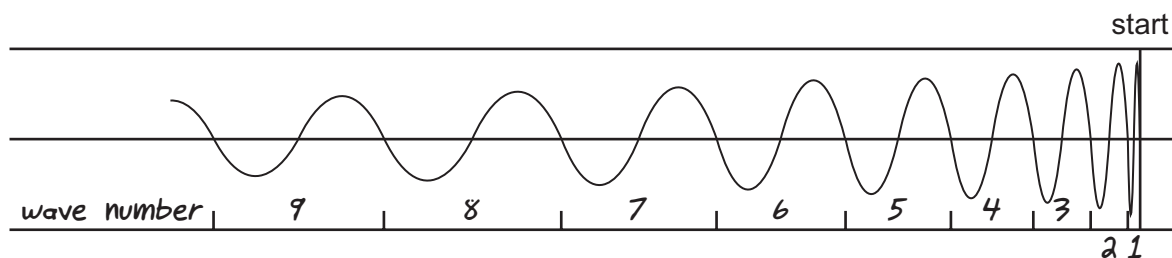


Fig. 6.4

- (b) (i) Use a ruler to measure the wavelength of **wave 4** to the nearest 0.1 cm. Use the marks that the student has made.

wavelength = ..... cm [1]

- (ii) Calculate the average speed of the trolley at this point on the trace. Remember that one wave takes 0.25 s. Give the units of speed of the trolley.

speed of the trolley at **wave 4** = ..... unit ..... [2]

- (c) (i) Measure the wavelength of **wave 9** to the nearest 0.1 cm.

wavelength = ..... cm [1]

For  
Examiner's  
Use

- (ii) Calculate the average speed of the trolley at this point.

speed of the trolley at **wave 9** = ..... [1]

- (d) Use your results from parts (b)(ii) and (c)(ii) to show that the trolley accelerates as it moves down the slope.

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

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