



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
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COMBINED SCIENCE

0653/61

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 **18** printed pages and **2** blank pages.



- 1 Two experiments were set up as in Fig. 1.1. The apparatus is a model of the digestive absorption of starch in the alimentary canal.

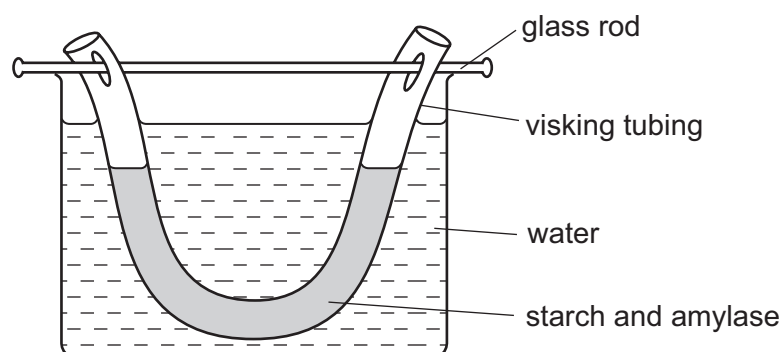


Fig. 1.1

The piece of “visking tubing” represents the alimentary canal. The visking tubing is a selectively permeable membrane, which allows smaller molecules to pass through it but not larger molecules.

In **experiment 1**, the liquid inside the visking tubing was starch solution.

In **experiment 2**, this liquid was a mixture of starch solution and amylase solution.

Both experiments were left for one hour. After this time, the liquid inside the visking tubing and the water in the beaker were each tested with iodine solution and with Benedict's solution.

The results are shown in Table 1.1.

Table 1.1

experiment	liquid tested	test	colour obtained	conclusion
1	inside visking tubing	iodine test		
		Benedict's test	blue	
	water in the beaker	iodine test	brown	
		Benedict's test	blue	
2	inside visking tubing	iodine test	brown	
		Benedict's test	red	
	water in the beaker	iodine test	brown	
		Benedict's test	red	

(a) (i) Fill in the colour that was obtained for the top row of the Table 1.1. [1]

(ii) In the top row of the last column of the table, state what can be concluded from this result. [1]

- (iii) Fill in the remainder of the last column of Table 1.1, stating in each case whether starch or sugar is present or absent.

- (b) (i) Explain what the results from **experiment 2** tell you about the effect of amylase on starch molecules.

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

- (ii) What do the results from **experiment 2** tell you about the ability of sugar molecules to pass through the visking tubing?

Explain your answer.

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

- (c) For the experiment shown in Fig. 1.1,

- (i) state which part of the alimentary canal is represented by the visking tubing,

..... [1]

- (ii) state what the beaker of water represents.

..... [1]

- (d) Using the results of these experiments, explain why starch needs to be digested in the alimentary canal.

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

- 2 A student is doing an experiment with a converging lens. She is using the apparatus in Fig. 2.1.

A converging lens is thicker in the middle and refracts light so that an image of an object can be seen on a screen some distance away.

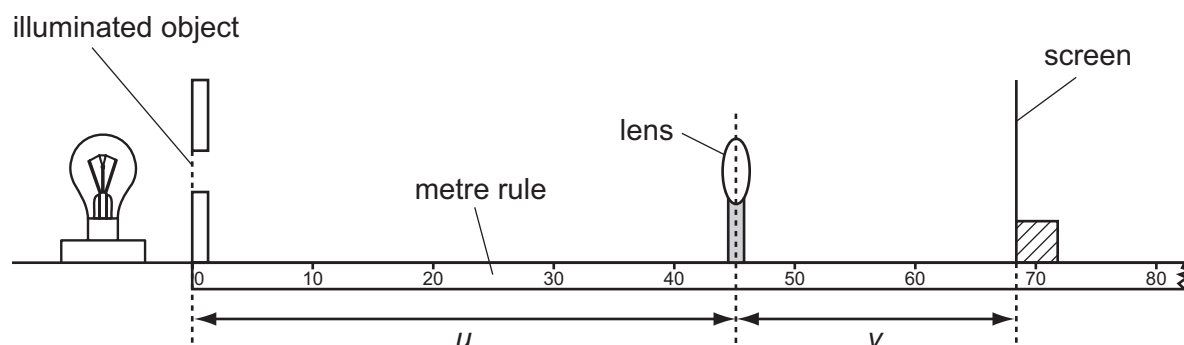


Fig. 2.1

When the lens is in the correct position between the illuminated object and the screen, a sharp image is formed on the screen.

The student is investigating the relationship between u , the distance between the object and the lens and v , the distance between the image on the screen and the lens.

- She places the lens so that u , the distance between the object and the lens, is 45.0 cm.
- She adjusts the position of the screen until a sharp image of the illuminated object is formed on the screen.
- She records, in Table 2.1, the position of the screen on the rule.
- She uses the position of the screen and u to calculate v .
- She calculates the ratio v/u .
- She repeats the procedure for the other values of u shown in Table 2.1, on page 6.

The positions of the screen when the values of u are 45.0 cm and 25.0 cm are shown in Fig. 2.2

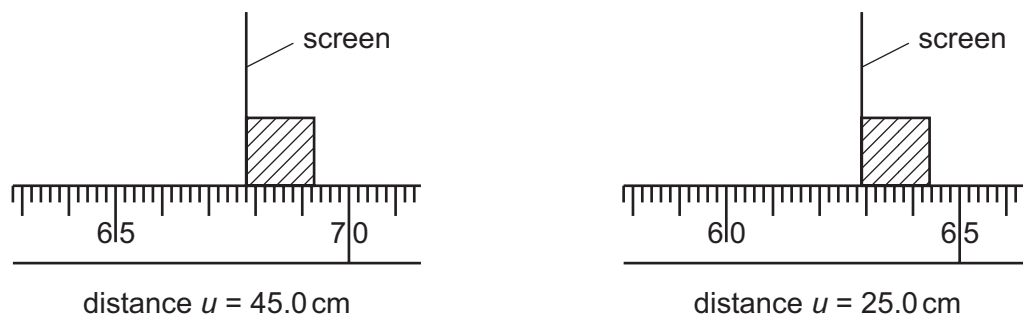


Fig. 2.2

(a) (i) Read the position of the screen for the missing values and record them in Table 2.1. [2]

(ii) Calculate the values of v , when the distances of u are 45.0 cm and 25.0 cm. Record these values in Table 2.1. [2]

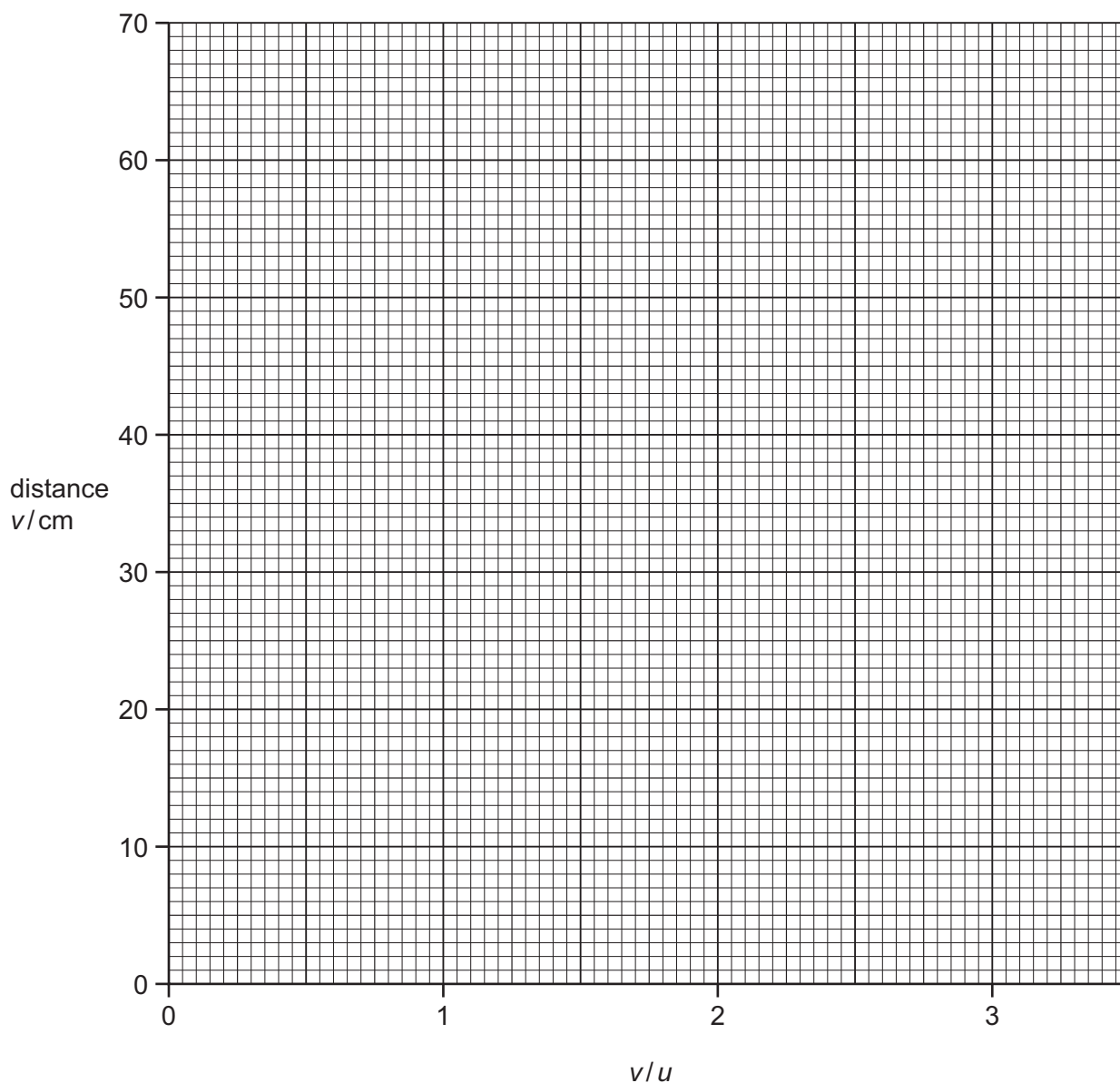
(iii) Calculate the missing values of the ratio v/u . Record them in Table 2.1. [2]

Table 2.1

distance u / cm	position of screen / cm	distance v / cm	ratio v/u
45			
35	61.4	26.4	0.75
30	59.8	29.8	0.99
25			
20	80.2	60.2	3.01

- (b) (i) On the graph grid provided, plot a graph of distance v against the ratio v/u .

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



- (ii) The gradient of the line is a useful number that indicates how much a lens can magnify an image.

Find the gradient of the straight line you have drawn.

Show on your graph the values you use to calculate the gradient.

gradient = ... [2]

- 3 A student has been given solid **X**, a green powder. She carries out tests on solid **X** so that she can identify it.

(a) Test 1

She heats solid **X** as shown in Fig. 3.1.

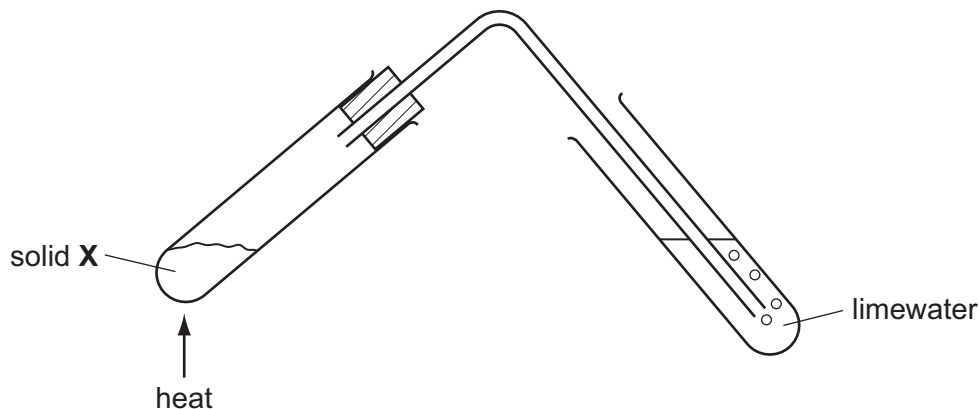


Fig. 3.1

When solid **X** is heated, a gas bubbles into the limewater. The appearance of the limewater changes. A black powder is left in the heated test-tube.

- (i)** Describe the change in the appearance of the limewater.

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

- (ii)** Name the gas that bubbles into the limewater.

..... [1]

- (iii)** As a result of this test, what can the student conclude about solid **X**?

..... [1]

(b) Test 2

The student allows the black powder left in the test-tube to cool. Then she adds dilute nitric acid and shakes the mixture. The black powder dissolves and a blue solution is made. She filters the mixture to obtain a blue filtrate.

Draw a labelled diagram to show how she filters the mixture.

[2]

(c) Test 3

She divides the blue filtrate into two parts. To the first part, she adds a few drops of ammonia solution. A blue precipitate is formed.

- (i) The student thinks that there are copper ions in the blue solution.

Name the blue precipitate.

..... [1]

- (ii) The student adds more ammonia solution until the ammonia is in excess. The appearance of the mixture changes.

State how the appearance of the mixture has changed.

..... [1]

(d) Test 4

To the second part of the blue filtrate from **(b)**, the student adds some iron filings. She shakes the mixture. The tube becomes warm and the appearance of the mixture changes.

Assuming that the blue filtrate does contain copper(II) ions, describe

- (i)** how the appearance of the solution changes,

..... [1]

- (ii)** how the appearance of the iron filings changes.

..... [1]

- (e)** Use the results of **Tests 1 – 4** to state the name and formula of solid **X**.

name

formula [1]

- 4 A student was investigating the structure of plants.

The student had a bean seedling. It is shown in Fig. 4.1.



Fig. 4.1

- (a) (i) Make a large drawing of the seedling in the space provided.

[2]

- (ii) Measure to the nearest millimetre the complete length of the seedling in the photograph in Fig. 4.1.

length = ... mm [1]

- (iii) Measure to the nearest millimetre the complete length of the seedling in your drawing.

length of drawing = ... mm [1]

- (iv) Calculate the magnification of your drawing.

magnification = ... [1]

- (b) The student then prepared a slide of a transverse section of the root of the bean seedling. Fig. 4.2 shows the distribution of the different tissues in this root using a microscope.

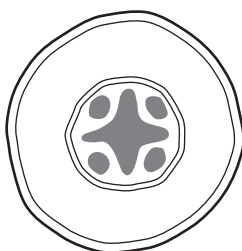


Fig. 4.2

- (i) Draw a clear straight line on **your** diagram in (a)(i) to represent the transverse section that the student made. [1]
- (ii) Label the xylem tissue on Fig. 4.2. [1]
- (c) Outline a method the student could use to find where the xylem tissue is distributed in the stem of the bean seedling.

.....

.....

.....

.....

.....

..... [3]

- 5 The science class is making a display to show the elements in Period 3 of the Periodic Table, as in Fig. 5.1.

A sample of each element is placed next to a card giving its symbol and atomic number.

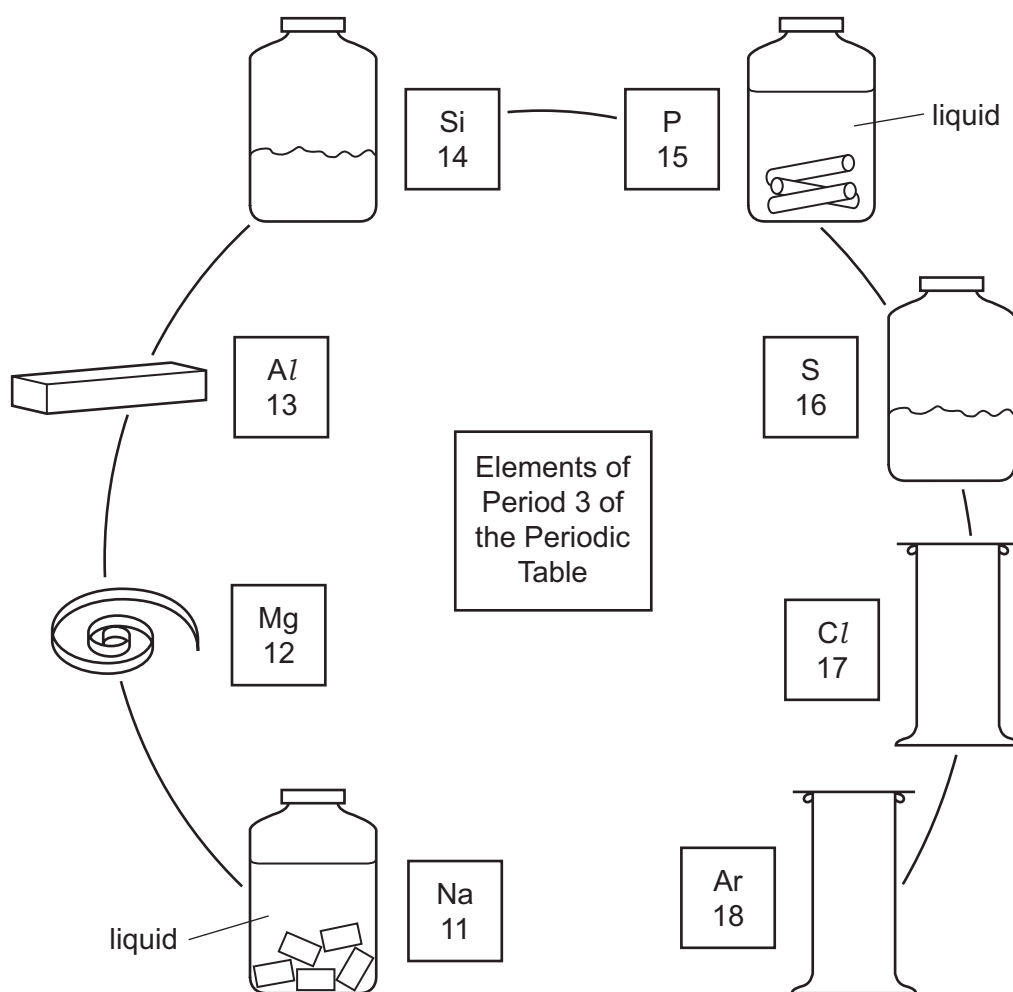


Fig. 5.1

- (a) Write the names of element number 12 and element number 14.

12 14 [2]

- (b) Elements 11 and 15 are contained in bottles and covered with a liquid to prevent the element reacting with air.

One element is covered by water and the other one by oil.

Complete the sentences.

The name of the element covered by water is

The name of the element covered by oil is [1]

- (c) The two gas-jars holding samples of elements 17 and 18 have lost their labels.

How can a student tell from the appearance of the gases which gas-jar contains element number 17?

..... [1]

- (d) Describe an experiment that a student can do to show that element number 13 is a metal.

State the observation that the student will make.

You may draw a diagram to help you.

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

Another student is doing an experiment to show the burning of element number 16 in oxygen. This is shown in Fig. 5.2.

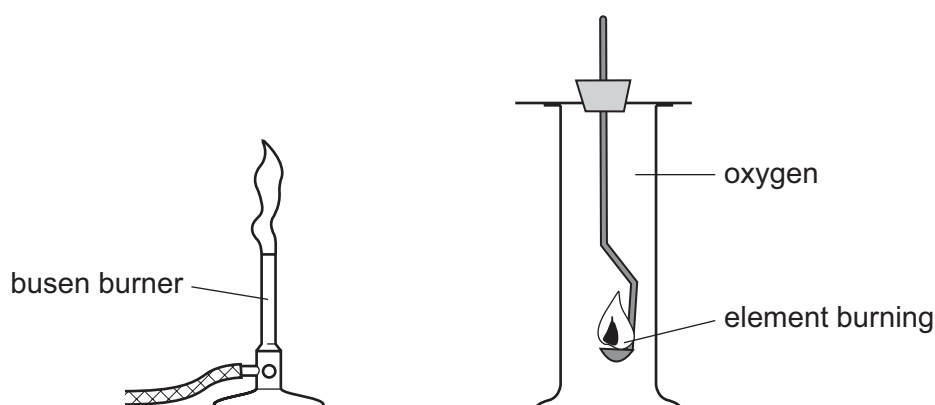


Fig. 5.2

He places some of the powder in a spoon and heats it in a Bunsen flame. When the element ignites, he holds the spoon in the gas-jar of oxygen. After the powder finishes burning, he adds water to the gas-jar, places the lid on and shakes the jar. Then he adds Universal Indicator (full-range indicator) solution.

(e) (i) State the flame colour of the burning element number 16.

..... [1]

(ii) Suggest why the student adds water to the gas-jar.

..... [1]

(iii) State the colour of the Universal Indicator (full-range indicator) in the gas-jar.

..... [1]

(iv) The student does the same experiment with a piece of element number 12.

Suggest the colour of the Universal Indicator in this gas-jar.

..... [1]

Please turn over for Question 6.

- 6 A student is finding the accurate value for the electrical resistance of a piece of resistance wire of length 1 metre. He uses the circuit shown in Fig. 6.1.

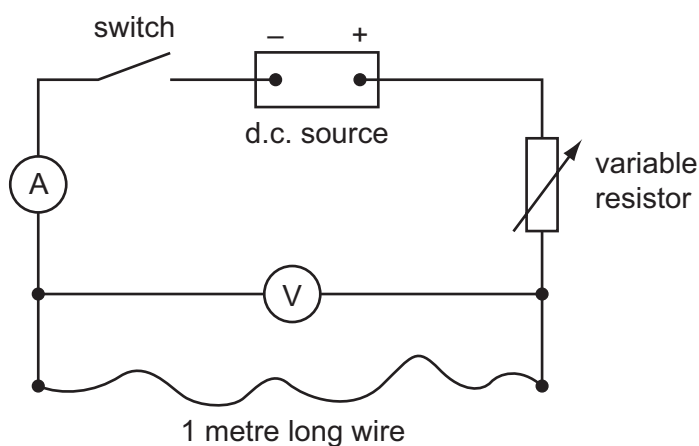


Fig. 6.1

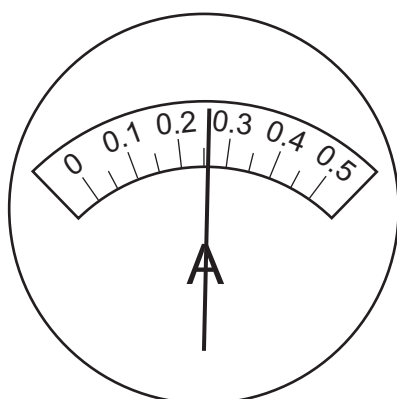
- The student sets the variable resistance at a high value.
- He closes the switch.
- He reads the ammeter to the nearest 0.01 A and the voltmeter to the nearest 0.05 V. He records the values in Table 6.1, reading number **1**.
- He opens the switch and decreases the variable resistance.
- He closes the switch and records the new values for current and voltage, reading number **2**.
- He repeats this procedure until he has five sets of readings.

Table 6.1

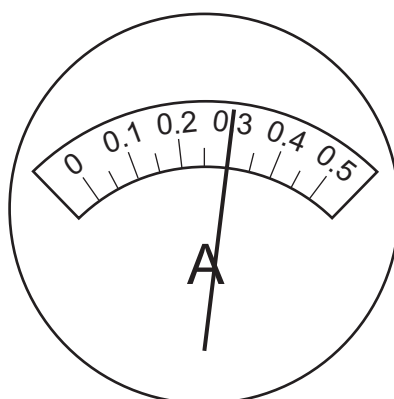
reading number	1	2	3	4	5
current / A	0.16	0.20			0.34
voltage / V	0.90	1.15			2.00
resistance of wire / ohms	5.6	5.7			5.9

- (a) The ammeter and voltmeter dials for the missing readings are shown in Fig. 6.2.

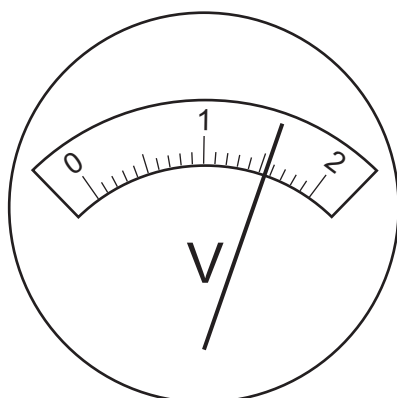
Record in Table 6.1 the values of current and voltage to the nearest 0.01 A and 0.05 V. [4]



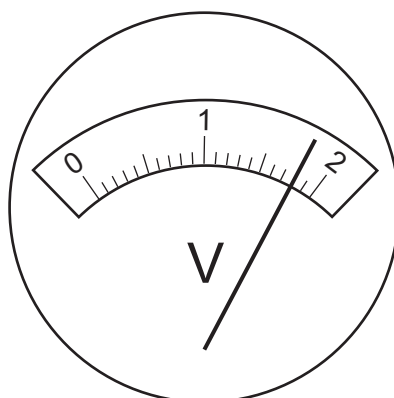
reading number 3



reading number 4



reading number 3



reading number 4

Fig. 6.2

- (b) (i) Find the resistance of the wire using the values for readings numbers 3 and 4 and record the answers in Table 6.1.

Calculate the resistance in ohms to one decimal place.

Use the formula

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

[2]

- (ii) The values of the resistance of the wire obtained from the five readings are the same.

Study the experimental details again.

Suggest a reason why the calculated values of the resistance are not all the same.

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

- (iii) The student decides that reading number **5** gave the best value for the resistance of the wire.

Suggest a better way of using the results to find the resistance of the wire.
(You do not have to find the value for the resistance.)

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

- (c) A current travels through the resistance wire each time that the student closes the switch. The teacher says that when the current is flowing, particles are passed from atom to atom along the wire.

- (i) Name these particles. [1]

- (ii) **On Fig. 6.1**, draw an arrow to show the direction of movement of these particles along the resistance wire. [1]



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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.

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.

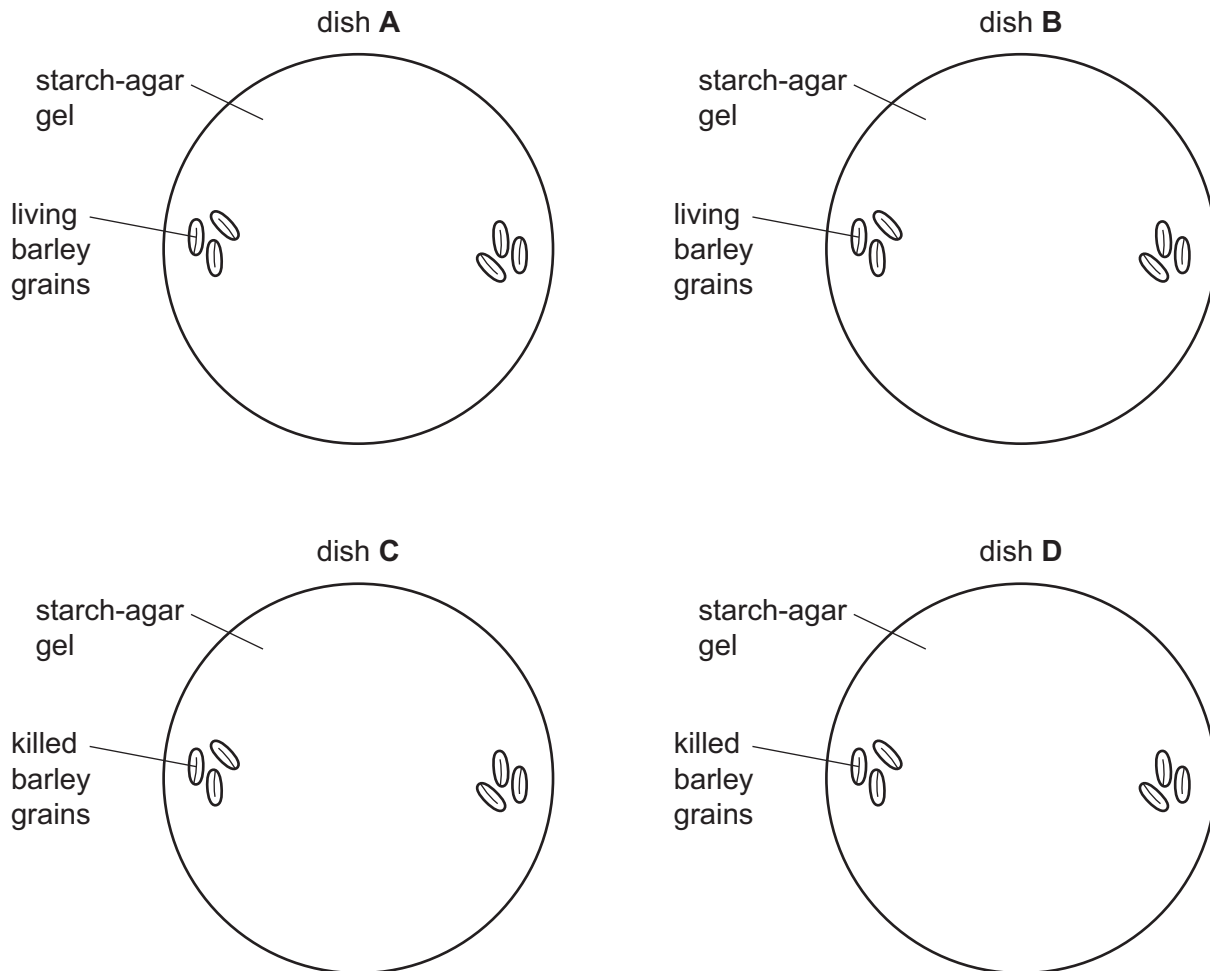


Fig. 1.1

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

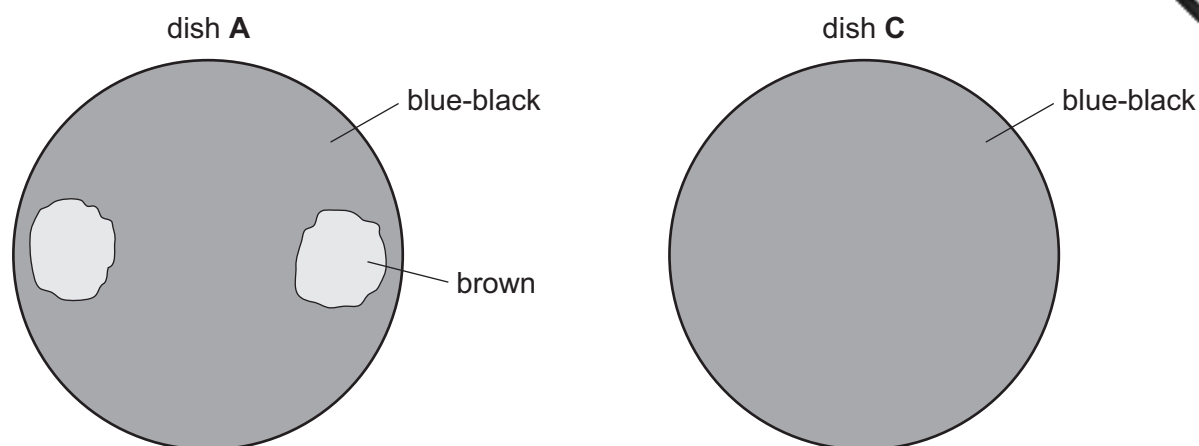


Fig. 1.2

- (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	test-tube D
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]

- (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.

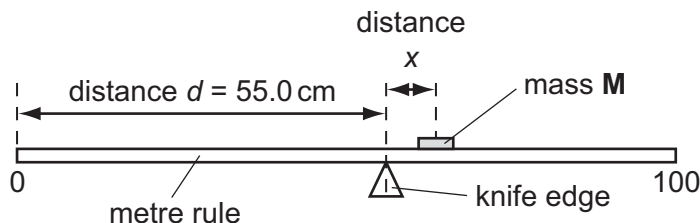


Fig. 2.1

- 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]

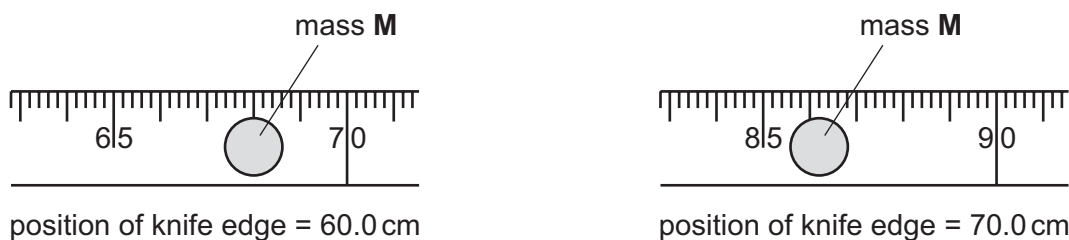
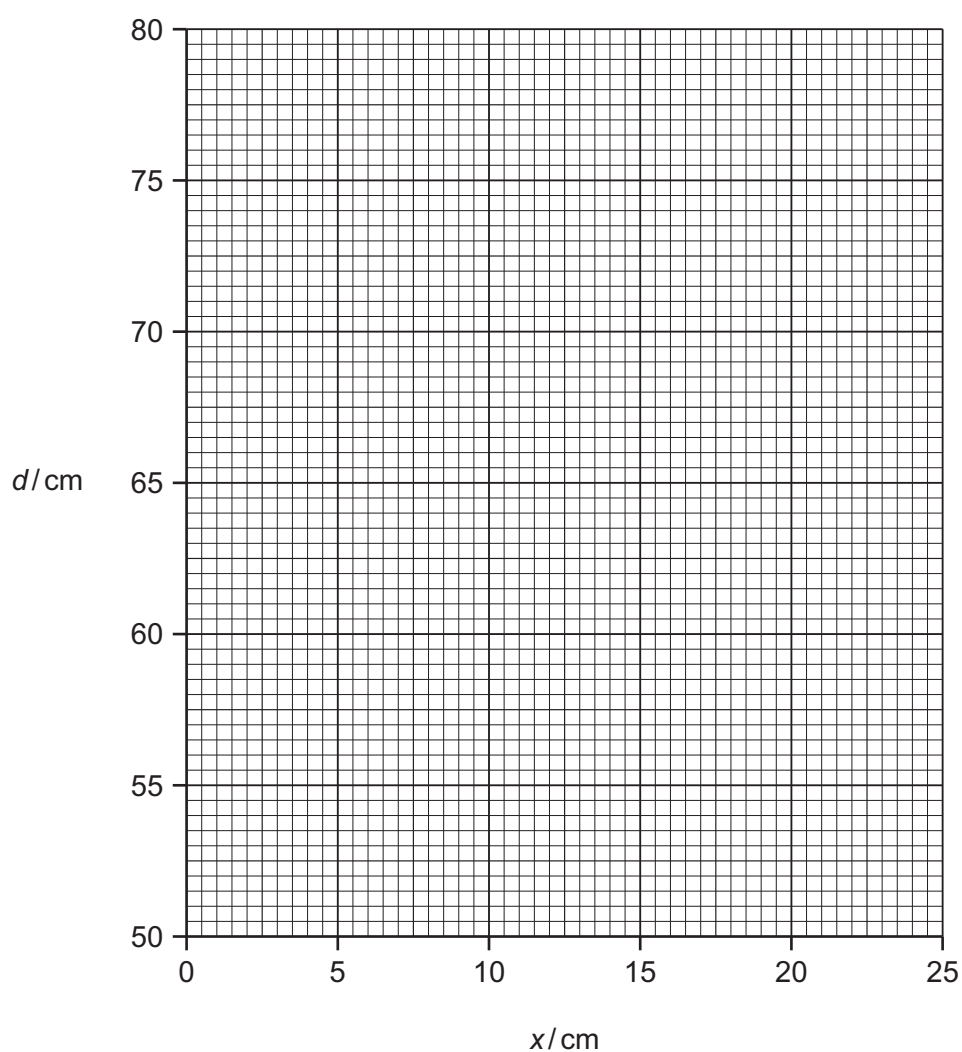


Fig. 2.2

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

(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 calculate the gradient.

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.

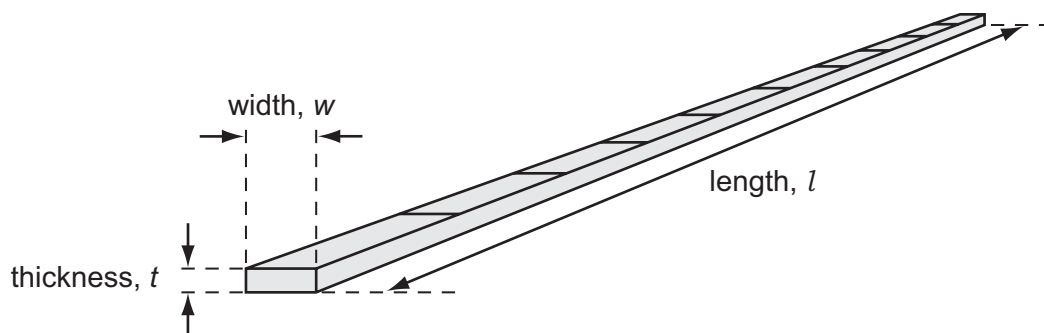


Fig. 2.3

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.

Table 3.1

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

(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.

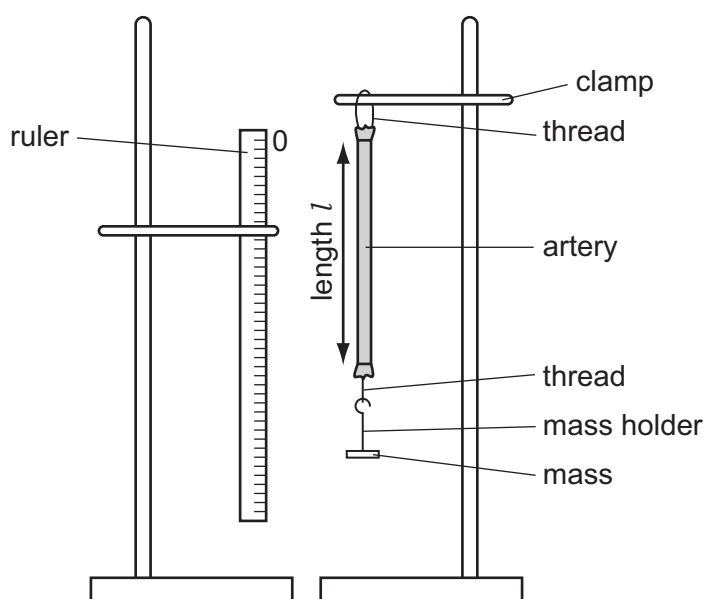


Fig. 4.1

- 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.

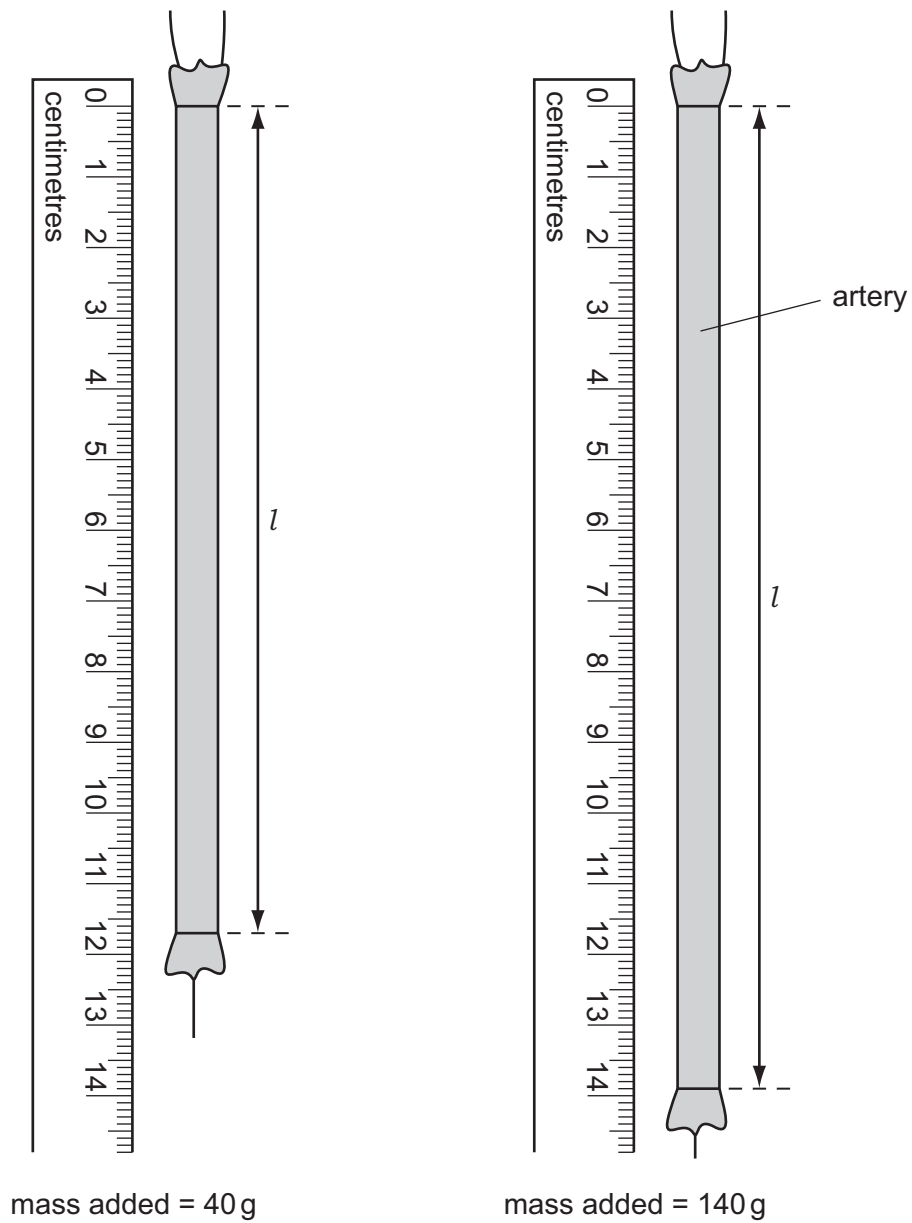
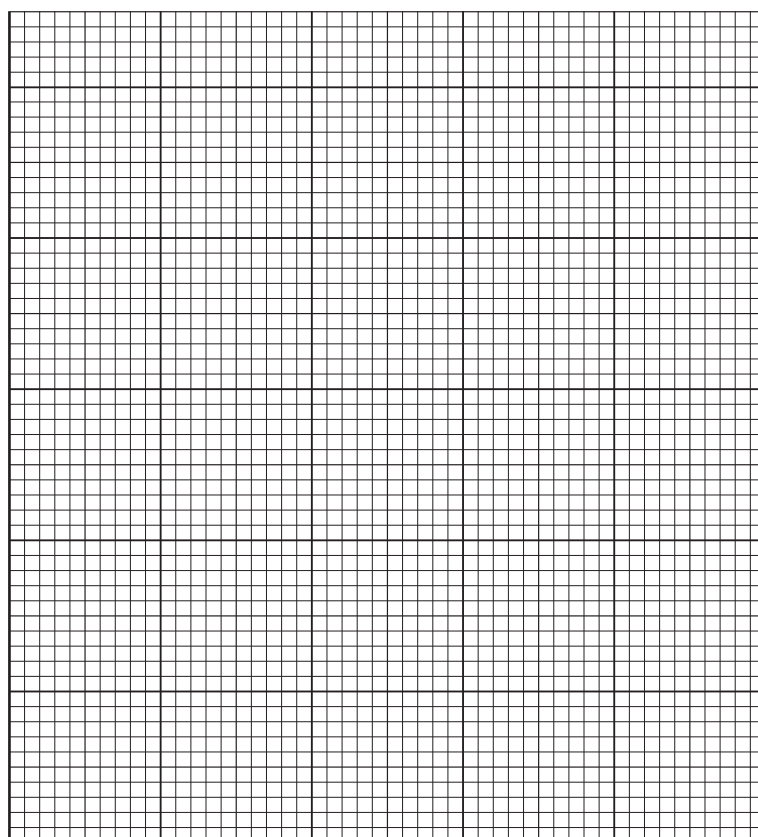


Fig. 4.2

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

length
 l / cm



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

average extension = ... cm/g

from 100 to 160 g.

average extension = ... cm/g

[2]

- (b) (i) The experiment was carried out on a piece of aorta. This is the artery that is 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 out how much acid is in each sample by titrating with aqueous sodium hydroxide.
- He measures out 50 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 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**.

Table 5.1

sample	A	B	C
volume of aqueous sodium hydroxide used / 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.

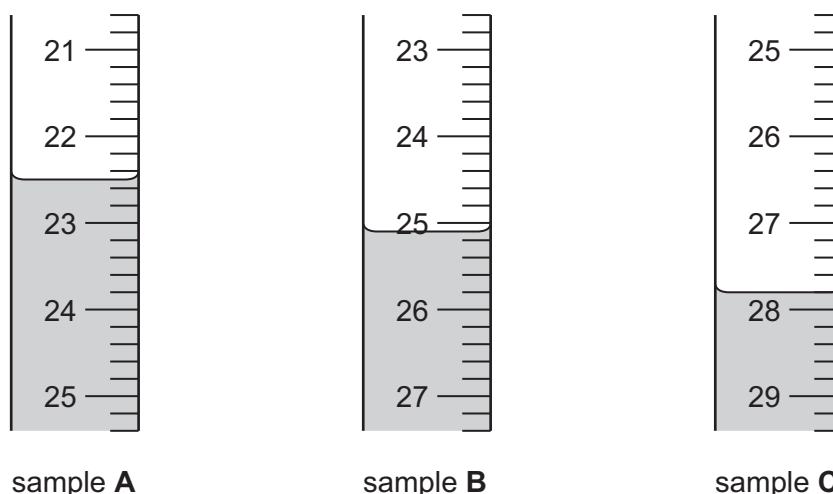


Fig. 5.1

[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.

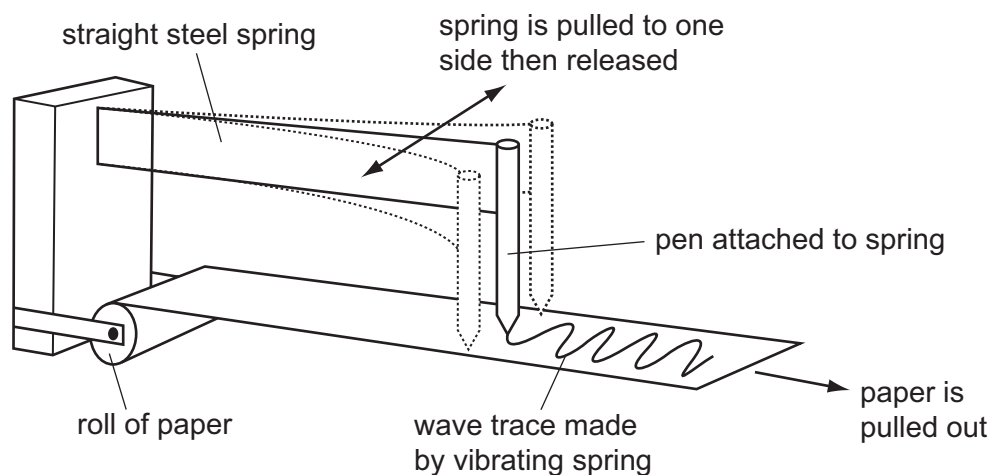


Fig. 6.1

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.

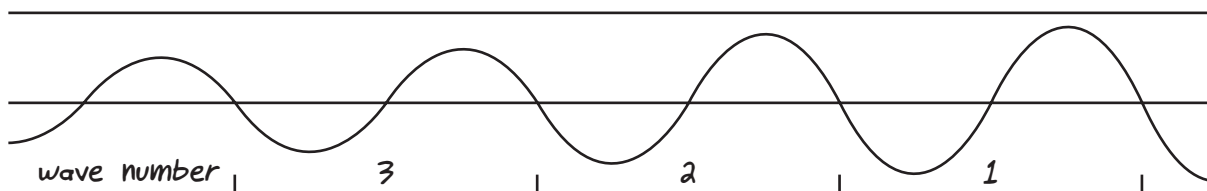


Fig. 6.2

- (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 $\text{speed} = \text{frequency} \times \text{wavelength}$ and your answer to part (ii) to calculate the frequency of the waves caused by the vibration of the steel spring.

frequency = ... Hz [2]

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.

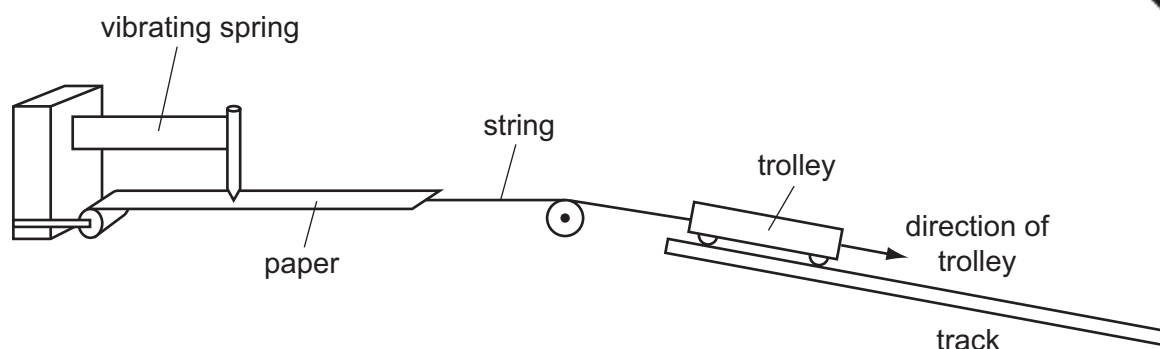


Fig. 6.3

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.

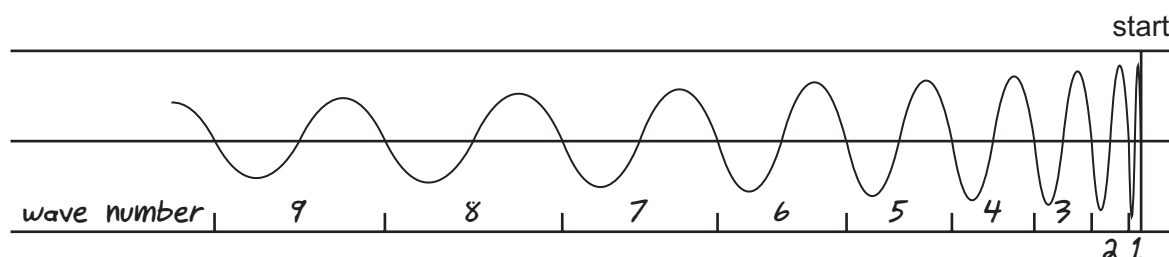


Fig. 6.4

- (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]

- (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]



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

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* 3 6 1 4 7 4 5 0 7 9 *

COMBINED SCIENCE

0653/63

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 Urease is an enzyme. It converts urea to ammonia, which is alkaline.

A student did an experiment in which urease acted on acidified urea. The rate of the reaction was measured by timing how long it took for the acid in the urea solution to be neutralised by the conversion of urea to ammonia.

The student investigated the effect of changing the urease (enzyme) concentration on the rate of the reaction.

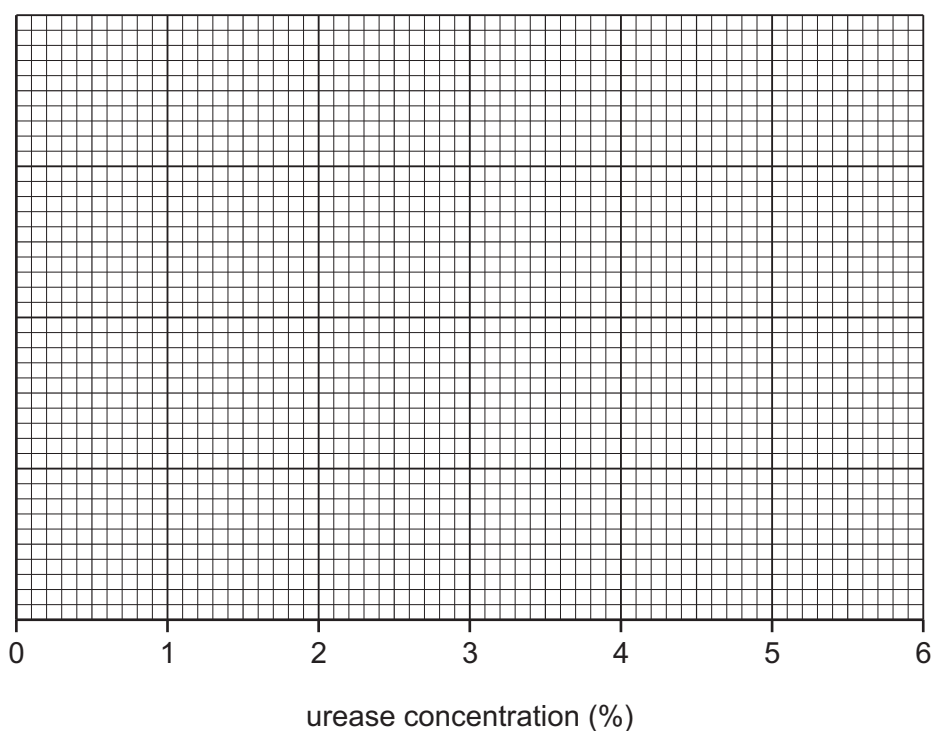
- Five test-tubes, **A**, **B**, **C**, **D** and **E**, were prepared, each containing 5 cm³ acidified urea solution, all of the same concentration.
- Five drops of Universal Indicator (full-range indicator) solution were added to each of the tubes **A** – **E**. The indicator solution turned red because of the acid.
- Five solutions of urease, each a different concentration of urease, were prepared. The concentrations were 1%, 2%, 3%, 4% and 5%.
- 5 cm³ of the 1% urease solution was added to test-tube **A**. The time taken for the indicator solution to change to a blue or green colour was measured.

The procedure was repeated with the other urease concentrations. The results are shown in Table 1.1.

Table 1.1

tube	urease concentration (%)	time taken for colour change / s
A	1	155
B	2	60
C	3	58
D	4	32
E	5	20

- (a) On the grid below, plot a graph of time taken for the colour change (vertical axis) against urease concentration (horizontal axis). Draw a best fit curve.



[3]

- (b) Identify any anomalous result from this experiment, and suggest a possible reason for any such result.

.....

 [1]

- (c) Use the graph to suggest how long the colour change would take for a 6% urease solution.

.....
 [1]

- (d) (i) Describe how this experiment could be modified to investigate the effect of temperature on the action of urease. Include experimental details in your answer.

.....

.....

.....

.....

..... [3]

- (ii) On the axes below, sketch the shape of the graph that would be expected from the results of an experiment investigating the effect of temperature on the action of urease.

Label the axes of the graph.



[2]

Please turn over for Question 2.

- 2 A student is investigating the resistances of two lamps, **X** and **Y**. The resistances of the two lamps are not the same.

The student connects the lamps in the circuit shown in Fig. 2.1. She closes the switch, reads the meters and records the readings in Table 2.1.

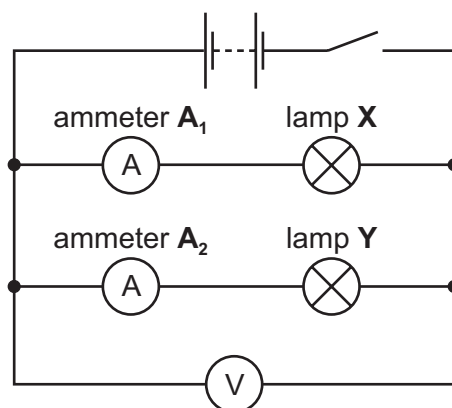


Fig. 2.1

- (a) (i) The ammeter and voltmeter dials are shown in Fig. 2.2.

Read the meters and record the readings in Table 2.1.

[3]

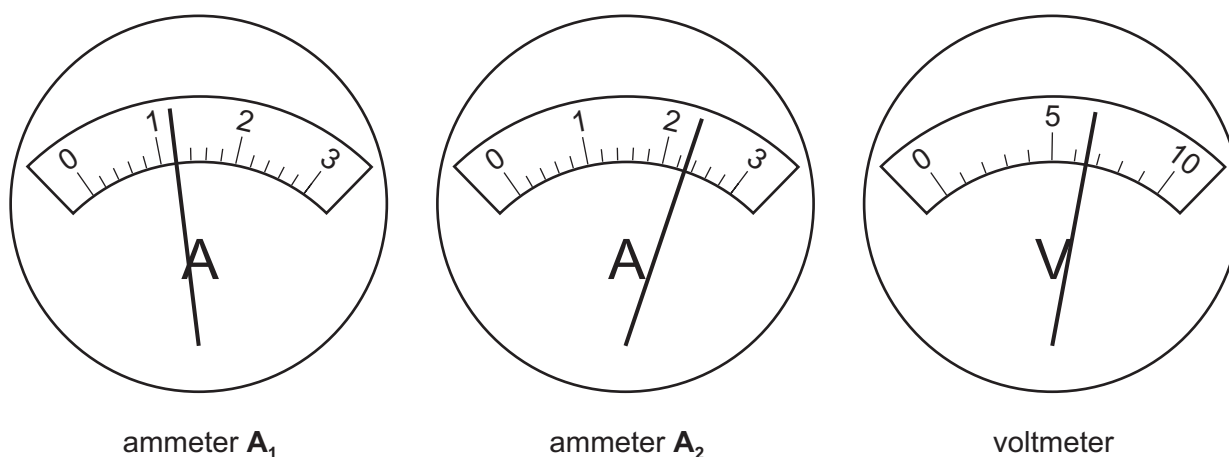


Fig. 2.2

Table 2.1

reading on ammeter A_1 / A	
reading on ammeter A_2 / A	
reading on voltmeter / V	

The student uses the data in Table 2.1 to calculate the resistance of the lamps.

She uses the equation shown below.

$$\text{resistance} = \frac{\text{voltage in volts}}{\text{current in amps}}$$

(ii) Calculate the resistance of lamp X.

resistance of lamp X = ... Ω [1]

(iii) Calculate the resistance of lamp Y.

resistance of lamp Y = ... Ω [1]

The student now connects the lamps in the circuit shown in Fig. 2.3 and closes the switch.

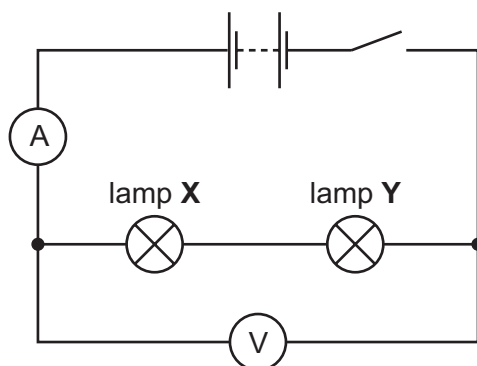


Fig. 2.3

The current shown on the ammeter is 0.75 A. The voltage is the same as in the circuit in Fig. 2.1, and on the voltmeter dial in Fig. 2.2.

(b) Calculate the combined resistance of the two lamps.

Use the equation shown in part (a).

combined resistance of the two lamps = ... Ω [1]

- (c) The student makes the following suggestion.

"The sum of the resistances of the lamps in the parallel circuit is equal to the combined resistance in the series circuit."

Use your values from (a)(ii), (a)(iii) and (b) to comment on this suggestion. Refer to possible experimental error.

.....

.....

.....

..... [2]

- (d) (i) Compare the data in Table 2.1 for the two lamps.

State what the student might observe when the lamps in the circuit shown in Fig. 2.1 on page 6 are lit.

.....

..... [1]

- (ii) Compare the ammeter reading for the circuit in Fig. 2.3 on page 7 with the data in Table 2.1.

State any difference that the student will observe for the lamps in the two circuits.

.....

..... [1]

Please turn over for Question 3.

- 3 A teacher asks a student to compare the heat changes that occur when sodium hydroxide reacts with excess amounts of three different unknown acids, **A**, **B** and **C**.

The three acid solutions all have the same concentration.

- The student places 20 cm³ aqueous sodium hydroxide in a flask.
- He measures the temperature using a thermometer and records it in Table 3.1.
- He adds 10 cm³ of acid **A** and stirs the mixture.
- He measures the maximum temperature reached, and records it in Table 3.1.
- He repeats the experiment using acids **B** and **C** and aqueous sodium hydroxide of the same concentration as before.

Table 3.1

acid	temperature of aqueous sodium hydroxide / °C	maximum temperature of mixture / °C	temperature change / °C
A	18.0		
B	19.5		
C	18.5		

- (a) The thermometer scales for the maximum temperatures of the mixtures of alkali and acids **A**, **B** and **C** are shown in Fig. 3.1.

Read the scales and record the temperatures in Table 3.1.

[3]

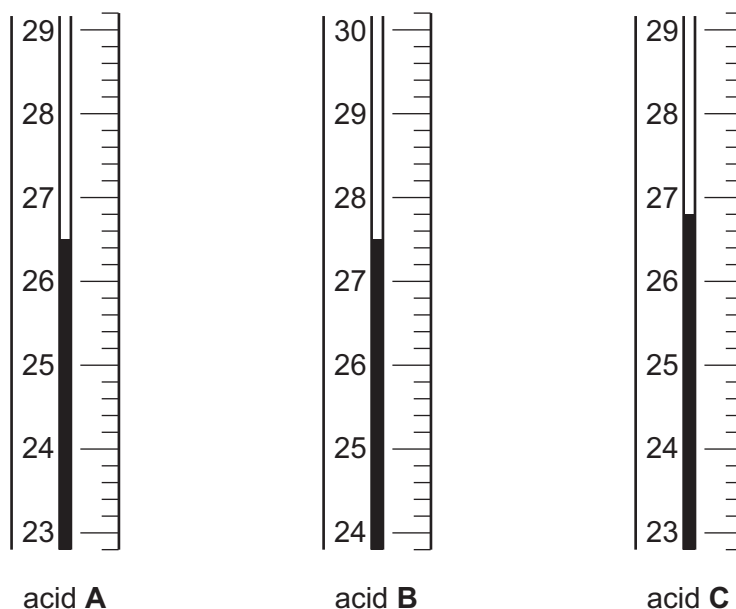
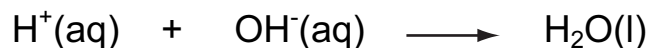


Fig. 3.1

- (b) (i) Calculate the temperature change for each mixture and complete Table 3.1.
(ii) Are these reactions exothermic or endothermic? Explain your answer.

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

- (c) The teacher gives the student a chemical equation showing how the ions from the acid and the alkali react together.



Explain, using details of the experiment and this equation, why approximately the same temperature change took place each time although three different acids were used.

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

- (d) The student thinks that doubling the concentration of the alkali, while keeping the acid in excess, might improve the accuracy of the experiment.

In a second set of experiments he uses sodium hydroxide of double the concentration.

This time, the temperature change is about 16 °C.

Suggest why the results for this second set of experiments will have smaller percentage errors than those for the first set.

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

- (e) The teacher asks the student to find out which of the three acids **A**, **B** and **C** is hydrochloric acid.

The student adds a few drops of a test solution to samples of the three acids. He observes a reaction and concludes that acid **A** is hydrochloric acid.

Name the test solution and state the observation that the student makes.

name of test solution

observation

..... [2]

- 4 A student was studying some changes in the water of an aquarium containing aquatic plants. The aquarium was placed in a sunny environment.

The student used two probes to study the changes. One probe monitored the dissolved oxygen levels. The other probe monitored pH.

The pH probe was used to follow changes in carbon dioxide levels in the water. When carbon dioxide dissolves in water it produces an acidic solution. As the level of carbon dioxide dissolved increases, the pH decreases.

The probes were attached to a computer for 28 hours. Data collected from both probes were displayed as graphs on the screen of the computer as shown in Fig. 4.1.

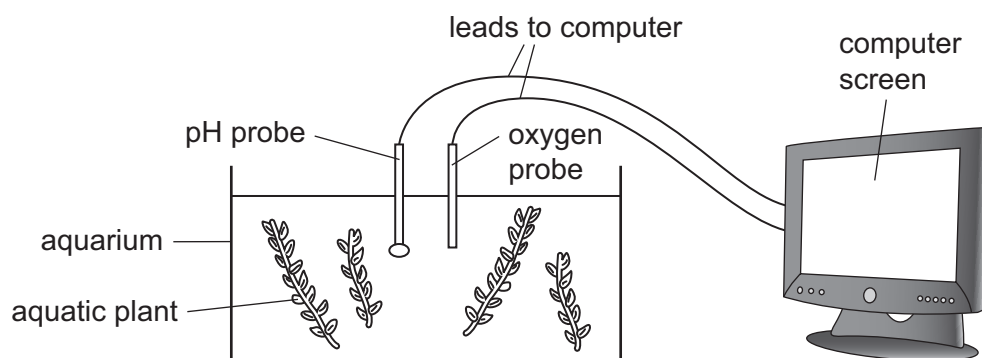


Fig. 4.1

- (a) The graph from the pH probe was printed after 28 hours. It is shown in Fig. 4.2.

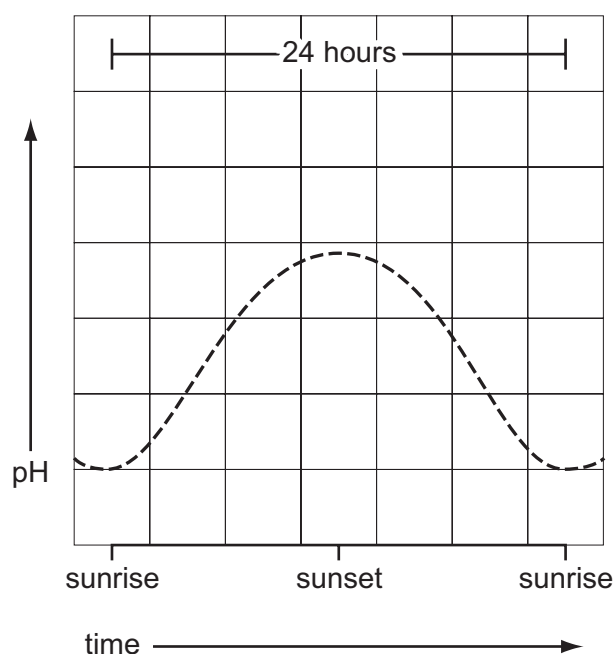


Fig. 4.2

- (i) Describe the change in pH level during the 24 hour period from sunrise to sunrise.

.....
 [1]

- (ii) Describe what is happening to the concentration of carbon dioxide in the aquarium during the 24 hours.

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

- (iii) Explain, in terms of respiration and photosynthesis, why the carbon dioxide levels change in the aquarium during the 24 hours.

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

- (b) Fig. 4.3 shows the oxygen curve from the experiment.

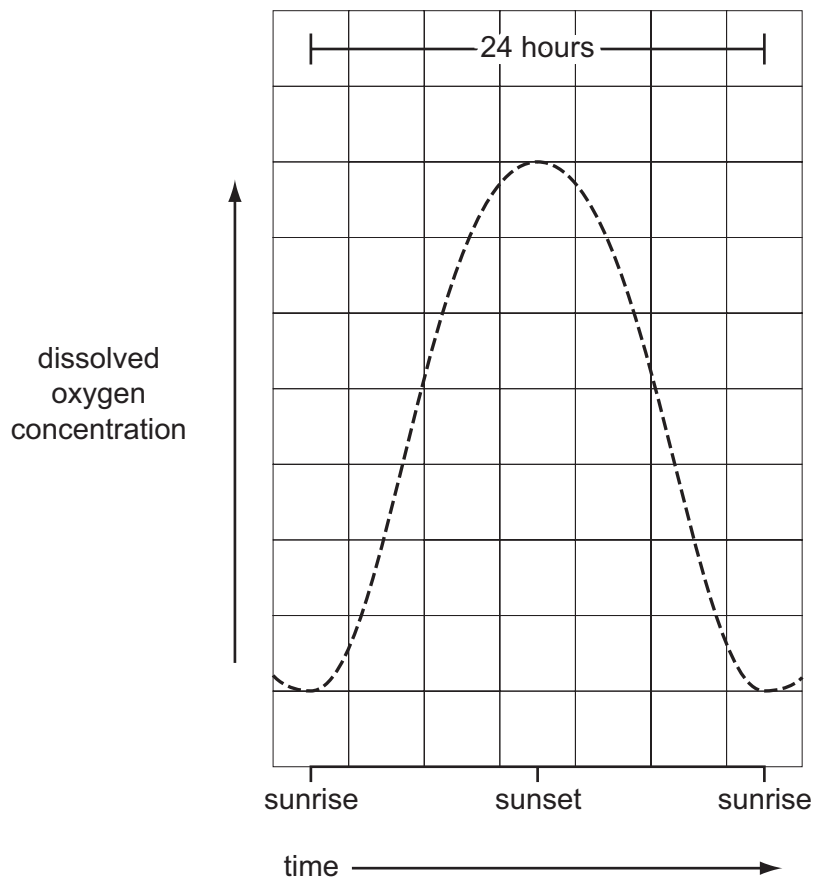


Fig 4.3

- (i) Put the letter **X** on a part of the curve that has the fastest rate of photosynthesis. [1]

- (ii) Suggest a reason for the recorded change in oxygen concentration between **sunset** and **sunrise**.

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

- (iii) Draw a curved line on Fig. 4.3 to show how the oxygen curve would be different during the 24 hour period if it was a cloudy day. [1]

- (c) The student used the apparatus to compare the rate of photosynthesis in the aquarium at different light intensities.

Outline a method for her investigation. You should include

- how she set up the apparatus,
- how she varied the light intensity,
- what measurements she took.

.....
.....
.....
.....
.....
.....
..... [3]

- 5 A student is making the salt magnesium sulfate using dilute sulfuric acid and powdered magnesium carbonate.

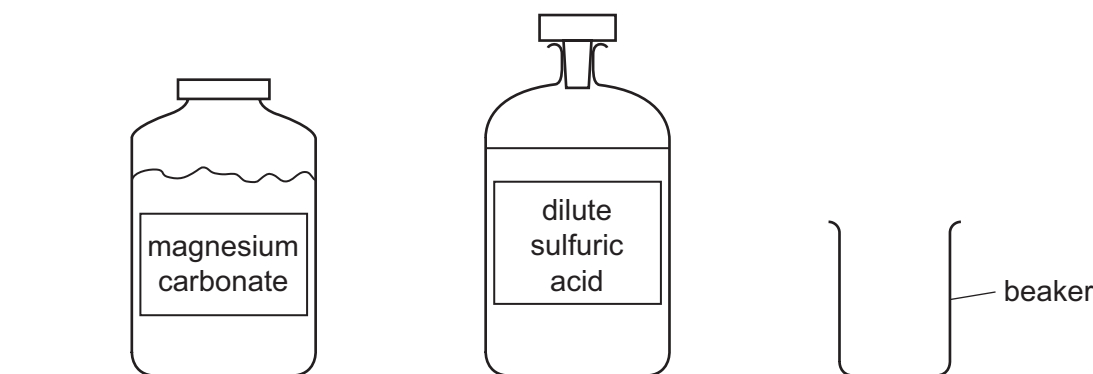


Fig. 5.1

- (a) (i) He places 100cm^3 dilute sulfuric acid in a beaker and reacts it with magnesium carbonate powder.

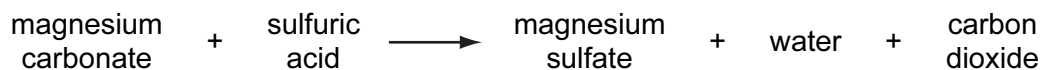
Name **two** other pieces of apparatus, not shown in Fig. 5.1, that the student will need to carry out this experiment.

1

2 [2]

- (ii) The reaction takes place at room temperature. Magnesium carbonate is insoluble in water.

The equation for the reaction is shown below.



Suggest **two** observations that will tell the student when he has added enough magnesium carbonate to react with all the sulfuric acid.

1

2 [2]

- (b) When the reaction has finished, the magnesium carbonate is in excess in the mixture.

Draw a labelled diagram to show how the excess magnesium carbonate can be separated from the mixture.

[2]

- (c) (i) The student wishes to make crystals of magnesium sulfate from the magnesium sulfate solution.

Explain how he can do this.

.....

.....

.....

.....

.....

[3]

- (ii) The student has made some small crystals of magnesium sulfate.

Explain how he can grow one large crystal of this substance.

.....

.....

.....

[1]

- 6 A student is using a ray box which emits two parallel beams of light. The student is investigating how a mirror, a lens and a glass block will affect the direction of the beams.

Experiment 1

The ray box is placed so that the beams meet a mirror at an angle, shown in Fig. 6.1. The rays are reflected on to a screen.

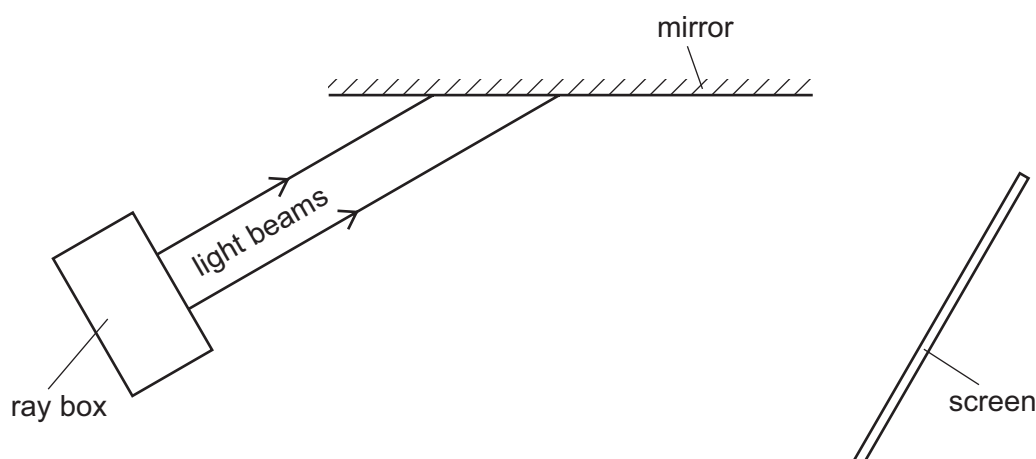


Fig. 6.1

- (a) (i) Use a protractor to draw lines on Fig. 6.1 showing the paths of the reflected beams from the mirror to the screen. [2]
- (ii) State the law that enables you to draw the rays.

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

Experiment 2

The ray box is placed so that the beams of light pass through a converging lens, Fig. 6.2. A converging lens is thicker in the middle and refracts rays of light so that they bend towards each other.

A focal point, **F**, is marked on the diagram. The beams of light pass through the lens, through the focal point and on to the screen.

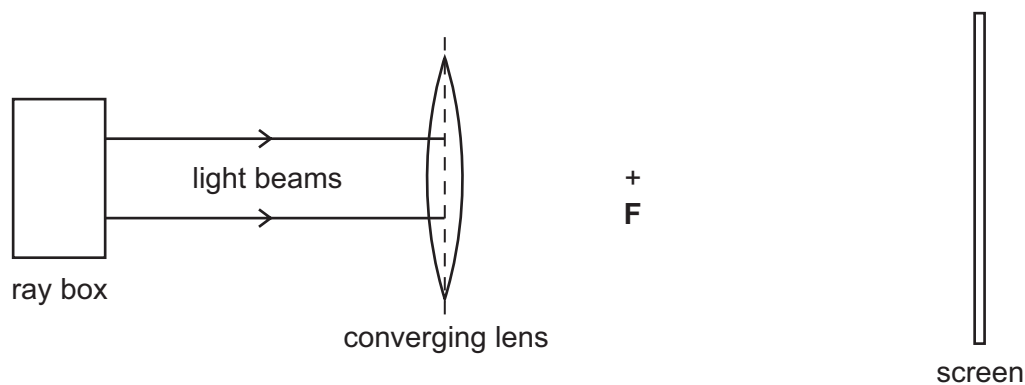


Fig. 6.2

- (b)** On Fig. 6.2, draw lines to show the paths of the two beams from the lens on to the screen.

Measure, to the nearest 0.1 cm, the distance between the two points where your drawn rays meet the screen.

distance = ... cm [1]

Experiment 3

The ray box is placed so that the rays pass through a parallel-sided glass block and on to the screen on the opposite side. This is shown in Fig. 6.3.

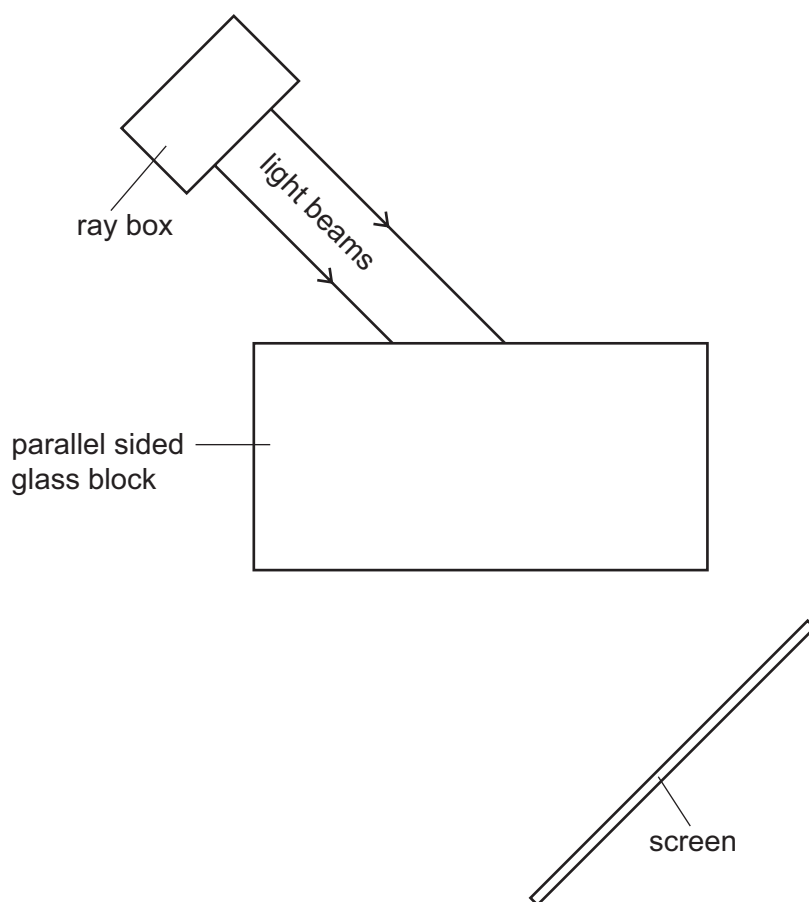


Fig. 6.3

- (c) (i) Use a ruler to draw lines on Fig. 6.3 to show the possible paths of the two beams of light as they pass through the glass block and on to the screen.

Draw the lines as accurately as possible. [4]

- (ii) At the point where **one** of the beams enters the block, draw a line at 90° to the edge of the glass block.

Label the angle of incidence and the angle of refraction. [2]