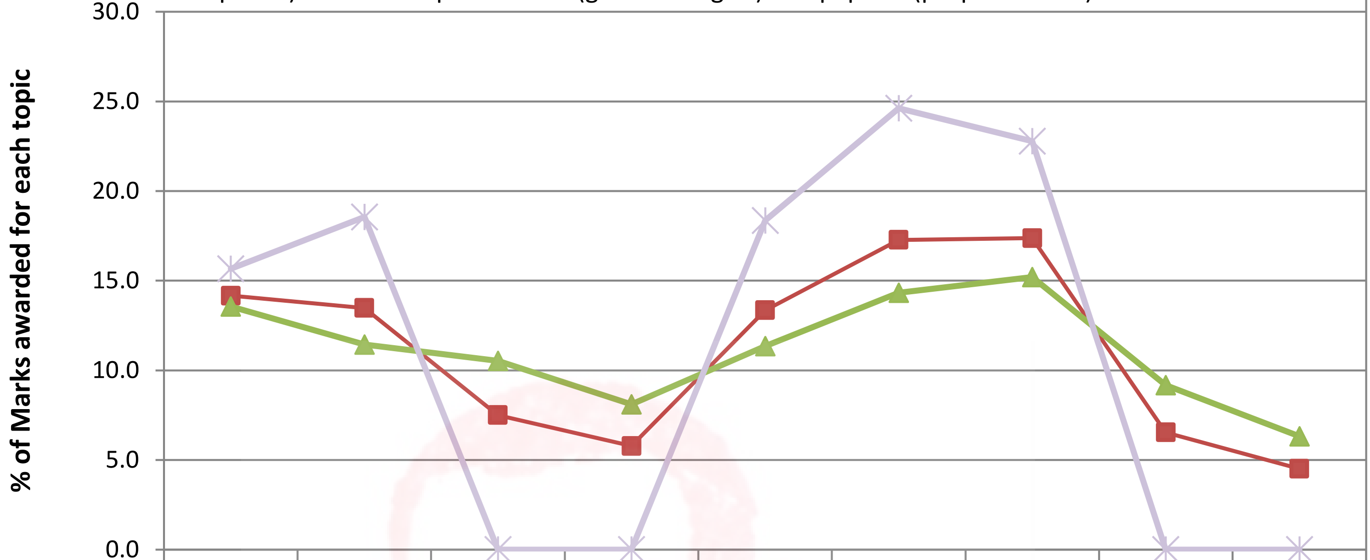
Name: Class: Date:

iG Phx 1 EQ 15w to 02s P6 4Students 163marks

For these stats only papers 3 (which after 2016 became paper 4) and paper 6 were used to investigate these topics.

iG Phx CIE 0625 PAPERS 3 and 6

Percentage of all WEIGHTED marks awarded for P3 & 6 each topic from s2002 to w2014 (red squares) and % of Paper 3 marks (green triangles) and paper 6 (purple crosses)

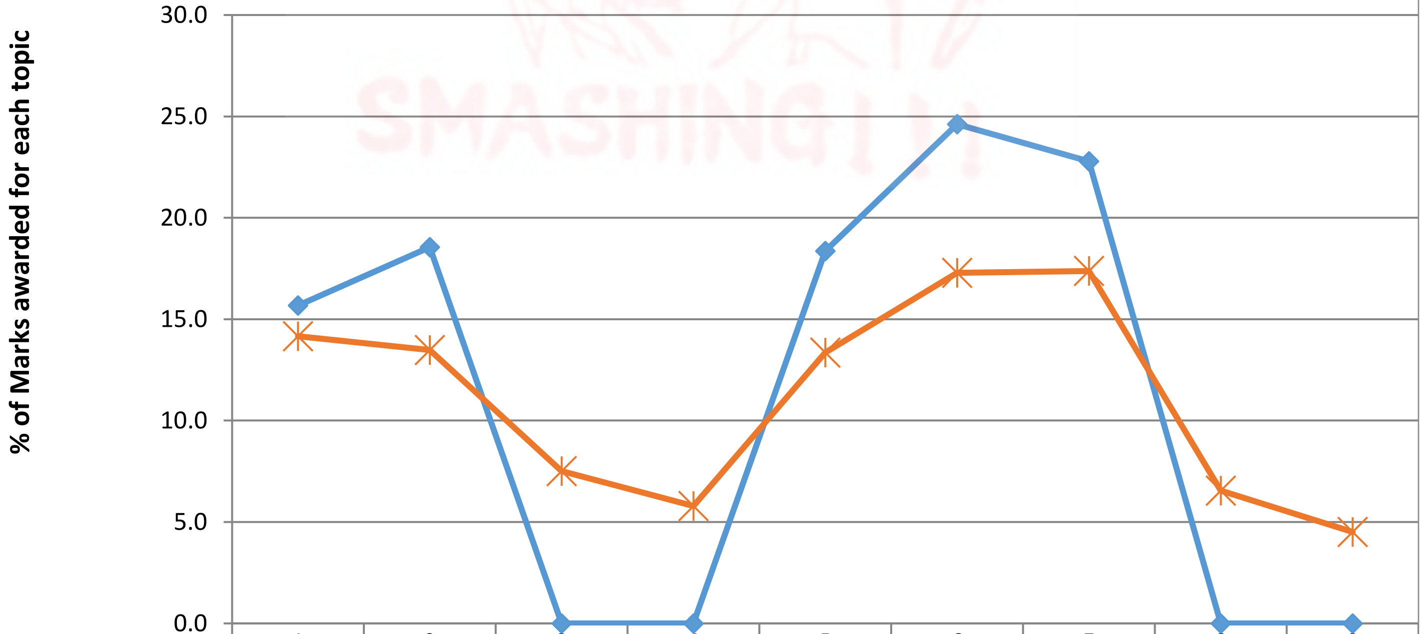


	1	2	3	4	5	6	7	8	9
PhxBoth P3&6	14.2	13.5	7.5	5.8	13.4	17.3	17.4	6.5	4.5
PhxP3	13.6	11.4	10.5	8.1	11.3	14.3	15.2	9.2	6.3
PhxP6	15.7	18.6	0.0	0.0	18.4	24.6	22.8	0.0	0.0

Papers 3 and 6 Topic Number

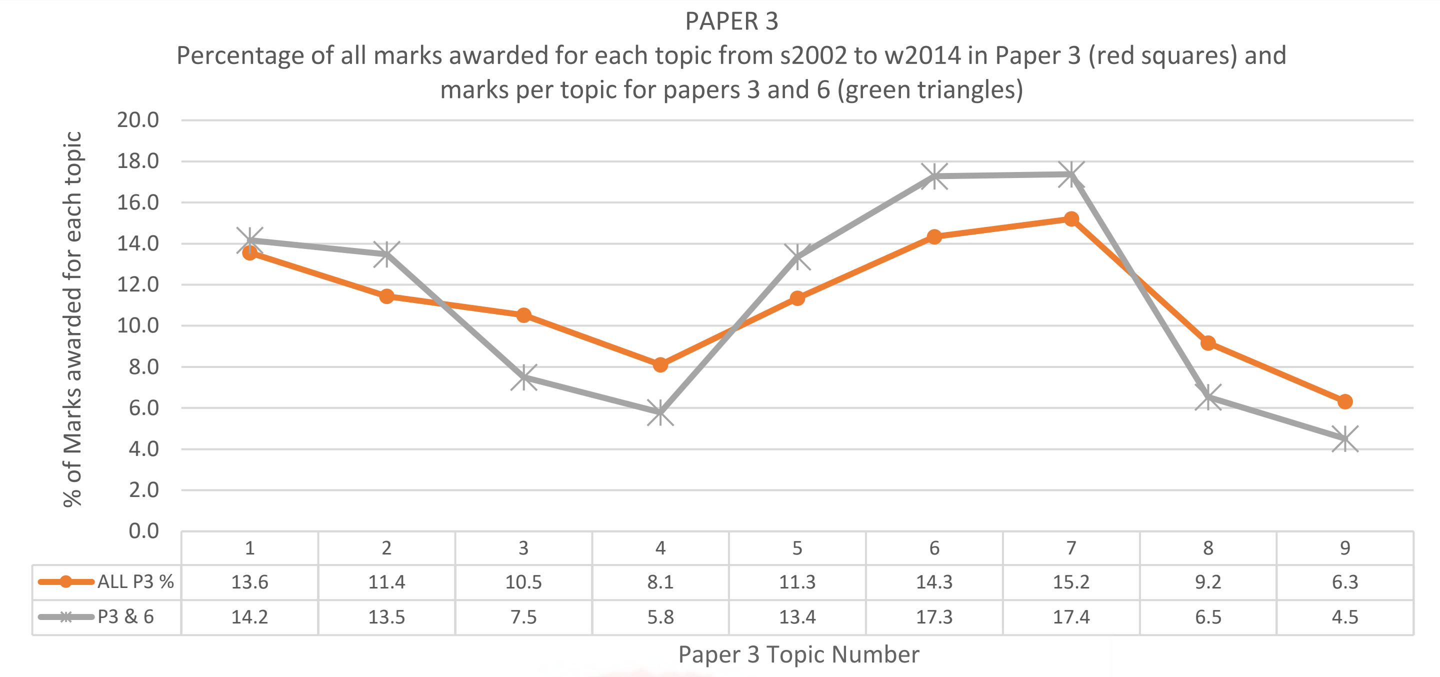
PAPER 6

Percentage of all marks awarded for each topic from s2002 to w2015 in Paper 6 (blue diamonds) and marks per topic for both papers 3/4 and 6 (red squares)



	1	2	3	4	5	6	7	8	9
PhxP6	15.7	18.6	0.0	0.0	18.4	24.6	22.8	0.0	0.0
PhxP3&6 weighted	14.2	13.5	7.5	5.8	13.4	17.3	17.4	6.5	4.5

Paper 6 Topic Number



Papers covered in this sample:

	1st Paper	Last Paper	Marks/ paper	Theor. All Papers	Actual All Marks	Difference	Difference %	Weight per paper	Weight per mark
Paper 3	2002w	2014w	80	2000	2072	72	3.6	50	0.63
Paper 6	2002s	2015w	40	1120	1040	-80	-7.1	20	0.50

There are a few missing: Got all Paper 31s (except 2014w Paper 31), and got 2014w 33. So papers in time zones 2 and 3 are not covered.

All topics ranked by frequency of marks in exams (P3 and 6 only):

Topic	PhxBoth P3&6	PhxP3	PhxP6
7	17.4	15.2	22.8
6	17.3	14.3	24.6
1	14.2	13.6	15.7
2	13.5	11.4	18.6
5	13.4	11.3	18.4
3	7.5	10.5	0.0
8	6.5	9.2	0.0
4	5.8	8.1	0.0
9	4.5	6.3	0.0

Other statistics that might be of interest:

	Topics:	1	2	3	4	5	6	7	8	9
P3/4 marks	2072	281	237	218	168	235	297	315	190	131
P3/4 %		13.6	11.4	10.5	8.1	11.3	14.3	15.2	9.2	6.3
P6	1040	163	193	0	0	191	256	237	0	0
P6 %		15.7	18.6	0.0	0.0	18.4	24.6	22.8	0.0	0.0
Total Marks (WIEGHTED)	1815	257	245	136	105	242	314	315	119	82
% of Marks (Weighted)	1815	14.2	13.5	7.5	5.8	13.4	17.3	17.4	6.5	4.5
# of Questions		63	64	35	16	63	74	70	26	20
Average marks per Q		**4.1**	**3.8**	**3.9**	**6.6**	**3.8**	**4.2**	**4.5**	**4.6**	**4.1**

Final note:

My iG and IB chemistry papers were broken down more carefully than these were, so there may be a mark or two in the wrong topic especially in topics 3 to 5, but if you learnt or taught these topics in sequence than you shouldn't have a problem with seeing material from an earlier topic.

Defining the Topics: Why not use the units given in the syllabus?

Artificial topics have been created for the physics syllabus by me so that each topic is roughly the same size. Topics go in syllabus order. I have decided to use the number of marks allocated in previous exams to each syllabus point to determine how many go into each topic.

1. General physics

Topic 1

1.1 Length and time
1.2 Motion
1.3 Mass and weight
1.4 Density

Topic 2

1.5 Forces
1.6 Momentum (Extended candidates only)

Topic 3

1.7 Energy, work and power
1.8 Pressure

2. Thermal physics

Topic 4

2.1 Simple kinetic molecular model of matter

Topic 5

2.2 Thermal properties and temperature
2.3 Thermal processes

3. Properties of waves, including light and sound

Topic 6

3.1 General wave properties
3.2 Light
3.3 Electromagnetic spectrum
3.4 Sound

4. Electricity and magnetism

Topic 7

4.1 Simple phenomena of magnetism
4.2 Electrical quantities
4.3 Electric circuits
4.4 Digital electronics (Extended candidates only)
4.5 Dangers of electricity

Topic 8

4.6 Electromagnetic effects

5. Atomic physics

Topic 9

5.1 The nuclear atom
5.2 Radioactivity

5 The class is investigating the oscillations of a pendulum.

Figs. 5.1 and 5.2 show the apparatus.

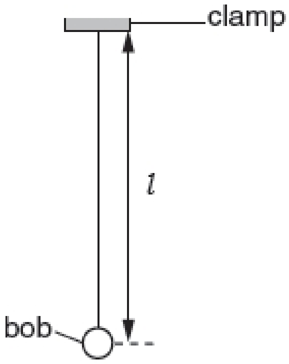


Fig. 5.1

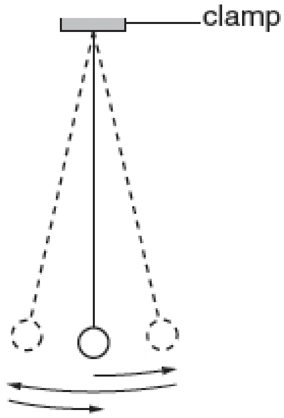


Fig. 5.2

A student measures the length l of the pendulum and takes readings of the time t for 20 complete oscillations. She calculates the period T of the pendulum. T is the time taken for one complete oscillation. She repeats the procedure for a range of lengths.

She plots a graph of T^2/s^2 against l/m. Fig. 5.3 shows the graph.

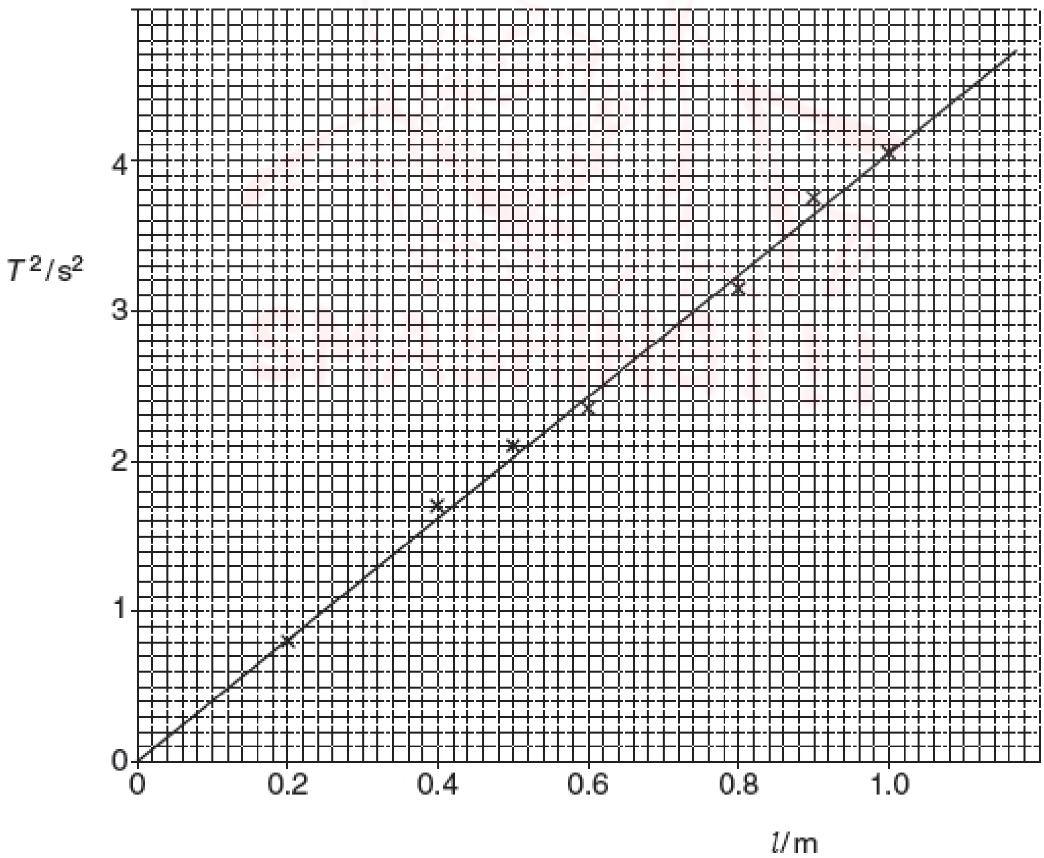


Fig. 5.3

(a) Using the graph, determine the length l of a pendulum that has a period T = 2.0 s. Show clearly on the graph how you obtained the necessary information.

l = ...[3]

(b) Explain why measuring the time for 20 swings, rather than for 1 swing, gives a more accurate value for T.

....

....[1]

(c) Another student investigates the effect that changing the mass m of the pendulum bob has on the period T of the pendulum.

(i) Suggest how many different masses the student should use for this laboratory experiment.

number of different masses = ...

(ii) Suggest a range of suitable values for the masses.

suitable range of masses = ...

[2]

[Total: 6]

5 An IGCSE student is taking measurements of a drinks cup.

Carry out the following instructions, referring to Fig. 5.1.

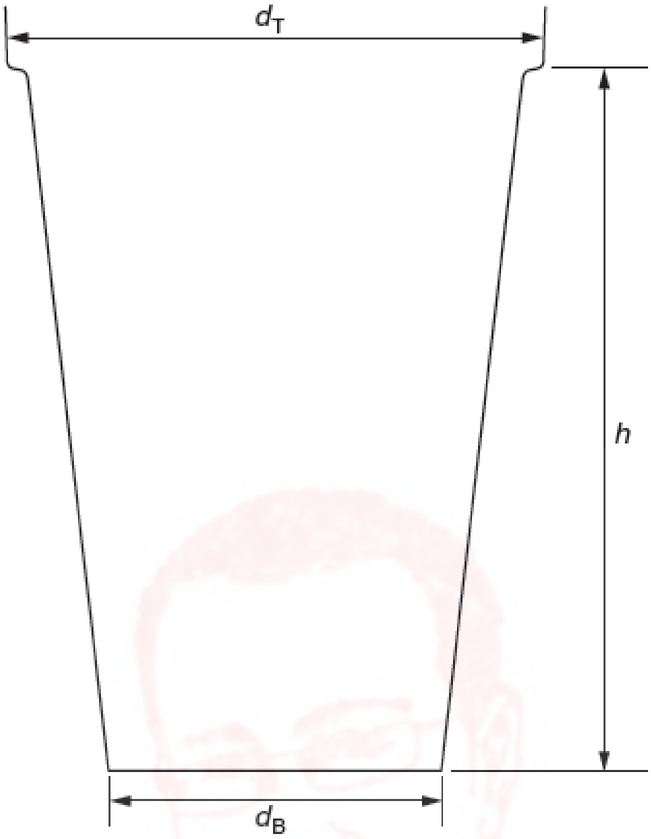


Fig. 5.1

(a) (i) On Fig. 5.1, measure the height h of the cup.

h = ... cm

(ii) On Fig. 5.1, measure the diameter d_T of the top of the cup.

d_T = ... cm

(iii) On Fig. 5.1, measure the diameter d_B of the bottom of the cup.

d_B = ... cm

(iv) Calculate the average diameter d_A, using the equation $d_A = \frac{d_T + d_B}{2}$.

d_A = ... cm

(v) Calculate an approximate value for the volume V of the cup, using the equation $V = \frac{\pi d_A{}^2 h}{4}$.

V = ... [3]

(b) The student determines the average circumference of the cup, using a 50 cm length of string and a metre rule.

Fig. 5.2 shows how the student used the string to determine the average circumference.

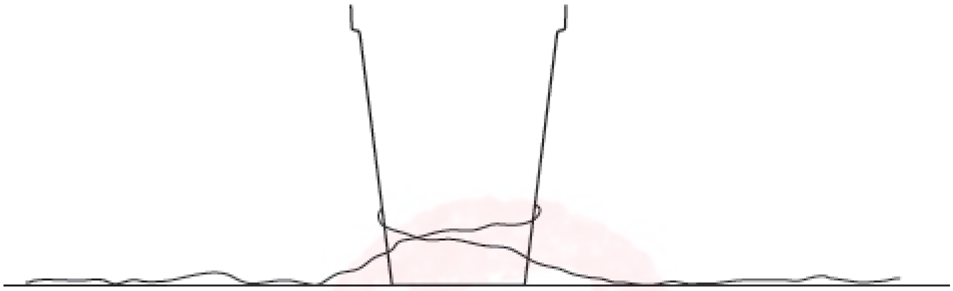


Fig. 5.2

Describe how you would use the string to obtain a more reliable value for the average circumference.

....

....

....[2]

(c) The student fills a measuring cylinder to the 500 cm^3 mark. He pours water from the measuring cylinder into the cup until the cup is full. Fig. 5.3 shows the water remaining in the measuring cylinder.

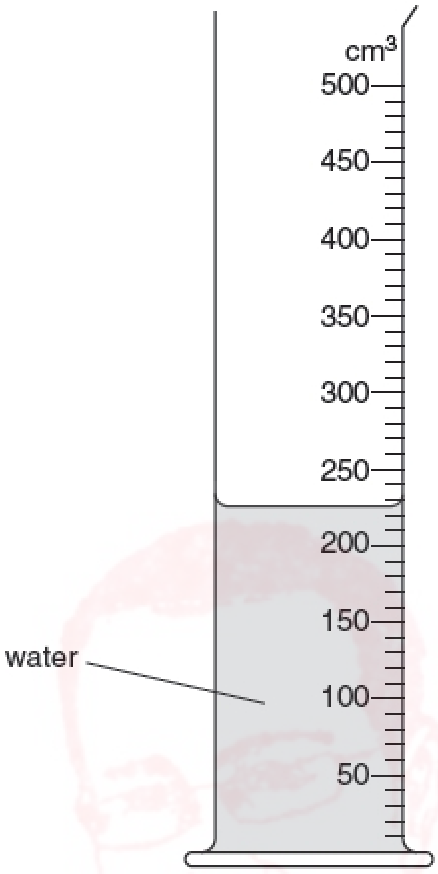


Fig. 5.3

(i) Record the volume of water V_R remaining in the measuring cylinder.

V_R = ...

(ii) Calculate the volume V_W of the water in the cup.

V_W = ...

[2]

(d) On Fig. 5.3, show clearly the line of sight required to take the reading of V_R. [1]

[Total: 8]

5 The IGCSE class is investigating the stretching of a spring.

Fig. 5.1 shows the apparatus.

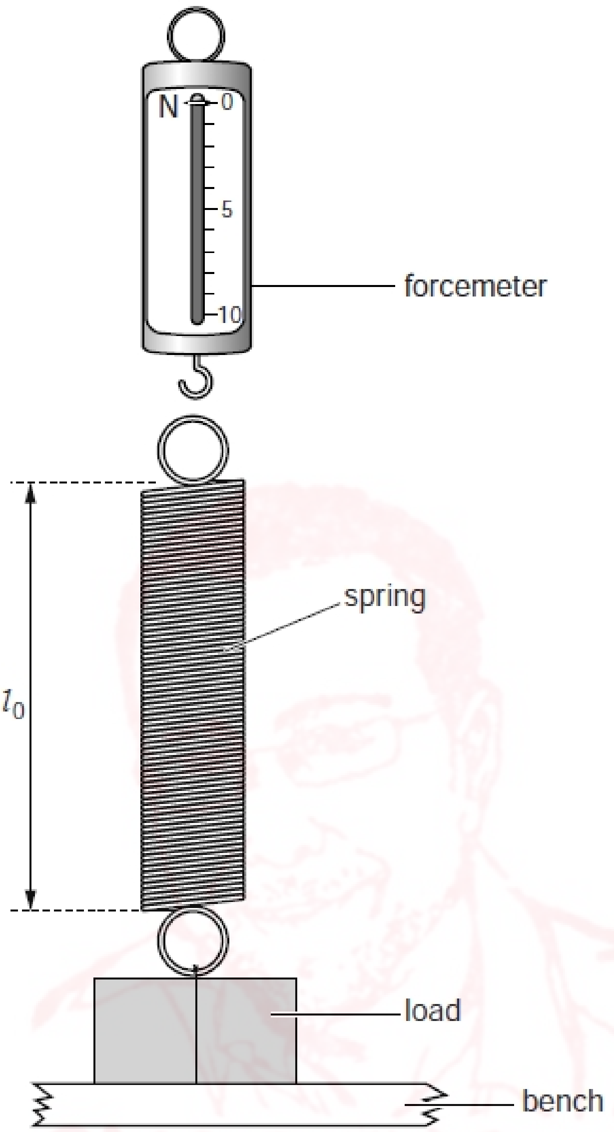


Fig. 5.1

(a) On Fig. 5.1, measure the unstretched length l_0 of the spring, in mm.

l_0 = ...mm [1]

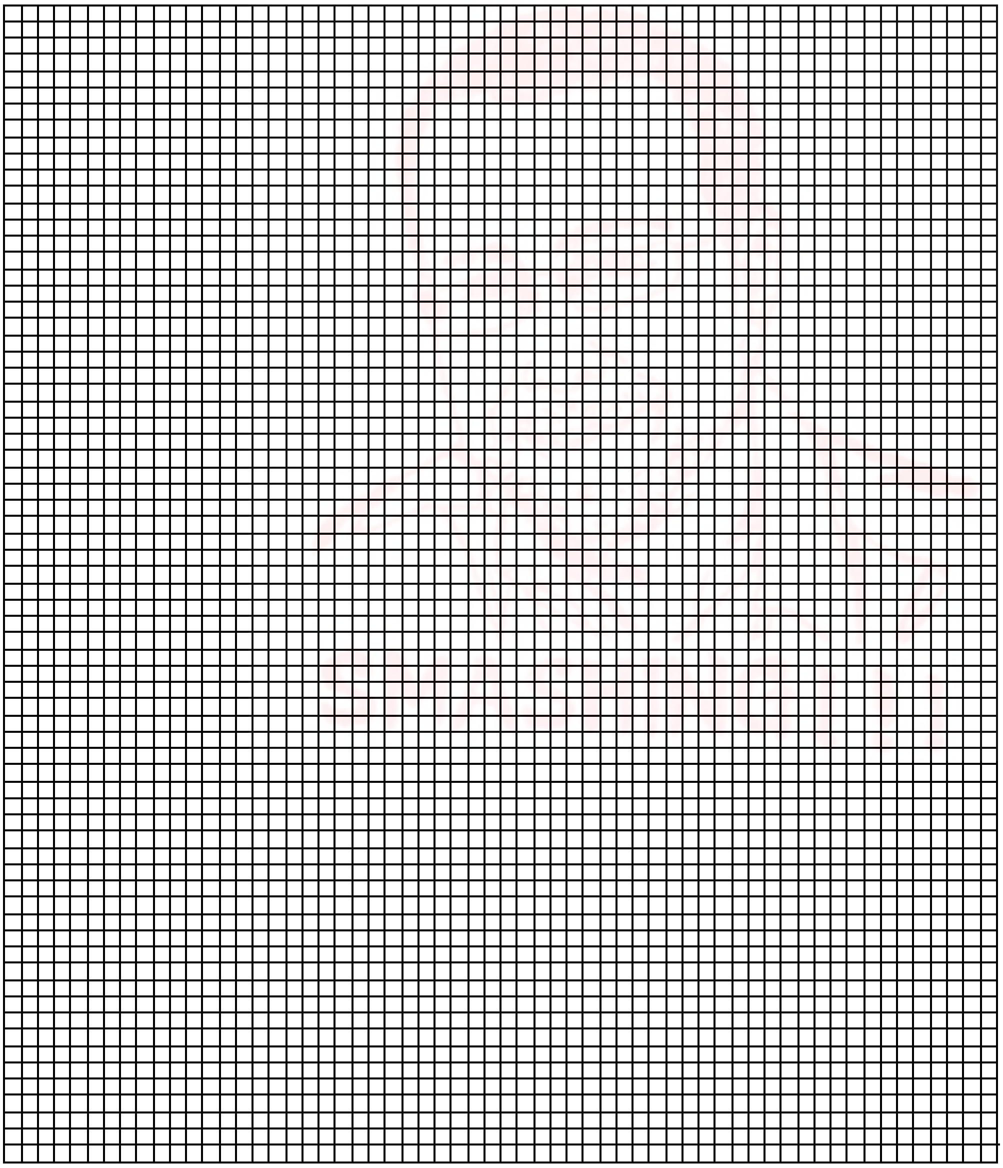
(b) A student hangs the spring on the forcemeter with the load attached to the bottom of the spring, as shown in Fig. 5.1. The load remains on the bench.

He gently raises the forcemeter until it reads 1.0 N. He measures the new length l of the spring. He repeats the procedure using a range of forcemeter readings. The readings are recorded in Table 5.1.

F / N	l / mm	e / mm
1.0	67	
2.0	77	
3.0	91	
4.0	105	
5.0	115	

(i) Calculate the extension e of the spring, for each set of readings, using the equation $e = (l - l_0)$. Record the values of e in Table 5.1. [1]

(ii) Plot a graph of e/mm (y-axis) against F/N (x-axis).



[5]

(iii) Determine the gradient *G* of the graph. Show clearly on the graph how you obtained the necessary information.

G = ... [2]

[Total: 9]

Q# 4/ iG Phx/2013/s/Paper 61/ www.SmashingScience.Org :o)

1 The IGCSE class is investigating the stability of a block of wood.

Figs. 1.1 and 1.2 show the dimensions of the block.

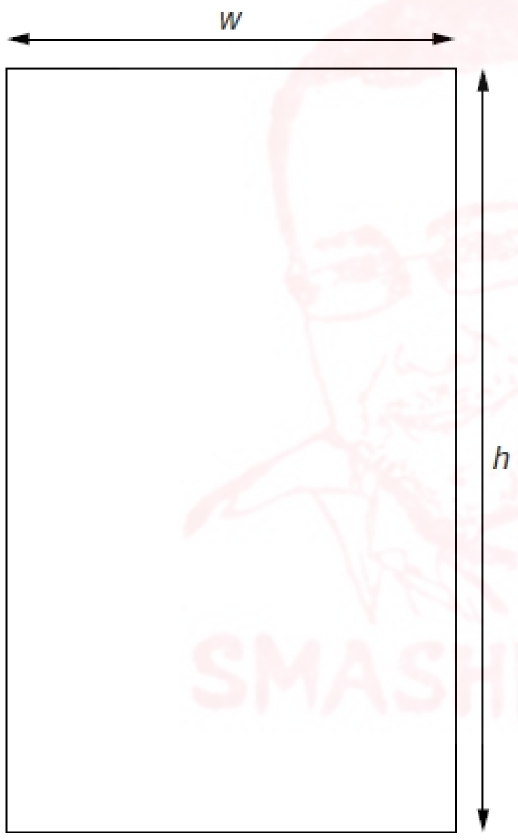


Fig. 1.1

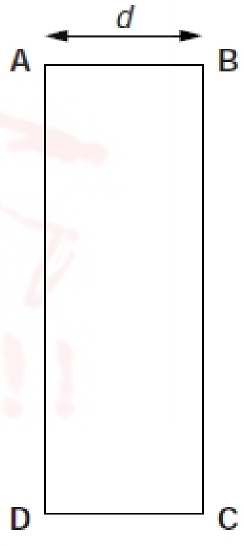


Fig. 1.2

(a) **(i)** On Figs. 1.1 and 1.2, measure the height *h*, width *w* and depth *d* of the block.

h = ...

w = ...

d = ...

[2]

(ii) On Fig. 1.2, draw the line **AC**. [1]

(iii) Measure and record the angle α between lines **AD** and **AC**.

α = ... [1]

(b) A student places the block on the edge of the bench, as shown in Fig. 1.3.

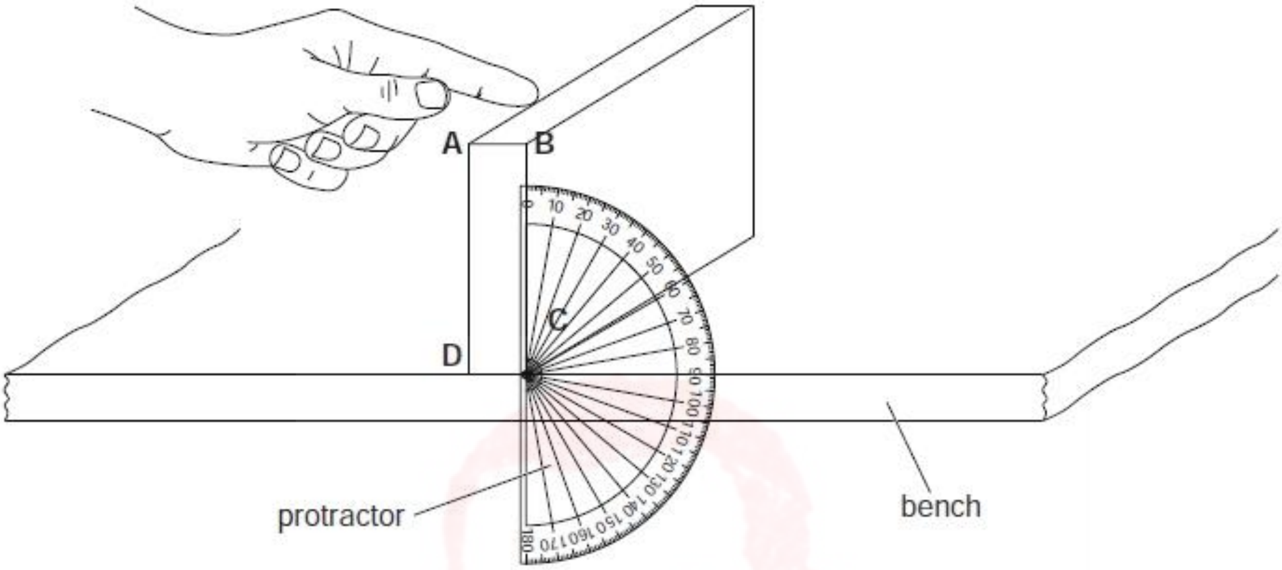


Fig. 1.3

He holds the protractor next to face **ABCD** of the block, as shown in Fig. 1.3. He gently pushes the top of the block (as indicated in Fig. 1.3) so that the block tips over.

He records the angle θ between side **BC** of the block and the vertical line on the protractor. The angle θ is when the block just tips over. He repeats this procedure a suitable number of times.

Suggest the number of measurements of θ that you think would be suitable for this experiment.

number = ... [1]

(c) The student calculates the average value θ_{av} of all his values for θ.

θ_{av} = ...20°..................

He suggests that θ_{av} should be equal to α. State whether the results support this suggestion. Justify your statement by reference to the results.

statement ....

justification ....

....

....

[2]

[Total: 7]

5 The IGCSE class is determining the internal volume of a test-tube using two displacement methods.

The apparatus used is shown in Figs. 5.1, 5.2 and 5.3.

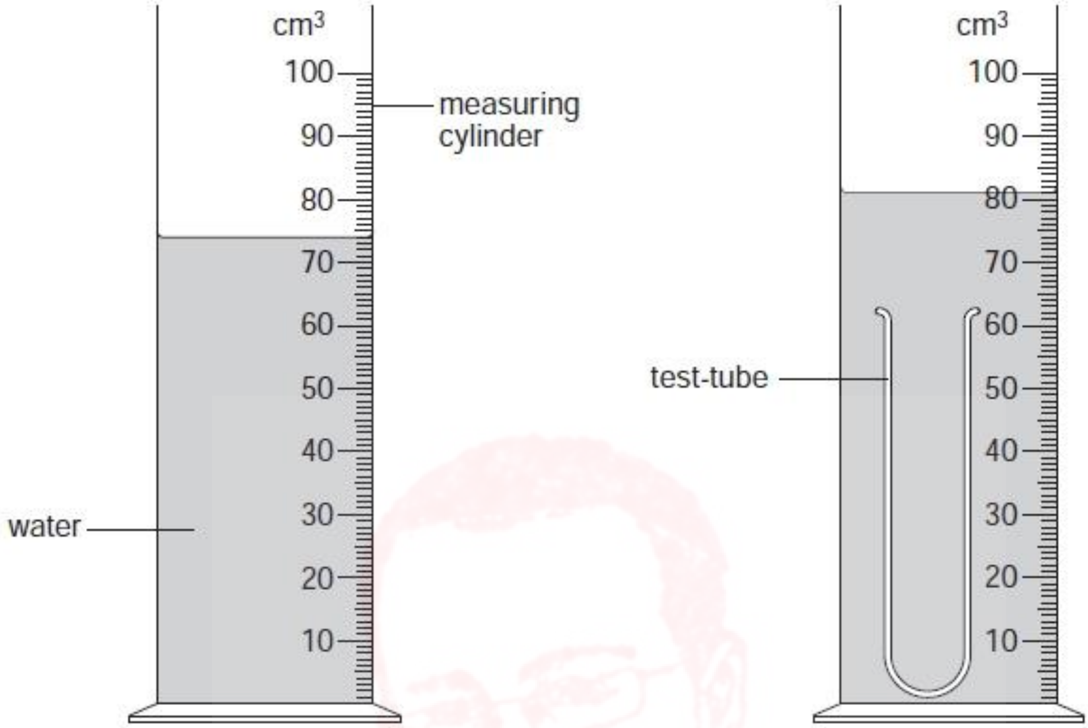


Fig. 5.1 **Fig. 5.2**

(a) **(i)** Fig. 5.1 shows water in a measuring cylinder. Record the volume V_1 of the water.

V_1 = ... [1]

(ii) On Fig. 5.1, show clearly the line of sight that you would use to obtain an accurate volume reading. [2]

(b) **(i)** A student lowers a test-tube, closed end first, into the water in the measuring cylinder and pushes the tube down until it is filled with water. From Fig. 5.2, record the new water level V_2.

V_2 = ...

(ii) Calculate the volume V_G of the glass of the test-tube using the equation $V_G = (V_2 - V_1)$.

V_G = ... [2]

(c) The student removes the test-tube from the measuring cylinder and empties the water back into the measuring cylinder. He then puts the test-tube, open end first, into the water in the measuring cylinder and carefully pushes it down with his finger until it is covered with water as shown in Fig. 5.3.

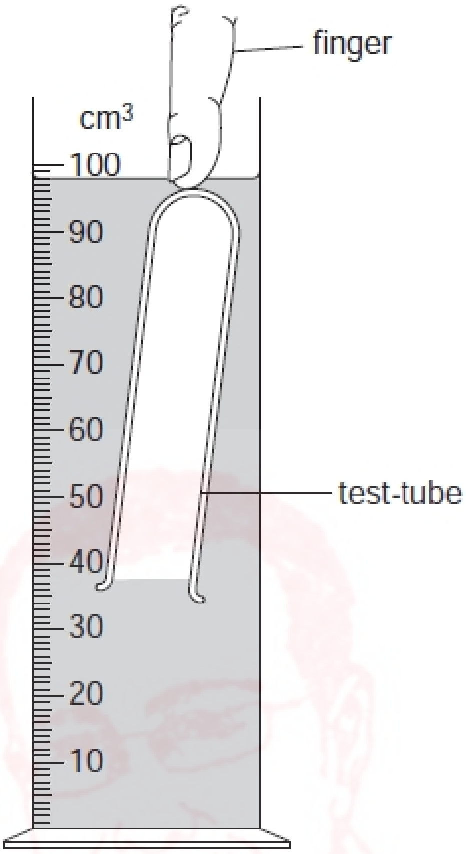


Fig. 5.3

(i) Record the new water level V_3.

V_3 = ...

(ii) Calculate the increase in water level $(V_3 - V_1)$.

$(V_3 - V_1)$ = ...

(iii) Calculate the volume V_A of air in the test-tube using the equation $V_A = (V_3 - V_1) - V_G$.

V_A = ...

[1]

(d) The student removes the test-tube from the measuring cylinder and fills the test-tube with water from a beaker. He pours the water from the test-tube into an empty measuring cylinder and records the volume V_W of water:

V_W = ...18 cm³...

The student has attempted to determine the internal volume of the test-tube by two methods. His two values for the internal volume are V_A and V_W.

Assuming that the experiments have been carried out correctly and carefully and that the measuring cylinder scale is accurate, suggest two reasons why the value V_A may be inaccurate and two reasons why the value V_W may be inaccurate.

V_A:

reason 1 ....

....

reason 2 ....

....

V_W:

reason 1 ....

....

reason 2 ....

....

[3]

[Total: 9]

5 The IGCSE class is investigating the swing of a loaded metre rule.

The arrangement of the apparatus is shown in Fig. 5.1.

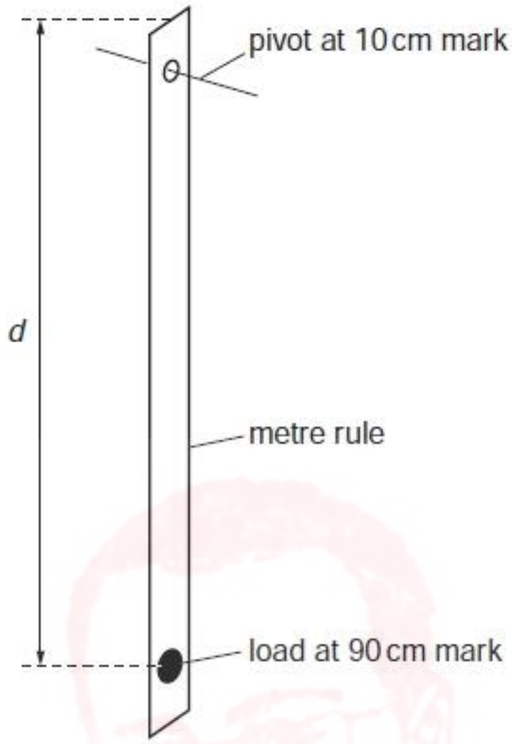


Fig. 5.1

A student displaces the rule a small distance to one side and allows it to swing. The time *t* taken for 10 complete swings is recorded. She calculates the time *T* taken for one swing. She repeats the procedure using different values of the distance *d*.

The readings are shown in the Table 5.1.

Table 5.1

0.900	18.4	1.84	
0.850	17.9	1.79	
0.800	17.5	1.75	
0.750	17.1	1.71	
0.700	16.7	1.67	

(a) Complete the column headings in the table. [3]

(b) Explain why the student takes the time for ten swings and then calculates the time for one swing, rather than just measuring the time for one swing.

....

....[1]

(c) The student tries to find a relationship between *T* and *d*. She first suggests that $T \times d$ is a constant.

(i) Calculate the values of $T \times d$ and enter the values in the final column of the table.

(ii) State whether or not the results support this suggestion and give a reason for your answer.

Statement ....

....

Reason ....

....

[2]

Q# 7/ iG Phx/2009/w/Paper 61/ www.SmashingScience.Org :o)

1 The IGCSE class is investigating the period of oscillation of a simple pendulum.

Fig. 1.1 shows the set-up.

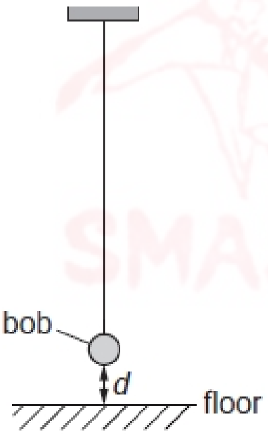


Fig. 1.1

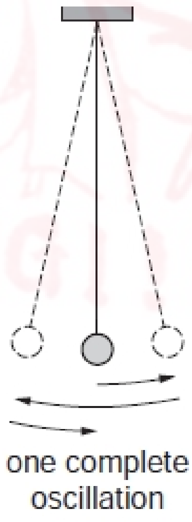


Fig. 1.2

(a) (i) On Fig. 1.1, measure the vertical distance *d* from the floor to the bottom of the pendulum bob.

d = ...

(ii) Fig. 1.1 is drawn one twentieth actual size. Calculate the actual distance *x* from the floor to the bottom of the pendulum bob. Enter this value in the top row of Table 1.1.

The students displace the pendulum bob slightly and release it so that it swings. They measure and record in Table 1.1 the time *t* for 20 complete oscillations of the pendulum (see Fig. 1.2).

Table 1.1

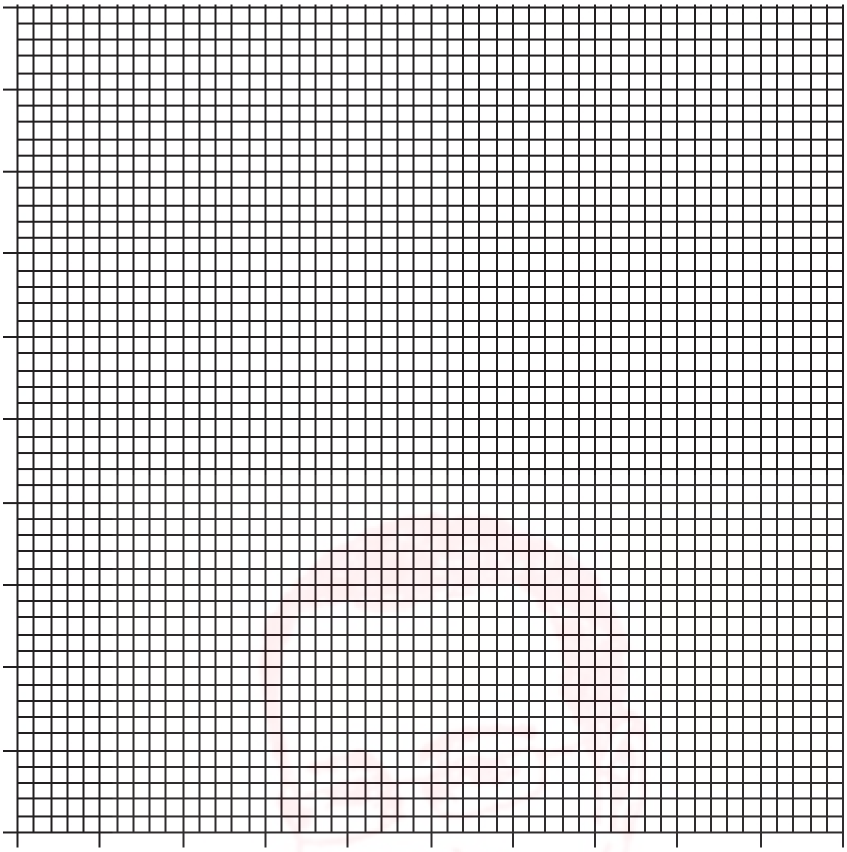
x / cm	t / s	T / s	T^2 / s^2
	20.0		
20.0	19.0		
30.0	17.9		
40.0	16.8		
50.0	15.5		

[4]

(b) (i) Calculate the period *T* of the pendulum for each set of readings. The period is the time for one complete oscillation. Enter the values in Table 1.1.

(ii) Calculate the values of T^2. Enter the T^2 values in Table 1.1.

(c) Use your values from Table 1.1 to plot a graph of T^2/s^2 (y-axis) against x/cm (x-axis). Draw the best-fit line.



[5]

(d) State whether or not your graph shows that T^2 is directly proportional to x. Justify your statement by reference to the graph.

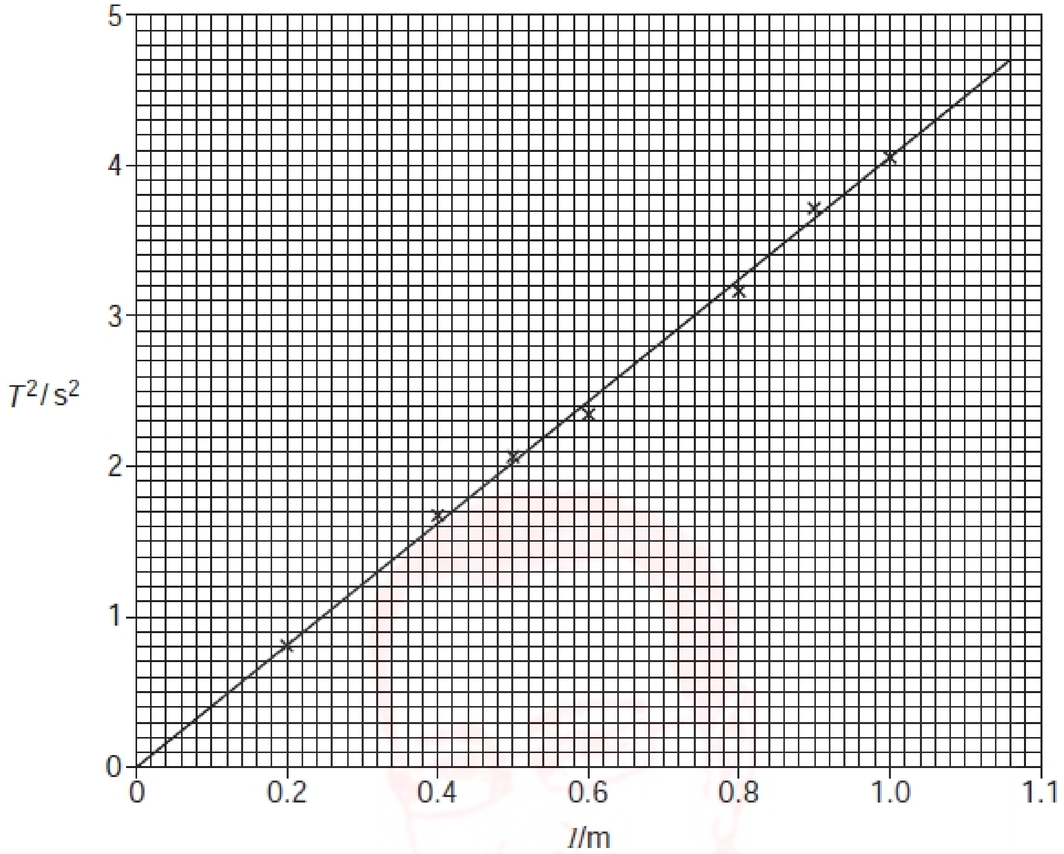
statement ....

justification ....

.... [1]

[Total: 10]

5 An IGCSE student has carried out a timing experiment using a simple pendulum. She plotted a graph of T^2/s^2 against l/m. T is the time for one swing of the pendulum and l is the length of the pendulum. The graph is shown below.



(a) **(i)** Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

G = ...

(ii) Calculate the acceleration g of free fall using the equation

$$g = \frac{4\pi^2}{G}.$$

g = ...m/s^2

(iii) The student could have calculated the acceleration of free fall g from just one set of readings. State the purpose of taking sufficient readings to plot a graph.

....

....[5]

(b) The student next studies the relationship between the mass *m* of the pendulum and the time for one swing *T*. The readings are shown in Table 5.1.

Table 5.1

m / g	*T* / s
50	1.58
100	1.60
150	1.61
200	1.57
250	1.59

(i) Suggest two variables that must be kept constant to make the experiment a fair test.

1. ....

2. ....

(ii) Study the readings in the table and complete the following sentence.

Within the limits of experimental accuracy, the readings show that the mass *m* of

the pendulum .... [3]

[Total: 8]

5 (a) An IGCSE student is investigating the differences in density of small pieces of different rocks. She is using an electronic balance to measure the mass of each sample and using the 'displacement method' to determine the volume of each sample. Fig. 5.1 shows the displacement method.

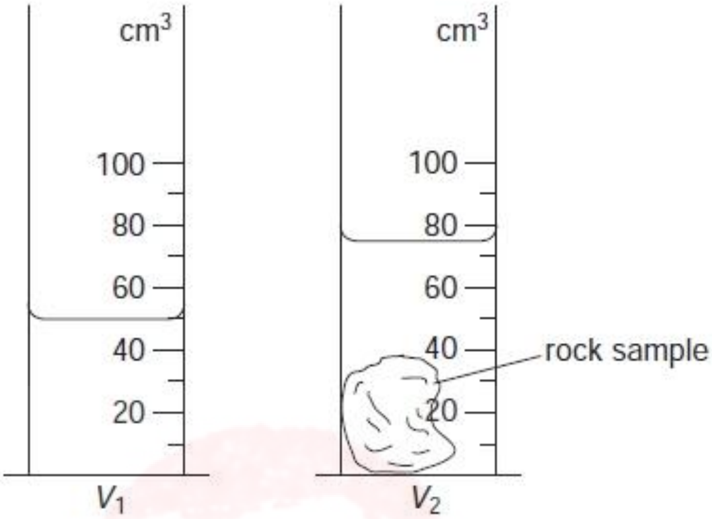


Fig. 5.1

(i) Write down the volume shown in each measuring cylinder.

V_1 = ...

V_2 = ...

(ii) Calculate the volume V of the rock sample.

V = ...

(iii) Calculate the density of sample **A** using the equation

$$density = \frac{m}{V},$$

where the mass m of the sample of rock is 109 g.

density = ...

[4]

(b) The table shows the readings that the student obtains for samples of rocks **B** and **C**. Complete the table by

(i) inserting the appropriate column headings with units,

(ii) calculating the densities using the equation *density* = $\frac{m}{V}$.

sample	m / g			V /	density /
B	193	84	50	34	
C	130	93	50	43	

[4]

(c) Explain briefly how you would determine the density of sand grains.

....

.... [1]

[Total: 9]

1 The IGCSE class is determining the density of a type of wood.

The students are provided with a bundle of wooden rods, as shown in Fig. 1.1.

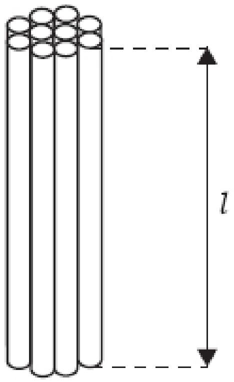


Fig. 1.1

(a) On Fig. 1.1, measure the length l of a rod.

l = ... cm [1]

(b) A student winds five turns of string round the bundle and marks the beginning and the end of the five turns. She then uses the metre rule to measure the distance x between the marks. She records that $x = 24.5$ cm.

(i) Determine the circumference c of the bundle of rods.

c = ...

(ii) Calculate the volume V of the bundle of rods using the equation

$$V = \frac{c^2 l}{4\pi}.$$

V = ... [4]

(c) The equation used in **(b)(ii)** assumes that the bundle is a solid cylinder. However, there are air gaps between the rods.

(i) Estimate the total volume V_r of the rods themselves.

V_r = ...

(ii) Calculate the density d of the wood using the equation

$$d = \frac{m}{V_r}$$

where the mass m of the bundle = 6.3 g.

d = ... [3]

2 The IGCSE class is investigating the swing of a loaded metre rule.

The arrangement of the apparatus is shown in Fig. 2.1.

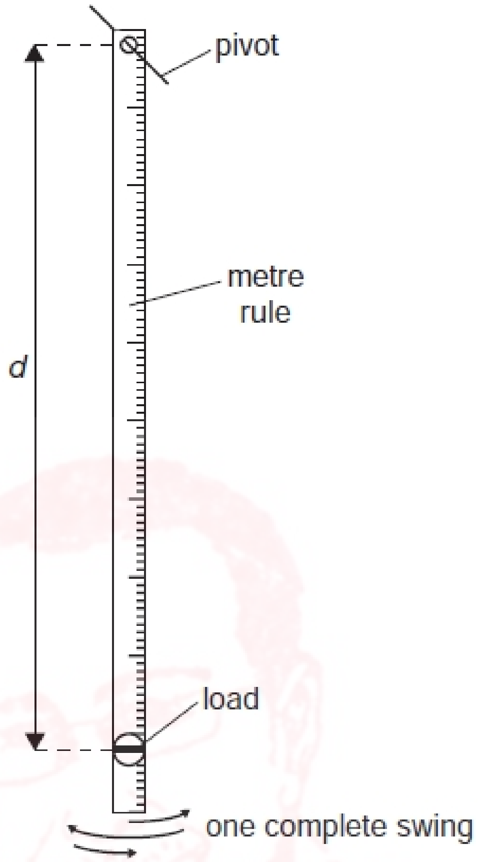


Fig. 2.1

The load is attached to the metre rule so that its centre is 90.0 cm from the pivot. The rule is displaced a small distance to one side and allowed to swing. The time *t* taken for 10 complete swings is recorded. This is repeated using different values of the distance *d*. The readings are shown in the table.

d /	*t* /	*T* /
90.0	18.35	
85.0	17.87	
80.0	17.53	
75.0	17.06	
70.0	16.72	

(a) Complete the column headings in the table. [1]

(b) Calculate the period *T* for each value of *d*. The period is the time taken for one complete swing. Enter the values in the table. [2]

(c) On the grid below, plot a graph of *T* / s (*y*-axis) against *d* / cm (*x*-axis). Start the *x*-axis at *d* = 70.0 cm and the *y*-axis at a suitable value of *T* / s to make best use of the graph grid. [5]

(d) A student suggests that *T* is proportional to *d*. State whether or not the results support this suggestion and give a reason for your answer.

statement ....

....

reason ....

.... [1]

(e) Explain why the student takes the time for ten swings and then calculates the time for one swing (the period), rather than just measuring the time for one swing.

....

.... [1]

1 The IGCSE class is determining the density of a sample of card.

Each student has a stack of ten pieces of card, as shown in Fig. 1.1.

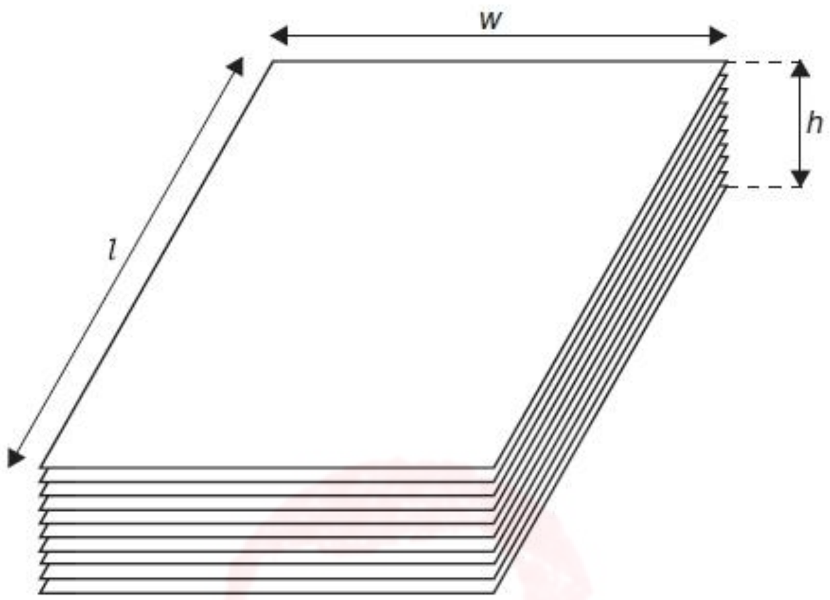


Fig. 1.1

(a) **(i)** On Fig. 1.1, measure the height h of the stack of card.

h = ... [1]

(ii) Calculate the average thickness t of one piece of card.

t = ... [2]

(b) **(i)** On Fig. 1.1, measure the length l and width w of the top piece of card.

l = ...

w = ... [1]

(ii) Calculate the volume V of one piece of card using the equation

$$V = ltw\ .$$

V = ... [2]

(c) Calculate the density *d* of the card using the equation

$$d = \frac{m}{V}$$

where the mass *m* of one piece of card is 1.3 g.

d = ... [2]

(d) A sample of corrugated card of the same length and width as the card in Fig. 1.1 consists of two thin sheets of card with an air gap in between. The sheets of card are separated by paper, as shown in the cross-section in Fig. 1.2. The thickness *y* of the air gap as shown in Fig. 1.2 is between 2 mm and 3 mm.

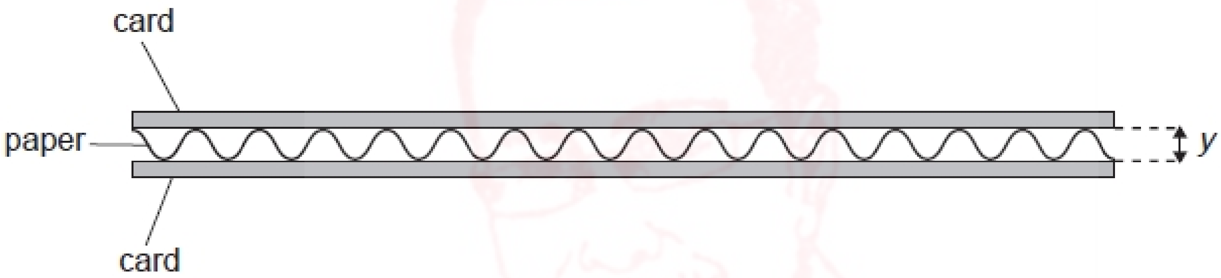


Fig. 1.2

Estimate the volume V_a of air trapped within the corrugated card shown in Fig. 1.2.

V_a = ... [1]

2 A student carries out an experiment to determine the density of plasticine. She records the mass *m* and the volume *V* of a range of differently-sized samples. These readings are plotted on a graph as shown in Fig. 2.1.

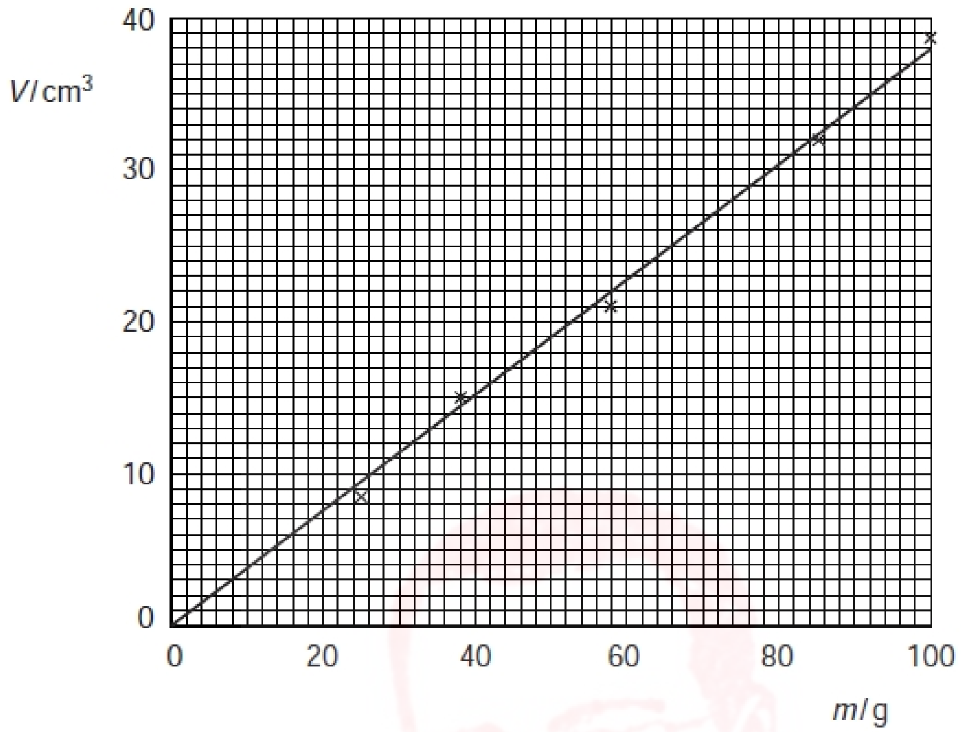


Fig. 2.1

(a) **(i)** Determine the gradient *G* of the line. Show clearly how you obtain the necessary information.

G = ...

(ii) Determine the density ρ of the plasticine using the equation $\rho = \frac{1}{G}$.

ρ = ...

[5]

(b) The student could calculate the density from one set of readings. Suggest why she takes more than one set of readings and plots a graph.

....

.... [1]

1 The IGCSE class is investigating the rate of cooling of water in a beaker. Some of the apparatus used is shown in Fig. 1.1.

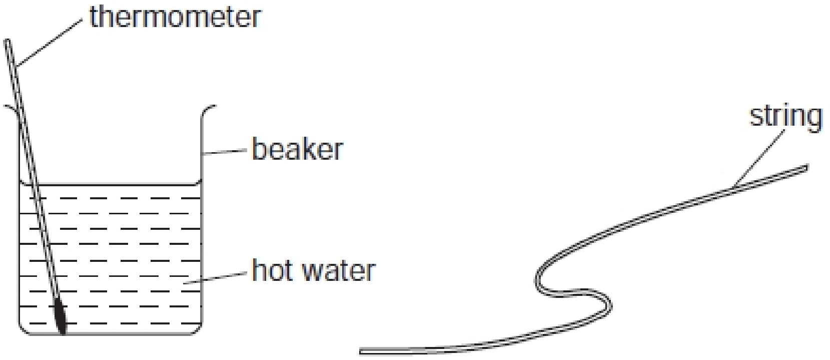


Fig. 1.1

During the experiment, a student measures the temperature of the water, its volume, the length of string wrapped round a beaker and the depth of water in the beaker.

(a) Write down the readings shown in Figs. 1.2 and 1.3. Include appropriate units.

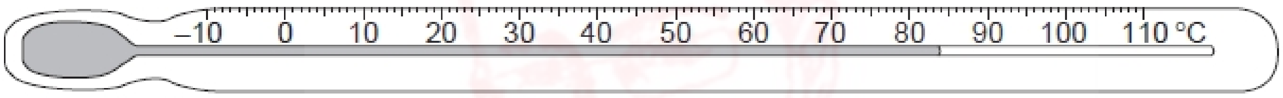


Fig. 1.2

temperature = ...

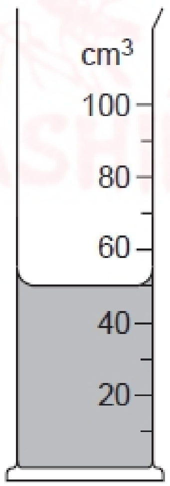


Fig. 1.3

volume of water in the measuring cylinder = ... [3]

(b) The string is wrapped 5 times round the beaker and marked as shown in Fig. 1.4.

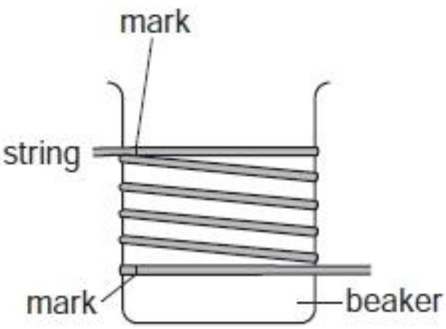


Fig. 1.4

The string is held against a metre rule as shown in Fig. 1.5.

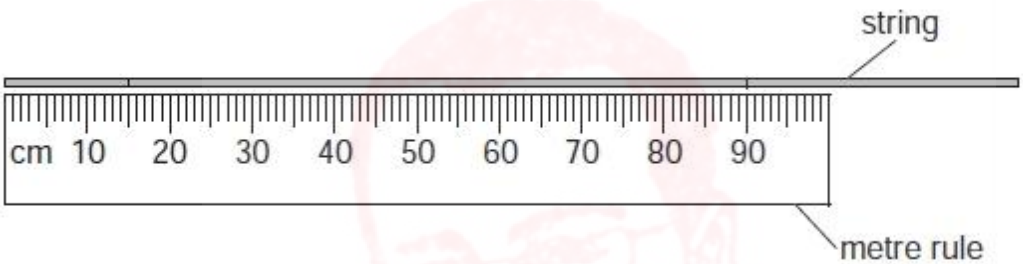


Fig. 1.5

(i) Write down the length of the string between the marks.

length = ... cm

(ii) Calculate the circumference *c* of the beaker.

c = ... cm

(iii) Suggest one source of error in this method of determining the circumference.

....

....

(iv) Suggest one improvement to this method.

....

....

[4]

(c) A rule is placed beside the beaker, as shown in Fig. 1.6.

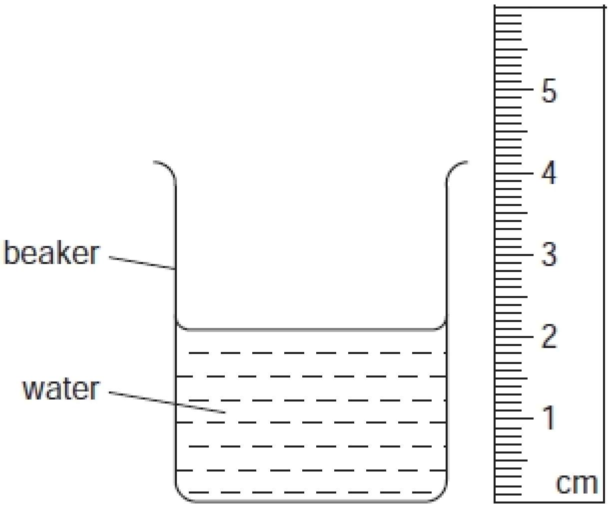


Fig. 1.6

(i) Write down the depth *d* of the water in the beaker.

d = ... cm

(ii) Calculate the surface area *A* of the curved surface of the beaker up to the water level using the equation $A = dc$.

A = ...

[2]

(d) State the other measurements that need to be taken to determine the rate of cooling of the water.

....

.... [2]

3 A student carries out an experiment using a simple pendulum. Fig. 3.1 shows the apparatus.

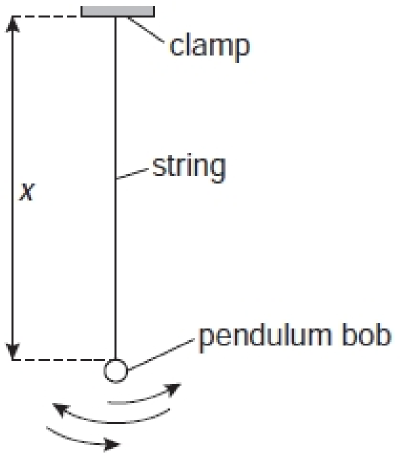


Fig. 3.1

The student records the time t taken for 20 complete oscillations for a range of different lengths x of the string. The readings are shown in the table.

x / cm	l / cm	t / s	T / s
90.0		38.5	
80.0		36.0	
70.0		33.4	
60.0		31.4	
50.0		28.2	
40.0		25.5	

The length l of the pendulum is given by the equation $l = x + r$, where r is the radius of the pendulum bob.

Fig. 3.2 shows the pendulum bob drawn actual size.

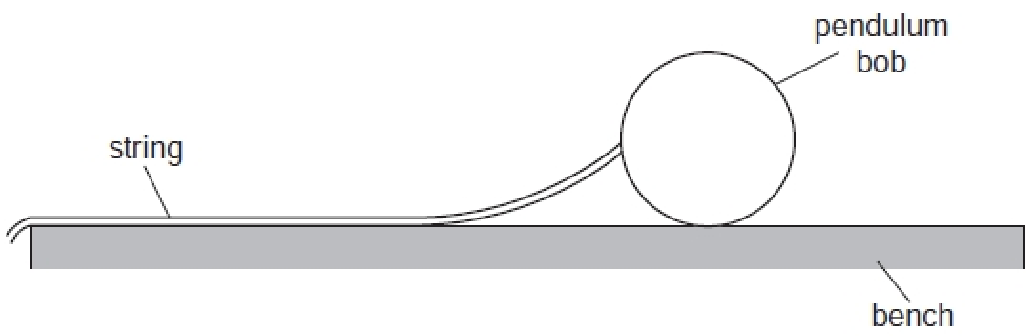


Fig. 3.2

(a) **(i)** Use your rule to measure the diameter *d* of the pendulum bob.

d = ...

(ii) Calculate the radius *r* of the pendulum bob.

r = ...

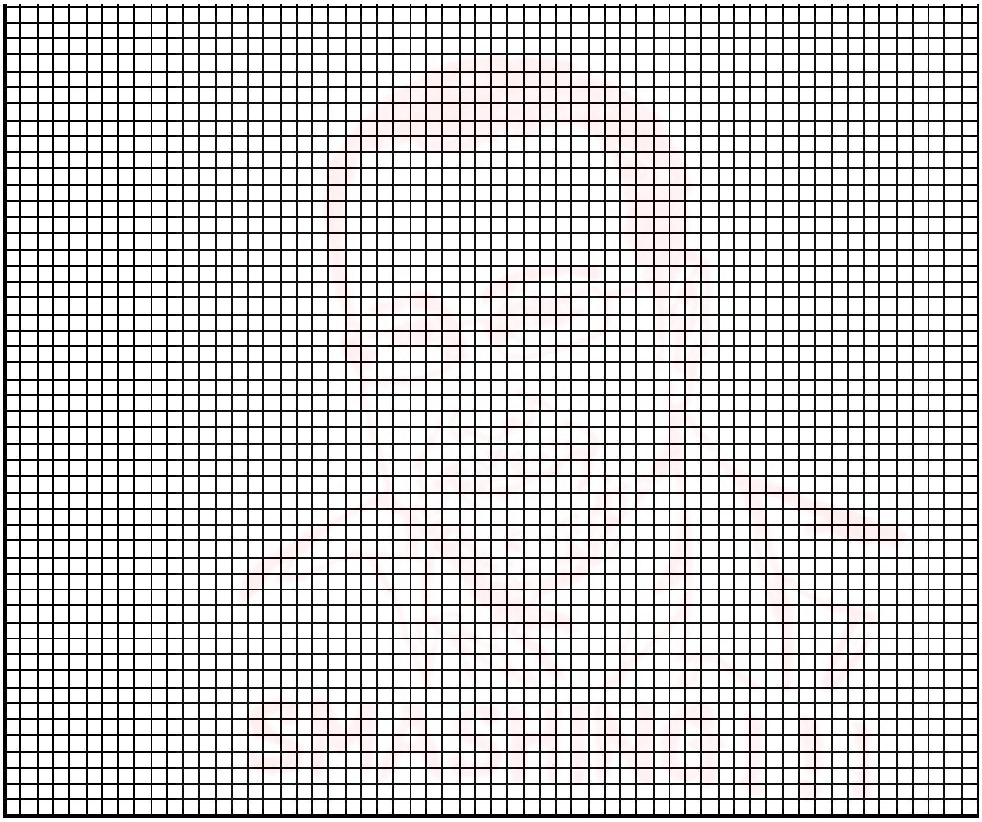
[2]

(b) **(i)** Complete the column for the length *l* / cm in the table using the equation $l = x + r$.

(ii) The period *T* is the time taken for one complete oscillation. Complete the column for the period *T* / s in the table.

[3]

(c) Plot the graph of *T* / s (*y*-axis) against *l* / cm (*x*-axis). Start the *T* / s axis at *T* = 1.0 s.



[5]

(d) Using the graph, find the length l_a of the pendulum that would have a period of 1.50 s.

l_a = ... cm [1]

1 **(a)** A student was asked to make some measurements of the test-tube shown in Fig. 1.1. He was given a 1 m length of thin string and a metre rule and instructed to determine **as accurately as possible** the circumference of the tube. The student used the rule to measure the diameter *d* of the tube and then calculated the circumference *c* using the equation

$$c = \pi d.$$

Describe how the student could have obtained a more accurate result with the apparatus given. You may draw on Fig. 1.1.

Fig. 1.1

....

....

.... [2]

(b) **(i)** On Fig. 1.2, show where you would place two small rectangular blocks of wood to help you make an accurate measurement of the overall length of the test-tube.

Fig. 1.2

(ii) The test-tube is shown actual size in Fig. 1.2. Use your rule to measure the length l of the test-tube.

l = ...

[2]

(c) Using another test-tube, the student obtained these readings.

$$l = 14.5\,\text{cm}$$

$$c = 5.3\,\text{cm}$$

Calculate the approximate external volume V of the test-tube using the student's readings and the equation

$$V = \frac{c^2 l}{4\pi}.$$

V = ... [2]

(d) The equation used in **(c)** assumes the test-tube to be a cylinder with flat ends. It does not allow for the rounded end of the test-tube.

(i) Estimate the volume V_m of the 'missing' part of the cylinder shown shaded in Fig. 1.3.

Fig. 1.3

V_m = ...

(ii) Using your values for V and V_m, calculate the actual external volume V_a of the test-tube.

V_a = ...

[2]

4 The IGCSE class was studying the acceleration *a* of a toy truck that was pulled along a track by a force *F*. The arrangement is shown in Fig. 4.1.

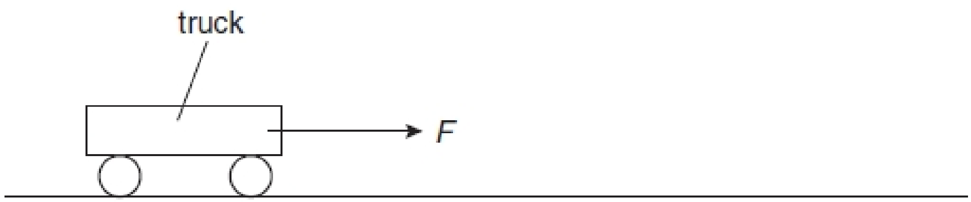


Fig. 4.1

The results obtained are shown in the table.

F / N	a / (m / s^2)
0.5	0.35
1.0	0.72
1.5	1.02
2.0	1.44
2.5	1.74

(a) Plot a graph of F / N (y-axis) against a / (m / s^2) (x-axis). Draw the line of best fit through your points. [6]

(b) Theory suggests that the relationship between force and acceleration is given by the equation

$$F = ma,$$

where m is the mass of the truck.

The gradient of the graph is equal to the mass of the truck.

From the graph, determine the mass m of the truck. Show clearly how you obtained the necessary information.

m = ... [4]

4 An IGCSE class watched a demonstration experiment to show that a metal rod expands when heated. The apparatus is shown in Fig. 4.1.

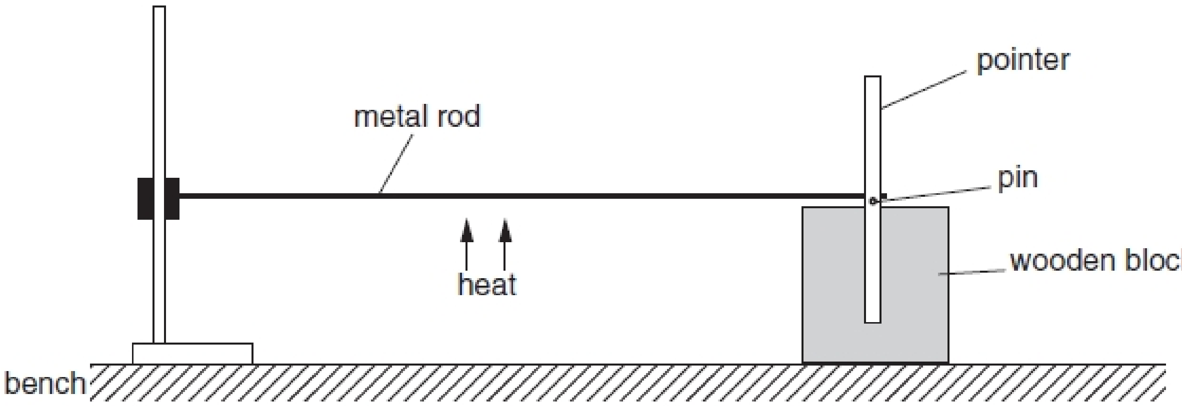


Fig. 4.1

When the rod expands, it rolls the pin which moves the pointer. So a very small expansion moves the pointer far enough to be seen clearly.

(a) One student wanted to find out how much longer the rod became when heated above room temperature with a Bunsen burner. The rod was 0.750 m long at room temperature.
To find the circumference of the pin, the student wrapped a piece of string 10 times round the pin, marked the string at the beginning and end of the 10 turns, and then measured the length of the string between the marks. Fig. 4.2 shows the string actual size.

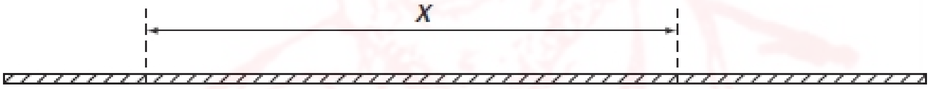


Fig. 4.2

(i) Use your rule to measure the distance x between the marks on the string on Fig. 4.2.

x = ...

(ii) Calculate the circumference c of the pin.

c = ...
[3]

(b) A second student measured the diameter d of the pin using a micrometer screw gauge.

The diameter was 1.20 mm. When the rod was heated, the pointer moved through 90°.

(i) Calculate the circumference c using the equation

$$c = \pi d.$$

c = ...[2]

(ii) Use this value of the circumference to calculate the increase e in the length of the rod when heated.

e = ...[1]

(iii) Calculate the length l of the heated rod.

l = ...[1]

(c) The micrometer screw gauge is a very accurate instrument. Suggest why the string and rule method of finding the circumference, used by the first student, was inaccurate.

....

....[1]

1 In an experiment to determine the volume of glass beads, a student used two different methods.

Method 1

The student measured the combined diameters of some beads and then calculated the volume of one bead. The end view of the apparatus used is shown in Fig. 1.1.

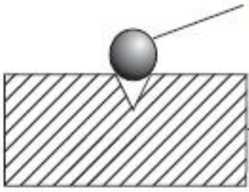


Fig. 1.1

Fig. 1.2 shows the side view of the same apparatus, drawn actual size.

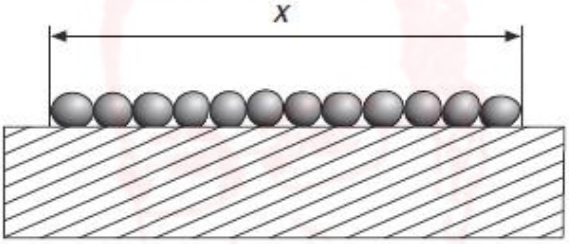


Fig. 1.2

(a) (i) On Fig. 1.2, use your rule to measure the distance x, in cm.

....

(ii) Calculate d, the average diameter in cm of one glass bead. Show your working.

d = ... cm

(iii) Calculate V, the volume of one glass bead using the equation

$$V = \frac{\pi d^3}{6}.$$

V = ...[6]

Method 2

The student used a displacement method to determine the volume of a glass bead. Fig. 1.3 and Fig. 1.4 show how this was done.

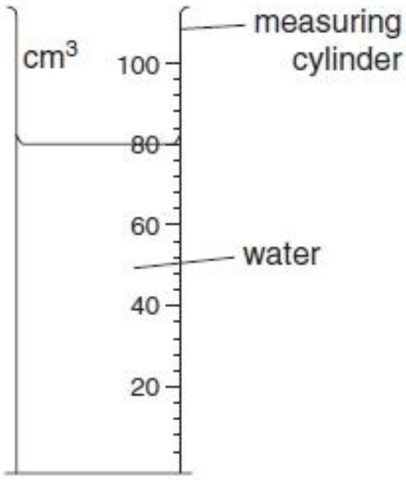


Fig. 1.3

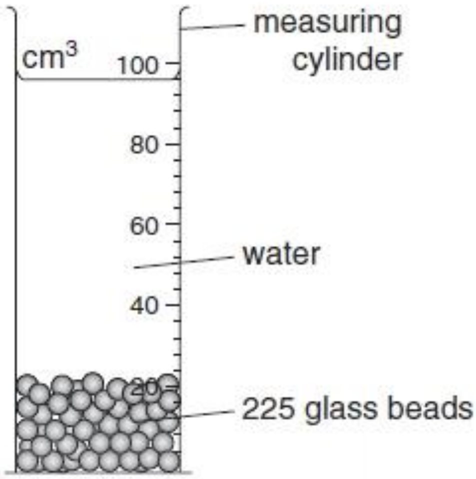


Fig. 1.4

(b) **(i)** Write down the values of the readings taken.

....

....

(ii) Calculate the volume of 225 glass beads.

volume = ...

(iii) Calculate V, the average volume of one glass bead.

V = ...

[3]

(c) Suggest which of the two methods will give the more accurate result for the volume of a glass bead. Give a reason for your answer.

....

....

....[1]

Q# 1/ iG Phx/2015/s/Paper 61/ www.SmashingScience.Org :o)

5 (a) use of $T^2 = 4\ s^2$ [1]

correct method shown clearly on graph [1]

l = 0.99 (m) cao OR ecf 0.49 if $T^2 = 2\ s^2$ used [1]

(b) reduce (percentage) uncertainty OR reduce (the effect of) error due to starting/stopping [1]

(c) (i) 5 – 10 [1]

(ii) minimum not less than 10 g; maximum not more than 1000 g; maximum must be at least double the minimum [1]

[Total: 6]

Q# 2/ iG Phx/2014/w/Paper 61/ www.SmashingScience.Org :o)

5 (a) h = 9.5 cm d_T = 7.2 cm – 7.3 cm and d_B = 4.5 cm [1]

d_A = 5.85 / 5.9 cm (no mark), V rounds to 260 cm^3 (no ecf) [1]

2 or 3 significant figures and cm^3 [1]

(b) measurement of circumference half way up, or at top and bottom [1]

more than one revolution used for the measurement in at least one position, and divide [1]

(c) (i) 225 [1]

(ii) 275 (ecf 500 – candidate's **(c)(i)**) [1]

(d) correct line of sight clearly shown at right angles outside measuring cylinder [1]

[Total: 5]

Q# 3/ iG Phx/2013/w/Paper 61/ www.SmashingScience.Org :o)

5 (a) 54 – 55 [1]

(b) (i) table:
e values 12, 22, 36, 50, 60 (e.c.f. from **(a)**) [1]

(ii) graph:
axes correctly labelled e / mm and F / N and correct way round [1]
suitable scales [1]
all plots correct to ½ small square [1]
good line judgement [1]
thin, single continuous line [1]

(iii) triangle method using at least half of candidate's line, shown on the graph [1]
G = 11 – 13, no e.c.f. [1]

[Total: 9]

Q# 4/ iG Phx/2013/s/Paper 61/ www.SmashingScience.Org :o)

1 (a) 9.7, 5.7, 2.0 (accept 2) or 97, 57, 20 [1]
all given to correct unit [1]
line AC drawn correctly, corner to corner [1]
α = 18 – 20° [1]

(b) number from 3 to 20 with no unit [1]

(c) correct statement for results (expect Yes) [1]
idea of within (or beyond) experimental accuracy [1]

[Total: 7]

Q# 5/ iG Phx/2012/s/Paper 61/ www.SmashingScience.Org :o)

5 (a) V_1 = 74 [1]
Line of sight perpendicular to scale [1]
Perpendicular line continues to measuring cylinder at surface level [1]

(b) V_2 = 81, V_G = 7 (ecf allowed) [1]
All volumes in cm^3, unit given at least once, not contradicted [1]

(c) $(V_3 - V_1)$ = 24, V_A = 17 (ecf allowed) [1]

(d) Any three from:
V_A: Finger increases V_3 / tube not pushed in far enough
Some water in test-tube/air is compressed
V_W: Water remaining in tube
Water remaining in measuring cylinder
Tube overfilled, wtte (surface tension effect) [3]
Either V_A or V_W (accept only once):
Measuring cylinder readings not very sensitive
Subtraction produces large percentage uncertainty

[Total: 9]

Q# 6/ iG Phx/2011/s/Paper 61/ www.SmashingScience.Org :o)

5 (a) column 1: d, m (or in words) [1]
columns 2 and 3: t, T (or in words) [1]
columns 2 and 3: s, s (or in words) [1]

(b) accuracy/reducing uncertainty/sensible comment on reaction time [1]

(c) (i) at least three correct values entered in table
1.66, 1.52, 1.40, 1.28, 1.17 (at least 2 significant figures) c.a.o [1]

(ii) statement matches result (expect NO) AND
justification matches statement and by reference to result
(expect decreasing, not equal, not constant, different, changing, wtte)
allow ecf from (i) [1]

[Total: 6]

Q# 7/ iG Phx/2009/w/Paper 61/ www.SmashingScience.Org :o)

1 (a) (i) *d* 0.5 cm or 5mm [1]

(ii) *x* 10.0 [1]

(b) (i)–(iii)
table: *T* 1.0, 0.95, 0.895 (0.90, 0.9), 0.84, 0.775 (0.78) [1]
T^2 1.00, 0.903, 0.801, 0.706, 0.601 (if *T* correct) [1]

(c) graph:
axes labelled [1]
scales suitable, plots occupying at least half grid [1]
plots all correct to ½ square [1]
well judged line [1]
thin line, 5 neat plots [1]

(d) statement NO and not through origin/
inverse/negative gradient/
x increases, T^2 decreases/ wtte [1]

[Total: 10]

Q# 8/ iG Phx/2008/s/Paper 61/ www.SmashingScience.Org :o)

5 (a) (i) triangle method used
(whether or not shown on graph) [1]
Triangle using more than half line
and position indicated on graph [1]
Expect *G* = 4.00–4.35 (but allow correct working
from points read from beyond 1.0 on x axis) [1]
Expect *g* = 9.07–9.87 (ecf from G) [1]

(ii) greater accuracy/average value [1]

(b) (i) amplitude [1]
length [1]
(other possible correct responses shape/size of bob
and number of swings)

(ii) does not affect time [1]

[Total: 8]

Q# 9/ iG Phx/2007/w/Paper 61/ www.SmashingScience.Org :o)

5 (a) (i) 50, 75/76 [1]

(ii) 25 (ecf) [1]
cm^3 (at least once and not contradicted) [1]

(iii) density 4.36 (ecf) [1]

(b) V_2, V_1 [1]
cm^3(at least once and not contradicted) [1]
density g/cm^3 [1]
5.68, 3.02 both to 2/3 sf [1]

(c) Same method, lots of grains [1]

[Total: 9]

Q# 10/_iG Phx/2006/w/Paper 61/ www.SmashingScience.Org :o)

1 (a) 4.1 (cm) [1]

(b) (i) 4.9 (cm) [1]
both in correct unit [1]

(ii) 7.83(4) (ecf) [1]
cm^3 [1]

(c) (i) 7/7.0/7.1/7.2/7.3/7.4/7.5
(ecf: less than V by up to 10% with equivalent sf) [1]

(ii) correct d value (0.84 – 0.90, no ecf) [1]
1/2/3 sf and g/cm^3 [1]

[Total: 8]

Q# 11/_iG Phx/2006/w/Paper 61/ www.SmashingScience.Org :o)

2 (a) cm; s; s [1]

(b) 1.835; 1.787; 1.753; 1.706; 1.672 (accept 3 sf) [1]
consistent sf (3/4) [1]

(c) Axes suitable (plots occupy at least ½ grid)
and labelled, false origin as instructed [1]
Plots correct to ½ small sq (–1 each error) [2]
Well judged best fit line [1]
line suitably thin [1]

(d) No and not a straight line through the origin [1]

(e) greater accuracy (wtte) [1]

[Total: 10]

Q# 12/_iG Phx/2006/s/Paper 61/ www.SmashingScience.Org :o)

1 (a) (i) 1.6 (cm) 16 (mm) **[1]**

(ii) 0.16 (cm) 1.6 (mm) **[1]**
both in cm (or mm) **[1]**

(b) (i) 1 = 5.8 cm and w = 6.0 cm (58 mm, 60 mm) **[1]**

(ii) V = 5.568 (or 5.57) **[1]**
V in cm^3 (or mm^3) **[1]**

(c) d = 0.233 (2/3 sf) **[1]**
d in g/cm^3 (or g/mm^3) **[1]**

(d) V_a = 7/8/9/10 cm^3 **[1]**

TOTAL 9

Q# 13/_iG Phx/2004/w/Paper 61/ www.SmashingScience.Org :o)

2	(a)	(i)	triangle seen	1
			large triangle (> ½ line)	1
			correct readings to ½ sq	1
			G = 0.37 – 0.39	1
		(ii)	ρ = 2.63 (ecf)	1
			2/3 sf and g/cm^3	1
	(b)		increased accuracy	1
				TOTAL 6

Q# 14/_iG Phx/2004/w/Paper 61/ www.SmashingScience.Org :o)

1	(a)	(i)	84	1
		(ii)	50	1
			both units correct °C and cm^3 (or ml)	1
	(b)	(i)	75	1
		(ii)	15 (ecf)	1
		(iii)	source of error e.g. thickness of string/extension of string/diagonal windings/identified parallax	1
		(iv)	improvement e.g. thinner string/inextensible string/parallel windings/ no gaps between windings/repeats and averages	1
	(c)	(i)	2.1 (cm)	1
		(ii)	31.5 or 32 cm^2 (2/3 sf and unit required)	1
	(d)		time	1
			another temperature	1
				TOTAL 11

Q# 15/_iG Phx/2004/w/Paper 61/ www.SmashingScience.Org :o)

3	(a)	(i)	2.15 – 2.25	1
		(ii)	1.1 (+ both with correct unit, cm/mm) ecf	1
	(b)	(i)	all correct 1 values, 91.1, 81.1, 71.1, etc	1
		(ii)	all correct T values, 1.93, 1.80, 1.67, 1.57, 1.41, 1.28	1
			3/4sf for T	1

(c) Graph:

scales suitable T start at 1.0s, T: 10sq : 0.2s

1: 10sq : 20cm; both labelled

and correct way round **1**

plots correct to ½ sq (-1 each error) **2**

line judgement **1**

line thickness **1**

(d) 58 cm **1**

TOTAL 11

Q# 16/ iG Phx/2003/w/Paper 61/ www.SmashingScience.Org :o)

1	**(a)**	wind string round more than once	1
		divide measured length by number of turns to find c	1
	(b) (i)	correct diagram, blocks parallel, one at each end	1
	(ii)	119 mm OR 11.9 cm to 121 mm OR 12.1 cm	1
	(c)	V = 32.39 to 32.41	1
		cm^3	1
	(d) (i)	$V_m = 0.5 – 2\ cm^3$	1
	(ii)	correct calculation and 2/3 sf (ignore unit)	1
			TOTAL 8

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4	**(a)**	Scales: y-axis 1N = 4 cm; x-axis 1m/s2 = 4/5 cm right way round	1
		Both axes labelled with quantity and unit	1
		Plots to ½ sq (-1 each error or omission, minimum mark zero)	2
		Line thickness less than 1 mm and no 'blob' plots	1
		Well judged best fit single straight line	1
	(b)	Large triangle used (> ½ line) clear on graph	1
		Interpolation to ½ sq (if large enough triangle present)	1
		Value 1.38 – 1.48	1
		kg and 2/3 sf	1
			TOTAL 10

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4	(a)	(i)	6.8cm (68mm)	1
		(ii)	6.8	1
			unit, mm	1
	(b)	(i)	3.8/3.77 or 0.38/0.377	1
			mm or cm as appropriate	1
		(ii)	0.94/0.95 (or evidence of division by 4)	1
		(iii)	0.75094/0.75095	1
	(c)		Thickness of string/thickness of marks on string/stretching of string/metre rule measures to 1mm	1
			TOTAL	8

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1. (a) (i) x = 6.0 /6.1	1
(ii) 6/12	1
d = 0.50	1
(iii) value 0.0654	1
unit	1
2/3 sf	1
(b) (i) 80	
96	1
(ii) 96 – 80 = 16	1
(iii) 0.0711 (ignore sf) with unit	1
(c)	
(ii) M1, difficult to measure liquid volume accurately	
M2, more beads	
M2, diameter variation	
other sensible suggestion.	1
TOTAL 10	