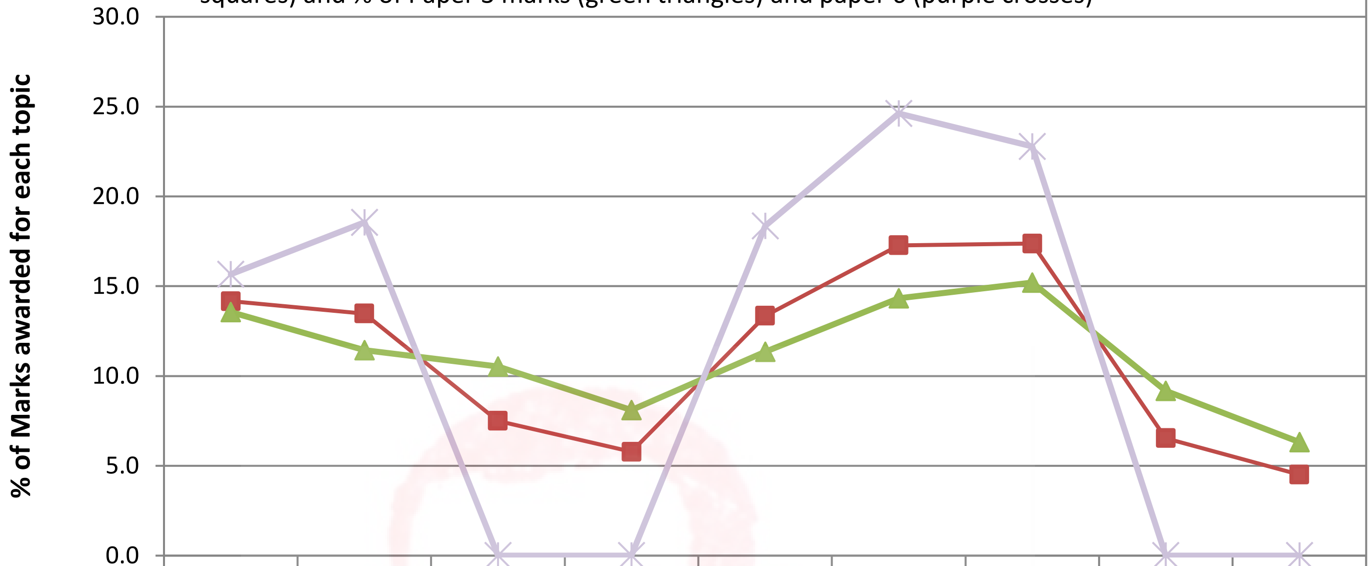
Name: Class: Date:

# iG Phx 2 EQ 15w to 02s P6 4Students 193marks

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)

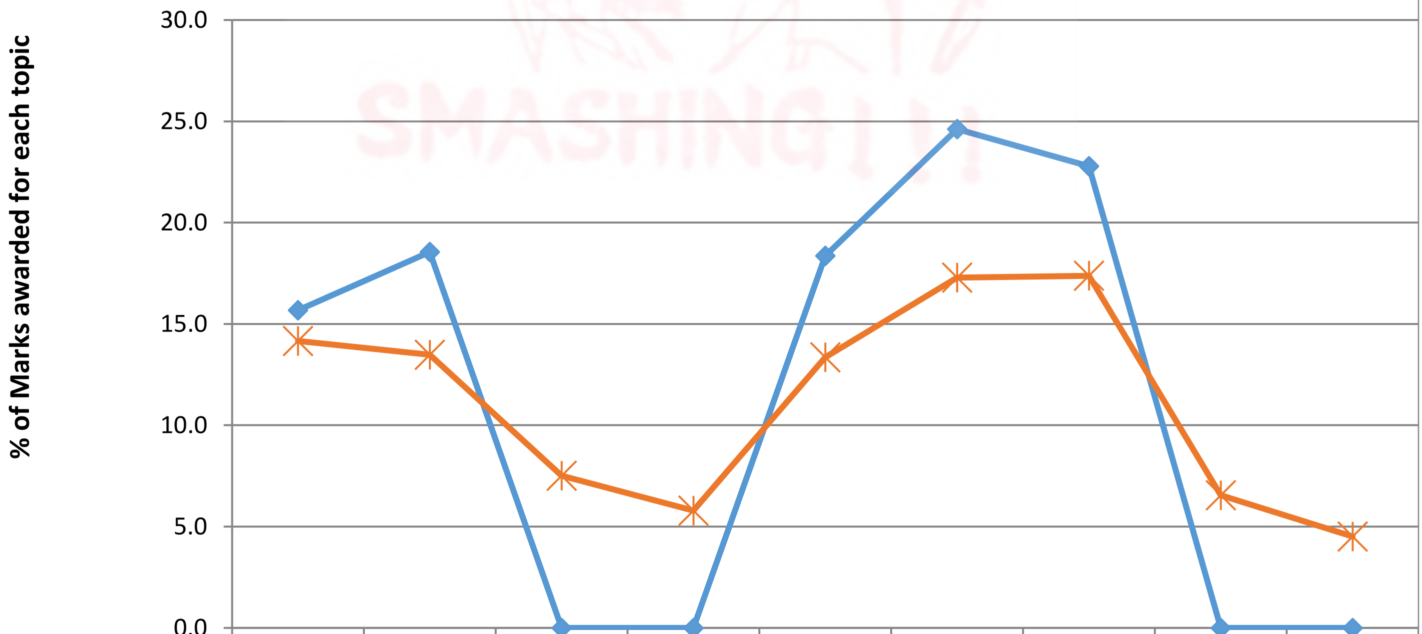



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| PhxBoth P3&6 | 14.2 | 13.5 | 7.5 | 5.8 | 13.4 | 17.3 | 17.4 | 6.5 | 4.5 |
| PhxP3 | 13.6 | 11.4 | 10.5 | 8.1 | 11.3 | 14.3 | 15.2 | 9.2 | 6.3 |
| PhxP6 | 15.7 | 18.6 | 0.0 | 0.0 | 18.4 | 24.6 | 22.8 | 0.0 | 0.0 |

**Papers 3 and 6 Topic Number**

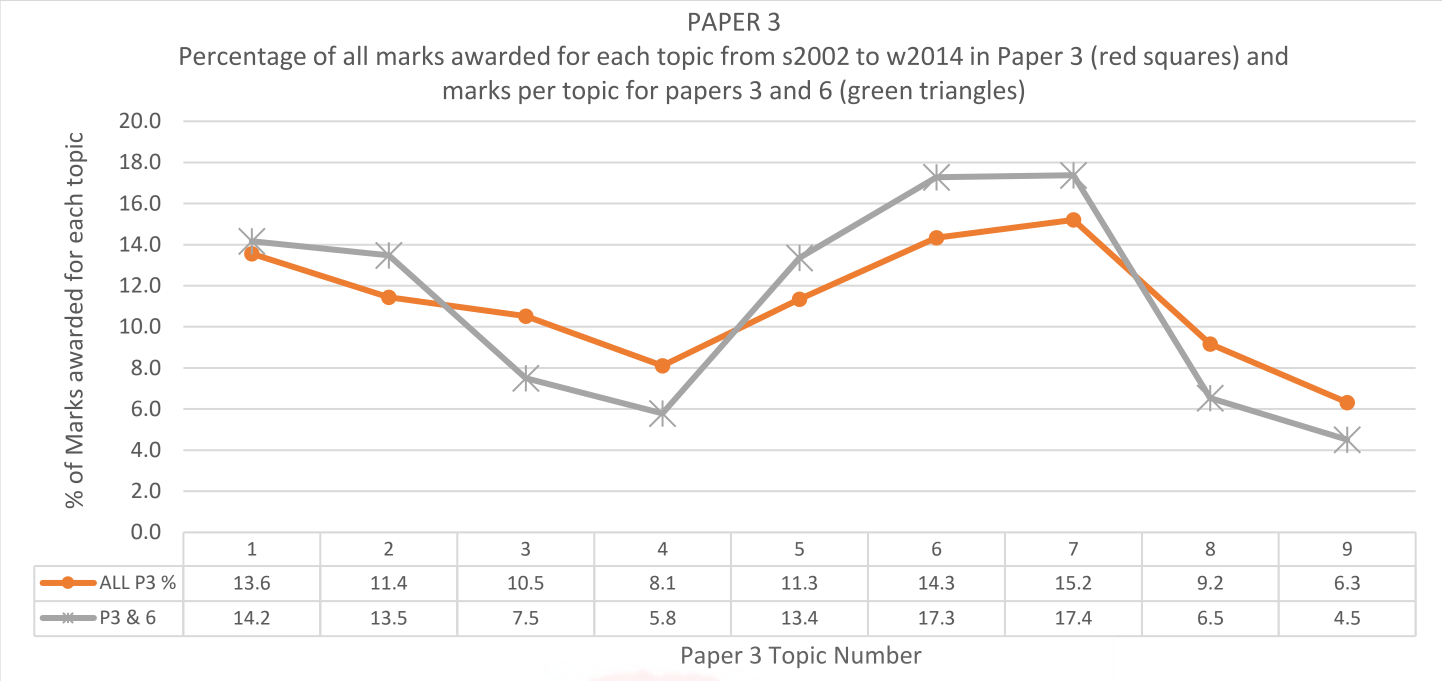
**PAPER 6**

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

1 The class is determining the weight of a metre rule using a balancing method.

The apparatus is shown in Fig. 1.1.

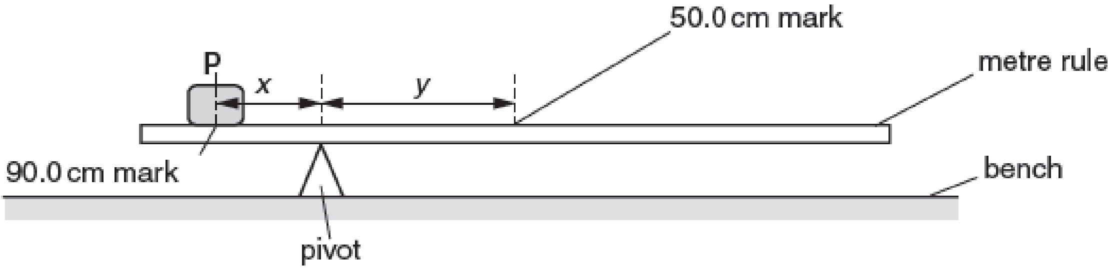



**Fig. 1.1**

**(a)** A student places a load **P** at the 90.0 cm mark on a metre rule and then balances the rule on a pivot.

**(i)** On Fig. 1.1, measure the distance *x* from the 90.0 cm mark to the pivot.

$x$ = ........................................................[1]

**(ii)** On Fig. 1.1, measure the distance *y* from the pivot to the centre of the rule.

$y$ = ........................................................[1]

**(b)** Fig. 1.1 is drawn one tenth of actual size.

**(i)** Calculate the actual distance $X$ from the 90.0 cm mark to the pivot.

$X$ = ........................................................

**(ii)** Calculate the actual distance $Y$ from the pivot to the centre of the rule.

$Y$ = ........................................................

[1]

**(iii)** Determine a value $W_1$ for the weight of the metre rule using the equation $W_1 = \frac{PX}{Y}$, where $P = 2.0\,\text{N}$. $P$ is the weight of the load **P**.

$W_1$ = ........................................................[1]

(c) The student keeps the pivot at the same position and moves load **P** to the 95.0 cm mark. He places a load **Q** of weight $Q = 1.0\,N$, on the metre rule. He adjusts its position so that the rule balances.

On Fig. 1.2 mark, with a letter Z, the approximate position of the load **Q**. You do not need to carry out a detailed calculation.

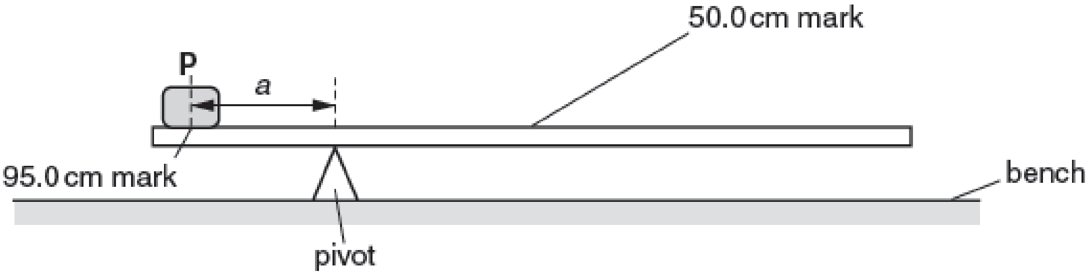



**Fig. 1.2**

[1]

(d) The student uses the values of **P** and **Q** and their distances from the pivot to calculate a second value $W_2$ for the weight of the rule.

$W_2$ = ........................ 1.12 N ........................

The student expects $W_1$ and $W_2$ to be the same.

State whether the results support his idea. Justify your answer by reference to the results.

statement ..............................................................................................................

justification ..............................................................................................................

..............................................................................................................

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

(e) Suggest one practical reason why it is difficult to obtain exact results with this experiment.

..............................................................................................................

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

[Total: 8]

1 The IGCSE class is investigating the motion of a mass hanging on a spring.

Fig. 1.1 shows the apparatus

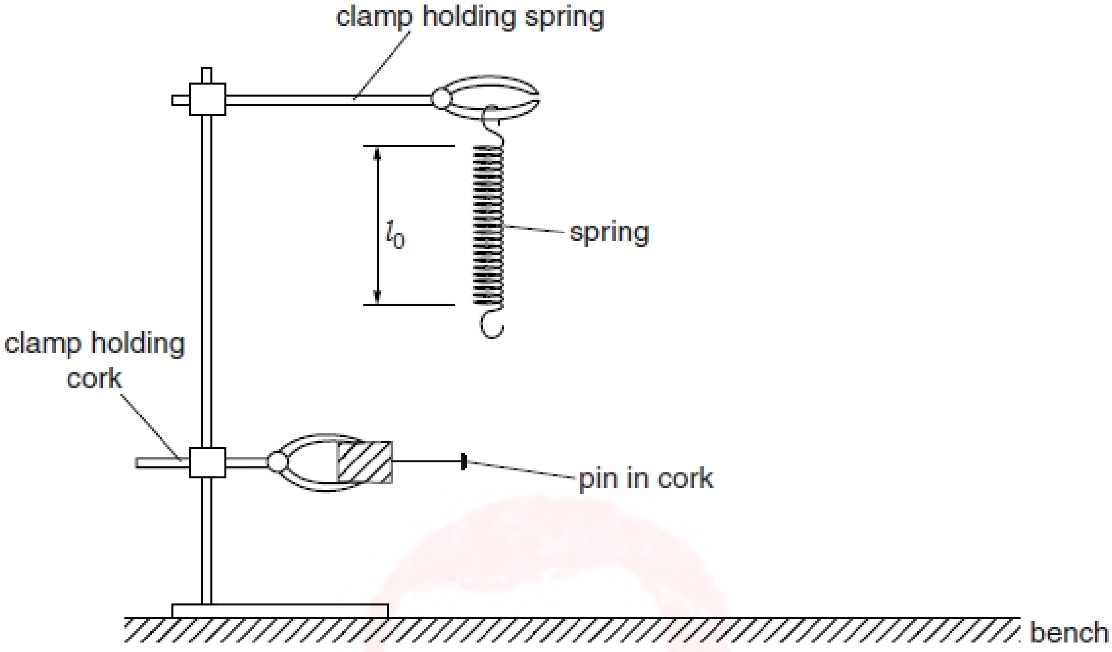



**Fig. 1.1**

**(a)** On Fig. 1.1, measure the length $l_0$ of the unstretched spring, in mm.

$l_0$ = .......................................... mm [1]

**(b)** The diagram is drawn one tenth of actual size. Write down the actual length $L_0$ of the unstretched spring, in mm.

$L_0$ = ..........................................mm [1]

A student hangs a 300 g mass on the spring and measures the new length $L$ of the spring.

$L$ = 255 mm

**(i)** Calculate the extension $e$ of the spring using the equation $e = (L - L_0)$.

$e$ = ..............................................mm

**(ii)** Calculate a value for the spring constant $k$ using the equation $k = \frac{F}{e}$, where $F$ = 3.0 N. Include the appropriate unit.

$k$ = ..............................................

[2]

**(c)** The student adjusts the position of the lower clamp so that the pin is level with the bottom of the mass when the mass is not moving. She pulls the mass down a short distance and releases it so that it oscillates up and down. Fig. 1.2 shows one complete oscillation.

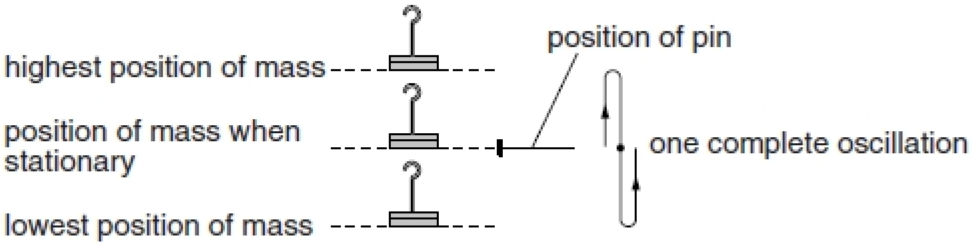



**Fig. 1.2**

She measures the time $t$ taken for 20 complete oscillations.

$t$ = 26.84 s ..........................................

Calculate the time $T$ taken for one complete oscillation.

$T$ = .......................................... [1]

**(d)** She replaces the 300 g mass with a 500 g mass. She repeats the timing as described in part **(c)**.

$t$ = 34.48 s ..........................................

**(i)** Calculate the time $T$ taken for one complete oscillation.

$T$ = ..........................................

**(ii)** The student suggests that the time taken for the oscillations of the spring should not be affected by the change in mass.

State whether her results support this suggestion and justify your answer by reference to the results.

statement ..........................................

justification ..........................................

..........................................

..........................................

[2]

(e) Explain briefly how you avoid a line-of-sight (parallax) error when measuring the length of a spring in this type of experiment. You may draw a diagram.

..........................................................................................................................................

..........................................................................................................................................

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

[Total: 8]

**1** The IGCSE class is carrying out a moments experiment by balancing a metre rule on a small pivot.

**(a)** A student has a small pivot and a metre rule.

Explain briefly how the student finds the position of the centre of mass of the metre rule.

..........................................................................................................................................

..........................................................................................................................................

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

**(b)** The student finds that the centre of mass is not in the middle of the rule but at the 50.2 cm mark.

Explain what the student could do to prevent this from affecting her results.

..........................................................................................................................................

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

**(c)** The student places the metre rule on a pivot so that it balances.

She places a load **P** on one side of the metre rule at a distance *x* from the pivot. She places another load **Q** on the metre rule and adjusts the position of the load **Q** so that the rule balances, as shown in Fig. 1.1.

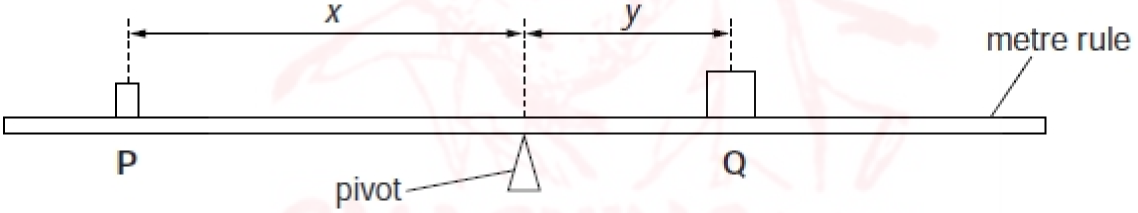



**Fig. 1.1**

The load **Q** is a distance *y* from the pivot.

The readings are shown in Table 1.1.

**Table 1.1**

| weight of **P** / N | weight of **Q** / N | *x* / | *y* / |
|---|---|---|---|
| 2.0 | 5.0 | 39.0 | 15.5 |

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

(ii) Calculate the clockwise moment and the anticlockwise moment using the equation

moment of a force = force × perpendicular distance to the pivot.

clockwise moment = ......................................................

anticlockwise moment = ......................................................
[1]

**(d)** In practice, it is difficult to adjust the loads to make the rule balance exactly.

Explain briefly how you would reduce the uncertainty in the position of **Q** required for exact balance.

..........................................................................................................................................

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

[Total: 5]

5 The IGCSE class is determining the mass of a load **X** using a balancing method.

Fig. 5.1 shows the apparatus.

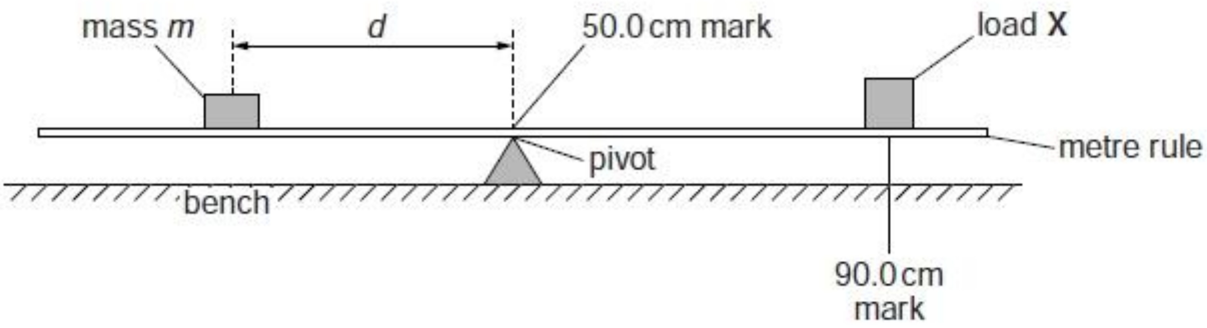



**Fig. 5.1**

The centre of the load **X** is fixed at the 90.0 cm mark on the rule.

A student uses a range of values of the mass *m* and determines the distance *d* from the pivot where the mass must be placed to balance the rule.
The readings are shown in Table 5.1.

**Table 5.1**

| *m* / g | *d* / cm |
|---|---|
| 40 | 30.2 |
| 50 | 23.9 |
| 60 | 20.0 |
| 70 | 17.1 |
| 80 | 15.1 |

**(a)** Calculate the distance *x* between the centre of the load **X** and the centre of the rule.

*x* = ........................................................ [1]

**(b)** Suggest a reason for the student using a range of *m* values.

..........................................................................................................................

..........................................................................................................................

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

**(c)** Using each set of readings and the value of $x$, the student calculates values for the mass of the load **X**.

He writes his results: 30.2 g, 29.875 g, 30 g, 29.925 g, 30.2 g.

Use these results to calculate an average value for the mass of **X** and give it to a suitable number of significant figures for this type of experiment.

average value for the mass of **X** = .................................................. [2]

**(d)** This type of balancing experiment is difficult to carry out.

Suggest one practical difficulty and one way to try to overcome the difficulty. You may draw a diagram, if you wish.

practical difficulty ..........................................................................................................

..........................................................................................................................................

..........................................................................................................................................

way to overcome the difficulty

..........................................................................................................................................

..........................................................................................................................................

[2]

[Total: 6]

**1** The IGCSE class is investigating the stretching of a spring.

Fig. 1.1 shows the experimental set up.

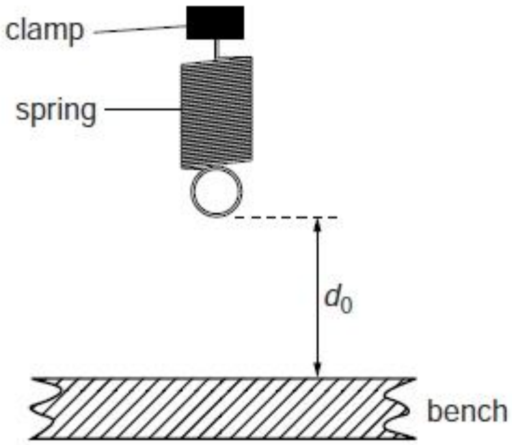



**Fig. 1.1**

**(a)** On Fig. 1.1, measure the vertical distance $d_0$, in mm, between the bottom of the spring and the surface of the bench.

$d_0$ = .......................................... mm [1]

**(b)** The diagram is drawn 1/10th actual size. Calculate the actual distance $D_0$, in mm, between the bottom of the spring and the surface of the bench.

$D_0$ = .......................................... mm [1]

**(c)** A student hangs a 1.0 N load on the spring. He measures and records the distance $D$ between the bottom of the spring and the surface of the bench, and the value of the load $L$.

He repeats the procedure using loads of 2.0 N, 3.0 N, 4.0 N and 5.0 N. The distance readings are shown in Table 1.1.

Calculate the extension $e$ of the spring, for each set of readings, using the equation $e = (D_0 - D)$. Record the values of $L$ and $e$ in Table 1.1.

**Table 1.1**

| $L$ / N | $D$ / mm | $e$ / mm |
|---|---|---|
| | 199 | |
| | 191 | |
| | 179 | |
| | 171 | |
| | 160 | |

[2]

**(d)** Plot a graph of $e$ / mm ($y$-axis) against $L$ / N ($x$-axis).

[4]

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

$G$ = .................................................. [2]

**(f)** When making measurements, the student is careful to avoid a line-of-sight error.

Suggest one other precaution that the student should take when measuring the distance $D$ between the bottom of the spring and the surface of the bench.

..............................................................................................................................

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

[Total: 11]

1 An IGCSE student is determining the mass of a metre rule using a balancing method.

Fig. 1.1 shows the apparatus.

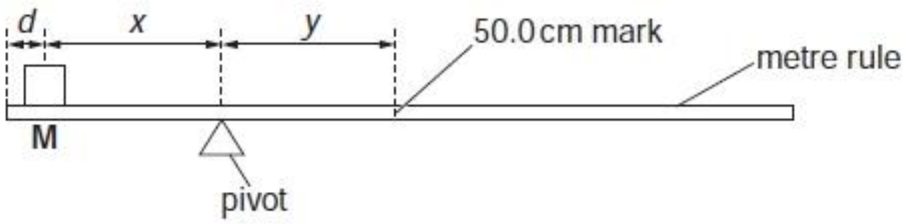



**Fig. 1.1**

Mass **M** is placed on the rule. The position of the pivot is adjusted until the rule balances.

**(a)** The student chooses a mass **M** which is similar to the mass of the metre rule. Suggest a suitable value for the mass.

suitable mass = .............................................. [1]

**(b)** The mass is cylindrical and has a diameter slightly larger than the width of the metre rule.

Describe briefly how you would place the mass so that its centre of mass is exactly over the 90.0 cm mark on the metre rule. You should draw a diagram and mark the position of the centre of mass on the cylinder.

..........................................................................................................................

..........................................................................................................................

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

**(c)** From your experience of carrying out balancing experiments of this type, suggest one difficulty that you are likely to come across that could make the final result inaccurate.

..........................................................................................................................

..........................................................................................................................

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

**(d)** The student takes a reading of *x* and the corresponding reading of *y*. He then calculates the mass of the metre rule.

Suggest how you would improve the reliability of the value of the mass of the metre rule, using this method.

..........................................................................................................................................

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

**(e)** Another student carries out a similar experiment to determine the mass of a 50 cm metal strip. She calculates the mass and writes down "mass = 234.872 g".

She checks the mass on an accurate balance. The value is 235 g. She thinks she must have made a mistake in her experiment.

Write a brief comment on the accuracy of her experimental result.

..........................................................................................................................................

..........................................................................................................................................

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

[Total: 6]

1 An IGCSE student is determining the weight of a metre rule.

Fig. 1.1 shows the apparatus.

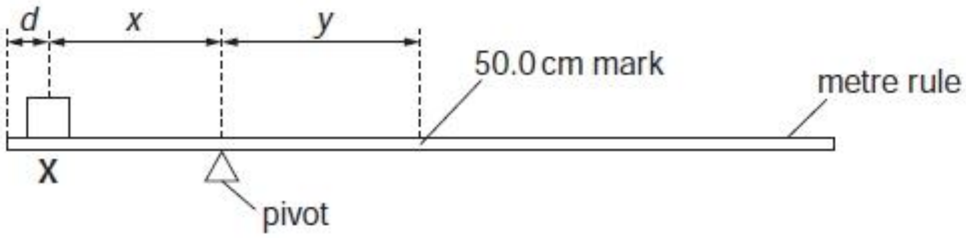



**Fig. 1.1**

**X** is a 1.0 N load.

The student places the load **X** on the rule so that its centre is at *d* = 5.0 cm from the zero end of the rule, as shown in Fig.1.1. He adjusts the position of the rule so that it is as near as possible to being balanced, with the 50.0 cm mark to the right of the pivot.

He measures and records the distance *x* from the centre of the load **X** to the pivot, and the distance *y* from the pivot to the 50.0 cm mark on the rule. He repeats the procedure using *d* values of 10.0 cm, 15.0 cm, 20.0 cm and 25.0 cm. The readings of *d*, *x* and *y* are shown in Table 1.1.

**Table 1.1**

| *d* / cm | *x* / cm | *y* / cm |
|---|---|---|
| 5.0 | 23.7 | 21.3 |
| 10.0 | 21.0 | 19.1 |
| 15.0 | 18.5 | 16.3 |
| 20.0 | 16.0 | 14.1 |
| 25.0 | 13.9 | 12.0 |

**(a)** Plot the graph of $y$/cm ($y$-axis) against $x$/cm ($x$-axis). You do not need to include the origin (0,0) on your graph.

[4]

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

$G$ = .......................................................... [2]

**(c)** Calculate the weight $W$ of the metre rule using the equation $W = \frac{L}{G}$, where $L$ = 1.0 N.

$W$ = .......................................................... [1]

**(d)** The calculation of *W* is based on the assumption that the centre of mass of the rule is at the 50.0 cm mark.

**(i)** Describe briefly how you would determine the position of the centre of mass of the rule.

..........................................................................................................................................

..........................................................................................................................................

**(ii)** Describe how you would modify the experiment if the centre of mass was at the 49.7 cm mark.

..........................................................................................................................................

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

[Total: 9]

1 An IGCSE student is determining the position of the centre of mass of a triangular card.

The apparatus is shown in Fig. 1.1.

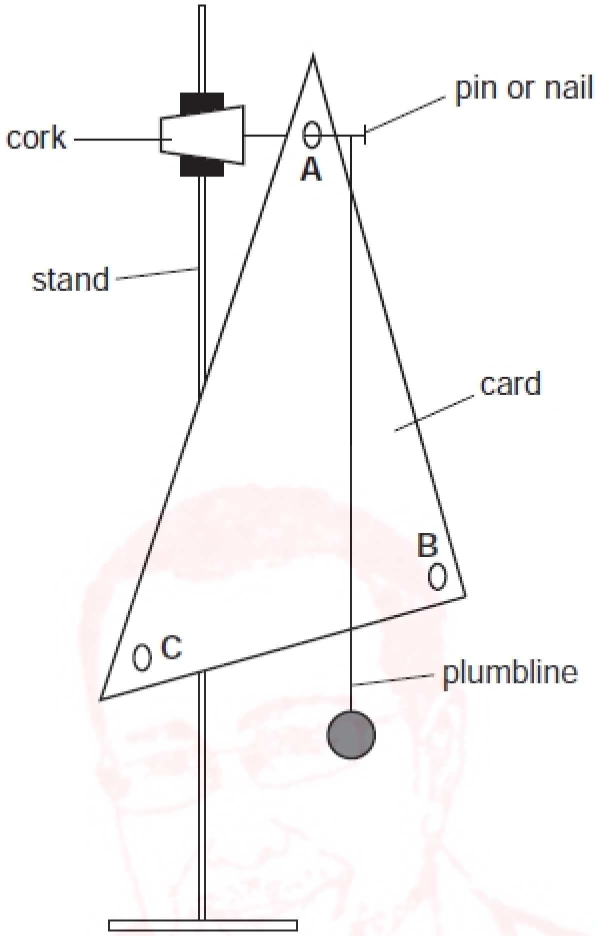



**Fig. 1.1**

**(a)** The student hangs the card on the nail through hole **A**. He checks that the card is able to swing freely and then hangs the plumbline from the nail so that it is close to, but not touching, the card. When the card and plumbline are still, he makes a small mark at the edge of the card where the plumbline crosses the edge. He removes the card and draws a line from the mark to hole **A**.

He repeats the procedure using holes **B** and **C**.

Fig.1.2 is a drawing of the card.

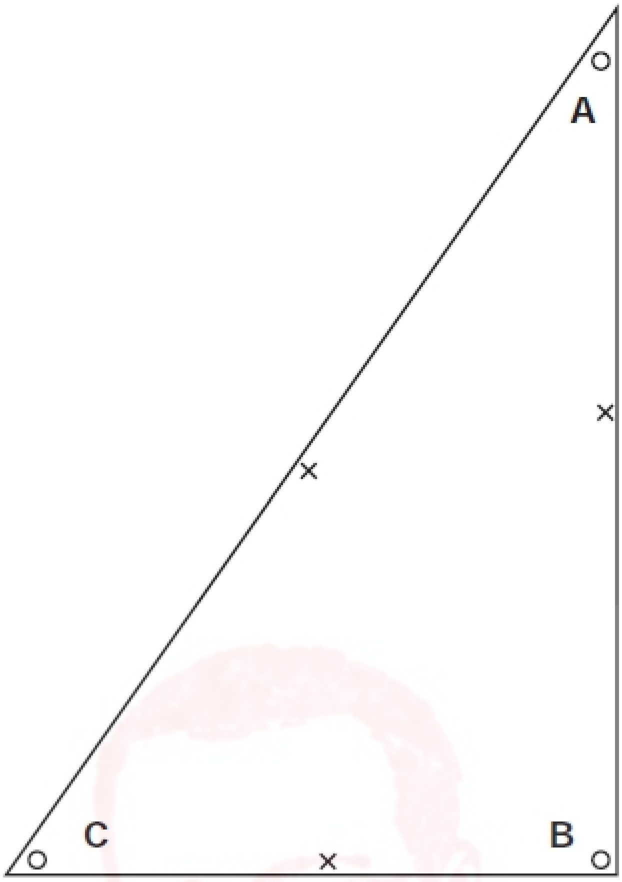



**Fig.1.2**

On Fig.1.2, the position of each of the marks the student makes is shown with a small cross. On Fig. 1.2, draw in the lines between the positions of the holes **A**, **B** and **C** and the corresponding crosses on the card. [2]

**(b)** If the experiment is completely accurate, the centre of mass of the card is at the position where the three lines meet. On Fig. 1.2, judge the best position for the centre of mass, marking it with a small cross. Draw a line from this position to the right-angled corner of the card and measure the distance *a* between the centre of mass and the right-angled corner of the card.

*a* = ..........................................[3]

**(c)** In this experiment, it is important that the card is able to swing freely. For this reason, the plumbline should not touch the card but be a small distance from it. This could cause an inaccuracy in marking the card at the correct position. Describe how you would minimise this possible inaccuracy. You may draw a diagram.

..........................................................................................................................................

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

[Total: 6]

1 An IGCSE student is investigating the stretching of springs.

Fig. 1.1 shows the apparatus used for the first part of the experiment.

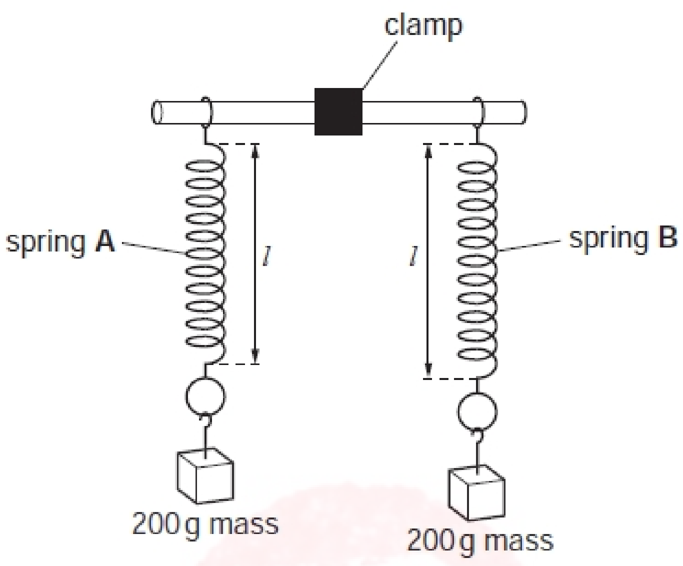



**Fig. 1.1**

The unstretched length $l_A$ of spring **A** is 15 mm.

The unstretched length $l_B$ of spring **B** is 16 mm.

**(a)** The student hangs a 200 g mass on each spring, as shown in Fig. 1.1.

**(i)** On Fig. 1.1 measure the new length $l$ of spring **A**.

$l$ = .................................... mm

**(ii)** Calculate the extension $e_A$ of the spring using the equation $e_A = (l - l_A)$.

$e_A$ = .................................... mm

**(iii)** On Fig. 1.1 measure the new length $l$ of spring **B**.

$l$ = .................................... mm

**(iv)** Calculate the extension $e_B$ of the spring using the equation $e_B = (l - l_B)$.

$e_B$ = .................................... mm
[2]

**(b)** The student then sets up the apparatus as shown in Fig. 1.2.

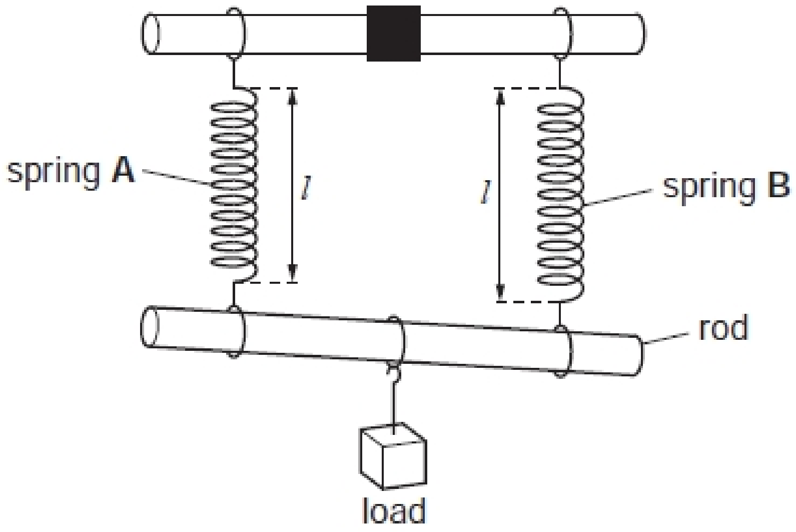



**Fig. 1.2**

**(i)** On Fig. 1.2 measure the new length of each of the springs.

spring **A**: $l$ = ...................................... mm

spring **B**: $l$ = ...................................... mm

**(ii)** Calculate the extension of each spring using the appropriate equation from part **(a)**.

spring **A**: $e$ = ...................................... mm

spring **B**: $e$ = ...................................... mm

**(iii)** Calculate the average of these two extensions $e_{av}$. Show your working.



$e_{av}$ = ......................................mm

[3]

**(c)** It is suggested that $(e_{\mathbf{A}} + e_{\mathbf{B}})/4 = e_{av}$.

State whether your results support this theory and justify your answer with reference to the results.

Statement ..........................................................................................................

Justification ......................................................................................................

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

**(d)** Describe briefly one precaution that you would take to obtain accurate length measurements.

..........................................................................................................................

**1** A student is determining the position of the centre of mass of an object using a balancing method.

Fig. 1.1 shows the apparatus used.

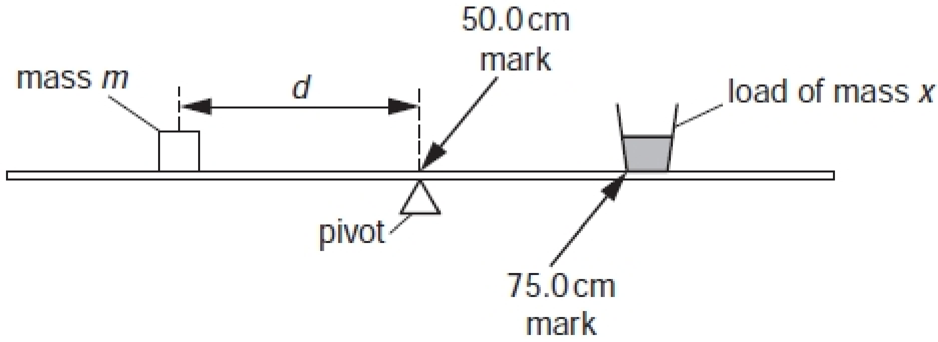



**Fig. 1.1**

A load of mass *x* is taped to the metre rule so that one side of the base is exactly on the 75.0cm mark. The student places a mass *m* of 30g on the rule and adjusts its position so that the rule is as near as possible to being balanced with the 50.0cm mark exactly over the pivot, as shown in Fig. 1.1.

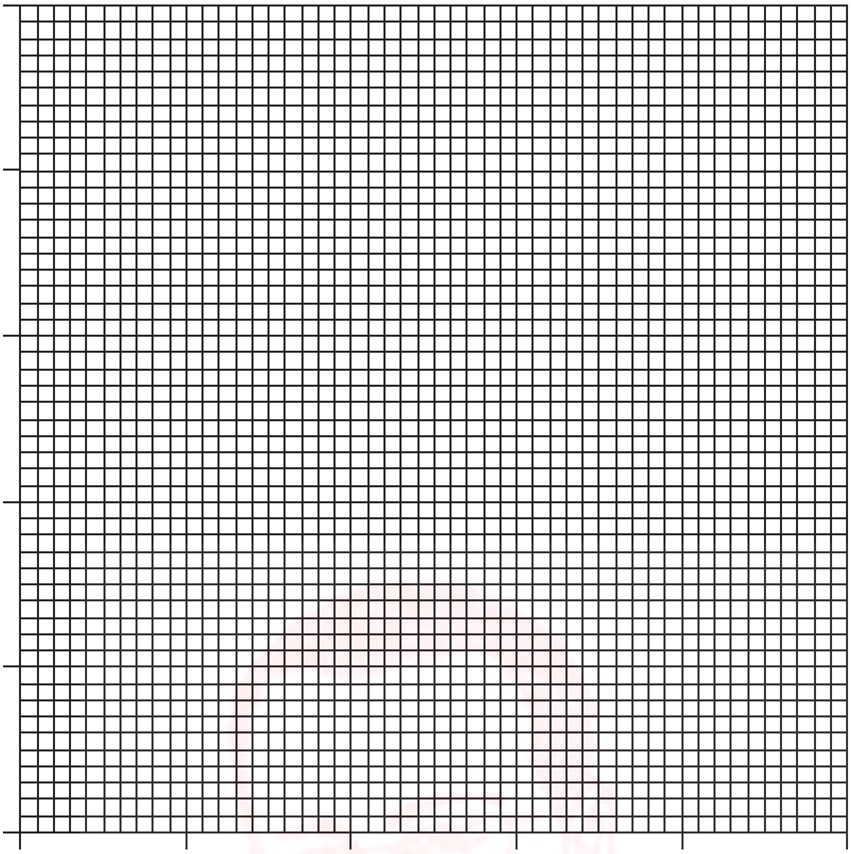
The student records the distance *d* from the centre of the 30g mass to the 50.0cm mark on the rule. He then repeats the procedure using different masses. The readings are shown in Table 1.1.

**Table 1.1**

| $m$/g | $d$/cm | $\frac{1}{d} / \frac{1}{\text{cm}}$ |
|---|---|---|
| 30 | 45.0 | |
| 40 | 34.0 | |
| 50 | 27.0 | |
| 60 | 22.5 | |
| 70 | 19.3 | |

**(a)** For each value of *d*, calculate 1/*d* and enter the values in the table. [2]

**(b)** Plot a graph of $m$/g ($y$-axis) against $\frac{1}{d} / \frac{1}{\text{cm}}$ ($x$-axis).



[4]

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

$G$ = ................................................... [2]

**(d)** Determine the horizontal distance $z$ from the 75.0 cm mark on the rule to the centre of mass of the load using the equation

$$z = \frac{G - k}{x},$$

where $k$ = 1250 g cm and $x$ = 50 g.

$z$ = ................................................... [2]

[Total: 10]

**5** An IGCSE student is investigating moments using a simple balancing experiment.

He uses a pivot on a bench as shown in Fig. 5.1.


**Fig. 5.1**

First, the student balances the metre rule, without loads, on the pivot. He finds that it does not balance at the 50.0 cm mark, as he expects, but it balances at the 49.7 cm mark.

Load **Q** is a metal cylinder with diameter a little larger than the width of the metre rule, so that it covers the markings on the rule. Load **Q** is placed carefully on the balanced metre rule with its centre at the 84.2 cm mark. The rule does not slip on the pivot.

**(a)** Draw on Fig. 5.1 the metre rule with load **Q** on it. [2]

**(b)** Explain, using a labelled diagram, how the student would ensure that the metre rule reading at the centre of **Q** is 84.2 cm.

[2]

**(c)** Calculate the distance between the pivot and the centre of load **Q**.

distance = ........................................ [1]

[Total: 5]

1 An IGCSE student is making measurements as accurately as possible in order to determine the density of glass.

Fig. 1.1 shows a glass test-tube drawn actual size.

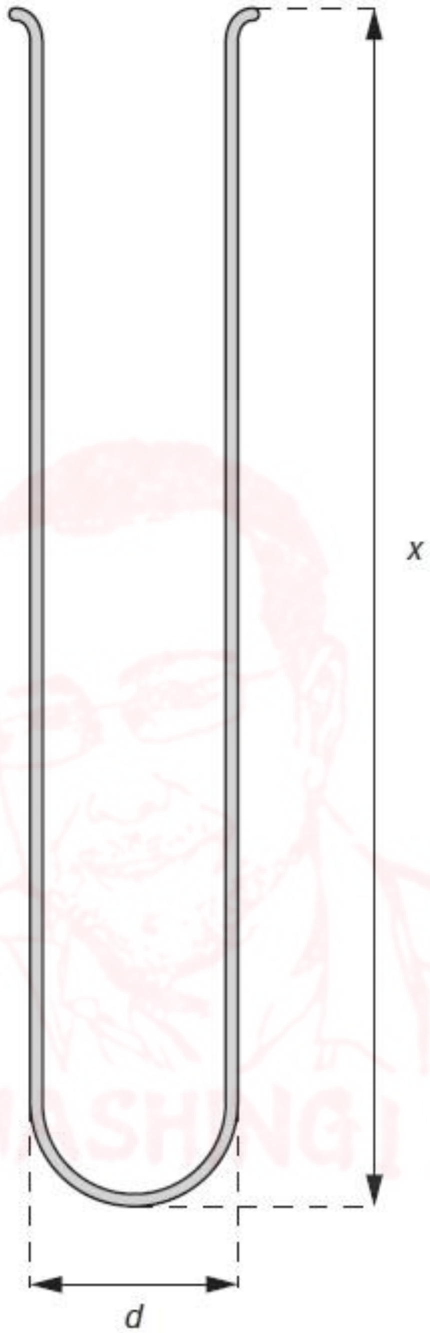



**Fig. 1.1**

(a) (i) Use your rule to measure, in cm, the external diameter *d* of the test-tube.

*d* = ........................................ cm

**(ii)** Use your rule to measure, in cm, the length *x* of the test-tube.

$x$ = ...........................................

**(iii)** Draw a labelled diagram to show how you would use two rectangular blocks of wood and your rule to measure the length *x* of the test-tube as accurately as possible.

[4]

**(b)** The mass *m* of the test-tube is 31.2 g.

**(i)** Calculate the external volume $V_e$ of the test-tube using the equation

$$V_e = \frac{\pi d^2 x}{4}.$$

$V_e$ = ...........................................

**(ii)** The student then fills the test-tube with water and pours the water into a measuring cylinder. Fig. 1.2 shows the measuring cylinder.

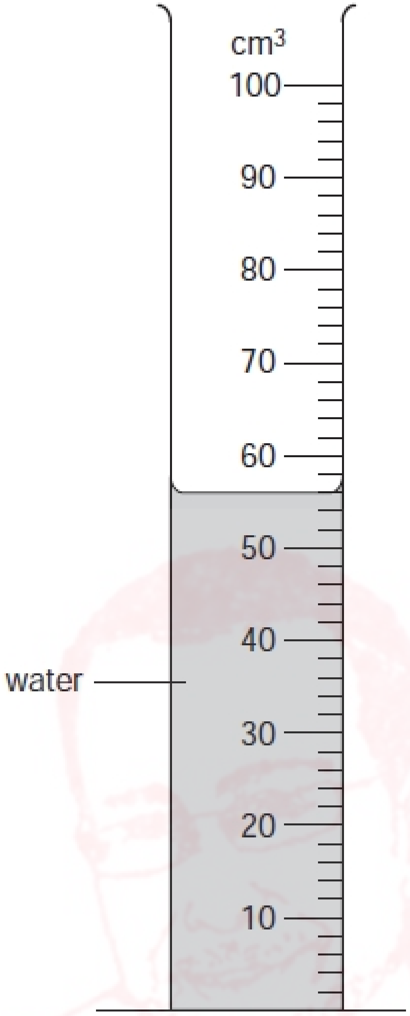



**Fig. 1.2**

Record the volume reading $V_i$ from the measuring cylinder. This is the internal volume of the test-tube.

$V_i$ = ..............................................

**(iii)** Calculate the density $\rho$ of the glass from which the test-tube is made using the equation

$$\rho = \frac{m}{(V_e - V_i)}.$$

$\rho$ = ........................................ [4]

[Total: 8]

1 An IGCSE student is determining the density of the metal from which a load is made.

The apparatus is shown in Fig. 1.1.

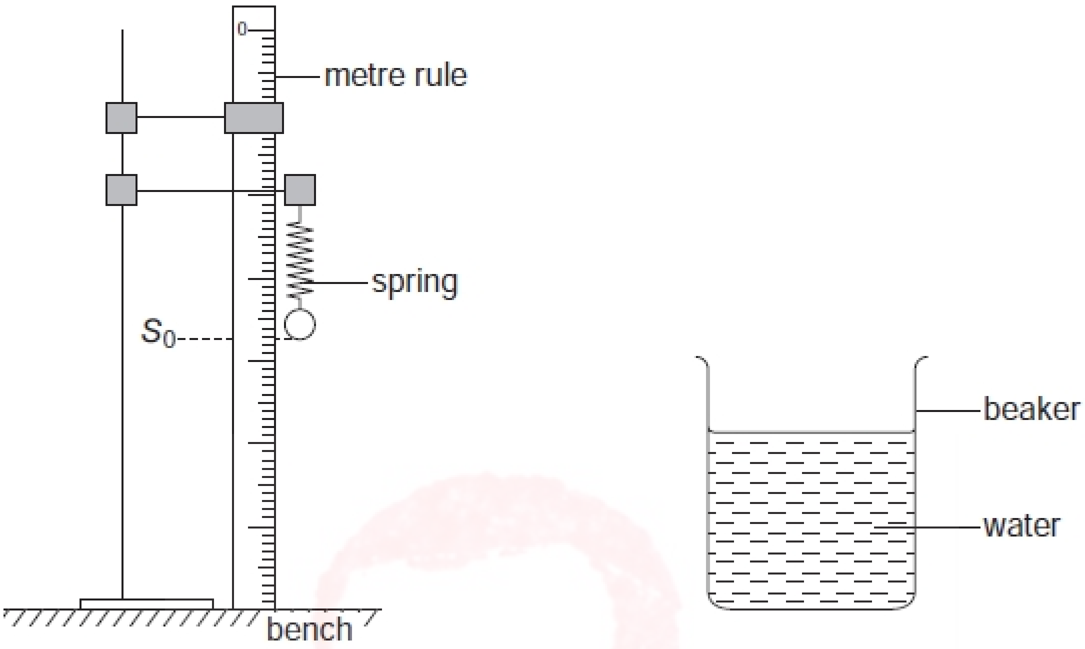



**Fig. 1.1**

**(a)** The student records the scale reading $S_0$ on the metre rule at the bottom of the spring, as shown in Fig. 1.1.

$S_0$ = 37.4 cm

Describe briefly how the student can avoid a parallax error when taking the scale reading.

..........................................................................................................................................

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

**(b)** He then hangs the load on the spring as shown in Fig. 1.2. He records the new scale reading $S_1$.

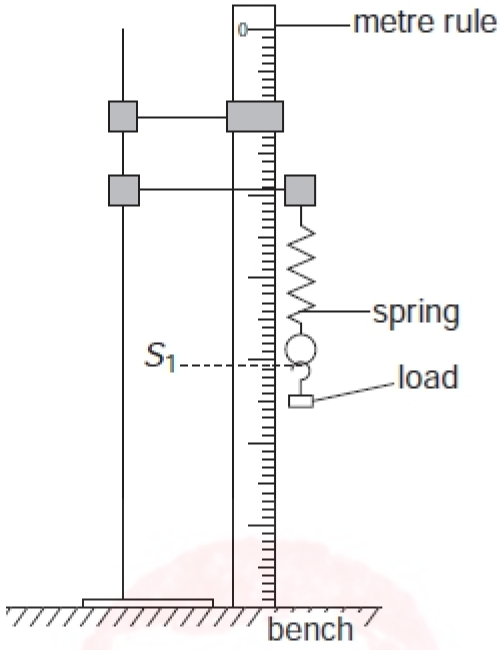



**Fig. 1.2**

$S_1 = 40.5\,\text{cm}$

**(i)** Calculate the extension $e_1$ of the spring using the equation

$$e_1 = (S_1 - S_0).$$

$e_1$ = ........................................................

The student carefully raises the beaker under the load until it is completely under water. The load does not touch the sides or base of the beaker. He records the new scale reading $S_2$.

$S_2 = 39.8\,\text{cm}$

**(ii)** Calculate the extension $e_2$ of the spring using the equation $e_2 = (S_2 - S_0)$.

$e_2$ = ........................................................

[2]

**(c)** Calculate the density $\rho$ of the material of the load using the equation

$$\rho = \frac{e_1}{(e_1 - e_2)} \times k$$

where $k = 1.00\,\text{g/cm}^3$.

$\rho$ = ................................................... [3]

**(d)** A second load, made from the same material and with the same mass, is too long to be completely submerged in the water.

Suggest whether

**(i)** the value obtained for $e_2$ would be greater, smaller or the same as that obtained in part **(b) (ii)**,

..........................................................................................................................

**(ii)** the value obtained for $\rho$ would be greater, smaller or the same as that obtained in part **(c)**.

..........................................................................................................................

[2]

[Total: 8]

1 An IGCSE student is determining the density of a solid metal cylinder using a balancing method. Fig. 1.1. shows the apparatus.

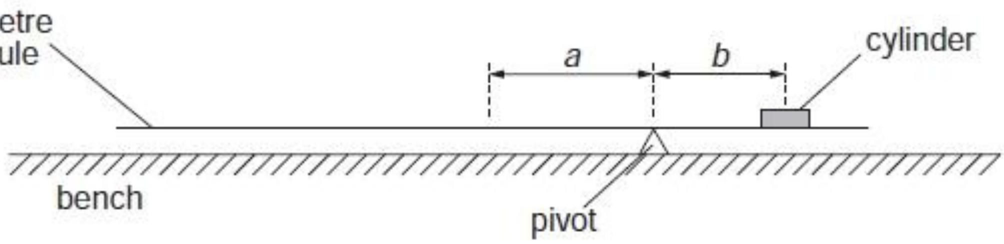



**Fig. 1.1**

He places the cylinder on the metre rule so that its centre is directly above the 10.0 cm mark. The rule is placed on the pivot so that the rule is as near as possible to being balanced.

He measures and records the distance *a* from the centre of the rule to the pivot and the distance *b* from the centre of the cylinder to the pivot. He repeats the experiment with the same cylinder at different positions on the rule.

The readings are shown in Table 1.1.

**Table 1.1**

| *a*/ | *b*/ | *M*/ |
|---|---|---|
| 12.6 | 27.4 | |
| 11.0 | 24.0 | |
| 9.5 | 20.5 | |

**(a)** **(i)** Complete the column headings in Table 1.1.

**(ii)** For each set of readings, calculate the mass *M* of the cylinder using the equation

$$M = \frac{ka}{b}.$$

The value of *k* is the mass of the rule which is 108 g.

Enter the results in Table 1.1.

[3]

**(b)** The cylinder completely covers the marks on the metre rule. Describe, with the aid of a diagram, how you would judge that the centre of the cylinder is directly above the 10.0 cm mark.

..........................................................................................................................................

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

**(c)** Use your answers in Table 1.1 to calculate and record the average of the three values for *M*. Show your working.

average value for *M* = ..................................................[2]

**(d)** Fig. 1.2 shows the cylinder placed flat on the bench and viewed from one side.

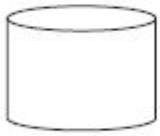


**Fig. 1.2**

**(i)** On the diagram, measure the diameter *d* and the thickness *t* of the cylinder.

$d$ = ........................................................

$t$ = ........................................................

**(ii)** Calculate the volume *V* of the cylinder using the equation

$$V = \frac{\pi d^2 t}{4}.$$

$V$ = ........................................................

**(iii)** Calculate the density *ρ* of the cylinder using the equation

$$\rho = \frac{M}{V}.$$

$\rho$ = ..................................................[3]

[Total: 9]

**2** The IGCSE class is investigating a simple balance.

The diagram below shows the apparatus.

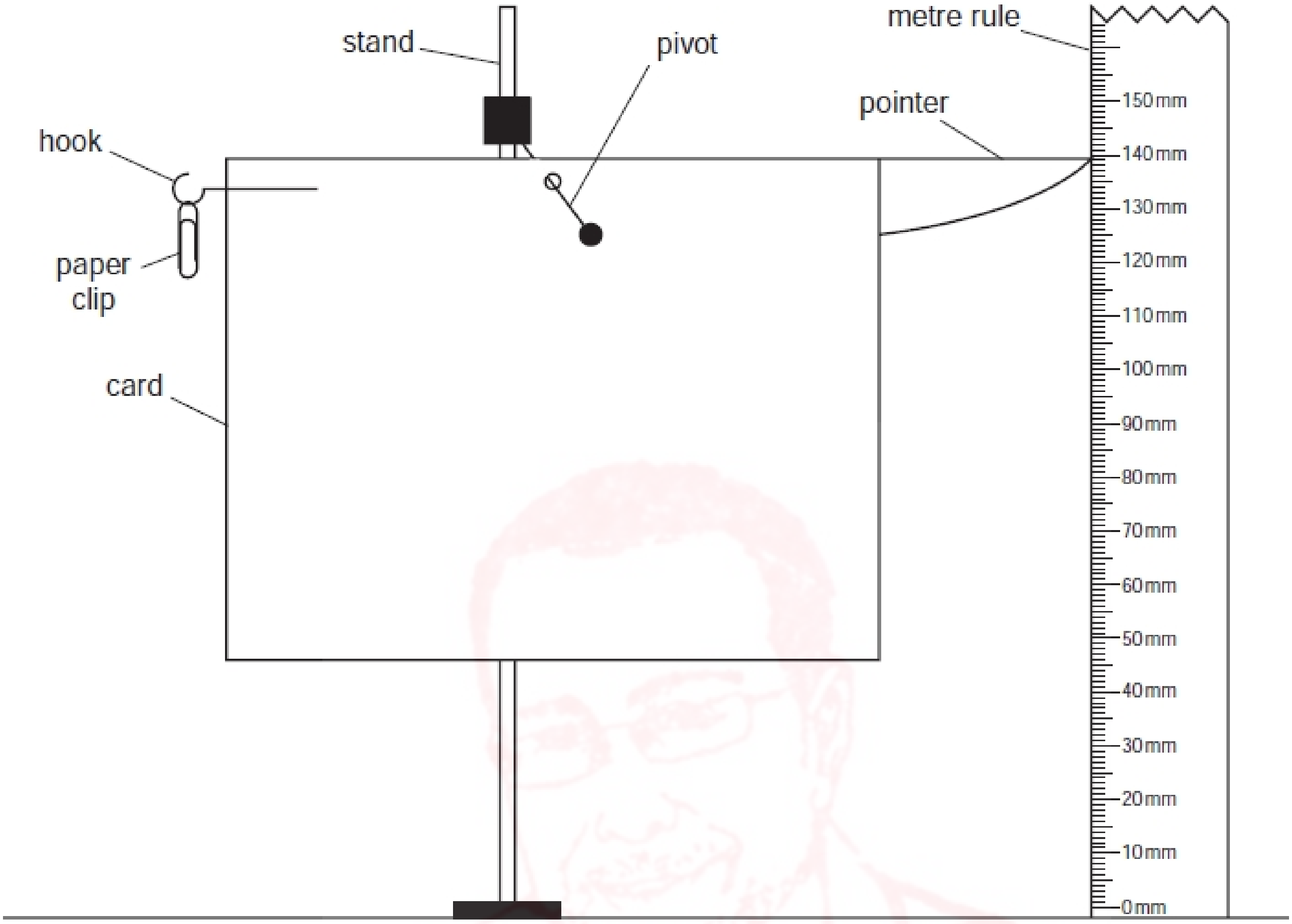



**Fig. 2.1**

**(a)** A student records the height $h_0$ of the pointer above the bench. She then hangs a paper clip on the hook and records the new height $h$ of the pointer above the bench. Next she records the heights of the pointer above the bench using different numbers $N$ of paper clips. The readings are shown in the table below.

$h_0$ = 100 mm

| $N$ | $h$ / mm | $d$ / mm |
|---|---|---|
| 1 | 108 | |
| 2 | 114 | |
| 3 | 120 | |
| 4 | 125 | |
| 5 | 134 | |
| 6 | 141 | |

Calculate the height differences $d$ using the equation

$$d = (h - h_0)$$

and enter them in the table. [2]

**(b)** **(i)** Plot the graph of $d$/mm ($y$-axis) against $N$ ($x$-axis).

**(ii)** Use your graph to predict the value of $d$ if a nail with the same mass as 4.6 paper clips were to be hung from the hook in place of the paper clips. Show clearly on the graph how you obtained your value.

$d$ = .................................................. [6]

[Total: 8]

5 (a) An IGCSE student is investigating the relationship between the extension of a spring of unstretched length $l_0$ and the load hung on the spring. The apparatus is shown in Fig. 5.1 below. The spring is shown larger than its actual size.

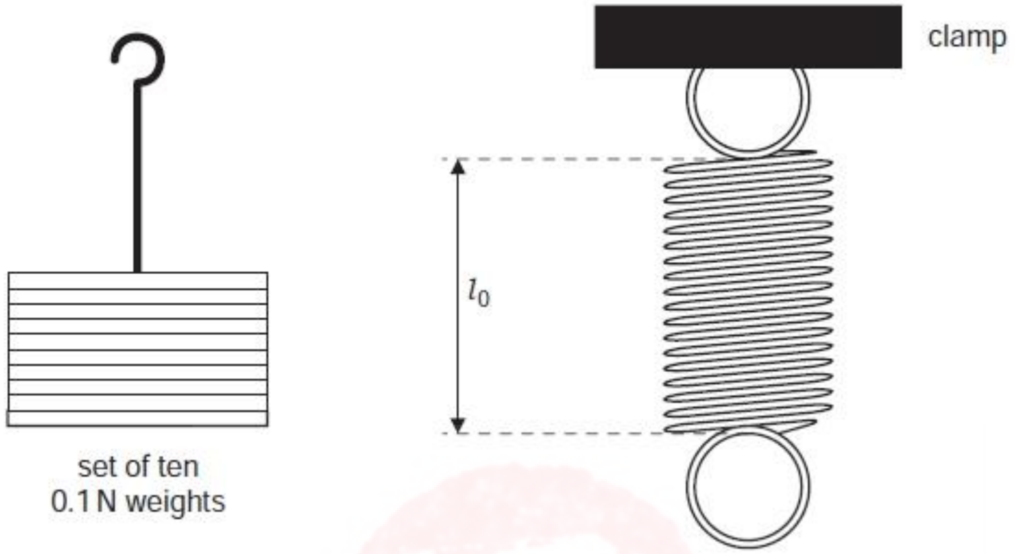



**Fig. 5.1**

Consider the readings that the student should take and write appropriate column headings, with units, in the table below.

$l_0$ = 25 mm

| | | |
|---|---|---|
| 0.0 | 25 | 0 |
| 0.1 | 30 | 5 |
| 0.2 | 36 | 11 |
| 0.3 | 43 | 18 |
| 0.4 | 50 | 25 |

[4]

(b) The student decides to repeat the experiment using a spring made of a different metal in order to study how the extension may be affected by the metal from which the spring is made. To make a fair comparison, other variables must be kept constant. Suggest three variables that the student should keep constant.

1. ..........................................................................................................................

2. ..........................................................................................................................

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

[Total: 7]

2 A student is investigating the position of a sheet of card that is hanging from a pivot.

Fig. 2.1 shows the apparatus drawn full size.

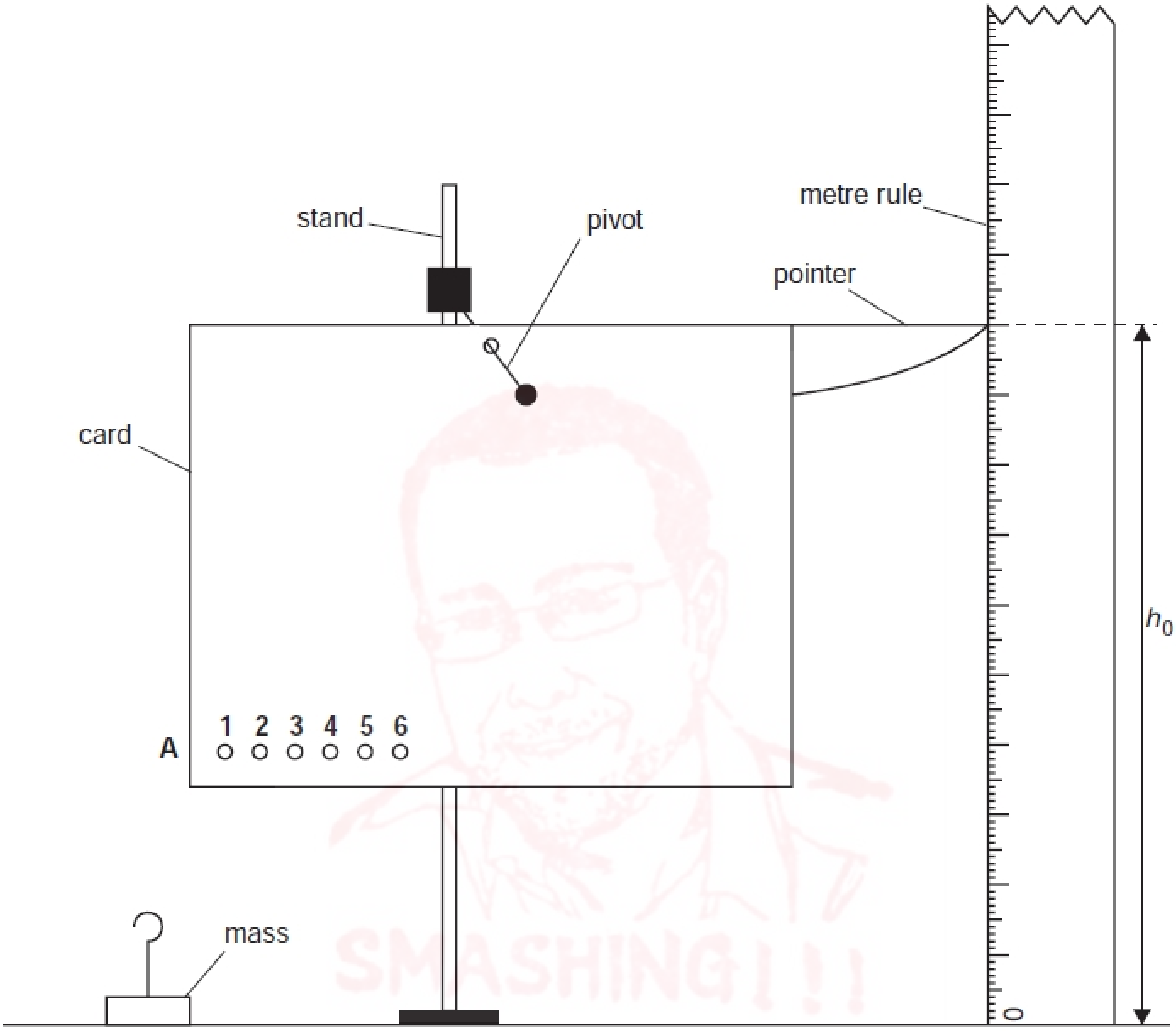



**Fig. 2.1**

**(a)** On Fig. 2.1 measure the distance *d* between the centre of the hole labelled **1** and the edge of the card at **A**. Record this value in the table.

| hole | *d* / mm | *h* / mm | *b* / mm |
|---|---|---|---|
| **1** | | 140 | |
| **2** | | 135 | |
| **3** | | 132 | |
| **4** | | 128 | |
| **5** | | 124 | |
| **6** | | 120 | |

[3]

**(b)** Repeat step **(a)** for each of the remaining holes **2** – **6**.

**(c)** On Fig. 2.1 measure the height $h_0$ of the pointer above the bench.

$h_0$ = ......................................................

[1]

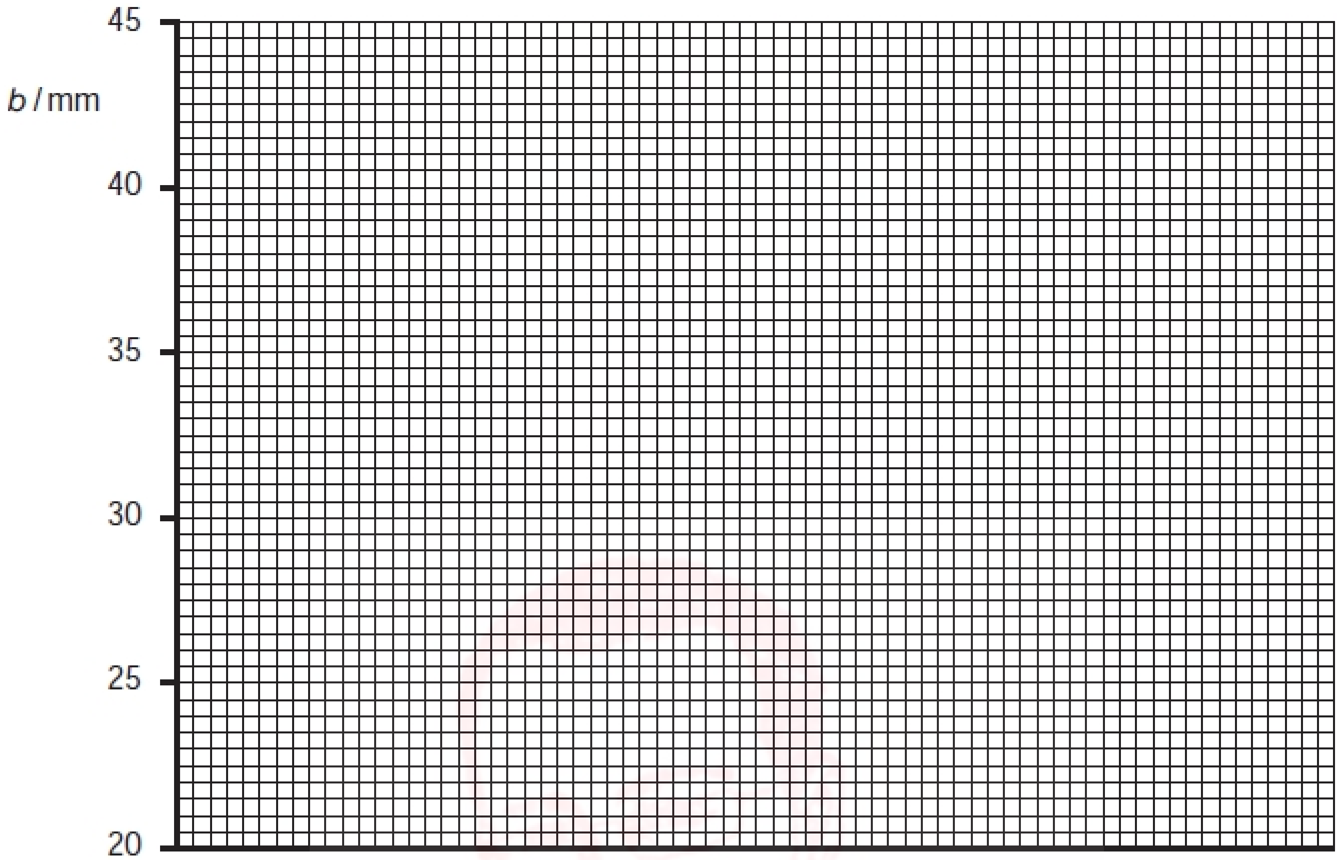
**(d)** A student hangs a 10 g mass from the hole **1** in the card. She records the height *h* of the end of the pointer above the bench. She then repeats this procedure by hanging the mass from each hole in turn. Her results are shown in the table above.

**(e)** Calculate the differences in heights *b* using the equation

$$b = (h - h_0)$$

and record the results in the table above.

**(f)** Plot the graph of *b*/mm (*y*-axis) against *d*/mm (*x*-axis).




[4]

**(g)** The student suggests that *b* is directly proportional to *d*. By reference to your graph, state whether or not the results support the student's suggestion. Give a reason for your answer.

Statement ..........................................................................................................

Reason ..............................................................................................................

..........................................................................................................................

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

**(h)** It is important when recording the heights that the rule is vertical. State briefly how you would check that the rule is vertical.

..........................................................................................................................

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

[Total: 11]

5 The IGCSE class is determining the weight of a metre rule.

The apparatus is shown in Fig. 5.1.


**Fig. 5.1**

A metre rule is supported at one end by a pivot through the 1.0 cm mark. The other end is supported at the 91.0 cm mark by a newton meter hanging from a clamp.

**(a)** Describe how you would check that the metre rule is horizontal. You may draw a diagram if you wish.

..........................................................................................................................

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

**(b)** The students record the force $F$ shown on the newton meter and the distance $d$ from the pivot to the 91 cm mark. They then repeat the experiment several times using a range of values of the distance $d$. The readings are shown in the table.

| $F$ / N | $d$ / m | $\frac{1}{d}$ / $\frac{1}{m}$ |
|---|---|---|
| 0.74 | 0.900 | |
| 0.78 | 0.850 | |
| 0.81 | 0.800 | |
| 0.86 | 0.750 | |
| 0.92 | 0.700 | |

Calculate and record in the table the values of $\frac{1}{d}$ . [1]

**(c)** **(i)** On the graph grid below, plot a graph of $F$ / N ($y$-axis) against $\frac{1}{d}$ / $\frac{1}{\text{m}}$ ($x$-axis). Start the $y$-axis at 0.7 and the $x$-axis at 1.0. [2]

**(ii)** Draw the line of best fit on your graph. [2]

**Question 5 continues on the next page.**

**(iii)** Determine the gradient $G$ of the line.

$G$ = ................................................ [3]

**(d)** Calculate the weight of the metre rule using the equation

$$W = \frac{G}{k}$$

where $k = 0.490\,\text{m}$.

$W$ = ................................................ [2]

1 The IGCSE class is investigating the effect of a load on a rule attached to a spring.

The apparatus used is shown in Fig. 1.1.

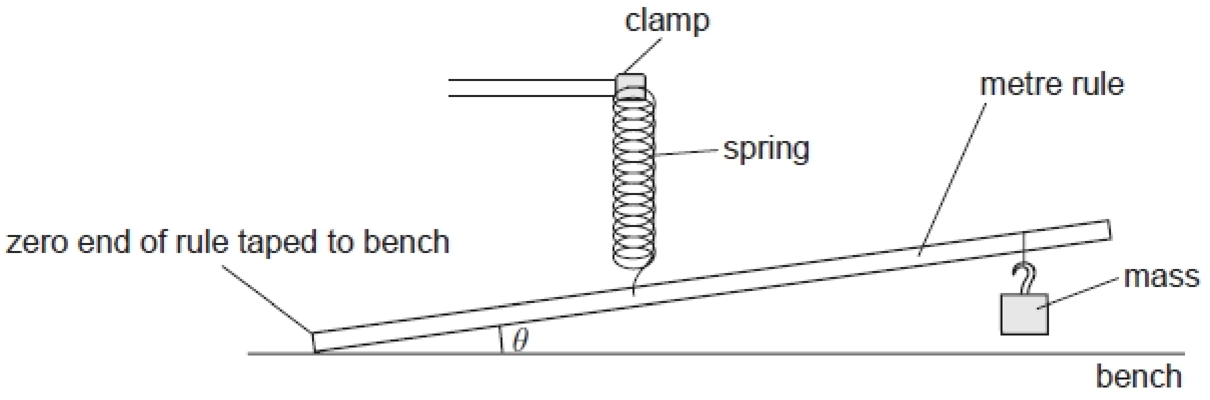



**Fig. 1.1**

The rule has the zero end taped to the bench so that it does not slip. The rule is attached to a spring at the 40.0 cm mark. The students hang masses, starting with a 10 g mass, on the rule at the 90.0 cm mark. For each mass, they measure the angle $\theta$ between the rule and the bench.

One student's readings are shown in the table.

| $m$ / | $\theta$ / |
|---|---|
| 0 | 29 |
| 10 | 28 |
| 20 | 26 |
| 30 | 25 |
| 40 | 22 |
| 50 | 19 |

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

**(b)** A student suggests that $\theta$ should be directly proportional to $m$. State, with a reason, whether the readings in the table support this suggestion.

statement ..........................................................................................................

reason ..............................................................................................................

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

**(c)** A student carries out this experiment using the 360 ° protractor shown in Fig. 1.2.

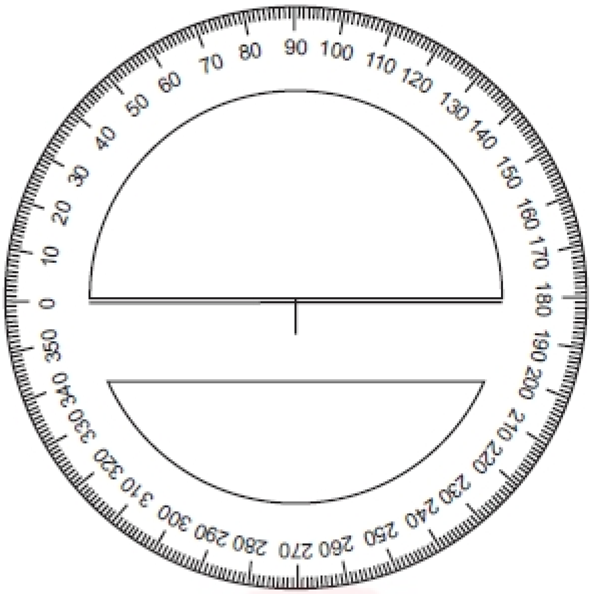


**Fig. 1.2**

Explain how the student could use this protractor to measure the angle $\theta$ between the metre rule and the bench. You may draw a diagram if you wish.

..........................................................................................................................................

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

**(d)** The range of angles measured in this experiment may be quite small. Using the same apparatus and with the masses and spring in the same positions, suggest another method of investigating as reliably as possible the extent by which the rule is pulled down by the masses. This method must not use a protractor but an additional rule may be used. You may draw a diagram if you wish.

..........................................................................................................................................

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

**4** A student investigates the period of oscillation of a mass attached between two springs.

The apparatus used is shown in Fig. 4.1.

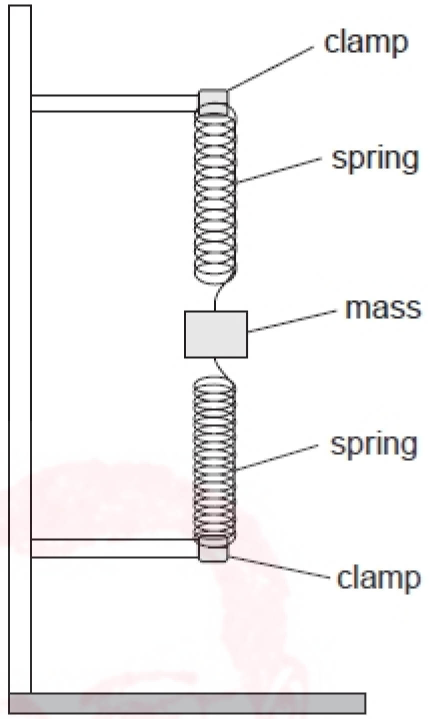



**Fig. 4.1**

A 400 g mass *m* is attached between two springs, displaced a small distance downwards, and then released so that it oscillates. The time *t* taken for 10 complete oscillations of the mass is recorded. The experiment is repeated using values for *m* of 300 g and 200 g. The readings are shown in the table below.

| *m* / g | *t* / s | *T* / s | $\frac{T}{m} \Big/ \frac{s}{g}$ |
|---|---|---|---|
| 400 | 9.0 | | |
| 300 | 7.8 | | |
| 200 | 6.3 | | |

**(a)** Calculate the period *T* of the oscillations. *T* is the time for one complete oscillation. Enter the values in the table. [2]

**(b)** Calculate and enter in the table the values of $\frac{T}{m}$. [2]

**(c)** The student suggests that $T$ should be directly proportional to $m$. State with a reason whether the results in the table support this suggestion.

statement ..........................................................................................................

reason ..........................................................................................................

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

**(d)** In this experiment, the mass oscillates rapidly so that it is difficult to take the times accurately. A technique has been included in this experiment to obtain an accurate value for the period $T$. State, briefly, what this technique is and any calculation involved to obtain the $T$ value.

..........................................................................................................

..........................................................................................................

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

**(e)** Another student carried out the same experiment using a wider range of masses. Suggest why, when the mass was 900 g, it could not oscillate freely.

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

2 A student is investigating the oscillation of a metre rule that has one end resting on the laboratory bench. The other end is held above the level of the bench by a spring attached at the 90.0 cm mark. The arrangement is shown in Fig. 2.1.

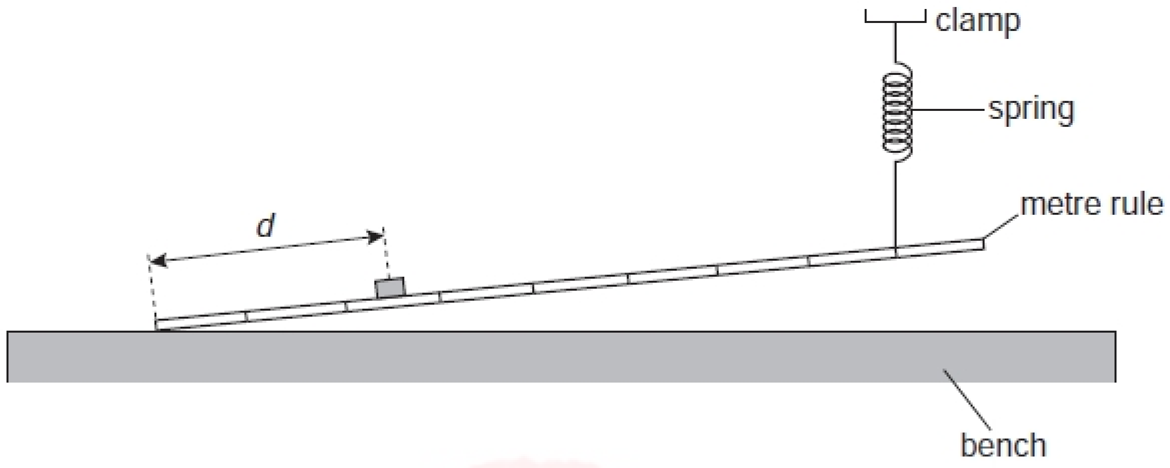


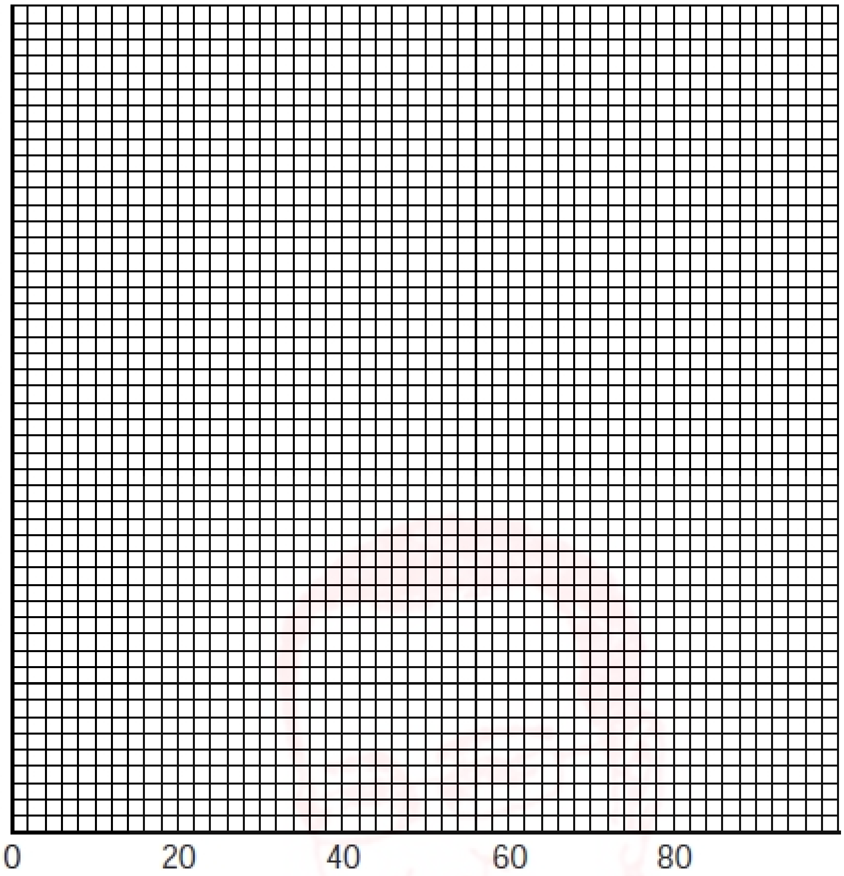

**Fig. 2.1**

The period of oscillation is changed by moving a 200 g mass to different positions along the rule. The student records the time *t* taken for 10 oscillations of the end of the rule for each position of the mass. He measures the distance *d* from the end of the rule to the mark under the centre of the mass. The readings are shown in the table.

| *d* / cm | *t* / s | *T* / s |
|---|---|---|
| 20.0 | 3.4 | |
| 40.0 | 4.4 | |
| 50.0 | 4.9 | |
| 60.0 | 5.3 | |
| 70.0 | 6.0 | |
| 80.0 | 6.3 | |

**(a)** Calculate the period *T* for each set of readings and enter the values in the table. [2]

**(b)** Plot a graph of *d* / cm (*x*-axis) against *T* / s (*y*-axis). The scale on the *x*-axis has been started for you. [5]




**(c)** Using the graph, determine the period *T* when the distance *d* is 55.0 cm.

*T* = ........................................................ [2]

**(d)** The student suggests that *T* should be proportional to *d*. State with a reason whether your results support this suggestion.

statement ........................................................................................................

reason ............................................................................................................

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

1 A student carried out an experiment to find the spring constant of a steel spring. The apparatus is shown in Fig. 1.1.

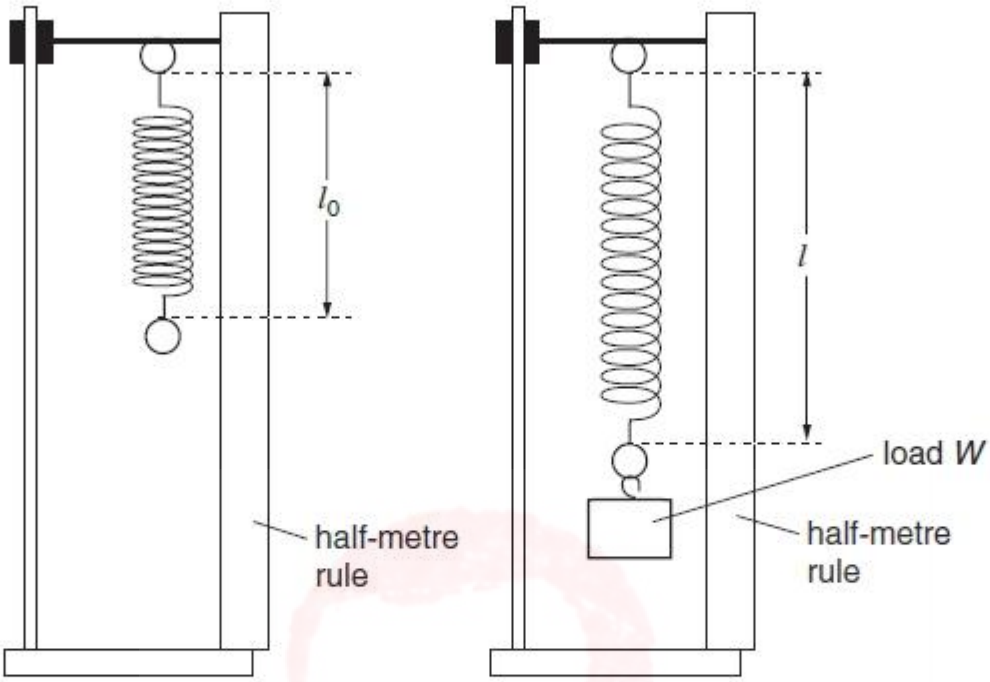



**Fig. 1.1**

The student recorded the unstretched length $l_0$ of the spring. Then she added loads $W$ to the spring, recording the new length $l$ each time. The readings are shown in the table below.

| $W$/N | $l$/mm | $e$/mm |
|---|---|---|
| 0 | 30 | |
| 1 | 32 | |
| 2 | 33 | |
| 3 | 36 | |
| 4 | 39 | |
| 5 | 40 | |
| 6 | 42 | |

$l_0$ = 30 mm

**(a)** Calculate the extension $e$ of the spring produced by each load, using the equation

$$e = (l - l_0).$$

Record the values of $e$ in the table. [2]

**(b)** Plot the graph of $e$ / mm ($y$-axis) against $W$ / N ($x$-axis). [4]

**(c)** Draw the best-fit straight line for the points you have plotted. Calculate the gradient of the line. Show clearly on the graph how you obtained the necessary information.

gradient = ..........................................[4]

3 A student carried out a 'principle of moments' experiment using a metre rule placed on a pivot at the 50.0 cm mark. The aim was to determine an unknown weight. The arrangement of the apparatus is shown in Fig. 3.1.

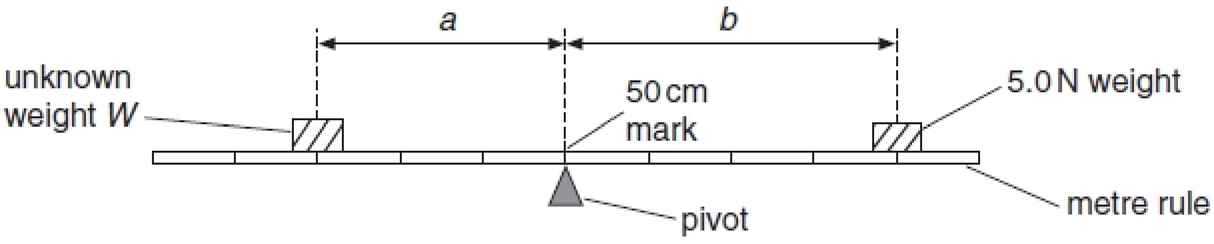



**Fig. 3.1**

The student placed the unknown weight $W$ at a convenient distance $a$ from the pivot. He found $b$, the distance from the pivot that the 5.0 N weight must be placed so that the rule balanced horizontally. He then repeated the experiment using different values of $a$.
The readings are shown in the table below.

| $a$/m | $b$/m |
|---|---|
| 0.100 | 0.122 |
| 0.200 | 0.238 |
| 0.250 | 0.302 |
| 0.300 | 0.360 |
| 0.350 | 0.435 |
| 0.400 | 0.470 |

**(a)** **(i)** Plot the graph of $b$/m ($y$-axis) against $a$/m ($x$-axis).

**(ii)** Draw the best-fit straight line.

[6]

**(iii)** Determine $G$, the gradient of the line.

$G$ = ....................................

**(iv)** Determine $W$, the unknown weight, using the equation

$$W = XG$$

where $X$ = 5.0 N.

$W$ = ....................................

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

**1** **(a)** $x$ = 1.4 (cm) or 14 (mm) or 0.014 (m)
AND $y$ = 2.6 (cm) or 26 (mm) or 0.026 (m) [1]

correct unit for $x$ and $y$ [1]

**(b)** $X$ and $Y$ both 10 × $x$ and $y$, ecf **(a)** [1]

$W$ = 1.08 (N), to 2 or more significant figures (ecf allowed) [1]

**(c)** sensible position indicated for Z, between pivot and centre of rule [1]

**(d)** statement matches results
(expect Yes, ecf from **(b)** only if difference >10%) [1]

justified with reference to results; must include idea of being close enough to be within limits of experimental accuracy, ecf **(b)** [1]

**(e)** difficulty in achieving balance OR difficulty in positioning load exactly, e.g. load covers rule markings or uncertainty about position of centre of mass of load [1]

**[Total: 8]**

**Q# 2/** iG Phx/2014/s/Paper 61/ www.SmashingScience.org :o)

**1** **(a) (b)** 21 (mm) [1]

210 (mm) ecf from $l_0$ [1]

**(b)** 45 (mm) <u>and</u>
0.067 or 0.0667 (N/mm), 2 or 3 sig. figs.
ecf from $l_0$ and $L_0$ [1]

correct unit N/mm or N/m or N/cm as appropriate [1]

**(c)** $T$ = 1.342 (s) or 1.34 (s) [1]

**(d)** $T$ = 1.724 s (no mark)
statement NO (ecf from **(c)**) [1]

difference <u>too</u> large (for experimental inaccuracy) (ecf) [1]

**(e)** clear diagram or explanation that indicates:
perpendicular viewing of spring or scale
OR appropriate use of horizontal pointer/set square/rule, etc.
OR rule touching/very close to spring [1]

**[Total: 8]**

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

1 (a) rule balanced and pivot at centre of mass [1]

(b) EITHER take readings from 50.2 cm mark
OR add mass/weight/load
OR place pivot at 50.2 cm mark [1]

(c) (i) cm, cm [1]

(ii) clockwise 77.5 (or 78) (N cm)
anticlockwise 78 (N cm) [1]

(d) EITHER repeats
OR estimate between two best positions that almost balance but tip opposite sides o.w.t.t.e
OR suitable method to locate centre of mass **Q** [1]

**[Total: 5]**

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

5 (a) 40.0 or 40(cm) [1]

(b) accuracy / reliability / check readings / spot anomaly / o.w.t.t.e. [1]

(c) correct method used [1]
30 or 30.0(g) [1]

(d) rule never quite balances, o.w.t.t.e. [1]
take average position / nearest to balance, o.w.t.t.e. [1]

**[Total: 6]**

1 (a) $d_0$ = 21 (mm) [1]

(b) $D_o$ = 210 (mm) or 10 × candidate's **(a)** [1]

(c) *L* values 1.0, 2.0, 3.0, 4.0, 5.0 [1]
*e* values 1.0, 9.0, 21.0, 29.0, 40.0 [1]

(d) Graph:
Axes correctly labelled with quantity and unit and correct way around [1]
Suitable scales [1]
All plots correct to ½ small square
Good line judgement and a single, thin, continuous line [1]

(e) Triangle method used and shown on the graph [1]
Using at least half of line [1]

(f) Any one from:
Always measure from same point on spring (top or bottom of ring)
Wait for spring/weight to stop bouncing
Use of horizontal aid/ensure ruler is vertical
Bench surface not uniform [1]

**[Total: 11]**

**Q# 6/** iG Phx/2012/s/Paper 61/ www.SmashingScience.org :o)

1 (a) 50–250g (or 0.05–0.25 kg) correct unit required [1]

(b) Centre of mass marked close to centre of cylinder [1]
Clear indication of how centre of mass is placed above the 90.0 cm mark [1]

(c) Rule unlikely to exactly balance/ difficult to balance
OR rule could slide on pivot
OR mass could slide
OR centre of mass of rule not at 50.0 cm mark
OR rule not uniform1

Do not accept comments about poor/careless technique [1]

(d) Repeat readings (wtte) [1]
OR a reference to finding exact position of centre of mass of metre rule
OR a reference to dealing with centre of mass of rule not being at 50.0 cm mark

(e) Good/ fine/ reasonable/ same to 3 significant figures
OR Within limits of experimental accuracy (wtte)
OR Too many significant figures in experimental result [1]

**[Total: 6]**

**Q# 7/** iG Phx/2011/w/Paper 61/ www.SmashingScience.org :o)

1 (a) graph:
axes: the right way round, labelled $x$ and $y$ with unit cm [1]
scale: both 10 small squares = 2 cm
(either or both 20 small squares = 5 cm also acceptable) [1]
plots: all correct to ½ small square [1]
line: well-judged, best-fit, straight, thin, continuous line [1]

(b) correct triangle method using at least ½ candidate's line, with method clearly indicated on graph [1]
$G$ = 0.94 – 1.00, no ecf [1]

(c) 1.0/(candidate's $G$) calculation correct, 2 or 3 significant figures and unit N [1]

(d) (i) (where rule) balances on pivot o.w.t.t.e. [1]

(ii) take readings from 49.7 OR
adjust rule by adding weight until it balances at 50.0 cm mark [1]

**[Total: 9]**

**Q# 8/** iG Phx/2011/s/Paper 61/ www.SmashingScience.org :o)

1. (a) Three straight lines in correct positions [1]
All lines continuous, straight, neat and thin [1]

(b) $a$ = 4.2 – 4.4 (cm) no ecf [1]
Well-judged position in triangle [1]
Line correctly drawn [1]

(c) Viewing line directly in front of card (owtte) [1]

[Total: 6]

**Q# 9/** iG Phx/2011/s/Paper 61/ www.SmashingScience.org :o)

1 (a) (i) $l$ = 29 (mm) and $l$ = 31 (mm) (allow 2.9 cm, 3.1 cm) [1]
$e_A$ = 14 (mm) and $e_B$ = 15 (mm) (ecf) (ignore minus signs) [1]

(b) (i) both $l$ correct to (21.5 – 22) and 24 [1]

(ii) (6.5 – 7) and 8 (ecf) (ignore minus signs) [1]

(iii) $e_{av}$ = 7.5 (c.a.o.) [1]

(c) statement matches readings (expect YES) (ecf NO) [1]
justification matches statement and by reference to results
(expect within limits of experimental accuracy, wtte) (too different, wtte) [1]

(d) any one of:
avoidance of parallax error explained
use of horizontal aid
measuring to same point each time
repeats
wait for springs to stop moving [1]

[Total: 8]

**Q# 10/** iG Phx/2010/w/Paper 61/ www.SmashingScience.org :o)

1 (a) correct 1/*d* values 0.0222, 0.0294, 0.0370, 0.0444, 0.0518 [1]
all to 2 significant figures or all to 3 consistent significant figures [1]

(b) graph:
axes suitable and labelled [1]
all plots correct to ½ small square [1]
good line judgement (position) [1]
thin line, single, no blobs (quality) [1]

(c) gradient by triangle method using at least ½ candidate's line [1]
clear, on graph, how obtained [1]

(d) *z* value 0.9 – 2.5 [1]
2 or 3 significant figures and unit cm given [1]

**[Total: 10]**

**Q# 11/** iG Phx/2009/s/Paper 61/ www.SmashingScience.org :o)

5 (a) **Q** correct position with suitable number(s) [1]
Rule correctly tilted, and on bench (or arrow to indicate) [1]

(b) Any two from:
Readings taken at either side/diameter of cylinder
Position of mid point found
Mark position of centre [2]

(c) 34.5 <u>cm</u> [1]

**[Total: 5]**

**Q# 12/** iG Phx/2009/s/Paper 61/ www.SmashingScience.org :o)

1 (a) *d* 2.5 (cm) [1]
*x* 14.5 (cm) [1]
diagram showing blocks correctly placed across the ends [1]
rule position (or distance) shown correctly [1]

(b) (i) $V_e$ 71.1 - 71.2 ($cm^3$) ecf allowed [1]

(ii) measuring cylinder reading 56 ($cm^3$) [1]

(iii) $\rho$ 2.05–2.08 (or 2.1) ecf allowed [1]
$g/cm^3$ <u>and</u> 2 or 3 significant figures [1]

**[Total: 8]**

**Q# 13/** iG Phx/2008/w/Paper 61/ www.SmashingScience.org :o)

1 (a) view perpendicular to (or straight in front of rule)/use of set square [1]

(b) (i) correct $e_1$ value 3.1 and correct $e_2$ value 2.4 [1]
$e$ in cm [1]

(c) density 4.43 (ecf) [1]
2/3 significant figures [1]
g/cm$^3$ [1]

(d) $e_2$ greater [1]
$\rho$ greater (or identical to $e_2$ answer) (ecf) [1]

[Total: 8]

**Q# 14/** iG Phx/2008/s/Paper 61/ www.SmashingScience.org :o)

1 (a) (i) cm, cm, g [1]

(ii) 49.66 (or 49.7), 49.50 (or 49.5), 50.05 (or 50.0) [1]
consistent significant figures (3 or 4) [1]

(b) clear explanation/diagram [1]

(c) correct method [1]
value 49.7 (ignore a fourth significant figure)
and allow ecf from (ii) [1]

(d) $d$ = 1.8 (cm), $t$ = 1.2 (cm) [1]
$V$ = 3.05 (cm$^3$) (ecf) [1]
$\rho$ = 16.3 unit g/cm$^3$, 2/3 significant figures (ecf) [1]

[Total: 9]

**Q# 15/** iG Phx/2007/w/Paper 61/ www.SmashingScience.org :o)

2 (a) 8, 14, 20, 25, 34, 41 (-1 each error) [2]

(b) (i) Graph:
suitable scales labelled symbol/unit [1]
all plots to nearest ½ sq (-1 each error or omission) [2]
line thin and straight [1]

(ii) correct value (29mm – 31mm)to nearest ½ sq. [1]
clear how obtained [1]

[Total: 8]

**Q# 16/** iG Phx/2007/s/Paper 61/ www.SmashingScience.org :o)

5 (a) weight / load / force / W / L / F [1]
length / *l* [1]
extension / *e* / *x* / ($l - l_0$) [1]
units N, mm, mm [1]

(b) any three from
length of spring / $l_0$
diameter/thickness of spring
range of loads
length of wire
diameter / thickness of wire
number of coils
coil spacing [3]
do NOT allow 'size' or room temperature

**[Total: 7]**

**Q# 17/** iG Phx/2007/s/Paper 61/ www.SmashingScience.org :o)

2 (a) and (b) 6 *d* values [1]
correct values for *d* 5, 10, 15, 20, 25, 30 [1]

(c) $h_0$ = 100mm (including unit, cm/m allowed) [1]

(e) correct values for *b* 40, 35, 32, 28, 24, 20 (ecf) [1]

(f) Graph:
correct *d* axis labelled with symbol / unit [1]
plots to nearest ½ sq (-1 each error or omission) [2]
best fit straight line [1]
single line, thin and best fit [1]

(g) no
line not through origin
OR when *b* increases, *d* decreases
OR negative gradient [1]

(h) use of set square / protractor / spirit level / plumbline [1]

**[Total: 11]**

**Q# 18/** iG Phx/2006/s/Paper 61/ www.SmashingScience.org :o)

**5** **(a)** description / diagram showing 2 equal heights from bench **[1]**

**(b)** 1.11(1); 1.18(1.176); 1.25(0); 1.33(3); 1.43(1.428) **[1]**

**(c)** **(i)** Axes suitable and labelled, false origin as instructed **[1]**
Plots correct to ½ small sq **[1]**

**(ii)** Well judged best fit line **[1]**
line suitably thin **[1]**

**(iii)** triangle method seen **[1]**
More than ½ line used **[1]**
Gradient value correct **[1]**

**(d)** Correct W value using cand's G **[1]**
2/3 sf and in N **[1]**

**TOTAL 11**

**Q# 19/** iG Phx/2005/w/Paper 61/ www.SmashingScience.org :o)

**1** **(a)** m in g and θ in degrees 1

**(b)** θ *not* directly proportional to m 1
as m increases θ decreases 1

**(c)** clear in words or diagram that 'centre point' of protractor
is at point where bottom edge of rule meets protractor
and 0 – 180 line is horizontal 1
similarly clear how 'dead space' is dealt with, e.g. protractor
stuck to edge of bench with 0 – 180 line at top of bench level
OR rule placed on block that is same height as 'dead space' 1

**(d)** words or diagram to show rule at end of metre rule
to measure height above bench level 1
clear that rule is vertical (e.g. use set square)
OR clamped at constant angle 1

**TOTAL 7**

**Q# 20/** iG Phx/2005/s/Paper 61/ www.SmashingScience.org :o)

**4** **(a)** 0.90; 0.78; 0.63 (-1 each error, ignore sf) **[2]**

**(b)** 0.00225; 0.00260; 0.00315 all correct (ecf) **[1]**
all to 2sf or all to 3sf **[1]**

**(c)** NO **[1]**
T/m increases as m decreases (wtte) - if statement (no) correct **[1]**

**(d)** time n oscillations **[1]**
divide by n (n at least 3) **[1]**

**(e)** lower spring fully compressed (wtte) **[1]**

**[total: 9]**

**Q# 21/** iG Phx/2004/s/Paper 61/ www.SmashingScience.org :o)

| | | | |
|---|---|---|---|
| 2 | (a) | All T values correct (0.34, 0.44, 0,49, 0.53, 0.60, 0.63) | 1 |
| | | All T values to 2 sf OR all to 3sf | 1 |
| | (b) | Graph: | |
| | | Scales suitable | 1 |
| | | Scales labeled and with units | 1 |
| | | Plots correct to ½ sq (-1 each error) | 2 |
| | | Line judgement | 1 |
| | | Line thickness (and small, neat plots) | 1 |
| | (c) | T = 0.51 (s) correct answer only; NO ecf | 1 |
| | (d) | Statement: NO | 1 |
| | | Reason: line not through origin (or equivalent) | 1 |
| | | (allow mark if candidate describes str. line or constant gradient) | |
| | | **TOTAL** | **11** |

**Q# 22/** iG Phx/2003/s/Paper 61/ www.SmashingScience.org :o)

| | | | |
|---|---|---|---|
| 1 | (a) | Seven correct values: 0, 2, 3, 6, 9, 10, 12 (-1 each error) | 2 |
| | (b) | Graph: | |
| | | Scales, labelled, suitable size | 1 |
| | | Axes, right way round | 1 |
| | | Plots to ½ sq (-1 each error) | 2 |
| | (c) | Line shape | 1 |
| | | Line thickness | 1 |
| | | Triangle greater than ½ line and method used | 1 |
| | | Correct interpolation to ½ sq | 1 |
| | | **TOTAL** | **10** |

**Q# 23/** iG Phx/2002/w/Paper 61/ www.SmashingScience.org :o)

| | |
|---|---|
| 3. (a) (i) & (ii) scales | 1 |
| labels | 1 |
| plots (-1 each error) | 2 |
| line judgement –str line thin & neat & good plots | 1 |
| - best fit | 1 |
| (iii) large triangle (> ½ line) seen | 1 |
| G = 1.15 – 1.25 | 1 |
| (iv) correct value (ecf) (= 6.0) | 1 |
| unit & 2/3 sf | 1 |
| (v) weight off end of rule | 1 |
| (b) add plasticine to end or balance at 50.3 cm and take measurements accordingly | |
| OR move pivot to 50.3 mark | |
| OR no action – result will still be correct | 1 |
| | TOTAL 12 |