1 A student did an experiment to find out if changing the mass of a pendulum has any effect on the time of swing.
The pendulum he used was a lump of plasticine on a piece of string.

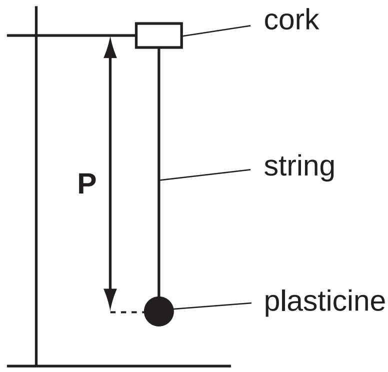


Fig. 6.1

- He weighed the pendulum to the nearest gram and recorded its mass in Fig. 6.2.
- He attached the string to the clamp. He pulled the pendulum to one side and allowed the pendulum to swing. He used a stopclock to find the time taken for 20 swings, to the nearest second, and noted it in Fig. 6.2
- He removed about 10 g of plasticine and weighed the pendulum again. He found the time taken for 20 swings, as before.
- He repeated the previous step until he had five sets of readings.

mass of pendulum/g	time for 20 swings/s	time for 1 swing /s
87	37	1.85
55	38	1.90
43	37	1.85

Fig. 6.2

(a) **(i)** Fig. 6.3 shows the balance windows and stopclock dials for the two sets of readings missing from Fig. 6.2.
Read the masses and times and record them in Fig. 6.2. [4]

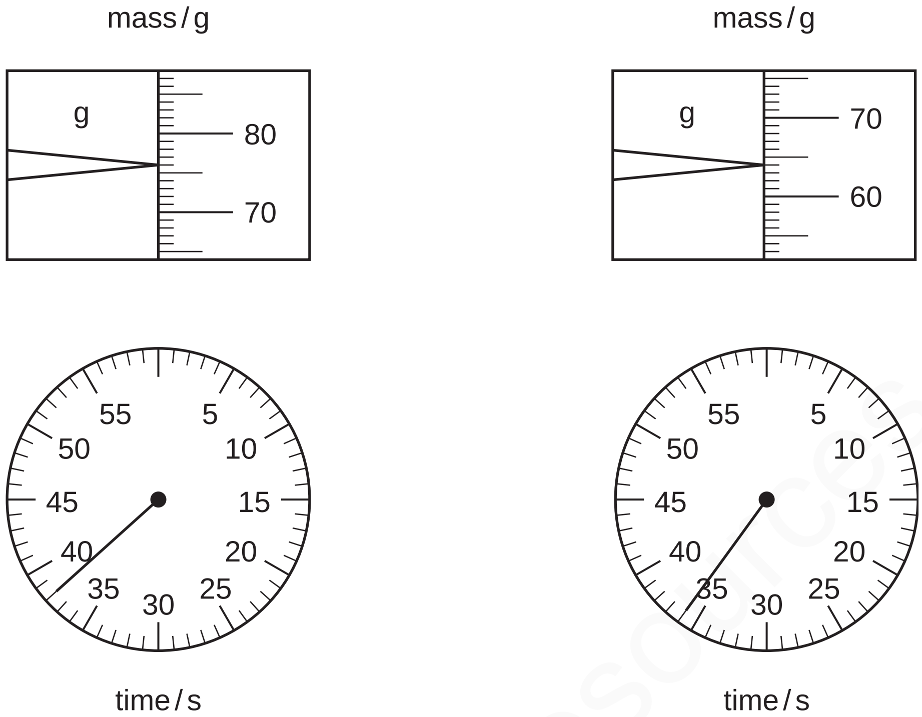
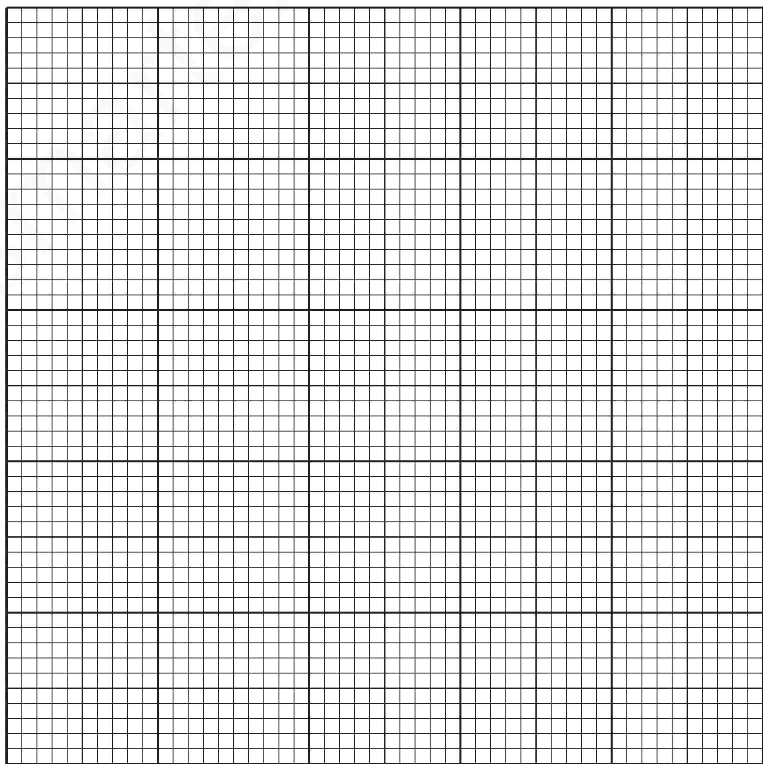


Fig. 6.3

(ii) Complete Fig. 6.2 by calculating the time for 1 swing for the readings noted in **(a)(i)**. [1]

(b) On the grid provided, plot a graph of time for 1 swing (vertical axis) against mass of pendulum.



[3]

(c) What does the graph show about the effect of changing the mass of the pendulum on the time of swing?

.... [1]

(d) Suggest a factor that might have an effect on the time taken for 1 swing of the pendulum.

.... [1]

MARKING SCHEME

(a)	76 g, 44 g: 38 s, 36 s (no tolerance)	**[4]**
(b)	1.90, 1.80 s (ecf) (both correct with second d.p.given)	**[1]**
(c)	axes correctly labelled and suitable scale chosen (1) points plotted accurately (1) best fit straight line drawn, (1)	**[3]**
(d)	no effect OWTTE	**[1]**
(e)	length of pendulum (string) increased, gravitational force changed, material of string changed (any one) OR (if the answer refers to variation in data given) inaccurate timing	**[1]**

[Total 10 marks]

2 The teacher gave the class four liquids labelled **A**, **B**, **C** and **D**. She asked them to identify the liquids by doing two experiments and using a key, shown in Fig. 6.2.

First experiment. Finding the density of the liquids.

- A 50 cm^3 measuring cylinder was placed on a balance.
- The balance was adjusted so that it read 0.0 g with the measuring cylinder on the pan.
- 50 cm^3 of each liquid was placed in the cylinder.

Fig. 6.1 shows the balance window for each liquid in turn.

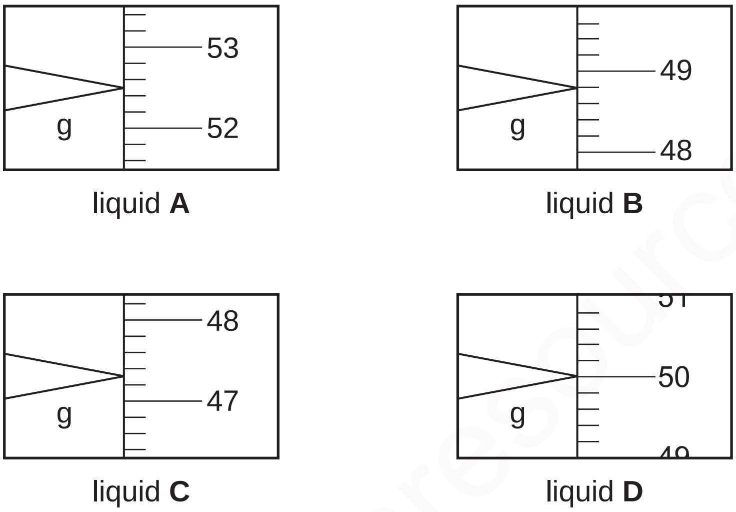


Fig. 6.1

(a) Read the balance windows and record the masses in the spaces provided.

mass of 50 cm^3 of liquid **A** ....g

mass of 50 cm^3 of liquid **B** ....g

mass of 50 cm^3 of liquid **C** ....g

mass of 50 cm^3 of liquid **D** ....g [4]

(b) Use the data from **(a)** to help you to write the letters of the four liquids in the correct spaces in boxes **1**, **2** and **3** of the key, Fig. 6.2. Do not attempt to complete boxes **4** and **5** until you answer part **(c)**. [2]

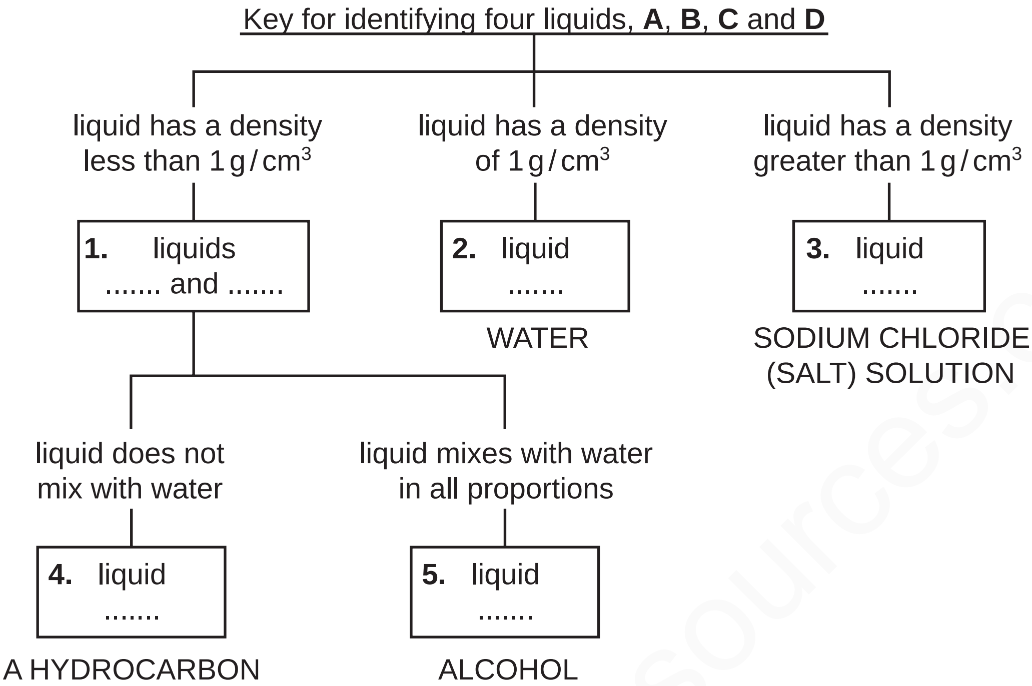
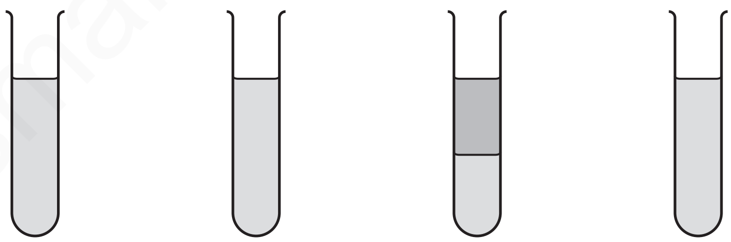


Fig. 6.2

Second experiment. Mixing the liquids with water.

Fig. 6.3. shows the effect of placing 10 cm^3 of each of the liquids with 10 cm^3 of water in a test-tube.

(c) Use information from Fig. 6.3 to help you to complete boxes **4** and **5** in the key, Fig. 6.2. [1]



liquid **A** + water | liquid **B** + water | liquid **C** + water | liquid **D** + water

Fig. 6.3

(d) Suggest a different test you can carry out to distinguish between the alcohol and the hydrocarbon.

....

.... [1]

(e) Describe a chemical test you can carry out to confirm the identity of the salt solution.

....

.... [2]

MARKING SCHEME

(a) 52.5, 48.8, 47.3, 50.0 (must say 50.0) no tolerance **[4]**

(b) **B** and **C** (1), **D**, **A** (in correct order) (1) **[2]**

(c) **C**, **B** (in correct order) ecf from part **(a)** **[1]**

(d) hydrocarbon will burn in air with a yellow(smoky) flame
alcohol burns with a blue flame
alcohol will react with conc. sulphuric acid
alcohol will form an ester
other suitable suggestion (any 1) **[1]**

(e) add silver nitrate solution (1), gives a white precipitate (1)
OR yellow (orange) (1) flame test (1) **[2]**

[Total: 10]

3 **(a)** The science teacher is doing an experiment to find the density of ice. He has cooled all the apparatus and chemicals to a temperature of –5 °C in a freezer, to prevent the ice from melting.

He has made ice cubes in the freezer. He places 4 ice cubes in a weighed beaker and weighs the beaker.

(i) Fig. 6.1 shows the balance window. Read the scale to the nearest 0.1 g and record the mass in Table 6.1. [1]

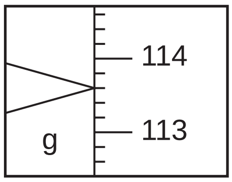


Fig. 6.1

Table 6.1

mass of beaker + ice / g	
mass of beaker / g	75.8
mass of ice / g	

(ii) Calculate the mass of ice and complete Table 6.1.

[1]

(b) The teacher pours 50 cm^3 of the hydrocarbon hexane, C_6H_{14}, into a 100 cm^3 measuring cylinder. Then he adds the ice cubes. This is shown in Fig. 6.2.

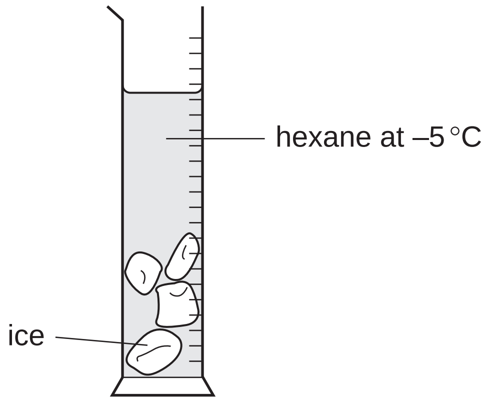


Fig. 6.2

(i) Fig. 6.3 shows the scale of the measuring cylinder after the ice cubes have been added to the hexane.

Read the scale to the nearest 1 cm^3 and record the total volume in Table 6.2. [1]

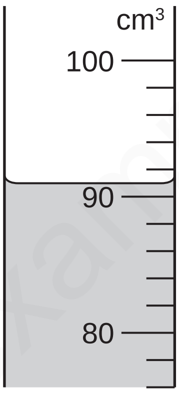


Fig. 6.3

Table 6.2

volume of hexane + ice / cm^3	
volume of hexane / cm^3	50
volume of ice / cm^3	

(ii) Calculate the volume of the ice and complete Table 6.2.

[1]

(c) Use data from Table 6.1 and Table 6.2 to calculate the density of ice in g / cm^3.

density of ice = ... g / cm^3 [2]

(d) State **two** properties of hexane that make it a suitable liquid to use in this experiment. Fig. 6.2 will help you to do this.

1 ....

2 .... [2]

(e) Fig. 6.4 shows a polar bear.

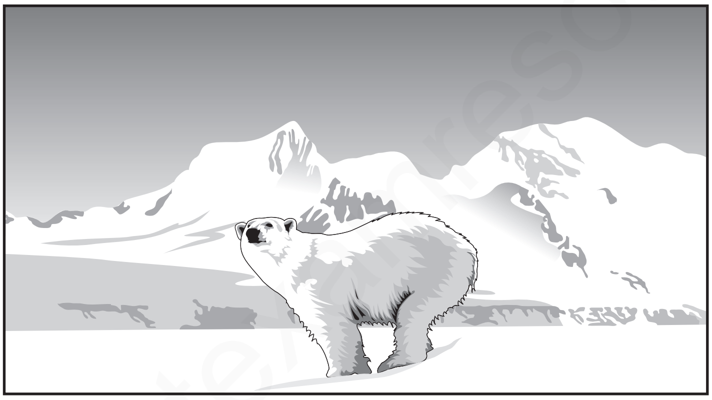


Fig. 6.4

(i) A large part of the Arctic Ocean around the North Pole is covered by ice. Explain why it is important for animals such as the polar bear that the density of ice is lower than the density of sea-water.

....

.... [1]

(ii) Considering your answer to **(e)(i)**, how might global warming badly affect animals such as the polar bear?

....

.... [1]

MARKING SCHEME

(a) **(i)** 113.6 g ; [1]

(ii) 37.8 g ; [1]

(b) **(i)** 91 cm^3 ; [1]

(ii) 41 cm^3 ; [1]

(c) density = mass / volume or 37.8 / 41;
= 0.9(2) g / cm^3 (ecf) ; [2]

(d) hexane is not as dense as ice ;
hexane melts at a temperature lower than –5 °C ;
hexane does not dissolve / react with ice ; [max 2]

(e) **(i)** ice floats on the surface **AND** the polar bears can walk on it / so that fish can live under the ice / other suitable answer ; [1]

(ii) the polar ice may melt **AND** the habitat of the polar bear will be destroyed / they may drown / other suitable answer ; [1]

[Total: 10]

4 A science student is using the apparatus shown in Fig. 3.1 to investigate the relationship between the mass of a trolley and the time taken to travel along a track.

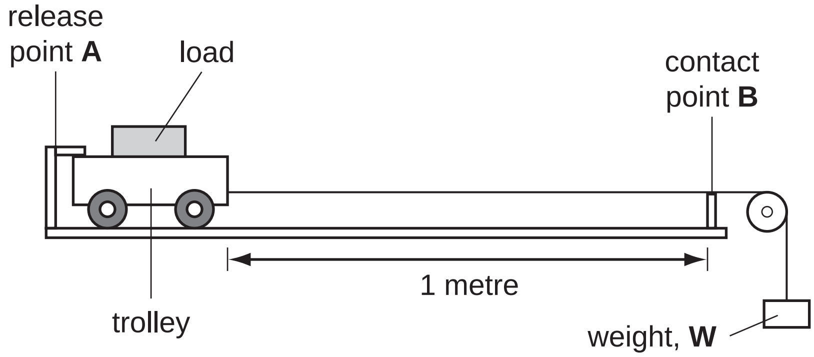


Fig. 3.1

The trolley has a mass of 100 g. It is made from a light but strong material. It can be loaded with more masses.

The weight, **W**, is a fixed mass used to accelerate the trolley along the smooth level 1 metre track.

The release mechanism at point **A** and the contact point **B** are connected to a timer.

- the student loads the trolley so that it has a total mass of 3 kg
- the trolley is released and the time taken to reach point **B** is recorded in Table 3.1
- the trolley is loaded to give a different total mass and the experiment is repeated

(a) Suggest the name of a metal or plastic that can be used to make the light, strong trolley.

.... [1]

(b) The timer displays for the two missing results are shown in Fig. 3.2.

Record the times in Table 3.1. [1]

Fig. 3.2

Table 3.1

total mass of trolley / kg	time, *t* / s
0.1	0.5
0.5	1.1
1.0	
2.0	
3.0	2.8

(c) (i) Plot a graph of the time taken, t against total mass of the trolley on the grid provided. Label the axes. Use the points to draw a smooth curve.

[3]

(ii) When the curve is extended, it does not pass through the point (0,0).

Suggest **one** reason why time, *t*, cannot be equal to 0.0 s.

....

....

.... [1]

(d) On the same graph grid, draw a curve that might be obtained if the mass of the weight, W, is increased. Label your curve **increased mass**. [1]

(e) (i) Name the force that causes the acceleration of the trolley.

.... [1]

(ii) State where, in the apparatus shown in Fig. 3.1, this force is acting to cause the acceleration of the trolley.

Explain your answer.

....

.... [2]

MARKING SCHEME

(a) aluminium, **or** a named plastic such as polyethene, polyvinyl chloride, nylon, polystyrene ; [1]

(b) 1.7, 2.3 ; [1]

(c) **(i)** correct labelling of axes / sensible scales ;
points correctly plotted (half square tolerance) ;
curve drawn ; [3]

(ii) the falling mass will take time to travel (1 metre even if the trolley weighs nothing) / impossible to travel a distance in 0 secs ; [1]

(d) curve drawn correctly below / to the right of the first curve ; [1]

(e) **(i)** (acceleration of) gravity / tension (in the string) ; [1]

(ii) **EITHER** gravity:
acts on the weight, **w** ;
which pulls the trolley ;

OR tension:
gravity acts on the weight ;
(causing tension in the string) which pulls the trolley ;
(answers to **(i)** and **(ii)** **must** match) [max 2]

[Total: 10]

5

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

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

The apparatus is shown in Fig. 2.1.

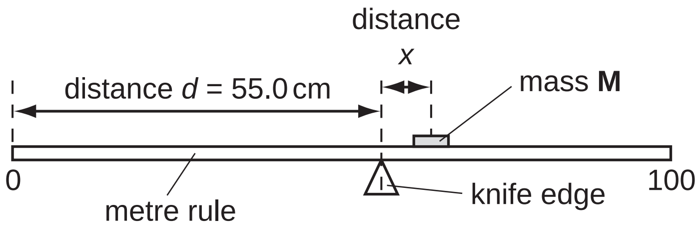


Fig. 2.1

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

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

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

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

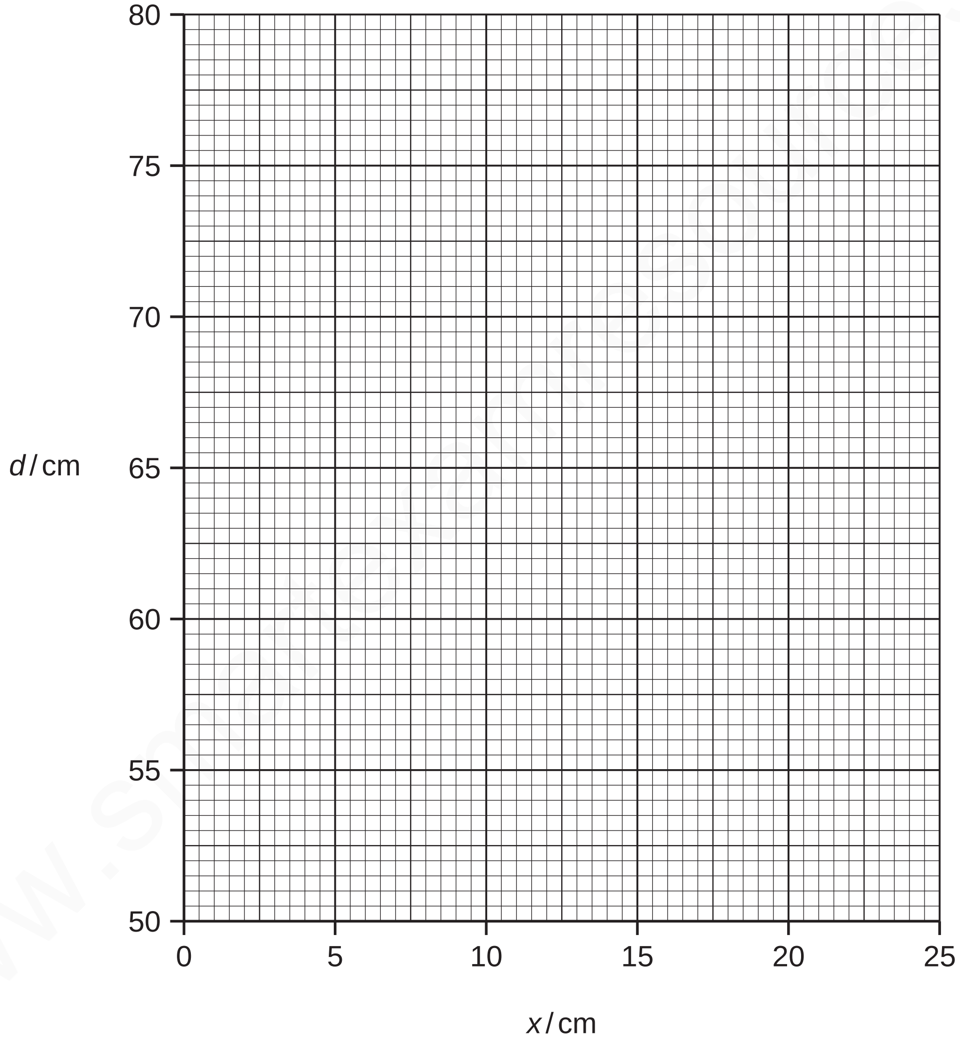
[2]

Fig. 2.2

Table 2.1

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

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



[2]

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

gradient = ... [2]

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

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

Use this equation to calculate the mass of the rule.

m = ... g [1]

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

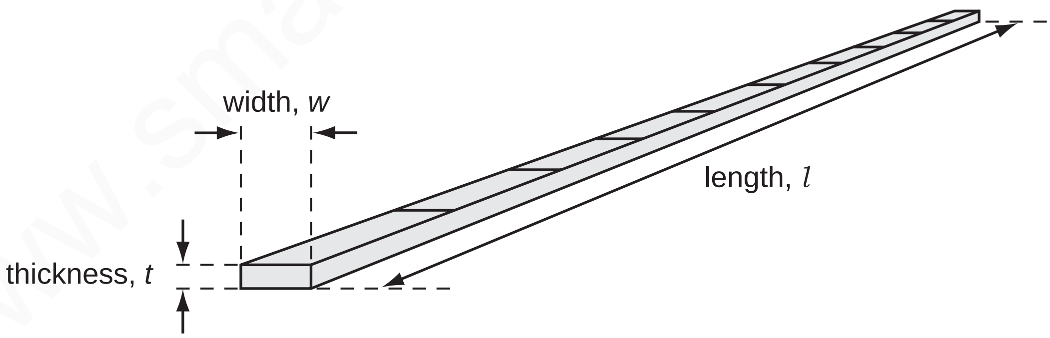


Fig. 2.3

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

density of the material =

[1]

MARKING SCHEME

(a) (i) 68.**0** ;
86.2 (±0.1) ; [2]

(ii) 8(0),
16.2 (ecf) ; ; [2]

(b) (i) points plotted correctly ; (allow 1 error)
suitable straight line drawn ; [2]

(ii) clear evidence on graph ;
allow 1.2 to 1.3 inclusive ; [2]

(c) 150/candidates answer = between 125 and 115 g (ecf) ; [1]

(d) density = $m / l \times t \times w$ (any order) ; [1]

[Total: 10]

The science teacher asks his students to find the height of the steep cliff shown in Fig. 6.1.

6 The students must find t, the time taken for a rock to fall from the top of the cliff to the bottom. They can use this value of t to calculate the height of the cliff.

Student **A** holds the rock, ready to drop it over the edge of the cliff. Student **B** has a timer which can measure to the nearest 0.1 s.

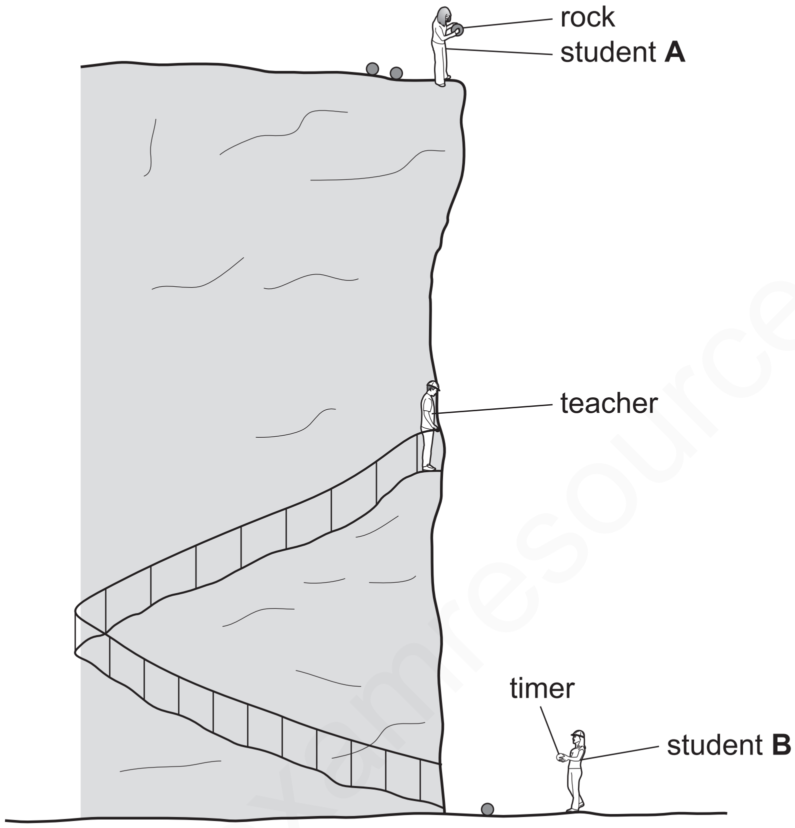


Fig. 6.1

Method

- Student **A** shouts to student **B**, calling “3, 2, 1, 0”.
- When student **A** calls “0” he releases the rock.
- When student **B** hears the count of “0” he starts the timer.
- When the rock hits the ground student **B** stops the timer and records the timer reading in Table 6.1.
- They repeat the experiment three more times. Student **B** does not reset the timer to zero between repeats.

(a) Fig. 6.2 shows the readings on the timer when the rock hits the ground for experiments 3 and 4. Remember that student **B** does not reset the timer to zero between the experiments.

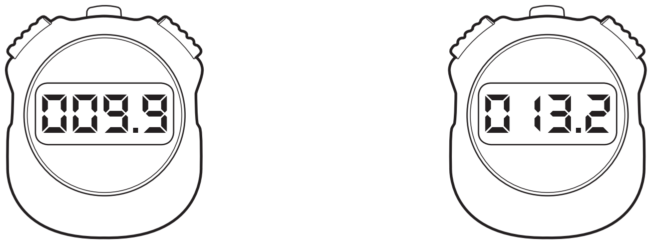


Fig. 6.2

Table 6.1

experiment number	1	2	3	4
timer reading when rock hits ground / s	3.2	6.5		
timer reading when rock is released / s	0	3.2		
t, time taken for the rock to fall / s	3.2	3.3		

(i) Use the timer readings shown in Fig. 6.2 to complete the first row of Table 6.1. [1]

(ii) Complete the second row of Table 6.1. [1]

(iii) Calculate the times taken for the rock to fall in experiments 3 and 4 and complete the third row of Table 6.1.

[2]

(b) (i) The students calculate the height of the cliff using g, the acceleration due to gravity, equal to 9.8 m/s^2 and the time t taken for the rock to fall.

Calculate h, the height of the cliff, using the value of t obtained in experiment 2.

Use the formula shown below.

$$h = \frac{1}{2} \times 9.8 \times t^2$$

h, the height of the cliff = ... m [2]

(ii) Explain why it might be better, when calculating *h*, to use an average of the four values of *t* instead of one of the values.

....

....

.... [2]

(c) The method used by the students gives a value of *h* that is less than the actual height of the cliff. The teacher tells them to do the experiment again, using a different method.

This time, the teacher shouts to the students from a ledge at equal distances from both students (See Fig. 6.1). The teacher counts down to zero, calling "3, 2, 1, 0."

Student **A** releases the rock and student **B** starts the timer when they hear the teacher call "0".

Student **B** stops the timer when the rock hits the ground, as before.

Explain why this method will give a more accurate value for *t*, the time for the rock to fall.

....

....

....

.... [2]

MARKING SCHEME

(a) **(i)** 9.9 **AND** 13.2 ; [1]

(ii) 6.5 **AND** 9.9 ; (ecf) [1]

(iii) 3.4 ;
3.3 ; (ecf) [2]

(b) **(i)** $9.8 \times \frac{3.3^2}{2}$;
= 53.4 ; [2]

(ii) errors ;
either:
errors evened out / decreased effect of errors ;
or
increases reliability ; [max 2]

(c) hear at same time / sound arrives at same time ;
drop and timer happen together ;
OR
sound takes time to travel (from **A** to **B**) ;
timer started late / time too small / drop before timer started ; [max 2]

[Total: 10]

7

A student is carrying out an experiment to determine the density of a stone.

In **Part 1** of the experiment he finds out how the extension of a spring varies with the load.
In **Part 2** he finds the extension produced when the stone is hung on the spring in air and in water.

Part 1

- The student sets up the apparatus shown in Fig. 3.1 so that the pointer reads 0.0 cm when there is no mass attached to the spring.
- He hangs a 250 g mass on the spring and records the pointer reading.
- He replaces the 250 g mass by a 500 g mass and records the pointer reading.

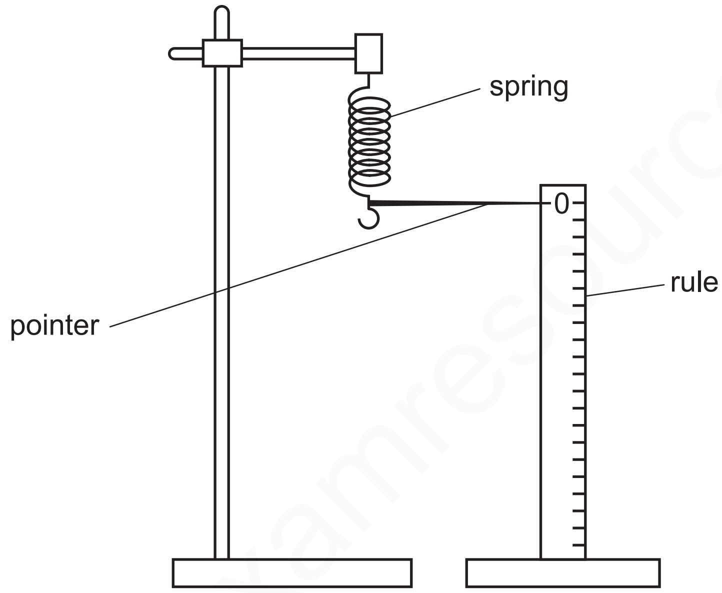


Fig. 3.1

Fig. 3.2 shows the pointer readings for the 250 g and 500 g masses.

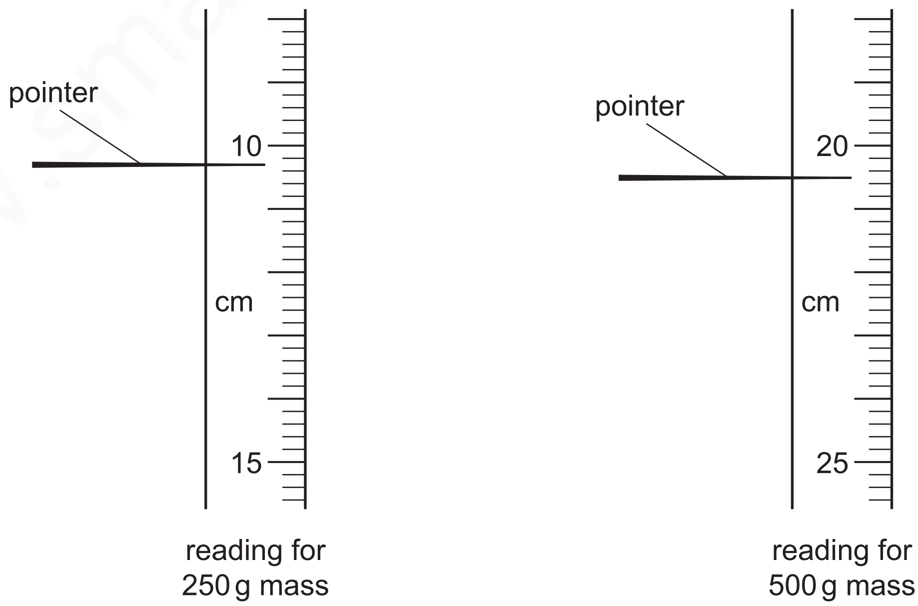


Fig. 3.2

Table 3.1

mass attached	position of pointer / cm
0	0.0
250 g	
500 g	

(a) (i) Read to the nearest 0.1 cm the positions of the pointer in Fig. 3.2 for the 250 g and 500 g masses.

Record the readings in Table 3.1. [2]

(ii) Use the results in Table 3.1 to state how the extension of the spring varies with the load.

.... [1]

Part 2

- The student attaches a piece of wire to the stone and hangs it on the spring.
- He reads E_A the position of the pointer and records it in Table 3.2.
- He immerses the stone in a beaker of water as in Fig. 3.3.
- He reads E_w the new position of the pointer and records it in Table 3.2.

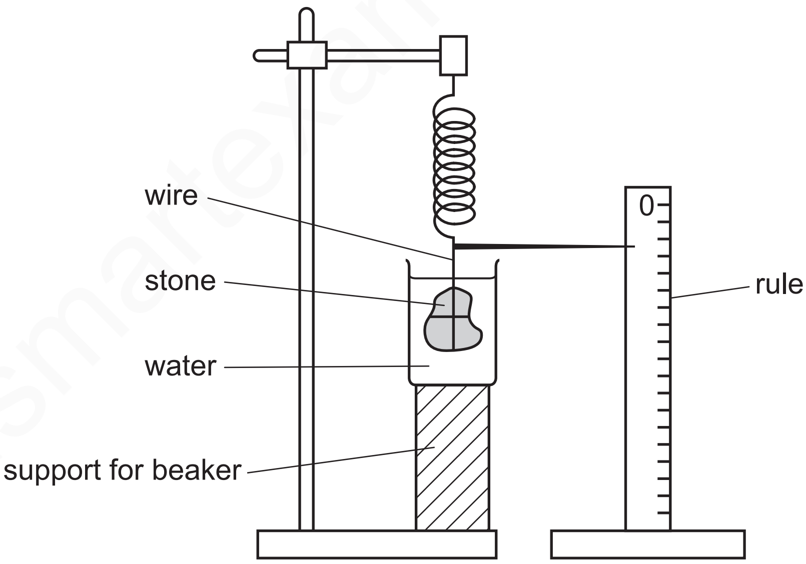
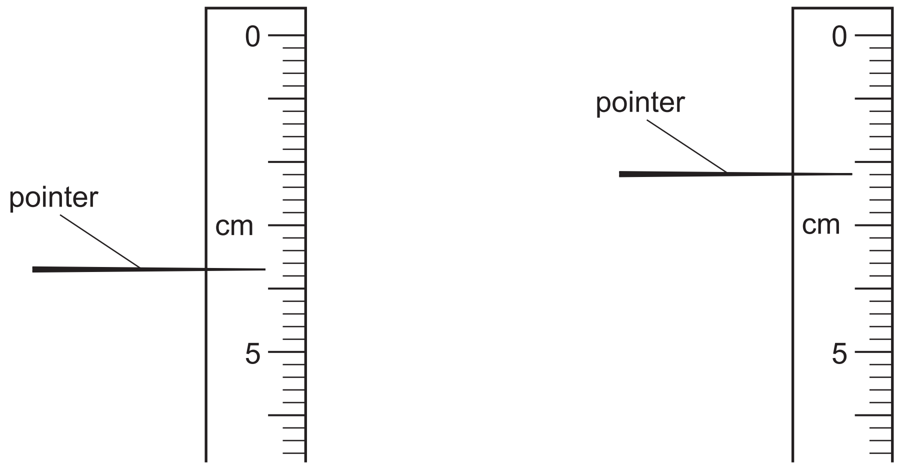


Fig. 3.3



E_A reading for stone in air

E_W reading for stone in water

Fig. 3.4

Table 3.2

mass attached	position of pointer / cm
stone hanging in air	E_A = ...
stone immersed in water	E_W = ...

(b) Read to the nearest 0.1 cm the positions of the pointer in Fig. 3.4. Record the readings in Table 3.2. [2]

(c) (i) The teacher has given the student an equation for calculating the density of the stone.

Use the equation and data from Table 3.2, to calculate the density of the stone.

$$\text{density of the stone} = \frac{E_A}{(E_A - E_W)}$$

density of the stone = ... g / cm^3 [1]

(ii) Compare the equation that you have used to calculate the density of the stone with the density equation $d = m / v$ to help you to complete this statement.

E_A is proportional to the .... of the stone. [1]

(iii) Compare the equation that you have used to calculate the density of the stone with the density equation *d* = *m* / *v* to help you to complete this statement.

(E_A – E_W) is proportional to the .... of the stone. [1]

(d) Suggest **two** reasons why the result may be slightly inaccurate when this method is used to find the density of the stone. Fig. 3.3 may help you.

....

.... [2]

(a) (i) 10.3 ;
20.5 ; [2]

(ii) the extension is proportional to the load ;
OR
the load is proportional to the extension ; [max 1]

(b) 3.7 ;
2.2 ; [2]

(c) (i) $\frac{3.7}{3.7 - 2.2} = \frac{3.7}{1.5} = 2.5\,(g/cm^3)$; [1]

(ii) <u>mass</u> ; [1]

(iii) <u>volume</u> ; [1]

(d) *any two from:*
the wire may have a different density ;
wire adds to the volume ;
wire adds to the mass ;
stone not fully immersed ;
spring could be in the water ;
pointer hitting the side of the beaker ;
stone touching the beaker ;
other sensible answer explained ; [max 2]

[Total: 10]