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You may not need to use all of the materials provided.

1 In this experiment, you will investigate the motion of a wooden strip balanced on a curved surface.

- (a)**
- Assemble the apparatus as shown in Fig. 1.1.
 - Use pieces of modelling clay to ensure that the beaker is secure and that its axis is horizontal.
 - The centre of each mass should be the same distance x from the line at the midpoint of the wooden strip, where x is approximately 15 cm.

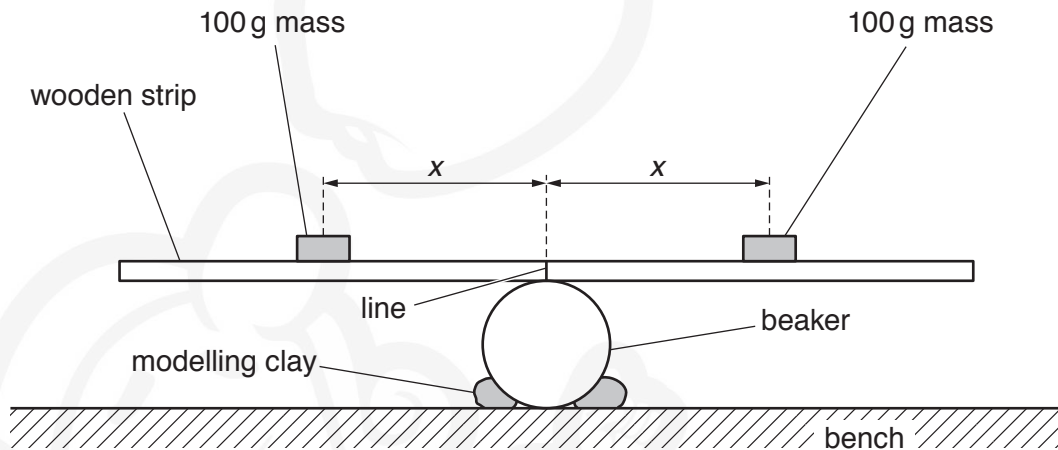


Fig. 1.1

- Measure and record x .

$x = \dots\dots\dots$ cm [1]

- (b)**
- Push one end of the strip down by approximately 2 cm and release it so that it oscillates.
 - Take measurements to find the period T of the oscillations.

$T = \dots\dots\dots$ s [1]

- (c) Change x and measure T . Repeat until you have six sets of values of x and T .

Record your results in a table. Include values of x^2 and T^2 in your table.

- (d) (i) Plot a graph of T^2 on the y-axis against x^2 on the x-axis.

[9]

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

[3]

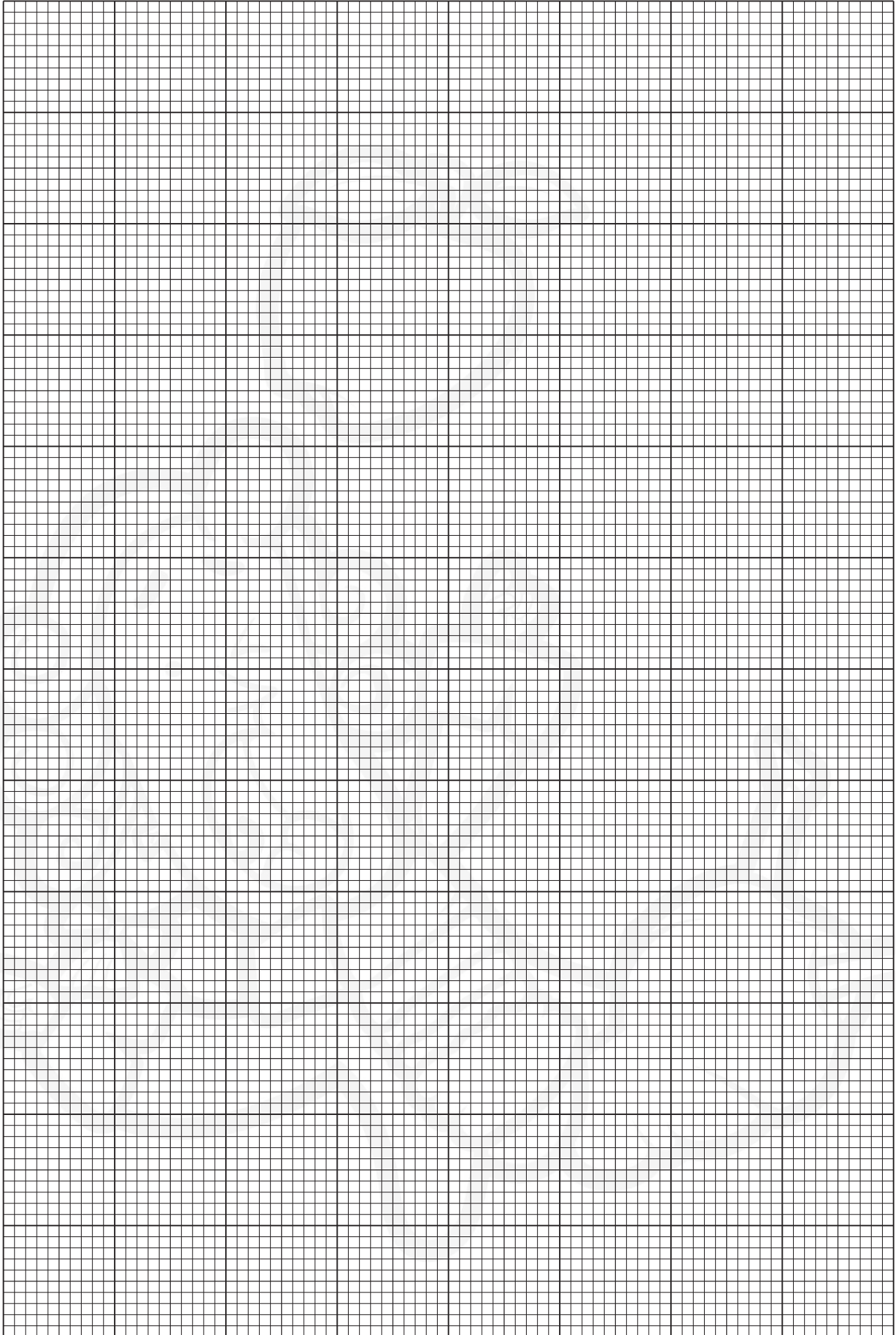
- (iii) Determine the gradient and y-intercept of this line.

[1]

gradient =

y-intercept =

[2]



- (e) It is suggested that the quantities T and x are related by the equation

$$T^2 = ax^2 + b$$

where a and b are constants.

Use your answers in (d)(iii) to determine the values of a and b .
Give appropriate units.

$a =$

$b =$

[2]

- (f) • Take measurements to find the radius R of the beaker.

$R =$

- An approximate value for the acceleration of free fall g is given by

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

Calculate g .

$g =$

[1]

[Total: 20]

You may not need to use all of the materials provided.

2 In this experiment, you will investigate the force needed to pull a cylinder up a step.

(a) Measure the thickness h of the board, as shown in Fig. 2.1.

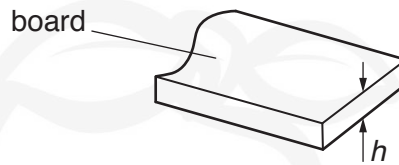


Fig. 2.1

$h =$ mm [1]

(b) • Suspend the two **larger** (100g) slotted masses from the newton meter using the loop of thread, as shown in Fig. 2.2.

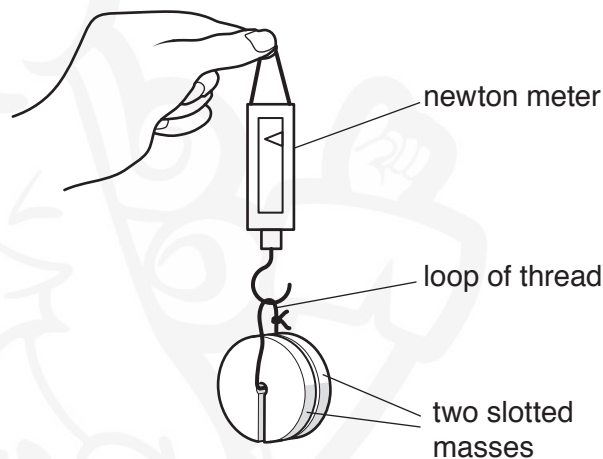


Fig. 2.2

• Record the total weight W of these masses.

$W =$ N [1]

(c) (i) Take measurements to find the radius r of one of the larger slotted masses.

$r =$ mm [1]

- (ii) The value of α is given by

$$\sin \alpha = \frac{(r-h)}{r}.$$

Calculate α .

$\alpha = \dots\dots\dots^\circ$ [1]

- (iii) Justify the number of significant figures you have given for your value of α .

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

- (d) • Place the board on the bench to make a step. Stand the two larger slotted masses on their edges next to the step with their slots at the top, as shown in Fig. 2.3.
• Attach the loop of thread to the masses and the newton meter, as shown in Fig. 2.3.

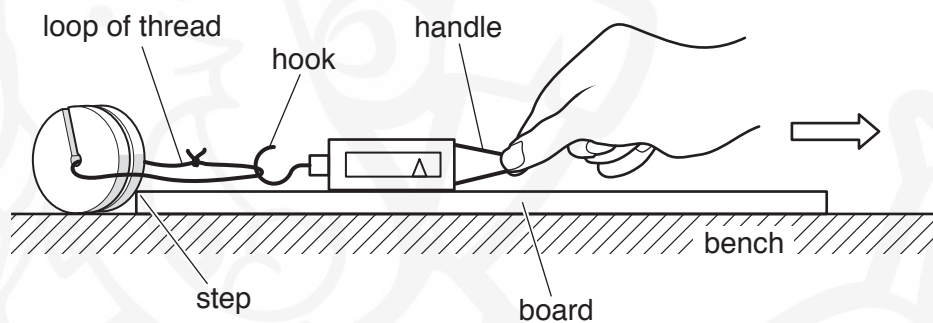


Fig. 2.3

- Pull the handle of the newton meter horizontally and at right angles to the step. The force required to just start the slotted masses rolling up the step is F .

Measure and record F .

$F = \dots\dots\dots$ [2]

(e) Estimate the percentage uncertainty in your value of F .

percentage uncertainty = [1]

(f) Repeat (b), (c)(i), (c)(ii) and (d) using the two smaller (50 g) slotted masses.

$W =$ N

$r =$ mm

$\alpha =$ °

$F =$ [2]

10

(g) It is suggested that the relationship between F , W and α is

$$F = \frac{kW}{\tan \alpha}$$

where k is a constant.

(i) Using your data, calculate two values of k .

first value of k =

second value of k = [1]

(ii) Explain whether your results support the suggested relationship.

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

(h) (i) Describe four sources of uncertainty or limitations of the procedure for this experiment.

1.
.....
2.
.....
3.
.....
4.
.....

[4]

(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1.
.....
2.
.....
3.
.....
4.
.....

[4]

[Total: 20]

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