

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

1 In this experiment, you will investigate the motion of a loaded metre rule.

(a) • Set up the apparatus as shown in Fig. 1.1.

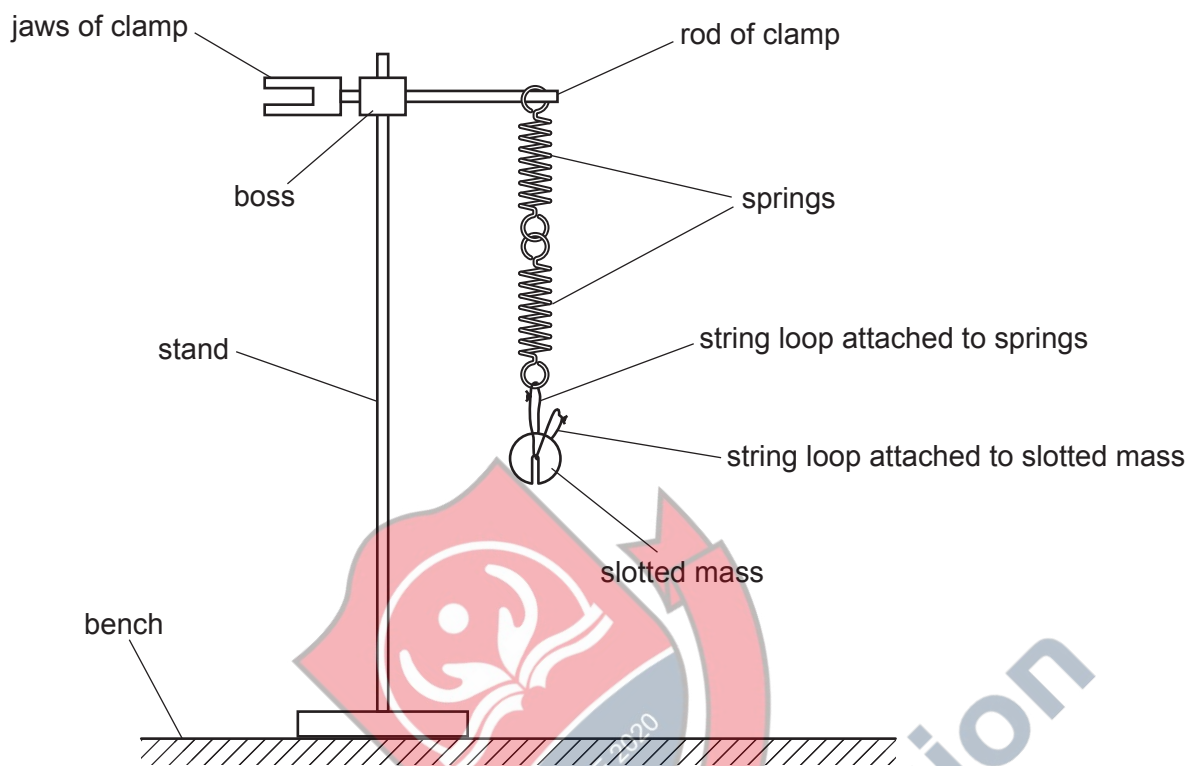


Fig. 1.1

- Place the slotted mass in the string loop attached to the springs.
- Pull the slotted mass downwards through a small distance.
- Release the mass. The mass will oscillate.
- Determine the period T_0 of the oscillations of the mass.

$T_0 = \dots\dots\dots$

- Remove the slotted mass from the string loop attached to the springs.

[2]

- (b) • Set up the apparatus as shown in Fig. 1.2.

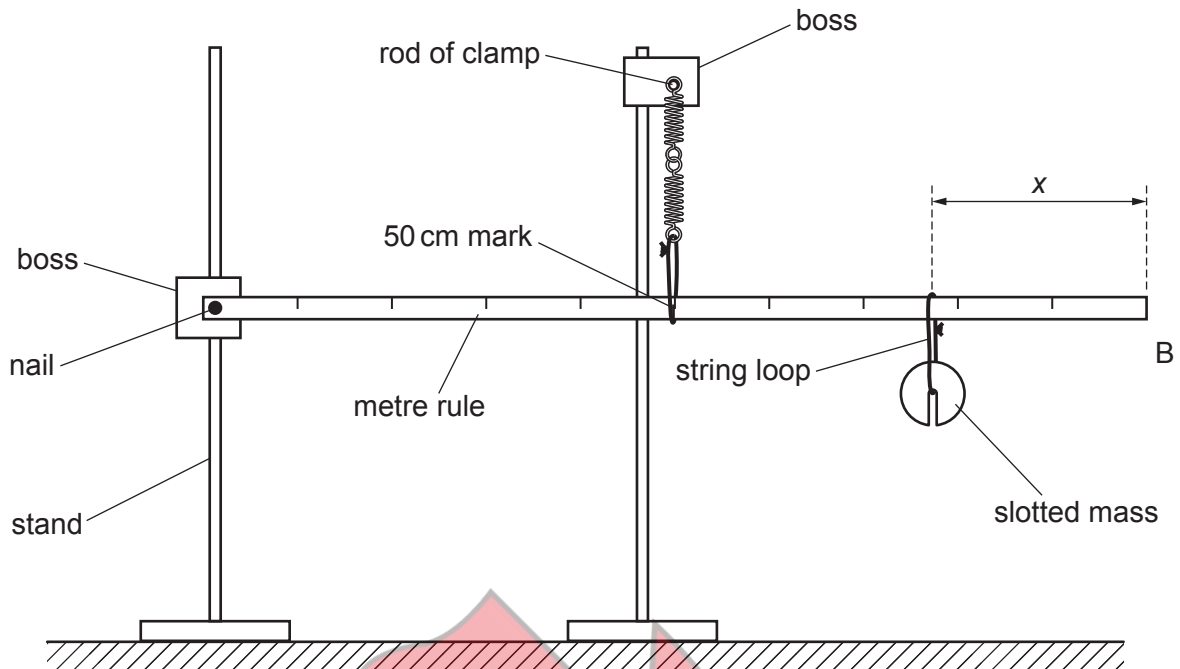


Fig. 1.2

- Position the string loop attached to the springs at the 50 cm mark on the rule. **This string loop must remain in this position throughout the experiment.**
- The distance between the string loop supporting the slotted mass and the end B of the rule is x .

Position the mass so that x is approximately 20 cm.

- Adjust the apparatus so that the rule is parallel to the bench and the springs are vertical.
- Record x .

$x =$

- Pull B downwards through a small distance.
- Release B. The rule will oscillate.
- Determine the period T of the oscillations of the rule.

$T =$

[1]

- (c) Change x by moving the mass along the rule. For each value of x , adjust the apparatus so that the rule is parallel to the bench and the springs are vertical, then determine T .

Repeat until you have six sets of values of x and T with x in the range $10\text{ cm} \leq x \leq 40\text{ cm}$.

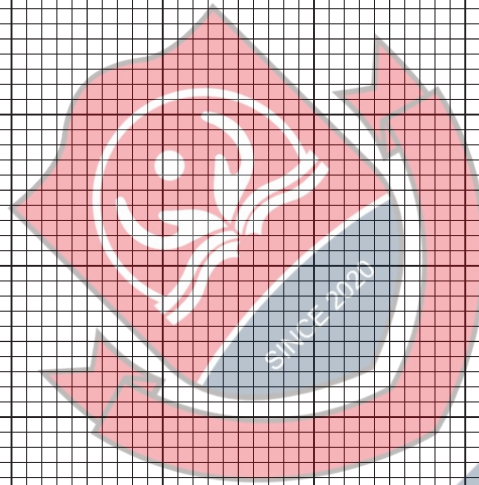
Record your results in a table. Include values of $(T - T_0)^2$ in your table.

- (d) (i) Plot a graph of $(T - T_0)^2$ on the y-axis against x 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 , T_0 and x are related by the equation

$$(T - T_0)^2 = -Px + Q$$

where P and Q are constants.

Using your answers in (d)(iii), determine the values of P and Q .
Give appropriate units.

$P =$

$Q =$ [2]

[Total: 20]



4Uadmission

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

- 2** In this experiment, you will investigate the optical properties of glass jars.

You have been provided with two glass jars A and B, each containing water. Each jar has a lid.

- (a)** The diameter of jar A is D , as shown in Fig. 2.1.

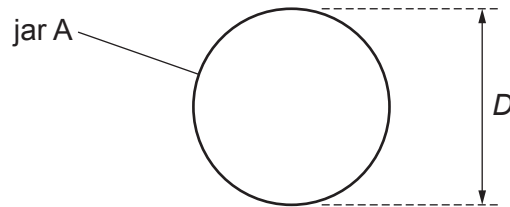
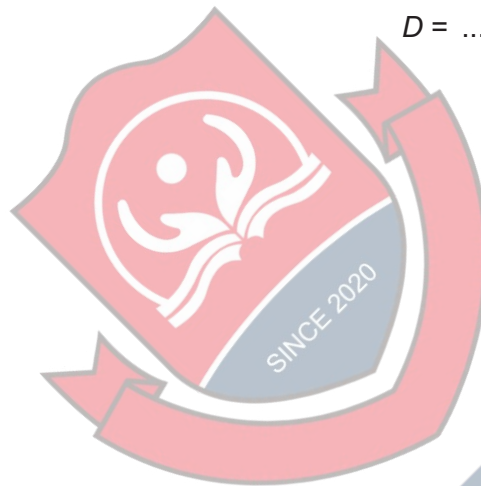


Fig. 2.1

Measure and record D .

$D = \dots\dots\dots$ [1]



4Uadmission

- (b) (i) • Hold the nail next to jar A, as shown in Fig. 2.2.

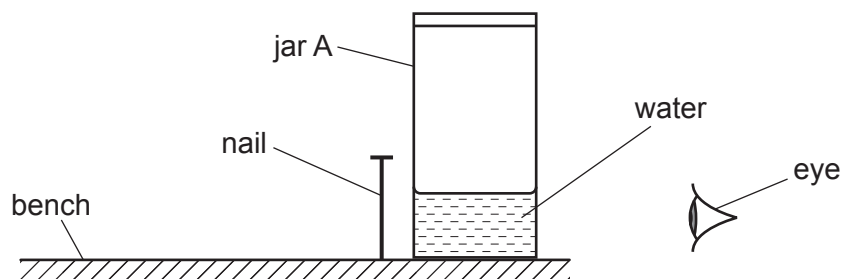


Fig. 2.2

- Close one eye and look at the nail **through the water**.

The bottom of the nail seen through the water will appear to be wider than the top of the nail, as shown in Fig. 2.3.

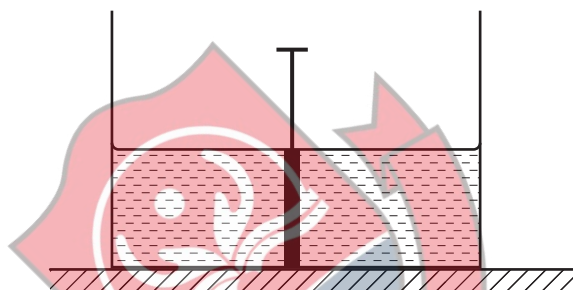


Fig. 2.3

- Move the nail **away** from the jar. The **bottom** of the nail will appear to become wider until it suddenly **disappears**. Hold the **nail** at this point.
- The distance between the nail and jar A is y , as shown in Fig. 2.4.

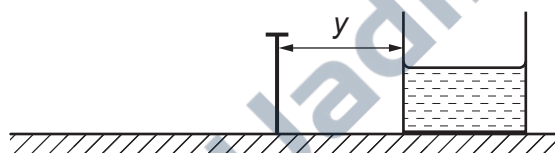


Fig. 2.4

Measure and record y .

$y = \dots\dots\dots$ [2]

- (ii) Estimate the percentage uncertainty in your value of y . Show your working.

percentage uncertainty = % [1]

- (iii) The radius r of jar A is given by

$$r = \frac{D}{2}.$$

Calculate $(r + y)$.

$(r + y) = \dots\dots\dots$ [1]

- (c) Repeat (a), (b)(i) and (b)(iii) using jar B.

$D = \dots\dots\dots$

$y = \dots\dots\dots$

$(r + y) = \dots\dots\dots$ [3]

- (d) It is suggested that the relationship between r and y is

$$\frac{(r + y)}{r} = k$$

where k is a constant.

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

first value of k =

second value of k = [1]

- (ii) Justify the number of significant figures that you have given for your values of k .

.....

 [1]

- (e) It is suggested that the percentage uncertainty in the values of k is 20%.

Using this uncertainty, explain whether your results support the relationship in (d).

.....

 [1]

- (f) • View the nail through the lens as shown in Fig. 2.5.

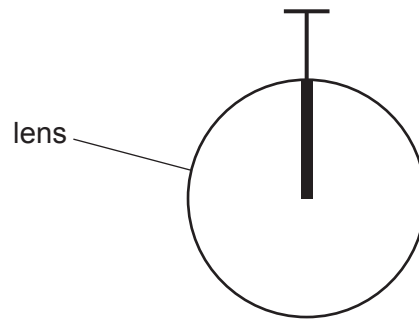


Fig. 2.5

- Increase the distance between the nail and the lens until the bottom of the nail seen through the lens disappears.
- Measure and record the distance y between the nail and the surface of the lens.

- Use your second value of k to determine a value of r for the lens. Give an appropriate unit.

$y = \dots\dots\dots$

$r = \dots\dots\dots$

[1]

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

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

1

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2

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3

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4

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[4]

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

1

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2

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3

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4

.....

[4]

[Total: 20]

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