



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

1 In this experiment, you will investigate an electrical circuit.

(a) • Connect the circuit shown in Fig. 1.1.

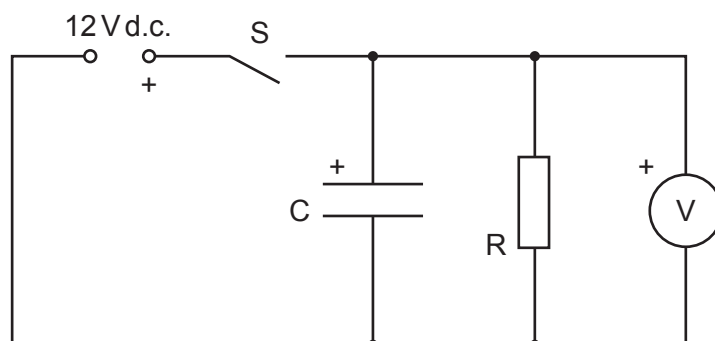


Fig. 1.1

- **Ensure that the polarities of the power supply, component C and the voltmeter are as shown in Fig. 1.1.**
- Close switch S for a short time and then open it.
- Watch the voltmeter reading as it reduces.
When the voltmeter reading passes a value V_S of 8.00 V, start the stop-watch.
When the voltmeter reading passes a value of 7.00 V, stop the stop-watch.
- Record the starting value V_S and the time T for the voltmeter reading to fall by 1.00 V.

$V_S =$

$T =$
[2]

- (b) Choose another starting value V_S . Close S for a short time and then open it. Measure the time T for the voltmeter reading to fall by 1.00 V from the starting value V_S .

Repeat until you have six sets of values of V_S and T .

Record your results in a table. Include values of $\frac{1}{T}$ in your table.

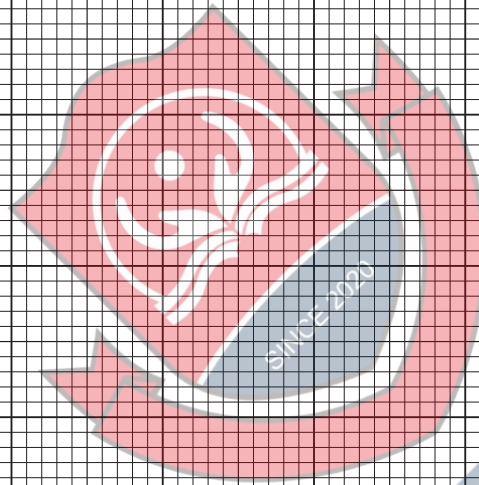


- (c) (i) Plot a graph of $\frac{1}{T}$ on the y-axis against V_S on the x-axis. [10]
- (ii) Draw the straight line of best fit. [3]
- (iii) Determine the gradient and y-intercept of this line. [1]

gradient =

y-intercept =

[2]



(d) It is suggested that the quantities V_S and T are related by the equation

$$\frac{1}{T} = aV_S + b$$

where a and b are constants.

Using your answers in (c)(iii), determine the values of a and b .
Give appropriate units.

$a =$

$b =$ [2]

[Total: 20]



4Uadmission

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

2 In this experiment, you will investigate the equilibrium of a wooden rod.

- (a) (i)**
- Assemble the apparatus as shown in Fig. 2.1.
 - Adjust the apparatus so that the wooden rod is parallel to the bench and the spring is vertical.

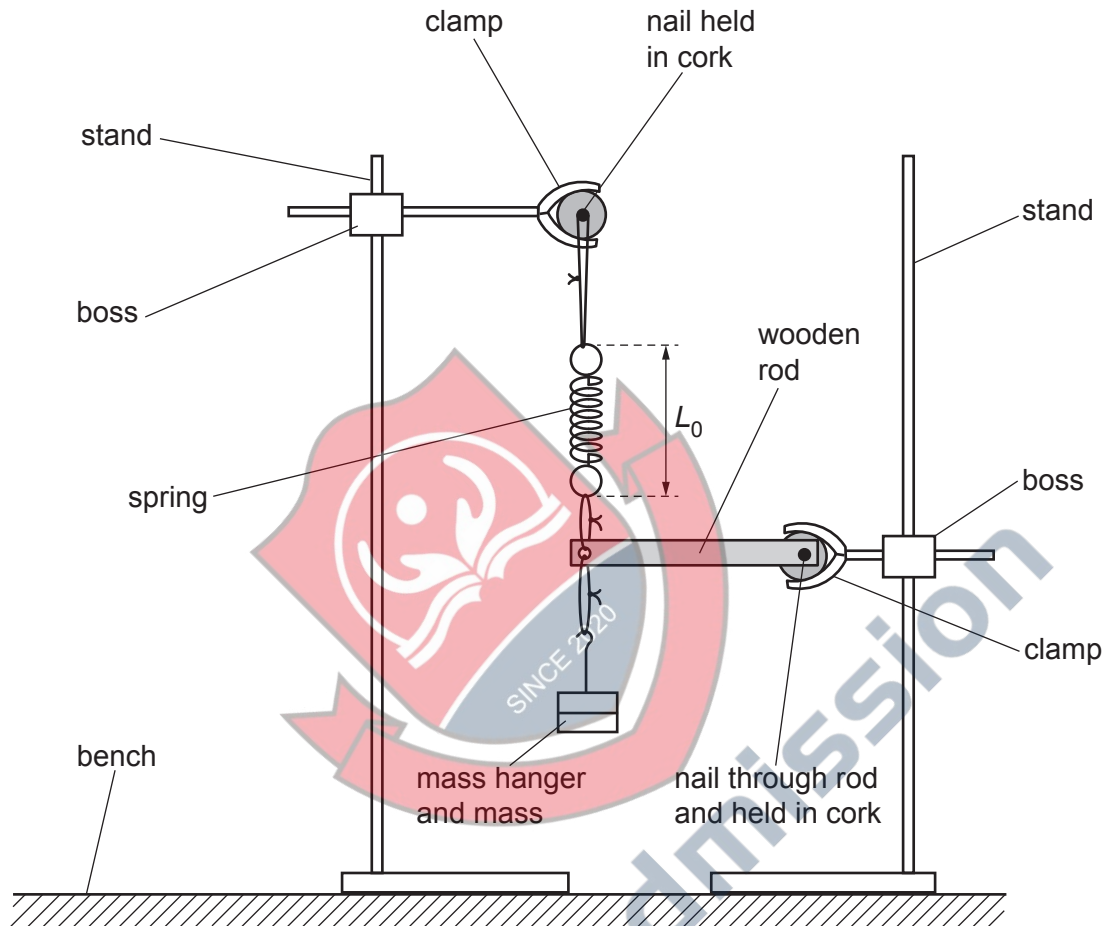


Fig. 2.1 (not to scale)

- The distance between the ends of the spring is L_0 , as shown in Fig. 2.1.
Measure and record L_0 .

$L_0 = \dots\dots\dots$ m [1]

- (ii)
- Pull the mass hanger down a short distance and then release it. The mass hanger will oscillate.
 - Take measurements to find the period T of the oscillations.

$T = \dots\dots\dots$ [2]

- (iii)
- Calculate the value of the spring constant k using

$$k = \frac{\alpha\pi^2}{T^2}$$

where $\alpha = 0.800$ kg.

$k = \dots\dots\dots$ Nm^{-1}

- Justify the number of significant figures that you have given for your value of k .

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.....

.....

[1]

- (b) (i) • Move the stand supporting the spring away from the other stand and add the plumb line, as shown in Fig. 2.2.

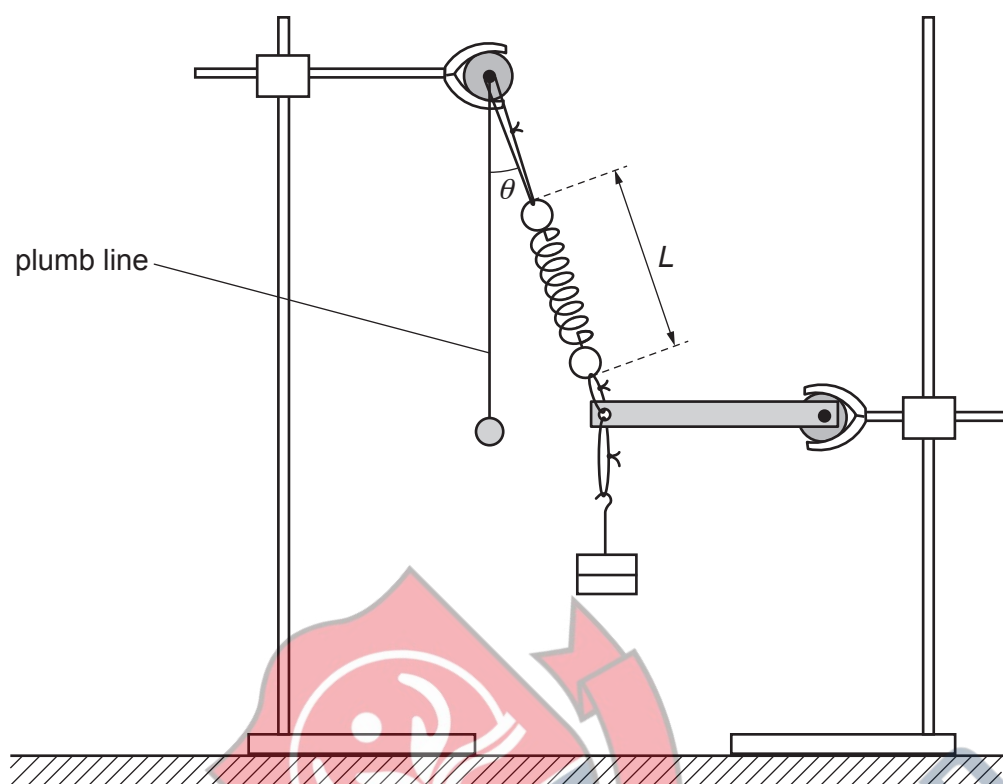


Fig. 2.2 (not to scale)

- Adjust the apparatus so that the angle θ between the spring and the vertical is approximately 20° and the wooden rod is parallel to the bench, as shown in Fig. 2.2.
- The new distance between the ends of the spring is L , as shown in Fig. 2.2.

Measure and record L .

$L = \dots\dots\dots$ m

- Measure and record θ .

$\theta = \dots\dots\dots^\circ$
[2]

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

percentage uncertainty = $\dots\dots\dots\%$ [1]

(iii) Repeat (b)(i) using an angle θ of approximately 45° .

$L = \dots\dots\dots$ m

$\theta = \dots\dots\dots^\circ$
[3]

(c) It is suggested that the relationship between L and θ is

$$k(L - L_0) + B = \frac{D}{\cos \theta}$$

where $B = 2.0\text{ N}$ and D is a constant.

Using your data, calculate two values of D .



first value of $D = \dots\dots\dots$

second value of $D = \dots\dots\dots$
[1]

(d) It is suggested that the percentage uncertainty in the values of D is 10%.

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

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

- (e) (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

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[4]

[Total: 20]



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