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

Some of the apparatus has been set up for you.

(a) (i) • Fig. 1.1 shows the rod with two eyes.

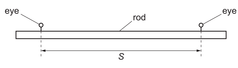


Fig. 1.1

The distance between the two eyes on the rod is S.

Measure and record S.

S = ...

• Complete the set-up of the apparatus as shown in Fig. 1.2.

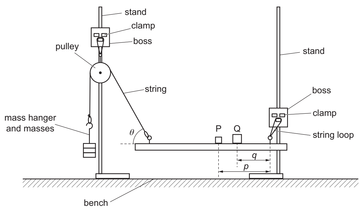


Fig. 1.2

• P and Q are masses.

The distance between the centre of mass P and the centre of the right-hand eye is p, as shown in Fig. 1.2.

The distance between the centre of mass Q and the centre of the right-hand eye is q, as shown in Fig. 1.2.

The angle between the string and the rod is θ.

Use some of the adhesive putty to attach Q to the rod so that q is approximately 26 cm.

• Use some of the adhesive putty to attach P to the rod. Adjust the position of P and the position of the stand with the pulley so that the rod is parallel to the bench and θ is approximately 45°.

Do not move the stands for the remainder of the experiment.

• Measure and record θ, p and q.

θ = ...°

p = ...

q = ...

[2]

(ii) The moment of the force about the eye due to mass P is T_P.

The moment of the force about the eye due to mass Q is T_Q.

The values of T_P and T_Q are given by:

$$T_P = 5Wp \quad \text{and} \quad T_Q = 7Wq$$

where W has the value 0.0981 N.

Calculate T_P and T_Q.

T_P = ...

T_Q = ...

[1]

(b) Change the position of Q and adjust the position of P until the rod is again parallel to the bench. Measure p and q. Repeat until you have six sets of values of p and q.

Record your results in a table. Include values of T_P and T_Q in your table.

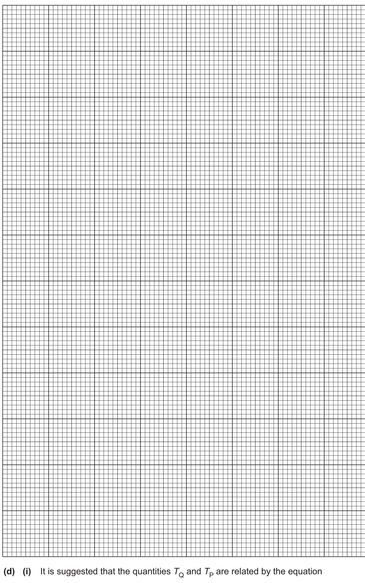
[8]

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

gradient = ...

y-intercept = ...

[2]



(d) (i) It is suggested that the quantities T_Q and T_P are related by the equation

$$T_Q = A + BT_P$$

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]

(ii) Theory suggests that

$$R = F\sin\theta - \frac{2A}{S}$$

where R is the weight of the rod and F has the value 2.94 N.

Use your answers in **(a)(i)** and **(d)(i)** to determine a value for R.
Give an appropriate unit.

R = ... [1]

[Total: 20]

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