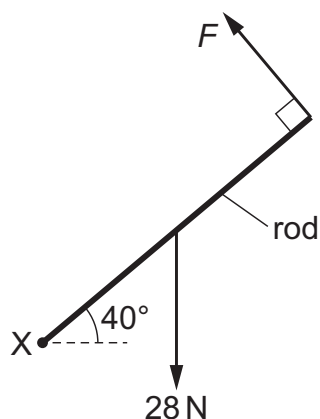


- 13** A uniform rod of weight 28 N is supported at one end by force F .

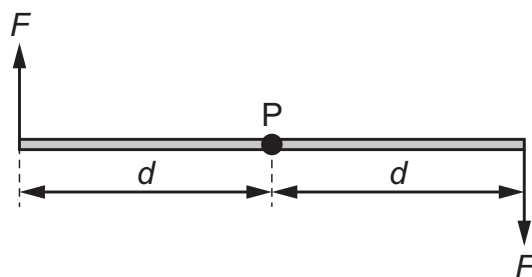
The rod is in equilibrium and attached to a frictionless hinge at end X.



What is the magnitude of F ?

- A** 9.0 N **B** 11 N **C** 18 N **D** 21 N

- 14** Two forces, each of magnitude F , act in opposite directions on a rod.



Each force acts on the rod at a distance d from the pivot P.

What is the torque of this couple about P?

- A** 0 **B** $F \times d$ **C** $2F \times d$ **D** $2F \times 2d$

- 16** The formula for the upthrust on a block of wood partially submerged in water is shown.

$$F = \rho g V$$

What do the symbols ρ and V represent?

	ρ	V
A	density of water	volume of whole block
B	density of water	volume of block below surface of water
C	density of wood	volume of whole block
D	density of wood	volume of block below surface of water

- 9** A sphere moves vertically downwards at terminal (constant) velocity in a liquid.

Which statement about the magnitude of the upthrust acting on the sphere is correct?

- A** It is proportional to the acceleration of free fall.
- B** It is equal to the weight of the sphere.
- C** It is proportional to the density of the sphere.
- D** It is proportional to the square of the radius of the sphere.

- 3 A spring is fixed at one end and attached to the frame of a pulley at the other end. A cable is passed around the wheel of the pulley. The spring is stretched to a fixed length using the cable and pulley.

Fig. 3.1 shows the view from above of the spring, cable and pulley.

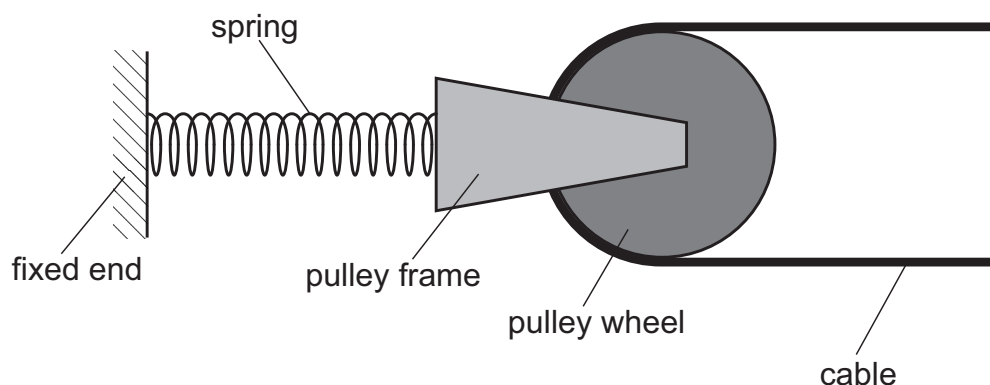


Fig. 3.1

The spring obeys Hooke's law and has a spring constant k of 250 N m^{-1} . A force F acts on the spring. The tension in the cable is T . The pulley is in equilibrium.

- (a) On Fig. 3.2, draw labelled arrows to show the directions of the forces acting on the pulley.

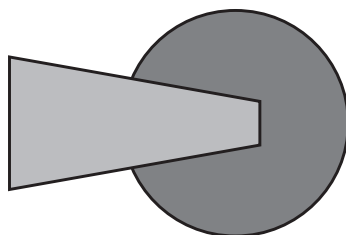


Fig. 3.2

[2]

- (b) The force F is 110 N .

- (i) Determine T .

$T = \dots\dots\dots \text{ N}$ [1]

- (ii) Calculate the extension of the spring.

extension = m [2]

- (c) A second identical spring with the same spring constant of 250 N m^{-1} is now also connected to the pulley, as shown in Fig. 3.3.

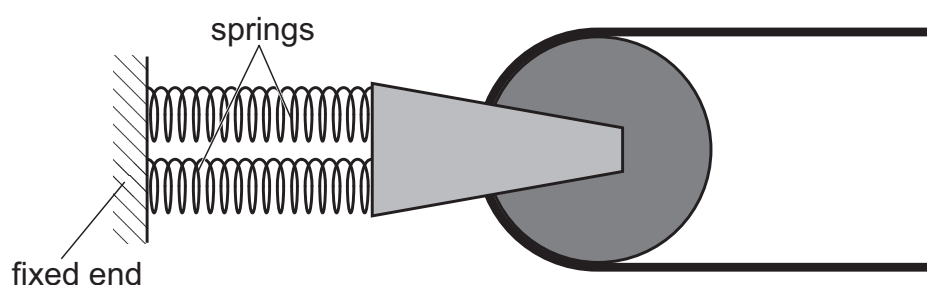


Fig. 3.3

The tension in the cable is kept the same. The pulley is again in equilibrium.

- (i) Determine the extension of the springs.

extension = m [2]

- (ii) The elastic potential energy stored in the spring in Fig. 3.1 is E_1 . The **total** elastic potential energy stored in the two springs in Fig. 3.3 is E_2 .

Calculate the ratio $\frac{E_1}{E_2}$.

ratio = [2]

[Total: 9]

2 In this experiment, you will investigate the tension in a string.

- (a) • Set up the apparatus as shown in Fig. 2.1.

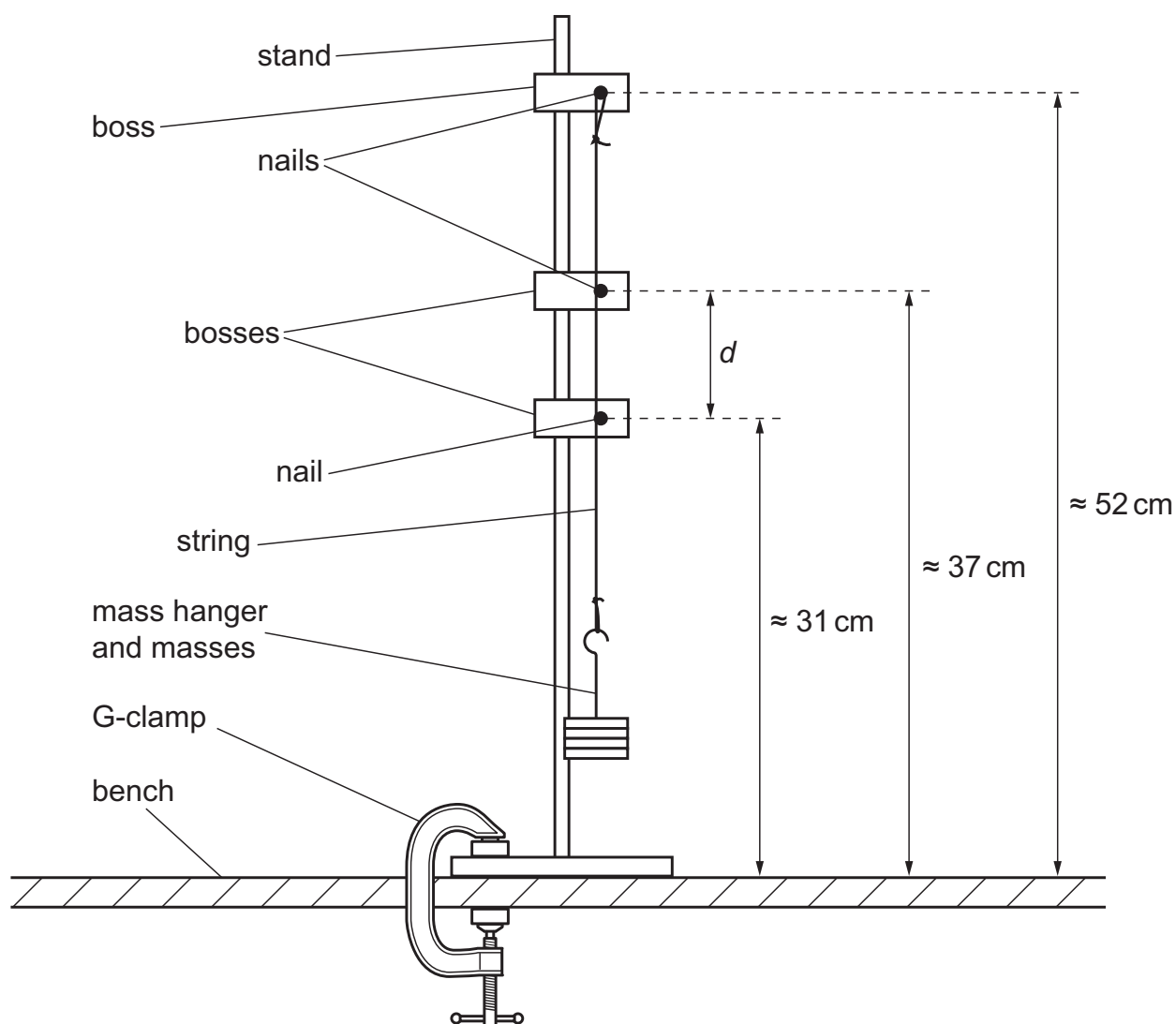


Fig. 2.1

- The mass hanger and masses should have a total mass M of 0.400 kg.
- The distance between the two lower nails is d , as shown in Fig. 2.1.

Measure and record d .

$d =$ cm [1]

(b) The tension in the string is T .

Calculate T using $T = Mg$, where $g = 9.81 \text{ N kg}^{-1}$.

$T = \dots\dots\dots \text{ N [1]}$

- (c) (i) • Hook the newton meter on the string half-way between the two lower nails and pull it horizontally with a force F of 5.0 N, as shown in Fig. 2.2.

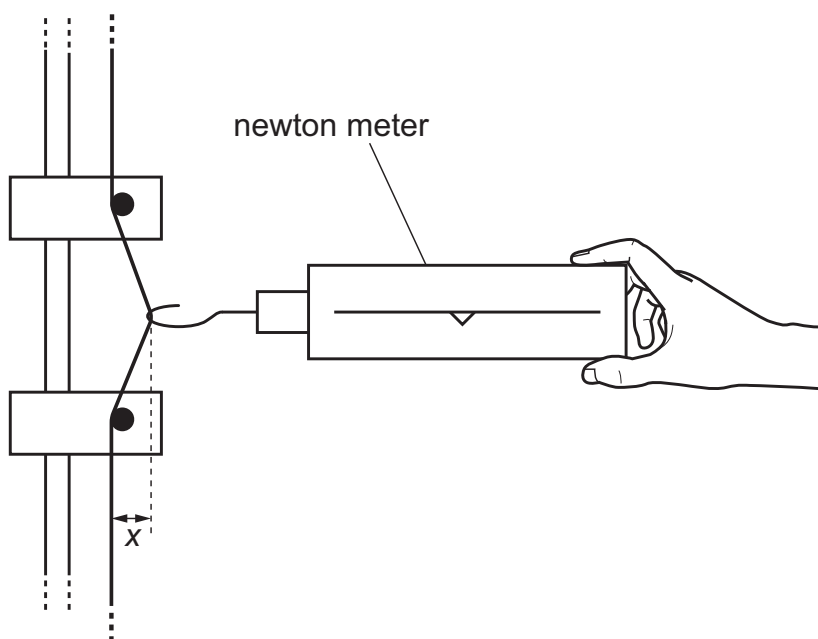


Fig. 2.2

- The force F causes the string to deflect a distance x , as shown in Fig. 2.2.

Measure and record x .

$x = \dots\dots\dots \text{ cm [2]}$

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

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

(iii) Calculate y , where

$$y = \sqrt{\left(x^2 + \frac{d^2}{4}\right)}.$$

$y =$ cm [1]

- (d) • Add slotted masses to the mass hanger so that the total mass M is 0.700 kg.
- Repeat (b), (c)(i) and (c)(iii).

$T =$ N

$x =$ cm

$y =$ cm
[3]

(e) It is suggested that the relationship between y , T and x is

$$ky = Tx$$

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]

(f) 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 (e).

.....
.....
.....
..... [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
-
- 2
-
- 3
-
- 4
-

[4]

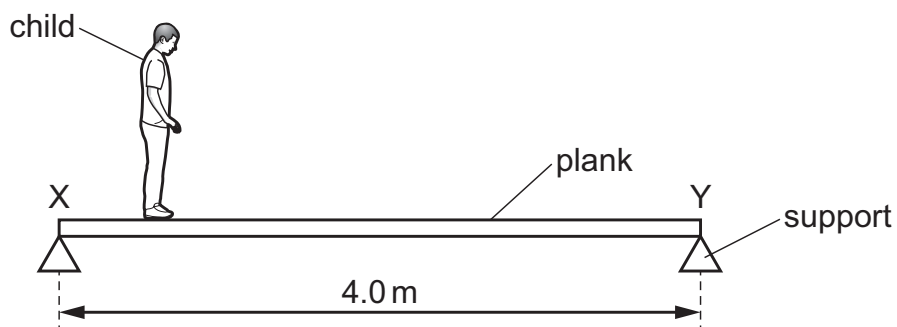
(ii) Describe **four** improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

- 1
-
- 2
-
- 3
-
- 4
-

[4]

[Total: 20]

13 The diagram shows a uniform plank XY of length 4.0 m and weight 300 N.



The plank rests on fixed supports at its ends X and Y.

A child of weight 600 N stands in different positions on the plank.

The support at end X exerts a force F vertically upwards on the plank.

What is the magnitude of F when the child stands at X and when the child stands at Y?

	F/N when child is at X	F/N when child is at Y
A	600	0
B	600	150
C	750	0
D	750	150