

1 Fig. 1 shows four forces acting at a point. The forces are in equilibrium.

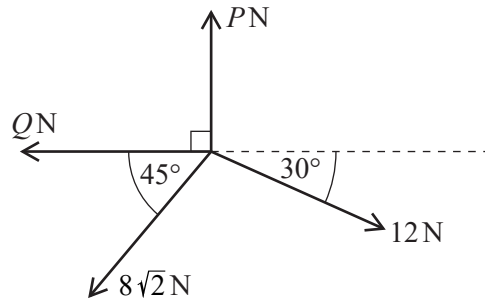


Fig. 1

Show that $P = 14$.

Find Q , giving your answer correct to 3 significant figures.

[5]

2 Fig. 1 shows a pile of four uniform blocks in equilibrium on a horizontal table. Their masses, as shown, are 4 kg, 5 kg, 7 kg and 10 kg.

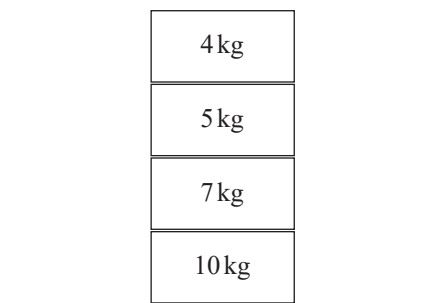


Fig. 1

Mark on the diagram the magnitude and direction of each of the forces acting on the 7 kg block.

[3]

- 3 Abi and Bob are standing on the ground and are trying to raise a small object of weight 250 N to the top of a building. They are using long light ropes. Fig. 7.1 shows the initial situation.

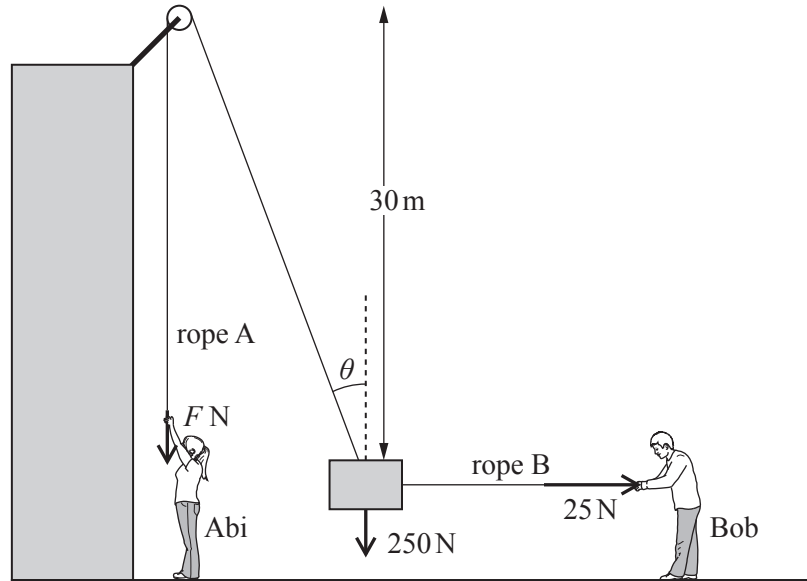


Fig. 7.1

Abi pulls vertically downwards on the rope A with a force F N. This rope passes over a small smooth pulley and is then connected to the object. Bob pulls on another rope, B, in order to keep the object away from the side of the building.

In this situation, the object is stationary and in equilibrium. The tension in rope B, which is horizontal, is 25 N. The pulley is 30 m above the object. The part of rope A between the pulley and the object makes an angle θ with the vertical.

(i) Represent the forces acting on the object as a fully labelled triangle of forces. [3]

(ii) Find F and θ .

Show that the distance between the object and the vertical section of rope A is 3 m. [5]

Abi then pulls harder and the object moves upwards. Bob adjusts the tension in rope B so that the object moves along a vertical line.

Fig. 7.2 shows the situation when the object is part of the way up. The tension in rope A is S N and the tension in rope B is T N. The ropes make angles α and β with the vertical as shown in the diagram. Abi and Bob are taking a rest and holding the object stationary and in equilibrium.

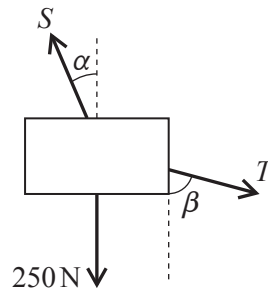


Fig. 7.2

(iii) Give the equations, involving S , T , α and β , for equilibrium in the vertical and horizontal directions. [3]

(iv) Find the values of S and T when $\alpha = 8.5^\circ$ and $\beta = 35^\circ$. [4]

(v) Abi's mass is 40 kg.

Explain why it is not possible for her to raise the object to a position in which $\alpha = 60^\circ$. [3]

- 4 Fig. 4 illustrates points A, B and C on a straight race track. The distance AB is 300 m and AC is 500 m. A car is travelling along the track with uniform acceleration.

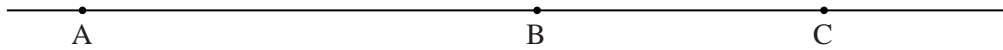


Fig. 4

Initially the car is at A and travelling in the direction AB with speed 5 ms^{-1} . After 20 s it is at C.

- (i) Find the acceleration of the car. [2]
- (ii) Find the speed of the car at B and how long it takes to travel from A to B. [3]

- 5 An egg falls from rest a distance of 75 cm to the floor.

Neglecting air resistance, at what speed does it hit the floor?

[3]

- 6 Fig. 1 shows four forces in equilibrium.

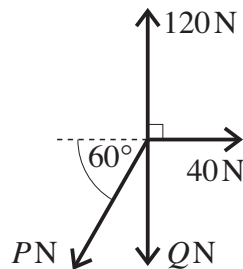


Fig. 1

- (i) Find the value of P . [3]

- (ii) Hence find the value of Q . [2]

- 7 A block of weight 100 N is on a rough plane that is inclined at 35° to the horizontal. The block is in equilibrium with a horizontal force of 40 N acting on it, as shown in Fig. 5.

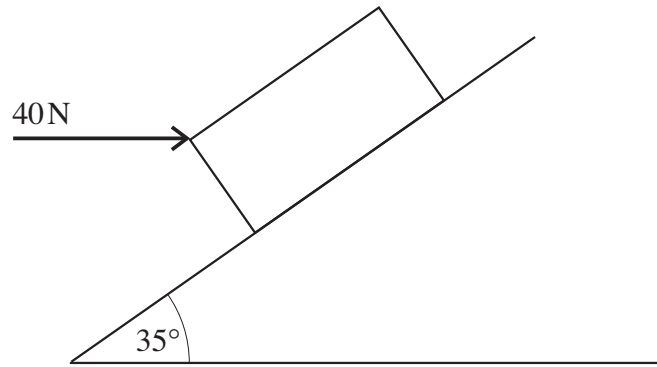


Fig. 7

Calculate the frictional force acting on the block.

[4]