3 **(a)** State what is meant by the *centre of gravity* of a body.

.....

.....[1]

(b) A uniform square sign with sides of length 0.68 m is fixed at its corner points A and B to a wall. The sign is also supported by a wire CD, as shown in Fig. 3.1.

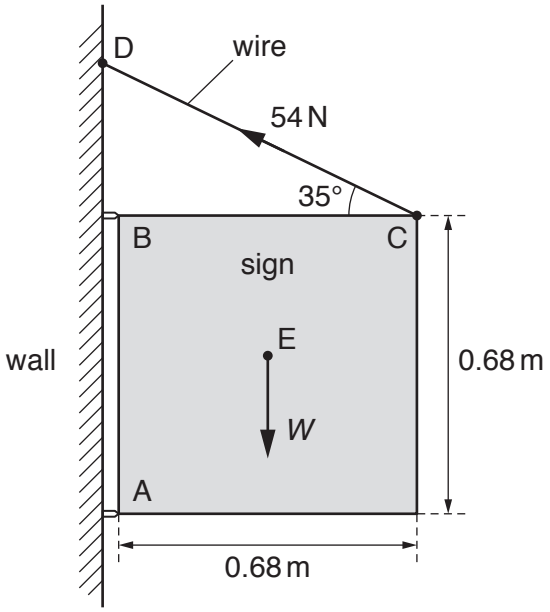

Fig. 3.1 (not to scale)

The sign has weight *W* and centre of gravity at point E. The sign is held in a vertical plane with side BC horizontal. The wire is at an angle of 35° to side BC. The tension in the wire is 54 N.

The force exerted on the sign at B is only in the vertical direction.

(i) Calculate the vertical component of the tension in the wire.

vertical component of tension = ... N [1]

(ii) Explain why the force on the sign at B does not have a moment about point A.

.....

.....[1]

(iii) By taking moments about point A, show that the weight W of the sign is 150 N.

[2]

(iv) Calculate the total vertical force exerted by the wall on the sign at points A and B.

total vertical force = ... N [1]

(c) The sign in **(b)** is held together by nuts and bolts. One of the nuts falls vertically from rest through a distance of 4.8 m to the pavement below. The nut lands on the pavement with a speed of $9.2\,m\,s^{-1}$.

Determine, for the nut falling from the sign to the pavement, the ratio

$$\frac{\text{change in gravitational potential energy}}{\text{final kinetic energy}}.$$

ratio = ... [4]

[Total: 10]