

- 3 (a) State the two conditions for an object to be in equilibrium.

1. ....

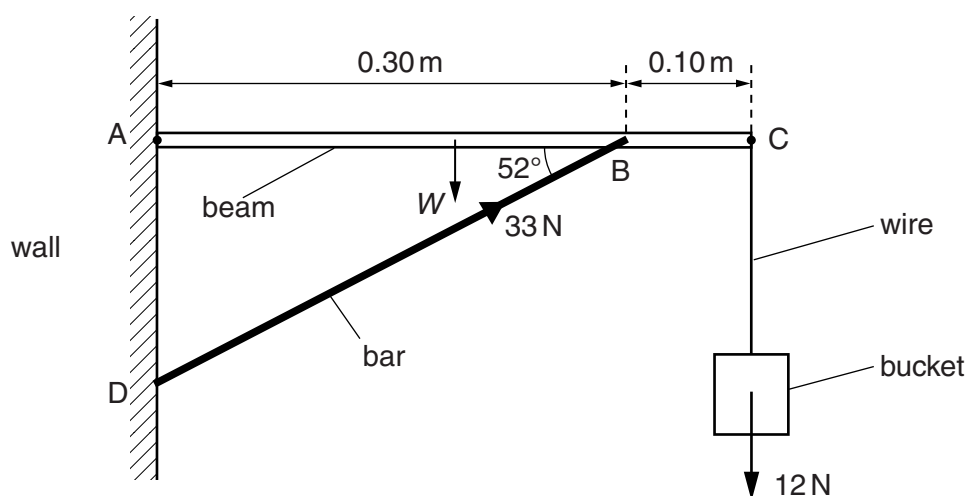
.....

2. ....

.....

[2]

- (b) A uniform beam AC is attached to a vertical wall at end A. The beam is held horizontal by a rigid bar BD, as shown in Fig. 3.1.



**Fig. 3.1** (not to scale)

The beam is of length 0.40m and weight  $W$ . An empty bucket of weight 12N is suspended by a light metal wire from end C. The bar exerts a force on the beam of 33N at  $52^\circ$  to the horizontal. The beam is in equilibrium.

- (i) Calculate the vertical component of the force exerted by the bar on the beam.

component of the force = ..... N [1]

- (ii) By taking moments about A, calculate the weight  $W$  of the beam.

$W =$  ..... N [3]

- (c) The metal of the wire in (b) has a Young modulus of  $2.0 \times 10^{11} \text{ Pa}$ . Initially the bucket is empty. When the bucket is filled with paint of weight  $78 \text{ N}$ , the strain of the wire increases by  $7.5 \times 10^{-4}$ . The wire obeys Hooke's law.

Calculate, for the wire,

- (i) the increase in stress due to the addition of the paint,

increase in stress = ..... Pa [2]

- (ii) its diameter.

diameter = ..... m [3]

[Total: 11]