

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.

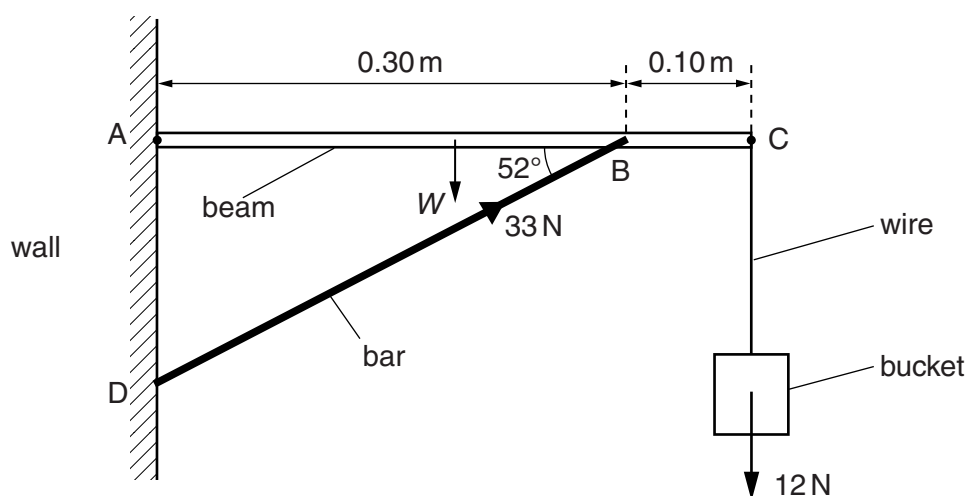


Fig. 3.1 (not to scale)

The beam is of length 0.40 m and weight W . An empty bucket of weight 12 N is suspended by a light metal wire from end C. The bar exerts a force on the beam of 33 N at 52° 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 N , the strain of the wire increases by 7.5×10^{-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]