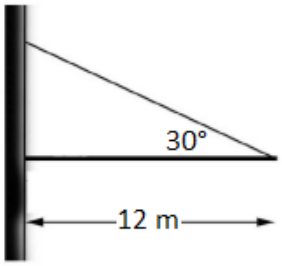
Answer on Question #79618 - Physics - Mechanics – Relativity

A horizontal rod with a mass of 10 kg and length 12 m is hinged to a wall at one end and supported by a cable which makes an angle of 30° with the rod at its other end. Calculate the tension in the cable and the force exerted by the hinge.

Solution

First, draw a picture and agree that $\beta = 30°$:



The rod doesn't move, it means that it is in the state of equilibrium and sum of all forces in X and Y directions is equal to zero, or:

$$0 = -T\cos\beta + F\cos\alpha$$

for X axis and

$$0 = -mg + T\sin\beta + F\sin\alpha$$

for Y,

where F – the force exerted by the hinge, α – angle of F.

Write expression for the torques equilibrium (the pivot point is in the hinge):

$$0 = T \cdot \sin\beta \cdot L - mg \cdot \frac{L}{2}.$$

Then derive T:

$$T = \frac{mg}{2\sin\beta} = \frac{10 \cdot 9.8}{2\sin 30°} = 98 \text{ N}.$$

Substitute T for $\frac{mg}{2\sin\beta}$ in previous expressions and see that $\alpha = \beta$, then

$$F = \frac{mg}{2\sin\beta} = \frac{10 \cdot 9.8}{2\sin 30°} = 98 \text{ N}.$$

Answer

$F = T = 98$ N.