Answer on Question #55906-Physics-Classical Mechanics

A uniform rod of mass m and length l rotates in a horizontal plane with an angular velocity w about a vertical axis passing through one end. The tension in the rod at a distance x from the axis is :-

Solution

The tension at x is equal to acceleration of the mass between x and l times mass between x and l.

The mass between x and l can be thought to be located in the center of gravity, which is at $\left(x + \frac{l-x}{2}\right)$. And the mass between x and l is $m\left(\frac{l-x}{l}\right)$.

So, the tension in the rod at a distance x from the axis is

$$T = a\,m = \omega^2 r\,m = \omega^2 \left(x + \frac{l-x}{2}\right)\left(\frac{m(l-x)}{l}\right) = \frac{m\omega^2(l^2 - x^2)}{2l}.$$