

Exercise 2.27

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Let's calculate the gravitational torque of the stick relative to the pivot. Consider an infinitesimal element dm distance x away from the pivot. Its contribution is given by

$$d\tau = dm g x = \left(\frac{M}{L} dx\right) g x = \left(\frac{Mg}{L}\right) x dx$$

Therefore

$$\tau = \int_0^L d\tau = \left(\frac{Mg}{L}\right) \int_0^L x dx = \frac{MgL}{2}$$

Note that the result is the same as the torque from a mass M located at the center of the stick.

$$\tau = Mg \left(\frac{L}{2}\right)$$