

Monday Reading Assessment: Unit 9, Torque and Angular Momentum

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1 Memory Bank

- $\tau = rF \sin \theta$... Definition of torque.
- Torque is the angular version of force. It is the result of a force F , separated from a pivot by a distance r , that rotates the system about the pivot. The angle between the force F and the distance r is θ .
- For systems in *static equilibrium*, the net force is zero, and the net torque is zero.

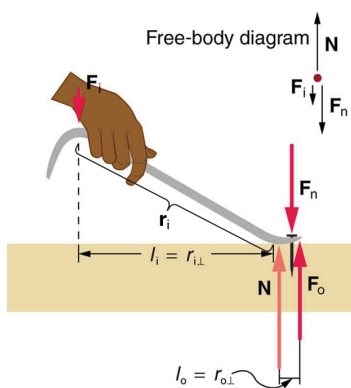


Figure 1: A crowbar is used to pry a nail loose.

2 Torque

1. Suppose a doorknob is a distance of $r = 1.2$ meters from the hinges of a door. If a force of $F = 3.0$ N is applied at an angle $\theta = 90$ degrees relative to the door, what is the torque?
2. Consider Fig. 1. The distance $r_{1\perp}$ corresponds to the torque caused by F_1 . The length of the crowbar is $r_1 = 20$ cm, and it makes a 45 degree angle with the wood. The little distance from the tool to the nail is $r_{0\perp} = l_0 = 4$ cm, and that distance corresponds to the force F_0 .
 - Use trigonometry to determine $r_{1\perp}$ from r_1 and the angle between the bar and the wood.
 - If the nail is not yet budging, this means the net torque is zero. Set the torque on the left side of the nail ($r_{1\perp}$ and F_1) equal to the torque on the right-hand side (r_0 and F_0). Solve algebraically for F_0 .
 - If F_1 is 40 N down, what is the magnitude of F_0 , and in what direction is it?
 - If 180 N is the force required to pop the nail, how hard must someone push on the crowbar (F_1 down)?