Thursday 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 sytems in *static equilibrium*, the net force is zero, and the net torque is zero.
- $\tau = I\alpha$ ... I is the moment of inertia, and α is the angular acceleration.
- $I = mr^2$ ... For a particle of mass m rotating about a point from a radius r, I is the moment of inertia.

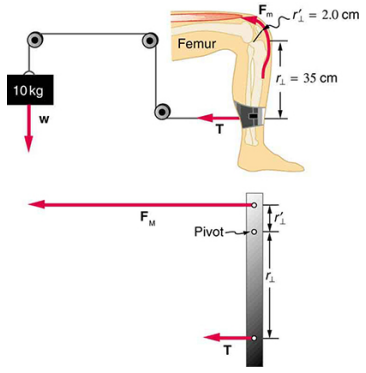

Figure 1: A person lifts a weight with their leg via an exercise machine.

2 Torque

1. A device for exercising the upper leg muscle is shown in Figure 1, together with a schematic representation of an equivalent lever system. Calculate the force exerted by the upper leg muscle to lift the mass at a constant speed.

2. Show using the following steps that $\tau = I\alpha$.
   - Start with the definition of torque: $\tau = rF\sin\theta$, and assume $\theta = 90$ degrees.
   - Use Newton's 2nd law to substitute for the net force F.
   - Use $a = r\alpha$, the relationship between tangential acceleration a and angular acceleration α, to eliminate a.
   - Define $I = mr^2$, and substitute it into the current expression.
   - Do you see that $\tau = I\alpha$?