Wednesday Reading Assessment: Unit 9, Torque, Angular Momentum, and Cross-Products

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1 Memory Bank

- $\hat{i} \times \hat{j} = \hat{k}$ ... Example of a right-handed cross-product.
- $\hat{k} \times \hat{i} = \hat{j}$ ... Example of a right-handed cross-product.
- $\hat{j} \times \hat{k} = \hat{i}$ ... Example of a right-handed cross-product.
- $\vec{\tau} = \vec{r} \times \vec{F}$ ... Definition of torque.
- $\vec{L} = \vec{r} \times \vec{p}$ ... Definition of angular momentum, where $\vec{p}$ is the momentum.
- $L = I\omega$ ... Relationship between angular momentum and angular velocity.

2 Torque, Angular Momentum, and Cross-Products

1. Suppose we have a wrench twisting a bolt. The vector describing the wrench is $\vec{r} = 0.2\hat{i} + 0.2\hat{j}$ (m). We place a force "upwards" on the wrench of $\vec{F} = 15\hat{j}$ N. What is the torque on the bolt? (Neglect the moment of inertia of the wrench).

2. Suppose a wrench is tossed in the air, and spinning in a circle. Suppose the moment of inertia is $I = \frac{1}{12}ML^2/12$, where the M is the mass of the wrench and L is the length of the wrench. If the wrench is spinning with angular velocity ω, write an expression for the angular momentum of the wrench.

3. If the wrench rotates at a rate of 60 rpm, has a mass of 0.3 kg, and a length of 15 cm, what is the angular momentum of the wrench?