12.3(B) Torque

**Announcements**

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**TORQUE**

12.3 I can define, analyze, and solve problems involving torque.

**UNIT 12 REVIEW**

**Rotational Kinetic Energy and Angular Momentum**

The rotational kinetic energy of an object is one-half the product of its moment of inertia and the square of its angular speed.

\[ K = \frac{1}{2} I \omega^2 \]

Angular momentum (L) is equal to the product of the object’s moment of inertia and the object’s angular velocity.

\[ L = I \omega \]

**Question**

How do you get an object to rotate?

**Torque**

Torque (τ) is a measure of how effectively a force causes rotation.
The Torque Experience

**Definition of Torque (tangential force)**

\[ \tau = F \cdot r \]

Torque = force \times radius

**Torque**

- Vector of Scalar?
- Units? \( N \cdot m \)
- Relationship? Direct Prop.

**Sign of Torque**

- \( \tau > 0 \) if the torque causes a counterclockwise angular acceleration
- \( \tau < 0 \) if the torque causes a clockwise angular acceleration

**Physics Opens Doors!**

Only the tangential component of force cause a torque.
12.3(B) Torque

AP PHYSICS
March 18, 2019

Definition of Torque (nontangential force)

\[ \tau = (F \sin \theta) r \]

torque = (force \times \sin \theta) \times radius

UNIT 12 IN CLASS PROBLEMS

15. To open a revolving door a tangential force \( F \) if applied at a distance \( r \) from the axis of rotation. If the minimum torque required to open the door is 3.1 N.m, what force must be applied if \( r \) if (a) 0.94 m or (b) 0.35 m?

16. Captains Sparrow and Barbosa are in a disagreement about which way to turn the ship. They exert forces shown below on the ship's wheel. The wheel has a radius of 0.74 m, and the two forces have magnitudes \( F_1 = 72 \) N, and \( F_2 = 58 \) N. (a) Find the torque caused by \( F_1 \). (b) Find the torque caused by \( F_2 \). (c) In which direction does the wheel turn as a result of these two forces?

UNIT 12 IN CLASS PROBLEMS

To open a revolving door a tangential force \( F \) if applied at a distance \( r \) from the axis of rotation. If the minimum torque required to open the door is 3.1 N.m, what force must be applied if \( r \) if (a) 0.94 m or (b) 0.35 m?

(a) \( F_1 = \frac{\tau}{r_1} = 3.3 \) N

(b) \( F_2 = \frac{\tau}{r_2} = 8.9 \) N

\( \tau_1 = (72 \text{ N} \sin 50.0^\circ) r = 41 \text{ N.m} \)

\( \tau_2 = -(58 \text{ N} \sin 90.0^\circ) r = -43 \text{ N.m} \)

\( \tau_{\text{total}} = \tau_1 + \tau_2 = -2 \text{ N.m} \) Clockwise

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Archimedes is said to have remarked about the lever: "Give me a place to stand on, and I will move the Earth."

UNIT 12 PROBLEMS

(18-23)