PRACTICE	LABS	TESTS
Unit 12 Problems (1-17)	Balancing Lab (Due Tues. 3/19)	Unit 12 Test Tuesday (3/26/19)

TORQUE

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

UNIT 12 REVIEW

Key Concepts

- Angular position and its changes are measured in radians. One complete revolution is 2π rad.
- Angular velocity is given by the following equation.

$$\omega = \frac{\Delta\theta}{\Delta t}$$

- Angular acceleration is given by the following equation.

$$\alpha = \frac{\Delta\omega}{\Delta t}$$

- For a rotating, rigid object, the angular displacement, velocity, and acceleration can be related to the linear displacement, velocity, and acceleration for any point on the object.

$$d = r\theta \quad v = r\omega \quad a = r\alpha$$

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.

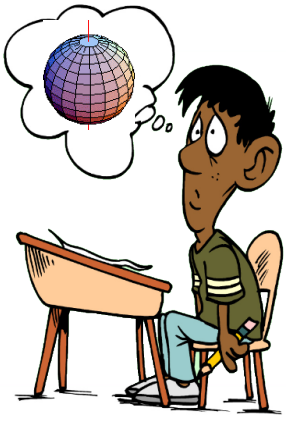
$$K = \frac{1}{2} I\omega^2$$

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

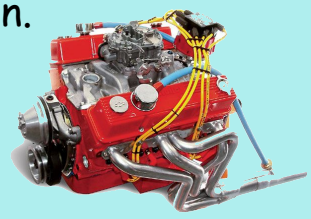
How do you get and object to rotate?



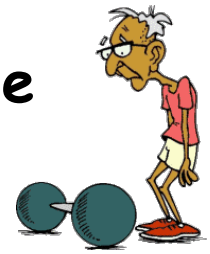
Torque

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

τ



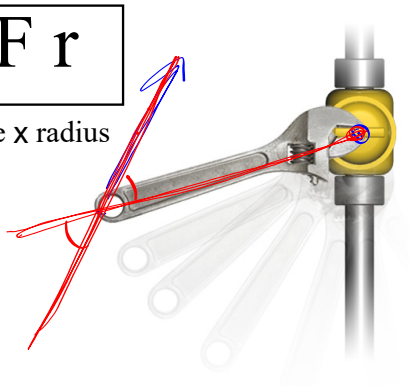
The Torque Experience



Definition of Torque (tangential force)

$$\tau = F\ r$$

torque = force x radius



Torque

Vector of Scalar?

$$\tau = F\ r$$

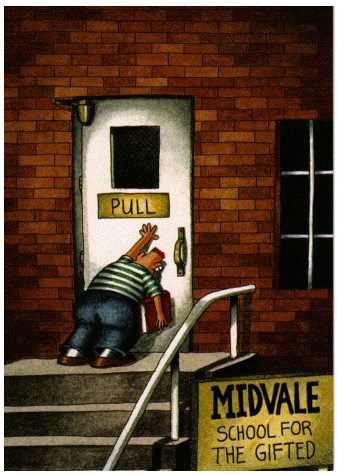
Units? N · m

Relationship? Direct Prop.

Sign of Torque

$\tau > 0$ if the torque causes a counterclockwise angular acceleration

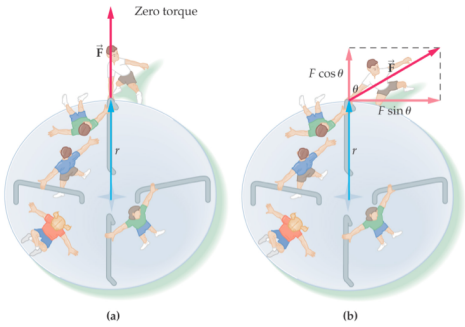
$\tau < 0$ if the torque causes a clockwise angular acceleration



Physics Opens Doors!

Torque

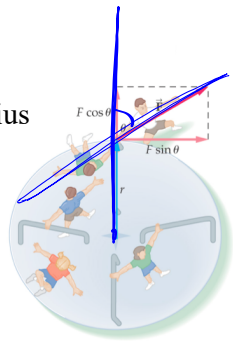
Only the tangential component of force cause a torque.



Definition of Torque (nontangential force)

$$\tau = (F \sin\theta)\, r$$

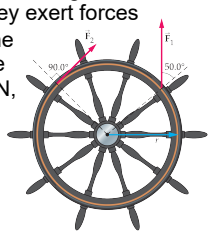
torque = (force x sin θ) x radius



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?



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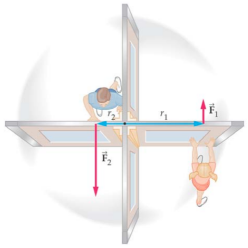
$\tau = (F \quad) r$



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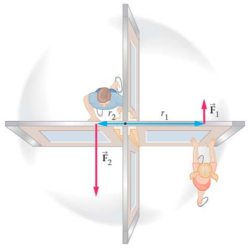
(a) $F_1 = \dfrac{\tau}{r_1} = 3.3$ N

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



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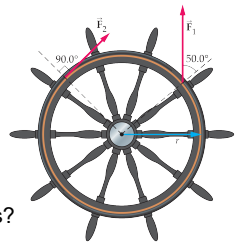
(a) Find the torque caused by F_1.

$\tau_1 = (F_1 \sin\theta)\, r_1$

(b) Find the torque caused by F_2.

(c) In which direction does the wheel turn as a result of these two forces?



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(a) Find the torque caused by F_1.

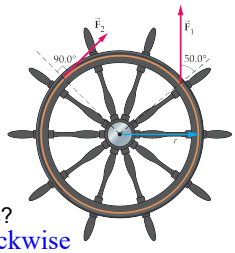
$\tau_1 = (72\text{ N} \sin 50.0^\circ)\, r = 41$ N·m

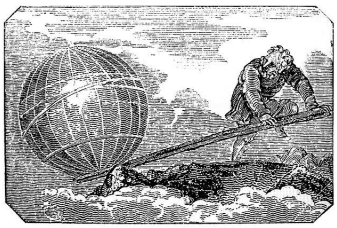
(b) Find the torque caused by F_2.

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

(c) In which direction does the wheel turn as a result of these two forces?

$\tau_{total} = \tau_1 + \tau_2 = -2$ N·m Clockwise





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)