

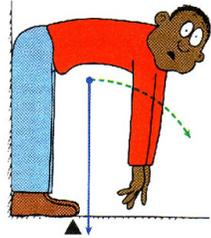
Torque

Mr. Sudbury



Torque & Center of Gravity

- ▶ With your heels and legs against the wall, you could not touch your toes.
- ▶ When your center of gravity extends beyond your feet, your center of gravity creates a **torque**...
 - Torque – A twisting force that causes rotation.



Twisting forces

- ▶ Twisting / turning forces are required to:
 - Turn a doorknob or push or pull open a door
 - Turn a water faucet off or on
 - Use a wrench to loosen or tighten a nut/bolt



Torque

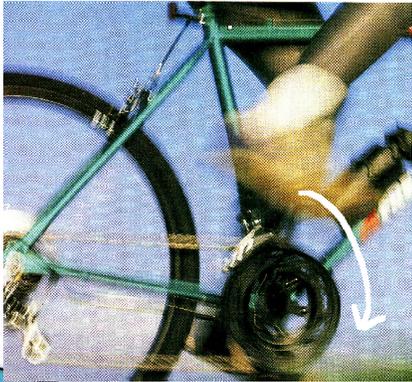
Rhymes with fork!

- ▶ The twisting or turning force is called **torque**
 - *is the rotational analogy of force.*
 - *the product of the force and the lever arm (N · m)*
 - *produces rotational acceleration.*

Torque

- ▶ These turning forces produce torque.
- ▶ Torque **is different** from force.

<h3>Force</h3> <ul style="list-style-type: none"> ▶ A push or pull that causes a change in motion. (Newton's Laws) ▶ Forces cause motion. ▶ Forces cause acceleration. 	<h3>Torque</h3> <ul style="list-style-type: none"> ▶ Torques make objects turn or rotate. ▶ Torques cause a_c ▶ Torques cause circular motion.
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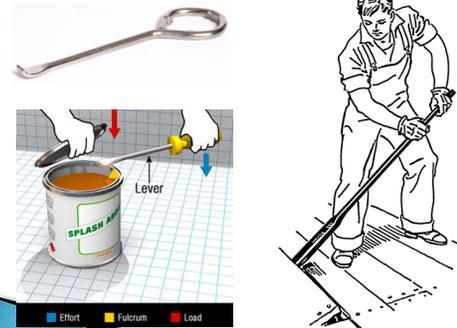


Torque

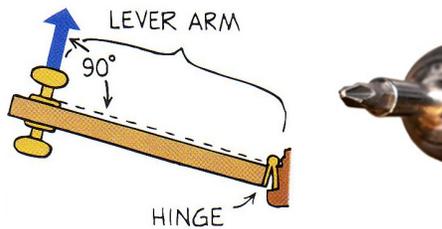
- ▶ A torque is produced when a force is applied with leverage.
 - "leverage" is the action of a lever or the mechanical advantage or power gained by using a lever.



Using Machines to apply torque

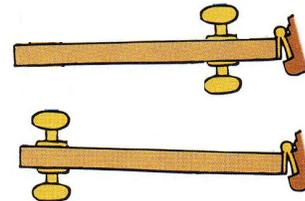


Applying Torque



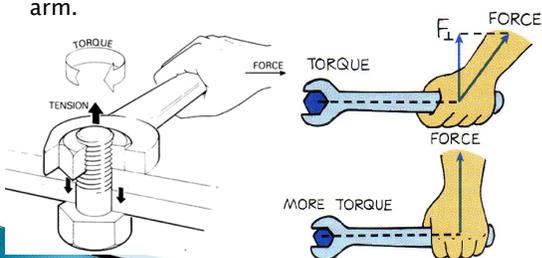
Torque

- ▶ Which doorknob position requires the least torque to open or close the door?



Torque

- ▶ The only effective torque that causes rotation is torque that is perpendicular to the lever arm.



Torque Wrench

- ▶ Lets you know how much torque you are using to tighten nut or bolt.
- ▶ Commonly used to tighten lug nuts on car tires.



Torque

- ▶ Using an object that you must torque to rotate is basically using a lever.
- ▶ The distance from the turning axis to the point of contact is called the lever arm.
 - Lever arm needs to be in meters preferably.
- ▶ The only component of the force that is useful to cause torque is the perpendicular component.

Torque

Pivot point AKA fulcrum

Lever arm - the distance from the turning axis to the point of contact.

Calculating Torque

torque = force_⊥ * lever arm

$$\tau = F_{\perp} * d$$

Solve for the Torque

$\tau = F_{\perp} * d$ $\tau = F_{\perp} * d$

How do you get more torque?

$$\tau = F_{\perp} * d$$

- ▶ Bigger force
- ▶ or
- ▶ Longer effort arm (d)

Torque

- ▶ Does she get more torque when she uses the rope?

$\tau = F_{\perp} * d$

Balancing Torques

$\tau = F_{\perp} * d$

Torque Part 2: Calculations

Mr. Sudbury

Balancing torques

$F_{\perp} d = F_{\perp} d$

Balancing Torques

► What force does it take to balance the meter stick?

$F_{\perp} d = F_{\perp} d$

Balanced torques are said to be at *stable equilibrium*

Balancing Forces

$F_{\perp} d = F_{\perp} d$

► Where must the 40 N weight hang to balance the system?

$F_{\perp} d = F_{\perp} d$

