



Physics 105

2025-2024

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Chapter -8- (Rotational Motion)

❖ Section (8.4): Torque

- **Torque:** Is a **measure** of **how much** a **force** acting on an object **causes** that object to **rotate** **OR** It is the **ability** to cause **rotation** **about an axis** is a **vector quantity**.
- **Note:** The **rotation axis** **passes** through the **hinge** and is **perpendicular** to the **plane of the page**.

$$\vec{\tau} = r F \sin \theta$$

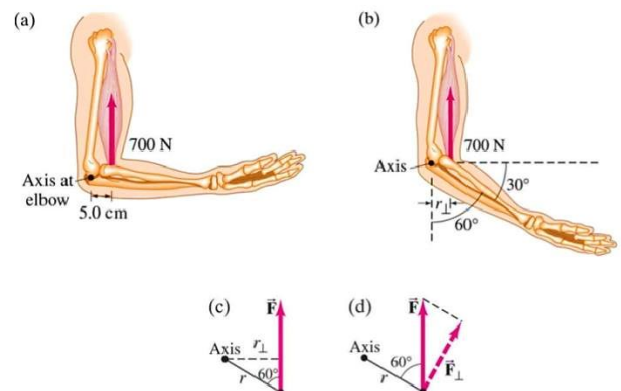
- \vec{r} : A **vector that extends** from point "O" to the point of **application** of the force.
- \vec{F} : Causes **the rod to rotate** about point "O" in a **counter clock wise direction**.
- θ : **Smaller angel** between \vec{r} and \vec{F} when both vectors **originate from the same point**.
- When $\vec{\tau} = 0$?
 - If $\theta = 0^\circ$
 - If $\theta = 180^\circ$
 - If $r = 0$
- When $\vec{\tau} = \text{Max value}$?
 - If $\theta = 90^\circ$
- **Convention** for the **sign** of **torque**
 - I. **Counter clock wise rotation** \rightarrow **positive torque**
(**F** causes the rod to **rotate** in **counter clock wise direction**)
 - II. **Clock wise rotation** \rightarrow **negative torque**.
(**F** causes the rod to **rotate** in **clock wise direction**)
- **Torque** is involved in so many **activities of our body**, for example:
 - Raising and lowering your fore arm.
 - Raising and lowering your arm.
 - Moving your lower Jaw while speaking.
 - Motion of your fingers.

✓ **Example:** The biceps muscle exerts a vertical force on the lower arm, bent as shown in Figs. For each case, calculate the **torque** about the axis of rotation through the elbow joint, assuming the muscle is attached **5.0 cm** from the elbow mass equal **1.5kg**

✓ **Solution:**

(a) $\vec{\tau} = r F \sin 90^\circ$ (where $F = 700 \text{ N}$).
 $= (0.05) * (700) * 1$
 $= 35 \text{ m. N}$

(b) $\vec{\tau} = r F \sin 60^\circ$
 $= (0.05) * (700) * (0.866)$
 $= 30 \text{ m. N}$





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