

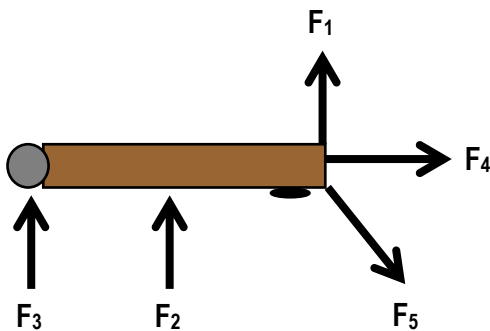
INTRO TO TORQUE

- TORQUE is a “twist” that a Force gives an object around an axis of rotation.
 - For example, when you push on a door, it rotates around its hinges.
 - When a Force acts on an object, away from its axis, it *produces a Torque* on it.
 - Similar to how Forces cause linear acceleration, Torques cause _____ (____). More later!



- The MAGNITUDE of the Torque is given by $\rightarrow \tau = \text{_____} [\text{_____}]$
 - Where $\mathbf{r}$ is a vector from the _____ to the point where _____.
 - θ is the angle between _____ and _____.
 - Torque is max when the Force is the farthest possible and _____ (____°) to the $\mathbf{r}$ vector.
- To calculate Torque, we'll use 3 steps: (1) Draw $\mathbf{r}$ vector $\rightarrow$ (2) Figure out $\theta \rightarrow$ (3) Plug numbers into equation

EXAMPLE: You push/pull on a 3-m wide door with 10 N in different ways, as shown. Calculate the Torque that each force produces. $\mathbf{F}_1$, $\mathbf{F}_4$, $\mathbf{F}_5$ act at the edge of the door, $\mathbf{F}_2$ half way through it, $\mathbf{F}_3$ at the hinge. $\mathbf{F}_5$ is directed 60° below the x-axis.



EXAMPLE: TORQUE ON A FISHING POLE

EXAMPLE: When a fish catches your bait, your 2 kg, 3 m long fishing pole is directed at 50° above the +x axis. Calculate the Torque produced on your fishing pole, about an axis of rotation on your hands, if the fish pulls on it with 40 N directed at 20° below the +x axis.

EXAMPLE: FIND MAXIMUM TORQUE

EXAMPLE: You must produce a torque of 100 Nm to properly tighten a given bolt using a 20-cm wrench. What is the *minimum* force you need to apply to the wrench to achieve this?



PRACTICE: TORQUE ON A WRENCH

PRACTICE: You pull with a 100 N at the edge of a 25 cm long wrench, to tighten a bolt (gold), as shown. The angle shown is 53° . Calculate the torque your force produces on the wrench, about an axis perpendicular to it and through the bolt.

