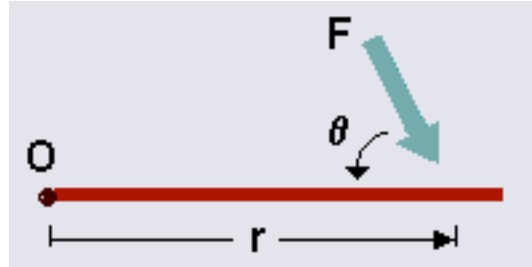
Torque

From Wikipedia, the free encyclopedia



Relationship between force **F**, torque **τ**, linear momentum **p**, and angular momentum **L** in a system which has rotation constrained in one plane only (forces and moments due to gravity and friction not considered).

Torque, **moment** or **moment of force** (see the terminology below), is the tendency of a force to rotate an object about an axis,[1] fulcrum, or pivot. Just as a force is a push or a pull, a torque can be thought of as a twist to an object. Mathematically, torque is defined as the cross product of the lever-arm distance and force, which tends to produce rotation.

Loosely speaking, torque is a measure of the turning force on an object such as a bolt or a flywheel. For example, pushing or pulling the handle of a wrench connected to a nut or bolt produces a torque (turning force) that loosens or tightens the nut or bolt.

The symbol for torque is typically *τ*, the Greek letter *tau*. When it is called moment, it is commonly denoted *M*.

The magnitude of torque depends on three quantities: the force applied, the length of the *lever arm*[2] connecting the axis to the point of force application, and the angle between the force vector and the lever arm. In symbols:

$$\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$$
$$\tau = rF \sin\theta$$

where

τ is the torque vector and *τ* is the magnitude of the torque,
r is the displacement vector (a vector from the point from which torque is measured to the point where force is applied), and *r* is the length (or magnitude) of the lever arm vector,
F is the force vector, and *F* is the magnitude of the force,
× denotes the cross product,
θ is the angle between the force vector and the lever arm vector.
The length of the lever arm is particularly important; choosing this length appropriately lies behind the operation of levers, pulleys, gears, and most other simple machines involving a mechanical advantage.