Torque

We have been looking at linear (translational) motion, but an object can also have rotational motion. Rotational motion is when an object rotates about an axis of rotation. Linear motion and rotational motion of an object can occur at the same time, but they can be separated.

Torque – the quantity that measures the ability to cause rotational acceleration.

Torque is the rotational motion equivalent to force.

The amount of torque depends on two things: the perpendicular force applied and the distance of the force to the axis of rotation (called the lever arm).

Torque is the product of force and the lever arm:

where: τ = torque (Nm)
F = force (N)
r = lever arm (m)

If the force is not perpendicular, the perpendicular component of the force must be used to find the torque:

$$\tau = Frsin\theta$$

To show the direction of the torque vector, any counterclockwise torque is positive and any clockwise torque is negative.

<u>ex</u>.
What torque is produced if a 10 N force is exerted on a 40 cm lever arm?

<u>ex</u>.
What is the force that produces a 45 Nm torque on a lever arm of 0.9 meters?