Torque

For translation a force is required to change an object's state of motion.

The same is true for rotation, but the force must ~~to~~ have a particular orientation.

Torque is the rotational equivalent of force

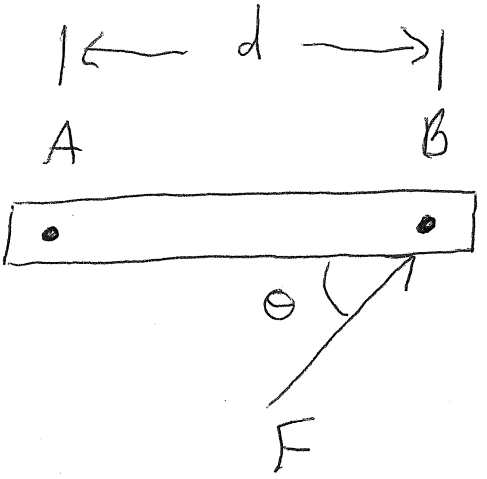
$$\tau = Fd$$

F = applied force $\perp$ to d (N)

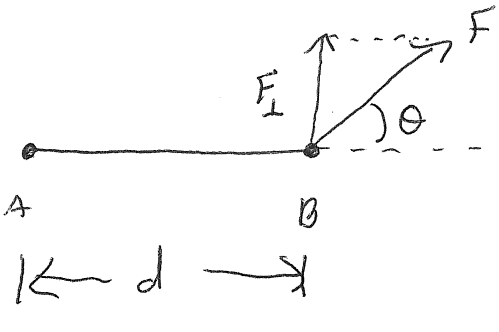
d = distance F is applied from a point of rotation (m)

Unit for torque

Nm



The torque is calculated using the component of force that is perpendicular to the lever-arm.

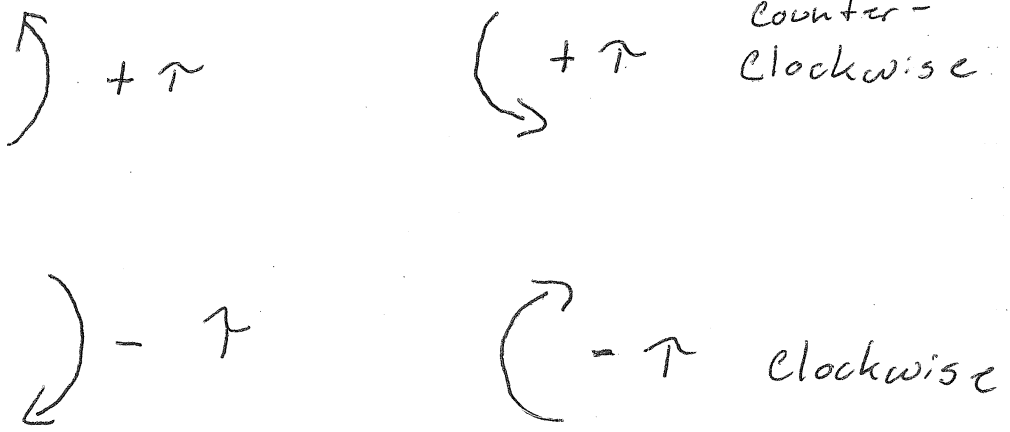


$$F_\perp = F \sin\theta$$

Notice that some point must be defined as the point of rotation.

(A in this case)

Torque sign convention



Recall:

Translation	Rotation
x	θ
v	ω
a	α
m	I
F	τ
↓	↓
$F = ma$	$\tau = I\alpha$

m = mass (kg)

a = acceleration $\left(\frac{m}{s^2}\right)$

F = force (N)

I = rotational inertia (kgm^2)

α = angular acceleration $\left(\frac{rad}{s^2}\right)$

τ = torque (Nm)

Static Equilibrium

Recall that previously we defined static Equilibrium as $\Sigma F = 0$.

Now we must also account for rotation.

Static Equilibrium

$\Sigma F = 0$ and $\Sigma \tau = 0$

↙ Sum of all forces

↙ Sum of all torques