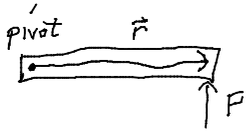
Torque



$\tau = rF$

direction matters

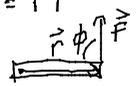
if ϕ is angle between $\vec{r}$ & $\vec{F}$

$$\tau = r F \sin\phi$$

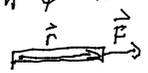
if $\phi = 90^\circ$

$\tau = rF\sin 90^\circ$

$= rF$



if $\phi = 0^\circ$

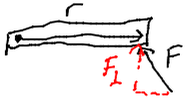


$\tau = rF\sin 0^\circ$

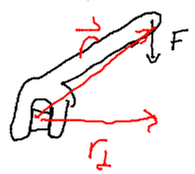
$= 0$

$F\sin\phi = F_\perp$

$\tau = r F_\perp$



$\tau = r_\perp F$

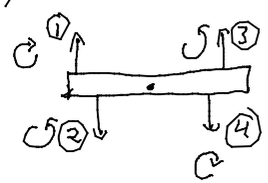


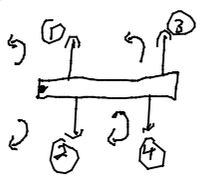
lever arm

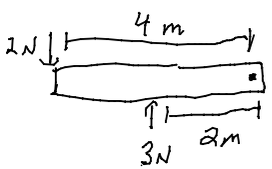
Torque has a direction – a sign

↻ (+) = counterclockwise torque positive

A) counterclockwise B) clockwise







(+)

$\tau_{net} = +8\,Nm - 6\,Nm$

$= +2\,Nm$

counterclockwise

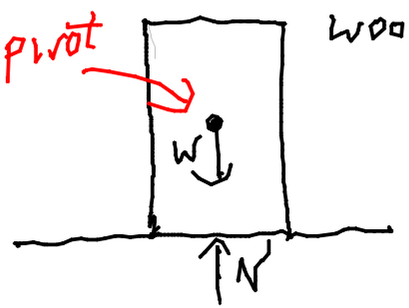
Equilibrium (no motion)

$\vec{F}_{net} = \bigcirc$ $\tau_{net} = \bigcirc$

- if object is spinning, pivot is obvious
- if at rest, <u>any</u> pivot will do

pivot is a mathematical thing.
not necessarily a physical object
like a hinge

e.g. pivot



wooden block

- gravity acts at center of mass
- normal force acts somewhere on surface of contact

$\tau_W = rF\sin\phi = \bigcirc$
b/c $r = \square$

$\tau_N = 0$ b/c $\phi = 180°$ $\downarrow\vec{F}$ $\uparrow\vec{N}$
$\sin 180° = 0$