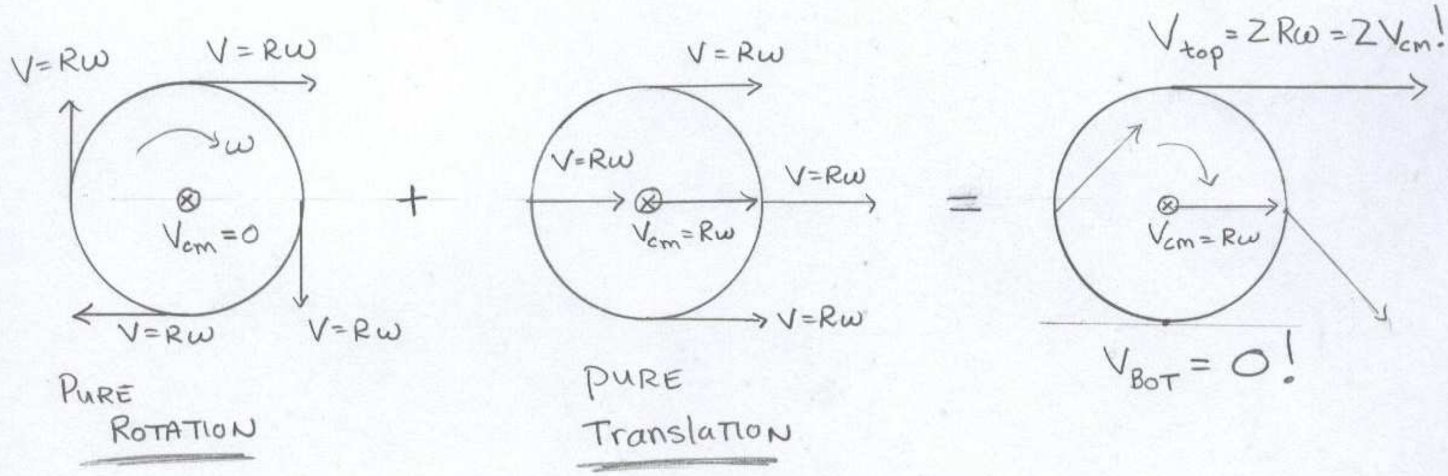
∴ If the wheel is Rolling, every point on the Rim:

1) has linear speed $V = R\omega$ due to rotation, and

2) is translating to the Right w/ the same speed as V_{cm}.

Thus, Rolling can be treated as a linear combination of pure Rotation about the CM + pure translation.

ROLLING

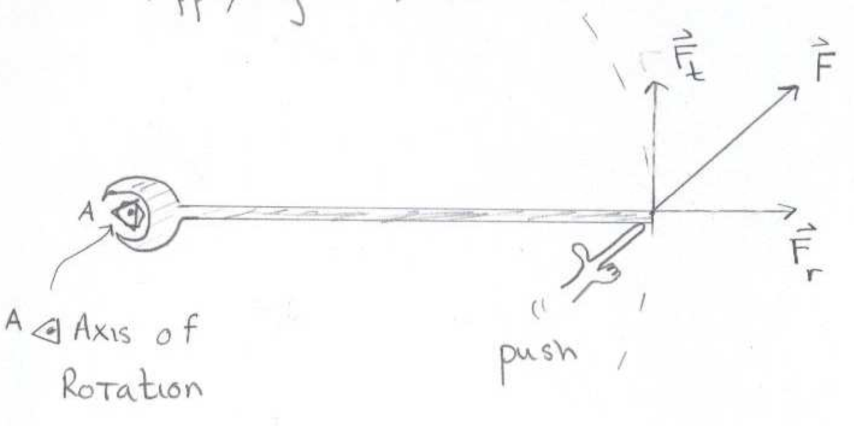


* $V_{top} = 2V_{cm}$!
* $V_{BOT} = 0$! The contact point has no Relative motion wrt the ground. $\{ f_k = 0 \}$

TORQUE (or "why a doorknob is mounted where it is")

↗ to twist

Ex) Applying a force $\vec{F}$ to a wrench:



$\vec{F}$ can cause a rotation about ◁A.

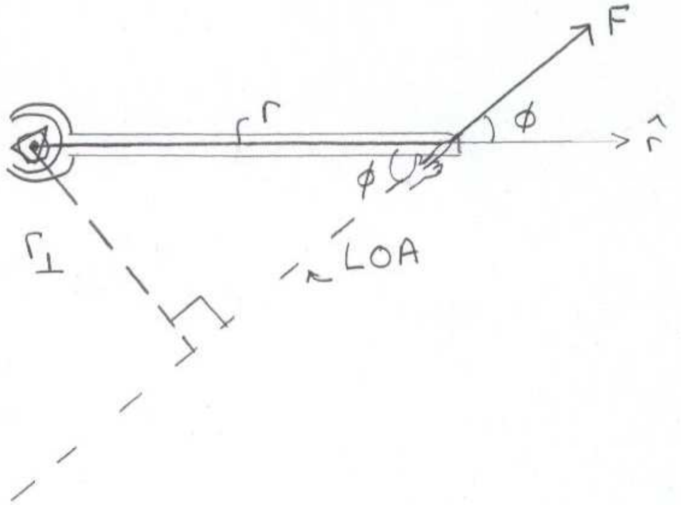
* Break $\vec{F}$ into its components. ONLY $\vec{F}_t$ can cause a rotation.

The Torque, τ, is a measure of the tendency of the applied force $\vec{F}$ to cause rotation about some specified axis ◁A.

This tendency depends on:

* the magnitude & direction of $\vec{F}$
* the distance from ◁A to where $\vec{F}$ is applied.

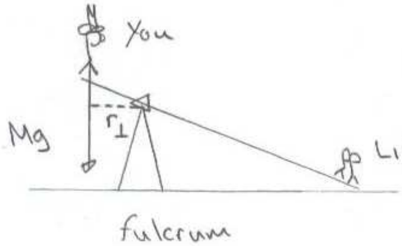
Torque ≡ (Applied Force)(the ⊥ distance from the Axis of Rotation @A to the Line of Action of the Force $\vec{F}$)



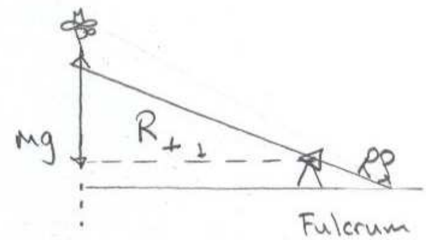
* $r_\perp = r\sin\phi$

or "Lever arm"

$\tau = (\text{Force})(r_\perp) = (\text{Force})(\text{"Moment Arm"})$



$\tau_{you} = Mg\,r_\perp$



$\tau_{you} = Mg\,R_\perp$

so $\tau = F r_\perp = F r\sin\phi \quad 0° \le \phi \le 180°$

$\tau = rF\sin(\vec{r}, \vec{F})$ units? $[N \cdot m]$

* Any Force that passes through the axis of Rotation causes No Torque! ∴ You Don't push on a Lightbulb - you twist it!