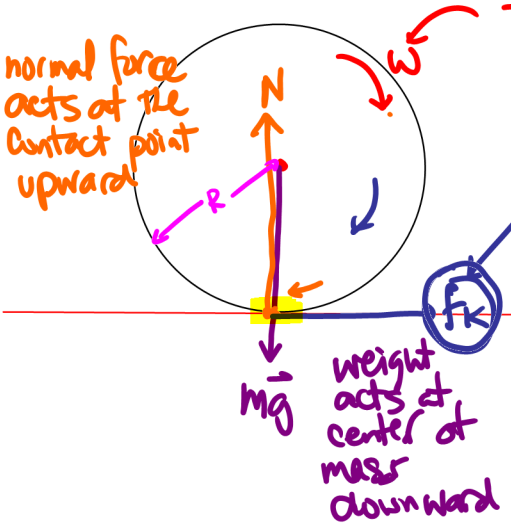
BALL ROLLING ON FLAT SURFACE WITH SLIPPAGE

- assume rigid bodies → no deformation
- ball rolling with initial angular velocity ω_0



→ net force comes only from kinetic friction

$-F_{net} = F_k = ma$ ← The center of mass of the ball accelerates toward the right.

$\mu N = ma$

$\mu mg = ma$

$\boxed{a = \mu g}$

neither $\vec{N}$ nor $m\vec{g}$ generate a torque, but kinetic friction does.

ω (+) α

ω and α in opposite direction ∴ The rotation slows down eventually.

→ $\tau_{net} = I\alpha$ ← moment of inertia for aspherical shell. Replace if it's something else rolling.

$-f_k \cdot R = \frac{2}{3}mR^2\alpha$

$-\mu_k mg \cdot R = \frac{2}{3}mR^2\alpha$

$-\mu g = \frac{2}{3}R\alpha \rightarrow \boxed{\alpha = \frac{-3}{2}\frac{\mu g}{R}}$

translation $\boxed{v(t)} = v_0 + at$ (probably zero)

v increases because of acceleration

rotation $\boxed{\omega(t)} = \omega_0 + \alpha t$

ω decreases because α is in the opposite direction.

The ball stops slipping when $\boxed{v = \omega R}$ → return to pure rolling case.