# Drag Force

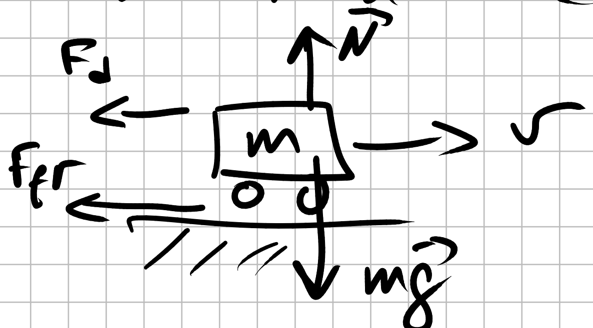
$$F_d = c \cdot \frac{1}{2} \rho_{Air} \cdot A \cdot v^2$$

- $c$: drag coefficient
- $\rho_{Air}$: density
- $A$: cross sectional area
- $v$: speed

$$\rho_{Air} = 1.2 \ kg/m^3$$

$$c < 1$$

Car on a road




$$F_{fr} = \mu \cdot N = \mu m g$$

- $\mu$: 0.01 rolling friction
- $m$: 1000kg
- $g$: 10 m/s²

$$= 10^{-2} \cdot 10^3 \cdot 10 = 100 [N]$$

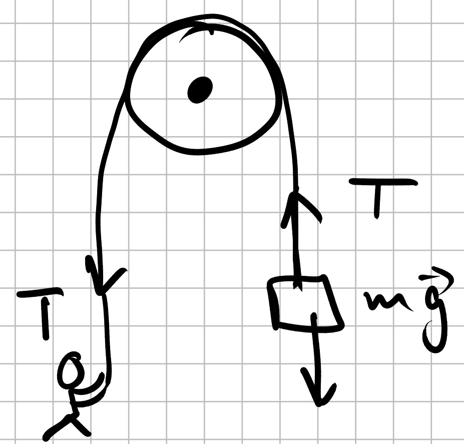
$$F_d = \frac{1}{2} \underbrace{C}_{\approx 0.5} \cdot \rho A v^2 =$$

$60 \text{ mi/h} = 26 \frac{m}{s}$ → $v^2$

$$= \frac{1}{2} \cdot \frac{1}{2} \cdot 1.2 \frac{kg}{m^3} \cdot \underbrace{(1.5m \cdot 2m)}_{A} v^2$$

$$= \frac{1.2}{4} \cdot 3 \cdot 26^2 = 0.3 \cdot 3 \cdot \underbrace{26^2}_{\approx 700} \approx 700 [N]$$

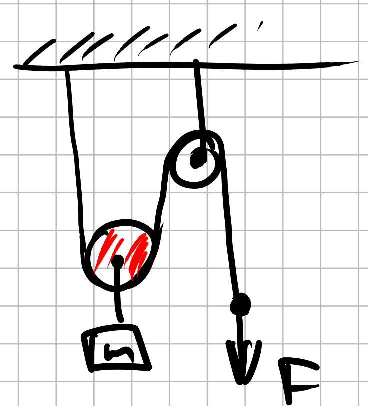
# Pulleys (massless, frictionless $\Rightarrow$ Assumption)

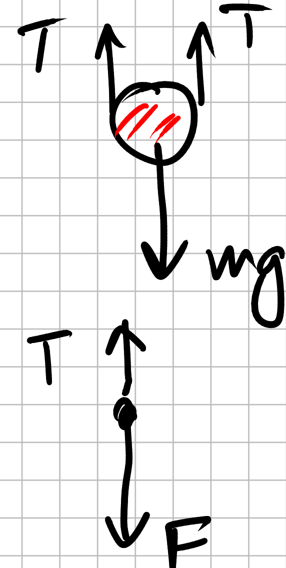



$\vec{a} = 0 \Rightarrow T = mg$

$T = F_{Human}$

## Tackle

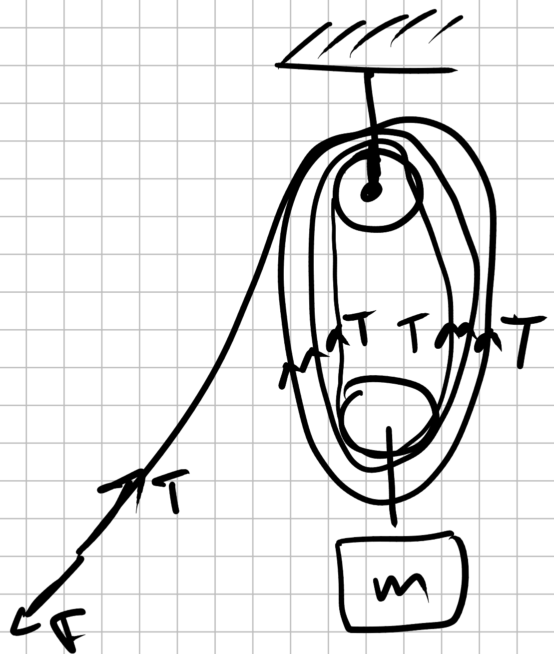


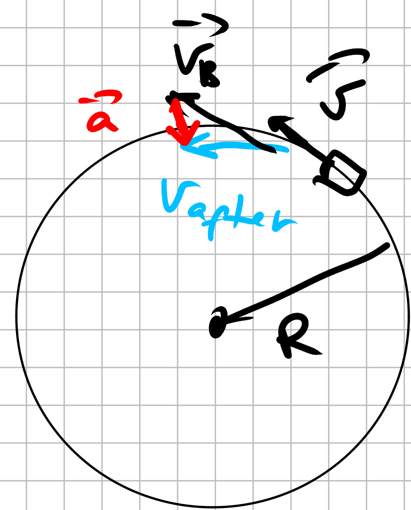

rope is massless
$\Rightarrow$ T is the same everywhere in the rope

$$\Rightarrow \boxed{F = \frac{mg}{2}}$$

# Advance tackle



# Circular motion




$|\vec{v}| = const.$

$$a = \left|\frac{d\vec{v}}{dt}\right| = \frac{v^2}{R}$$

↑ centripetal acceleration

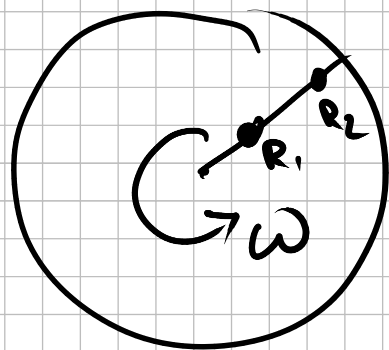
$$ma = m\frac{v^2}{R} = F_{fr} \leq \mu m g$$

$$\frac{v^2}{R} \leq \mu g \qquad v_{max} \leq \sqrt{\mu R g}$$

$$v = \omega \cdot R$$

↑ omega, angular speed $\left[\frac{radians}{seconds}\right]$

$$\omega = \frac{2\pi}{T}$$ ← period




$$v_1 = \omega R_1$$

$$\cancel{m}\frac{v_1^2}{R_1} \leq \mu \cancel{m} g$$

$$\omega R_2$$

$$\cancel{m}\frac{v_2^2}{R_2} \leq \mu \cancel{m} g$$

$$\frac{\omega^2 R_i^2}{R_i} \leq \mu g$$

$$\omega^2 R_i \leq \mu g$$