Dynamics Notes

Kinematics ⇒ describes motion
Dynamics ⇒ why motion happens.

Formulas

$\vec{F} = m\vec{a}$

$\vec{F}_g = m\vec{g}$ → m = mass, unchangable
F = weight, depends on the accel due to gravity

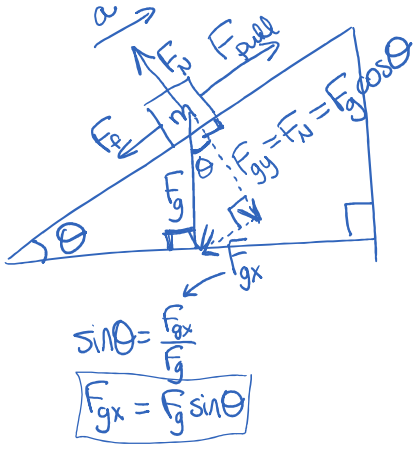
$F_f = \mu F_N$ → F_N, normal force, ⊥ to surface
→ $F_N = F_g$ on a horizontal surface

μ ↑ coefficient of friction = how sticky?

✡ $\boxed{F_{net} = F_{applied} - F_{against}}$

$m_{Total}\, a$ = Forces in direction of F_{net} − Forces opposite to direction of F_{net}

Ex



$\sin\theta = \frac{F_{gx}}{F_g}$

$\boxed{F_{gx} = F_g \sin\theta}$

$F_{net} = F_{app} - F_{ag}$

$ma = F_{pull} - F_f - F_{gx}$

$ma = F_{pull} - \mu F_N - F_g \sin\theta$

$ma = F_{pull} - \mu F_g \cos\theta - F_g \sin\theta$

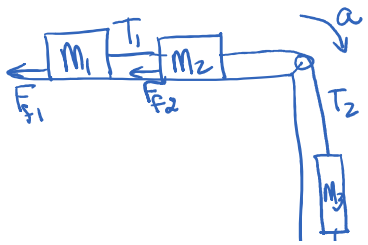
⋮

plug in #s to find what looking for.

at a constant velocity, $a = 0$ and then $F_{net} = 0$

Friction is always opposite direction of motion

Ex



① Need accel first, before can find tensions

$F_{net} = F_{app} - F_{ag}$

$M_{Tot}\, a = F_{g3} - F_{f2} - F_{f1}$

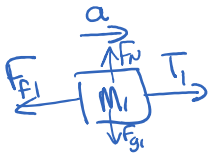
$$m_{Tot}a = F_{g3} - F_{f2} - F_{f1}$$
$$(m_1+m_2+m_3)a = m_3g - \mu F_{N2} - \mu F_{N1}$$

F_{N2}: F_{g2} since on horizontal; F_{N1}: F_{g1}

solve for "a"

Then ② Find tensions → use Free Body Diagrams (FBDs) of just one mass.

T_1:



$$F_{net} = F_{ap} - F_{ag}$$
$$ma = T_1 - F_{f1}$$
$$m_1a = T_1 - \mu F_{g1}$$

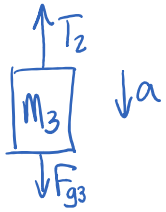
solve for T_1

or

$$F_{net} = F_{ap} - F_{ag}$$
$$m_2a = T_2 - F_{f2} - T_1$$

↑ if know T_2 already

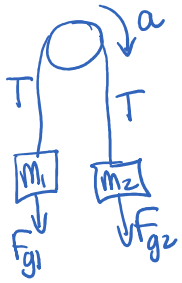
T_2:



$$F_{net} = F_{app} - F_{ag}$$
$$m_3a = F_{g3} - T_2$$

↑ solve for T_2

Ex



① accel. first

$$F_{net} = F_{app} - F_{ag}$$
$$m_Ta = F_{g2} - F_{g1}$$

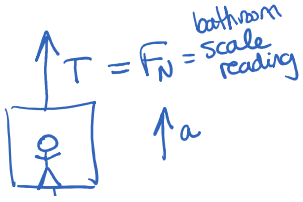
② Then tension → FBD use either m_1 or m_2

$$F_{net} = F_{app} - F_{ag}$$
$$m_1a = T - F_{g1}$$

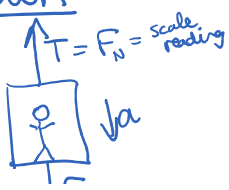
↑ solve for T

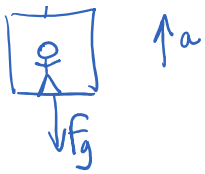
Ex Elevator

up



down





$F_{net} = F_{app} - F_{ag}$

$ma = T - F_g$

⋮

$F_{net} = F_{app} - F_{ag}$

$ma = F_g - T$

⋮