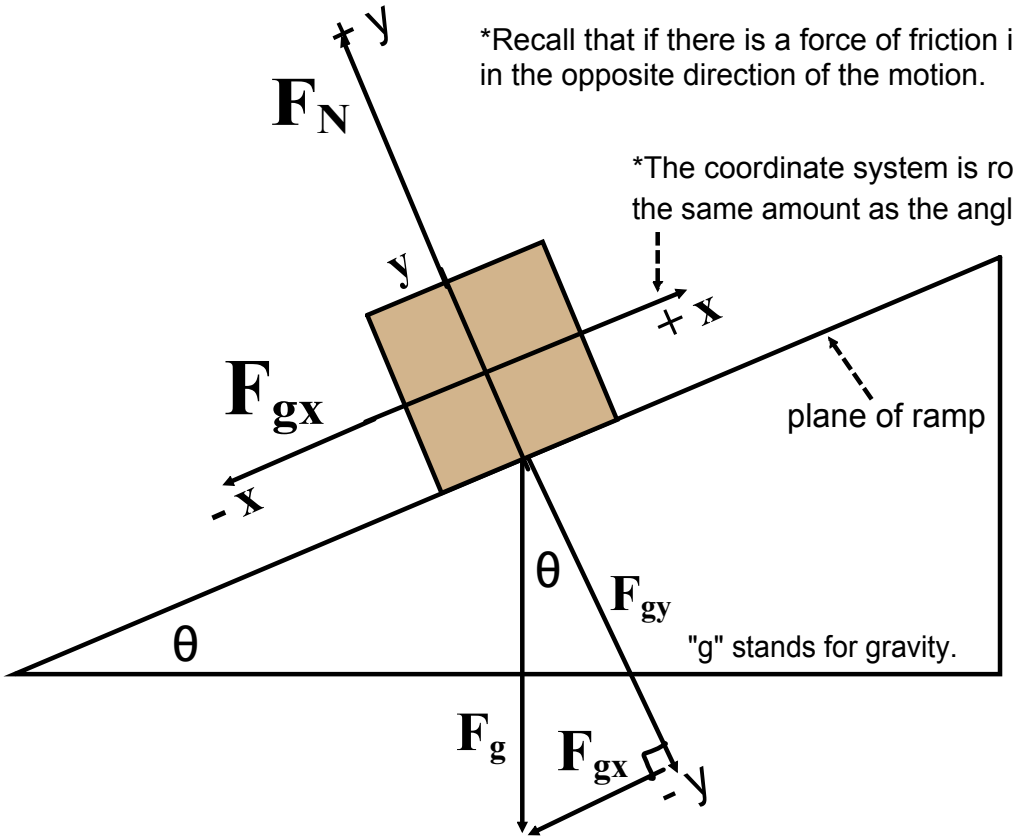
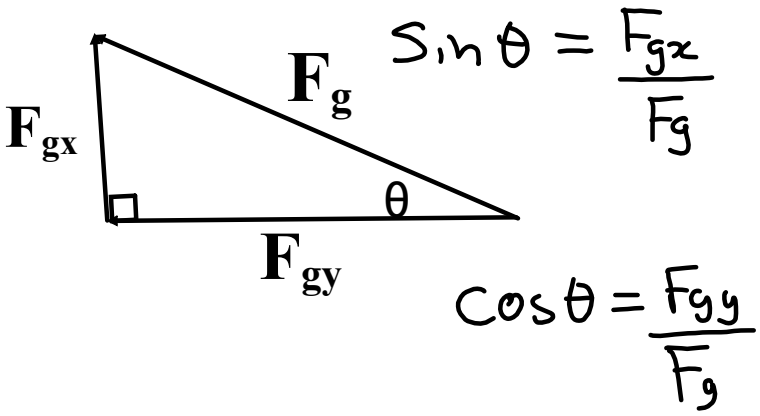
Type III - Inclined Planes, Hills, Ramps



F_{gy} and F_g are separated by θ because of two similar triangles.



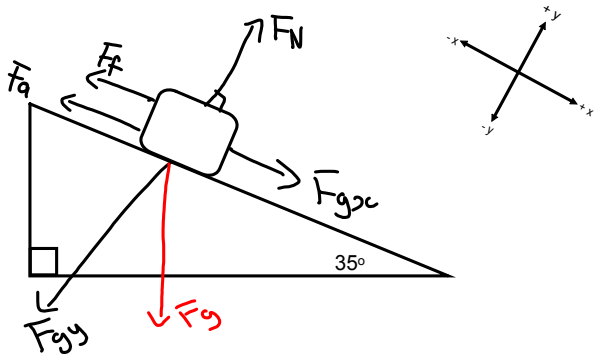
$F_{gx} = F_g \sin\theta$ ⟵ component parallel to the plane.

$F_{gy} = F_g \cos\theta$ ⟵ component perpendicular to the plane.

NOTE! The *sin* and *cos* have switched places in the way we label the problem. This will only happen when dealing with objects on a ramp.

NOTE FURTHER! Every ***F*** in the above diagram can be replaced with an ***a*** for acceleration.

1. A 55 kg block is sliding down an incline. The coefficient of kinetic friction is 0.13 and the incline makes an angle of 35° with the ground. What applied force up the ramp is necessary so the block accelerates with a magnitude of 0.83 m/s² down the ramp?



$F_{netx} = \sum$ Forces parallel to ramp

and

$= ma_x$

$ma_x = F_{gx} + F_f + F_a$

$\hookrightarrow \mu F_N = 0.13 |F_{gy}|$

$F_f = (0.13)(F_g \cos\theta)$

$= (0.13)(55\text{kg})(9.81)\cos 35$

$F_g = mg$

$|F_f| = 70.14\text{ N}$

★ $|F_{gx}| = F_g \sin\theta$

$= (55)(9.81)\sin 35$

$|F_{gx}| = 309\text{ N}$

$|F_{netx}| = |ma_x| = (55)(0.83)$

$= 45.7\text{ N}$

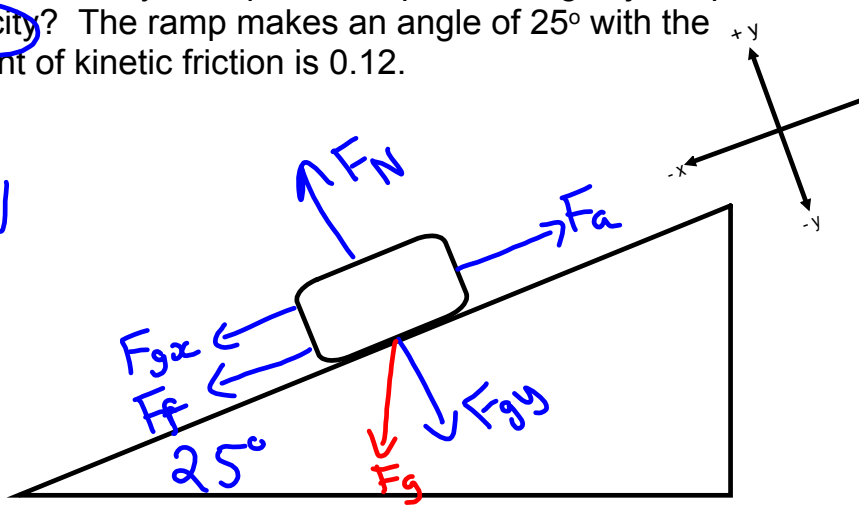
$F_{netx} = F_{gx} + F_f + F_a$

$45.7 = 309 + (-70.14) + F_a$

$-193\text{ N} = F_a$

2. What applied force is necessary for a person to pull a 30 kg object up a ramp at a constant velocity? The ramp makes an angle of 25° with the ground and the coefficient of kinetic friction is 0.12.

$F_{netx} = 0$ N



$F_{netx} = \sum Forces$ $\quad F_a = ?$

$F_{netx} = F_{gx} + F_f + F_a$

$|F_f| = \mu F_N = \mu F_{gy} = \mu F_g \cos\theta$

$|F_f| = (0.12)(30\text{ kg})(9.81)\cos 25^\circ$

$= 32$ N

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

$= (30)(9.81)\sin 25^\circ$

$= 124$ N

F_{netx}

$0 = (-124) + (-32) + F_a$

$\boxed{156\text{ N} = F_a}$