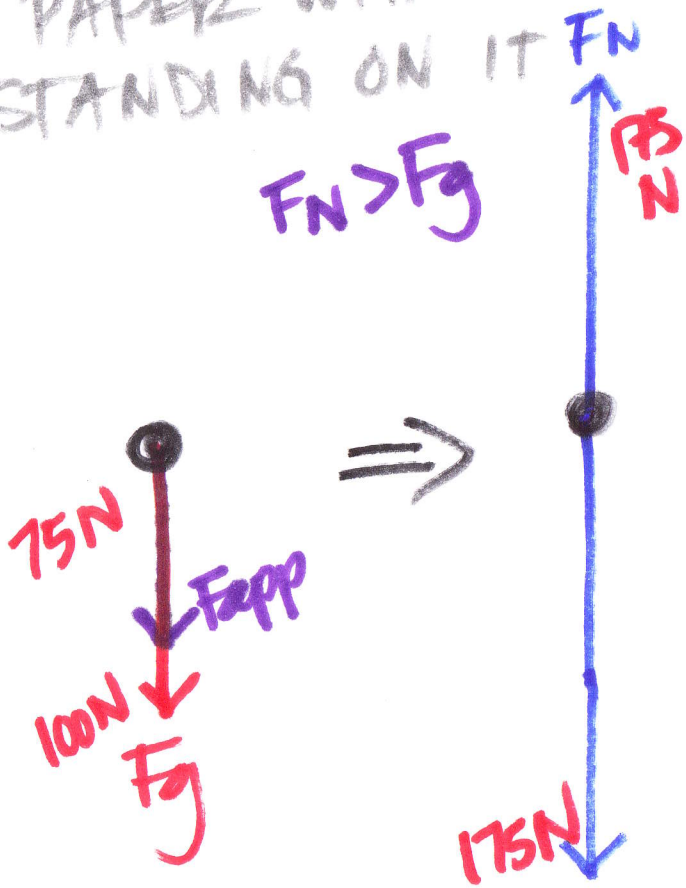
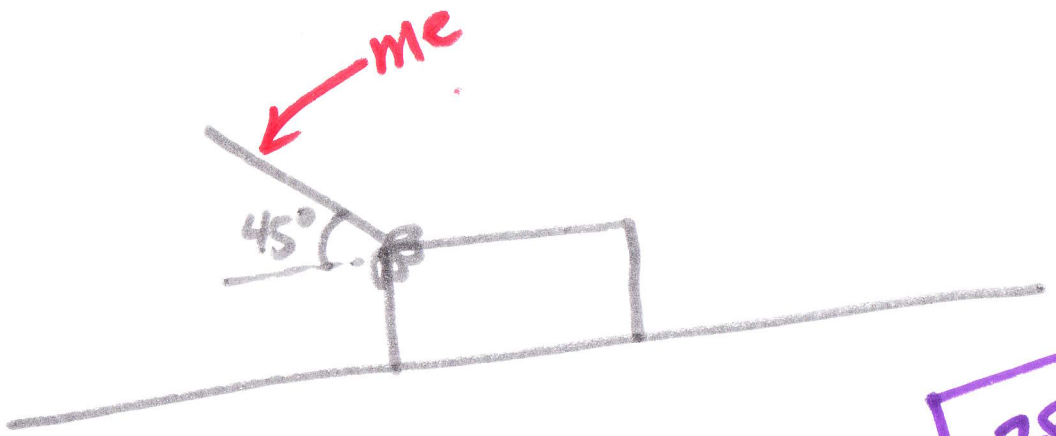
Forces at angles

BOX OF PAPER AT REST

BOX OF PAPER WITH ME STANDING ON IT



ME PUSHING ON THE BOX
AT 45° to the horizontal (AT REST)



$F_N = 128N$

$28N = F_f$

$x = 28N$

$y = 28N$

$F_{app} = 40N$

$F_g = 100N$

F_f:

$\cos 45 = \frac{x}{40N}$

$x = 40N \cdot \cos 45$

$x = 28N$

$F_f = x$

F_N:

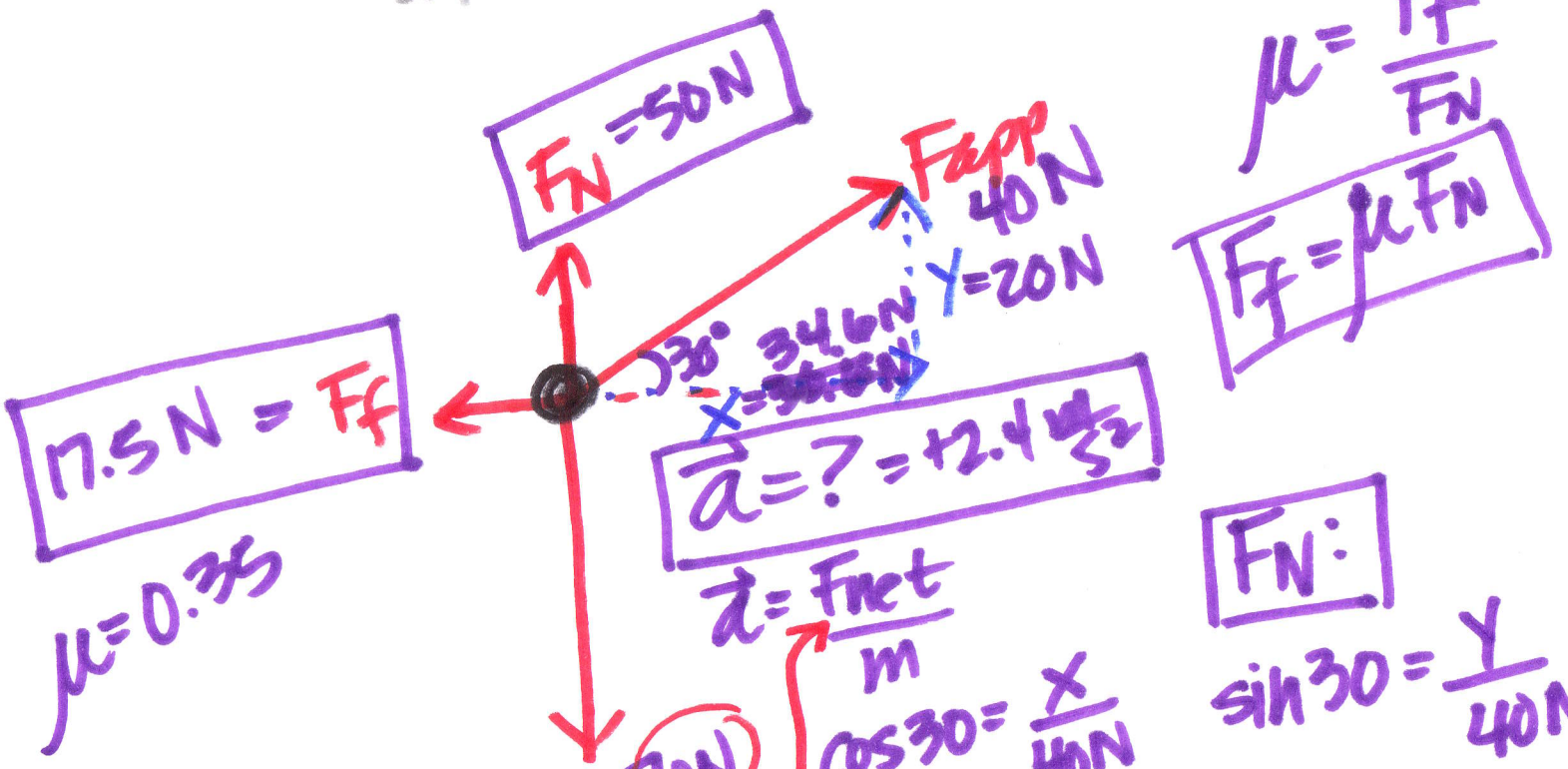
$\sin 45 = \frac{y}{40N}$

$y = 40N \cdot \sin 45$

$y = 28N$

$F_N = y + F_g$

ME PULLING ON A LAB CART
~~horizontal~~ horizontally accelerating
at 30° to the horizontal



$\mu = \frac{F_f}{F_N}$

$F_f = \mu F_N$

$\vec{a} = \frac{F_{net}}{m}$

F_f:

$F_f = \mu F_N$

$F_f = (0.35)(50N)$

$F_f = 17.5N$

F_N:

$\sin 30 = \frac{Y}{40N}$

$Y = 40N \cdot \sin 30$

$Y = 20N$

$F_N = 70N - 20N$

$F_N = 50N$

$\cos 30 = \frac{X}{40N}$

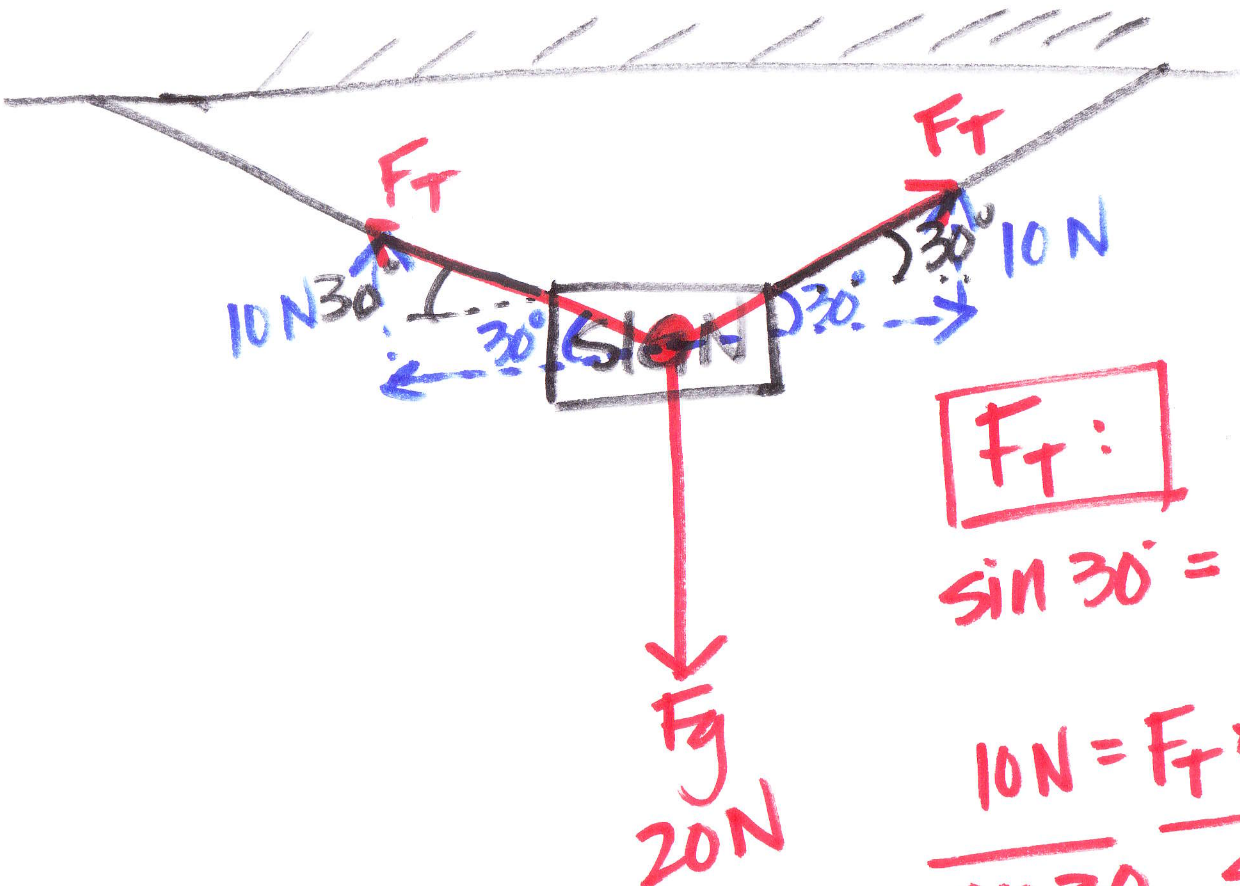
$X = 40N \cdot \cos 30$

$X = 34.6N$

$F_{net} = +17.1N$

$a = \frac{+17.1N}{7kg} = +2.4 \frac{m}{s^2}$

Sublevel 4



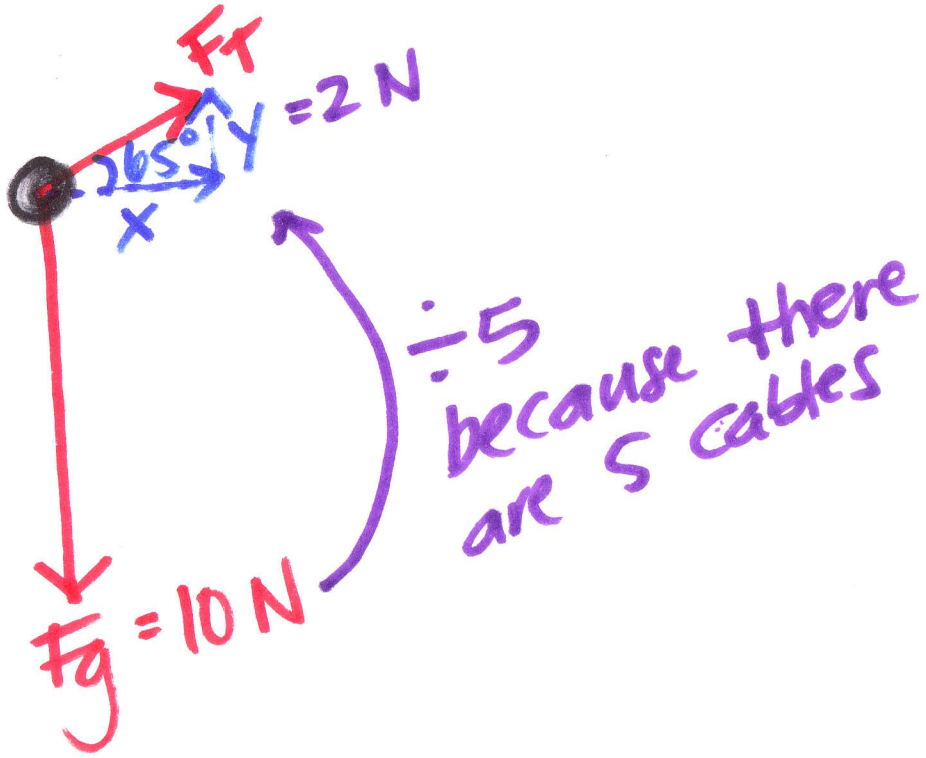
F_T:

$$\sin 30° = \frac{10N}{F_T}$$

$$\frac{10N}{\sin 30} = \frac{F_T \times \sin 30}{\sin 30}$$

$F_T = 20\ N$

5 cables hanging a candle symmetrically spaced at 65° to the horizontal



F_T:

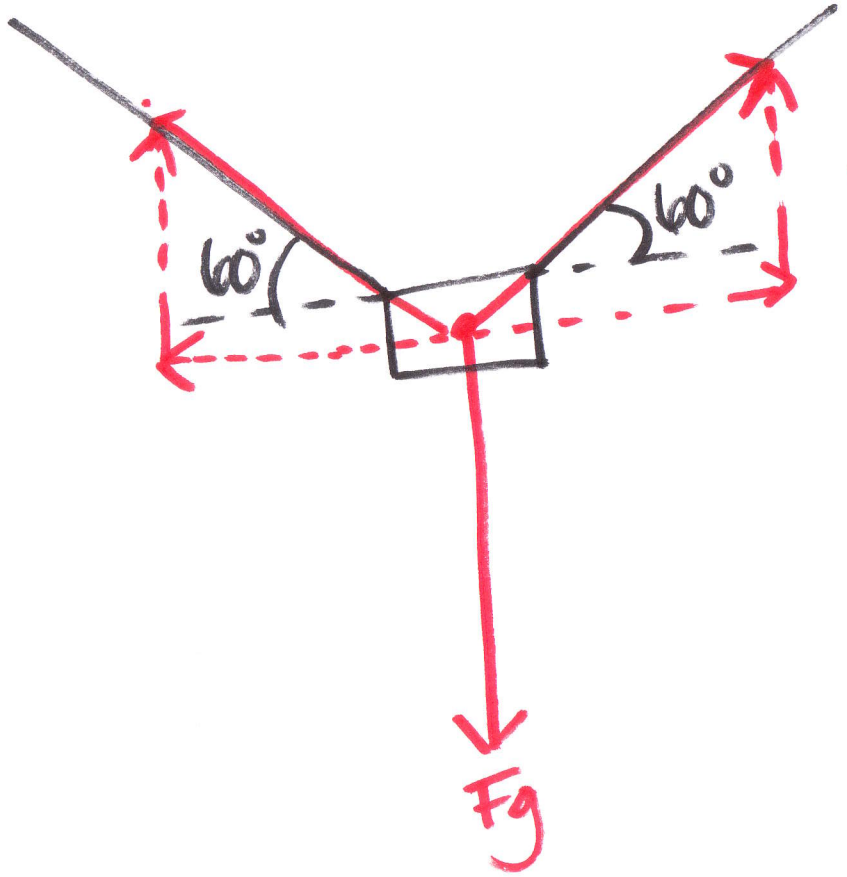
$\sin 65 = \frac{2N}{F_T}$

$2N = F_T \times \sin 65$

$\frac{2N}{\sin 65} = \frac{F_T \times \sin 65}{\sin 65}$

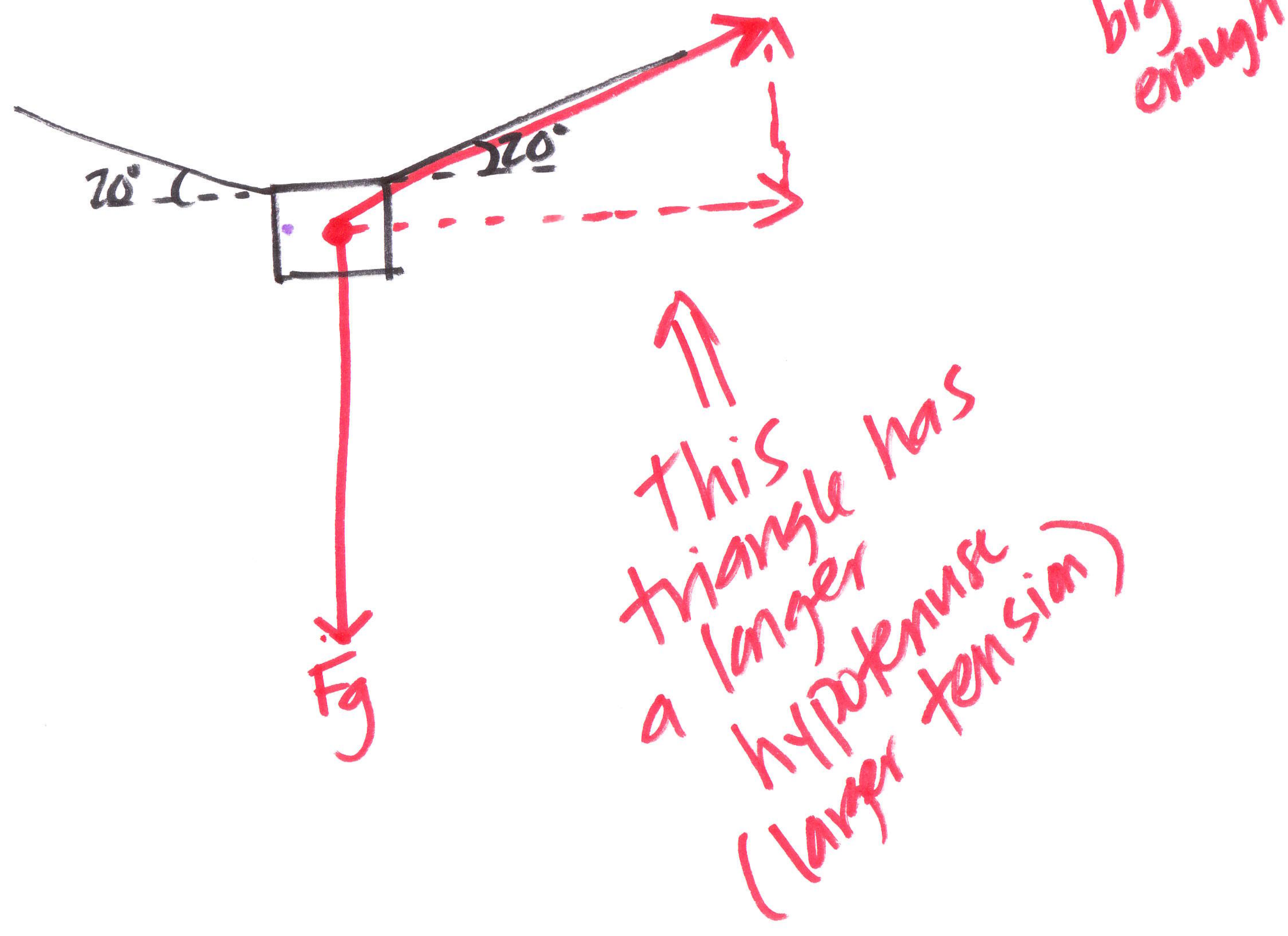
$F_T = 2.2\,N$

As angle ↓ ⇒ tension ↑



⇐ vertical is half the weight

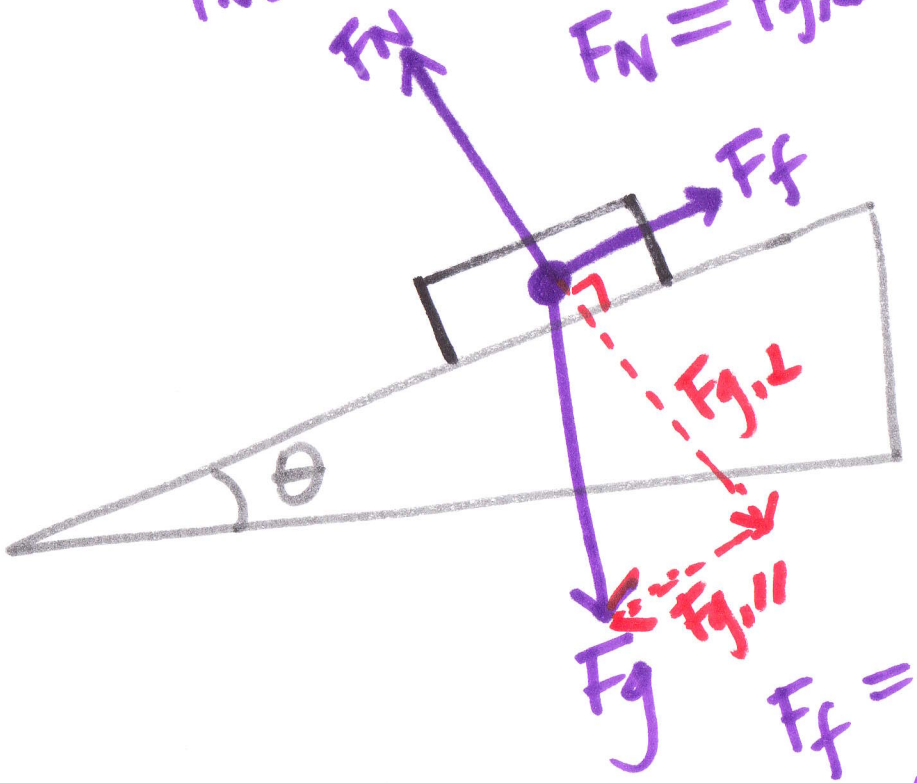
Decrease angle to 20°



20°
20°
Fg
vertical still needs to be half the weight so must make a bigger triangle to get the height big enough
This triangle has a larger hypotenuse (larger tension)

Drawing FBD's for Inclined Planes

BOX AT REST ON AN INCLINE:



$F_N = F_{g,\perp}$

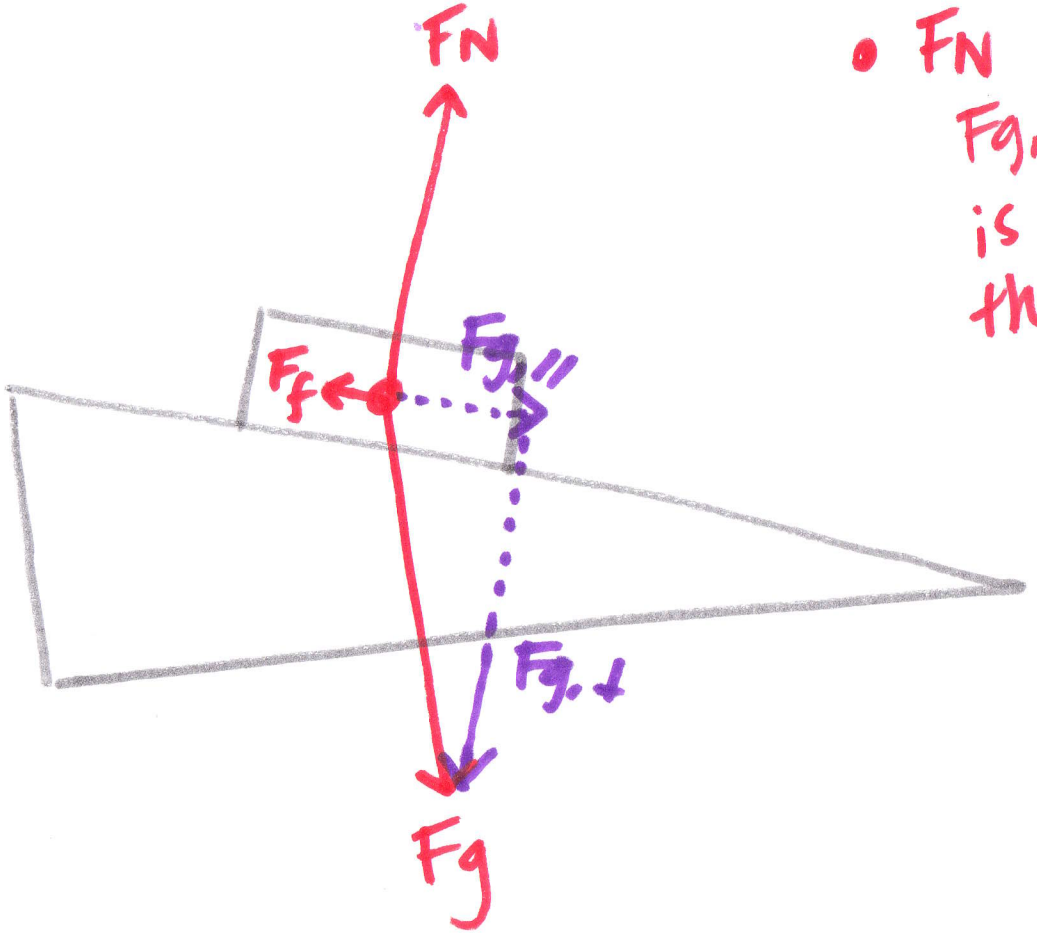
$F_f = F_{g,\parallel}$ because at rest

Motion would be along the incline so.... make a triangle out of Fg → parallel to ramp & perpendicular to ramp

If in equilibrium:
parallel's must cancel
& perpendicular's must cancel

Practice

Draw an FBD for a box accelerating down a ramp.



- F_N must equal $F_{g,\perp}$ because there is no motion ⊥ to the ramp.
- F_f must be less than $F_{g,//}$ because it's accelerating // to the ramp.