Dynamics (Newton's 2nd Law)

Dynamics: The case where forces do not all cancel.

If forces in any direction are not balanced, the object will accelerate in that direction.

$$\Sigma F \neq 0 \Rightarrow \Sigma F_x \neq 0 \text{ And/or } \Sigma F_y \neq 0$$

Newton's 2nd Law governs this situation:

$$\boxed{\Sigma \vec{F} = m\vec{a}} \Rightarrow \Sigma \vec{F}_x = m\vec{a}_x \quad \Sigma \vec{F}_y = m\vec{a}_y$$

kg m/s^2 $\frac{kg \cdot m}{s^2} = N$

$\neq$ Weight $= mg$

Steps For Solving Dynamics Problems:

1. Draw a picture.
2. Establish a reference frame.
3. Identify variables / check units.
4. Draw a FBD.
5. Resolve all forces into X and Y components.
6. $\Sigma F_x = m a_x$
7. $\Sigma F_y = m a_y$
8. Solve for unknowns.

Note: A static situation is just a special case of the more general dynamic situation -- when the object(s) is not accelerating.

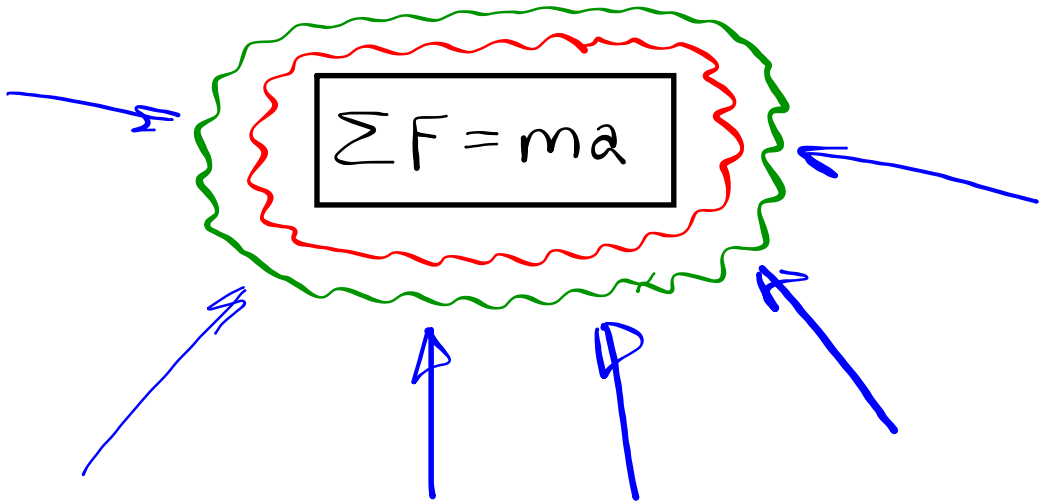
$$\Sigma F = ma$$

IF $a = 0$, THEN

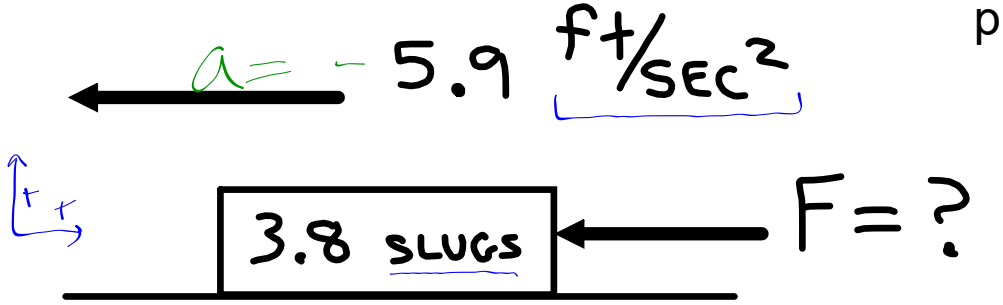
$$\Sigma F = m(0) = 0$$

$$\Sigma F = 0 \quad \text{(STATICS)}$$

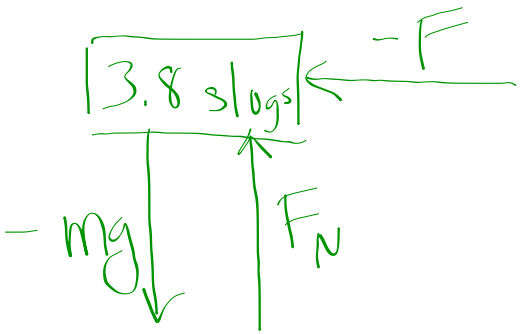
So, if you only end up remembering one thing, let it be this:



Example 1:



Assume there is no friction in this and all of the following problems

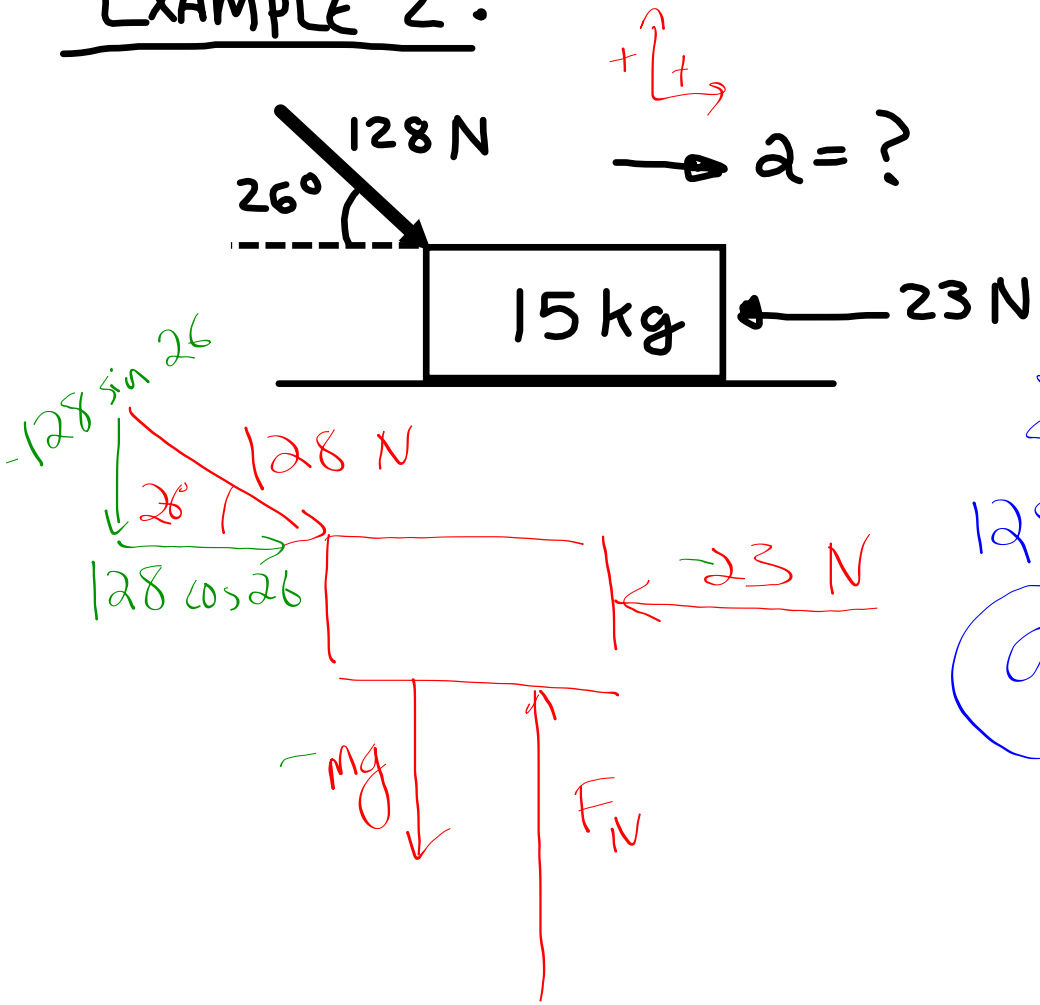


$$\Sigma F_x = ma_x$$

$$-F = (3.8)(-5.9)$$

$$F = 22.4 \text{ lb}$$

Example 2:



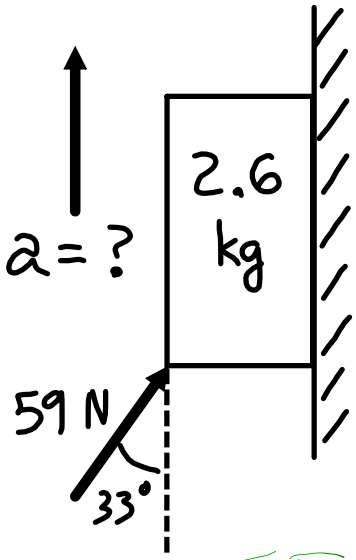
$$\Sigma F_x = ma_x$$

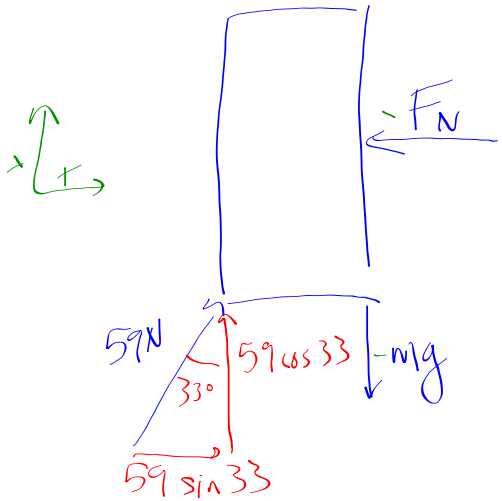
$$128\cos 26 + -23 = (15)a_x$$

$$a_x = 6.14\ m/s^2$$

Example 3:

~9.2? ~19.x?





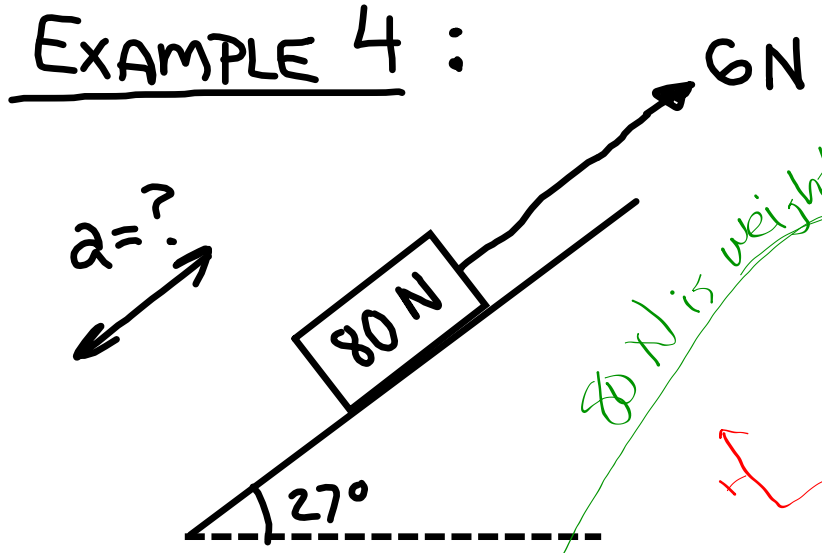
$$\Sigma F_y = ma_y$$

$$59\cos 33 + -mg = ma_y$$

$$a_y = \frac{59\cos 33 - (2.6)(9.8)}{2.6}$$

$$a_y = 9.2\ m/s^2$$

Example 4:



80 N is weight not mass...

weight

$\sum F_x = ma_x$

$-mg \sin 27 + 6N = ma_x$

$-80 \sin 27 + 6 = \left(\frac{80}{9.8}\right) a_x$

$a_x = -3.71\ m/s^2$ (down the ramp...)

Weight = mg

$\text{Mass} = \frac{\text{weight}}{g}$