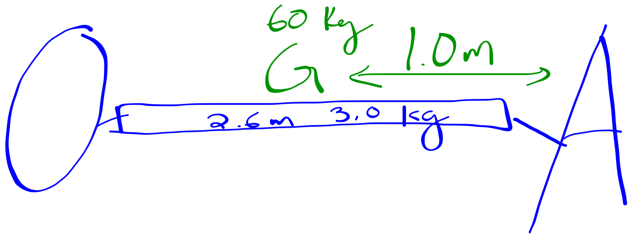
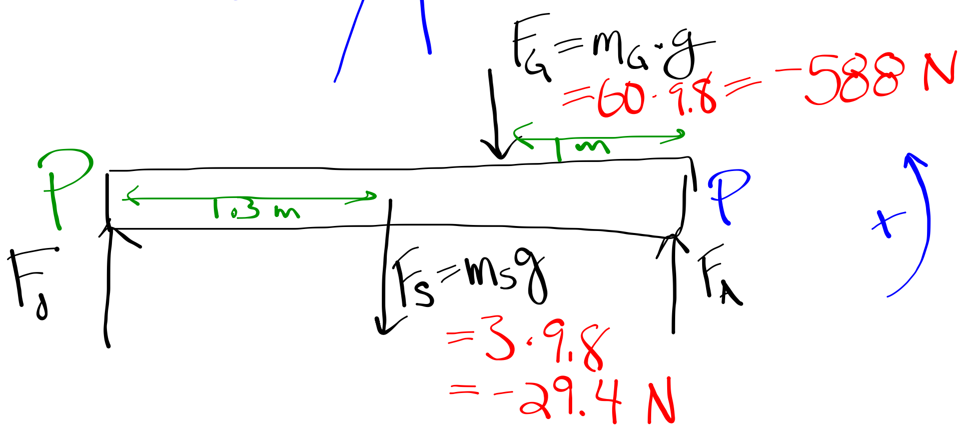
2. Orin and Ann, two paramedics, rush a 60.0 kg man from the scene of an accident to a waiting ambulance, carrying him on a uniform 3.00 kg stretcher held by the ends. The stretcher is 2.60 m long and the man's center of mass is 1.00 m from Ann. How much force must Orin and Ann exert to keep the man horizontal? [Orin = 241 N; Ann = 376 N]





P $\quad \Sigma \tau = 0$

$$-F_O \cdot (2.6) + (29.4)(1.3) + (588)(1) + \cancel{F_A(0)} = 0$$

$$F_O = \frac{588 + (29.4)(1.3)}{2.6} = \boxed{241 \text{ N}}$$

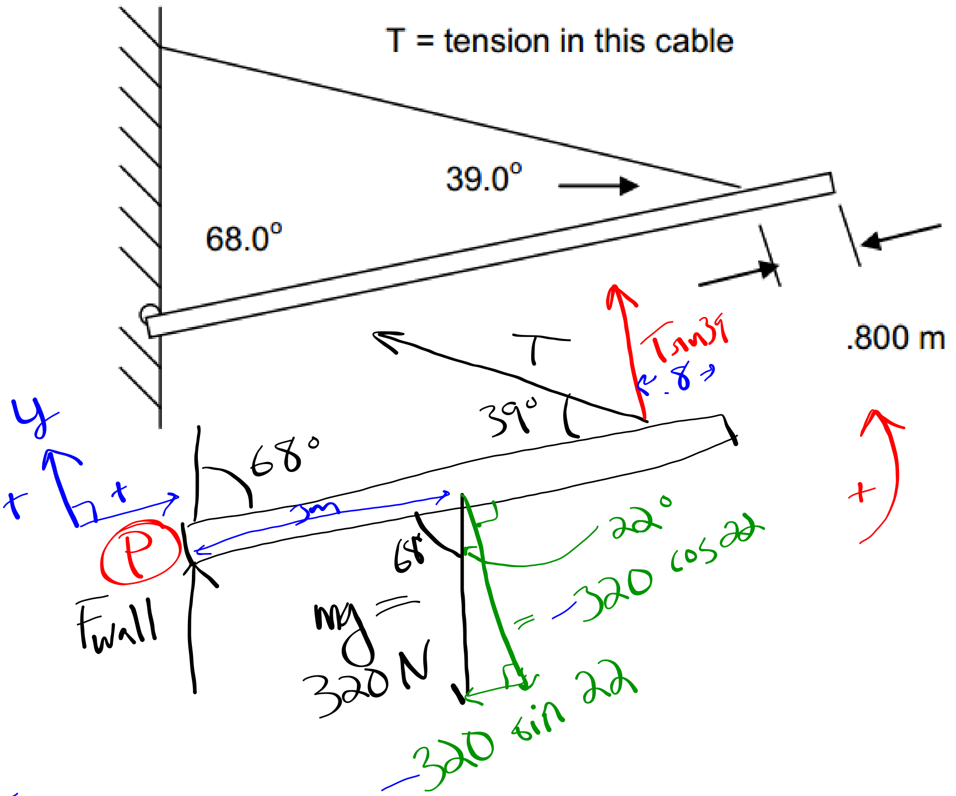
P $\quad \Sigma \tau = 0$

$$F_A(2.6) + {}^{-}(588)(1.6) + {}^{-}(29.4)(1.3) + 0 = 0$$

$$F_A = \frac{(588)(1.6) + (29.4)(1.3)}{2.6}$$

$$= 376.5 \text{ N}$$

5. Find T if this beam has a length of 6.0 meters and a weight of 320 N. [T=272 N]



$$\Sigma \tau = 0$$

$$-(320 \cos 22)(3) + (T \sin 39)(5.2) = 0$$

$$T = \frac{(320 \cos 22)3}{(\sin 39)(5.2)} \approx 272\,N$$

Dynamics (Newton's 2nd Law)

and

Inclined Planes

Dynamics: The case where forces do not all cancel.

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

$$\Sigma F \neq 0 \Rightarrow \Sigma F_x \neq 0$$

AND/OR

$$\Sigma F_y \neq 0$$

Newton's 2nd Law governs this situation:

$$\boxed{\Sigma \vec{F} = m\vec{a}} \Rightarrow \begin{array}{l} \Sigma \vec{F}_x = m\vec{a}_x \\ \Sigma \vec{F}_y = m\vec{a}_y \end{array}$$

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:

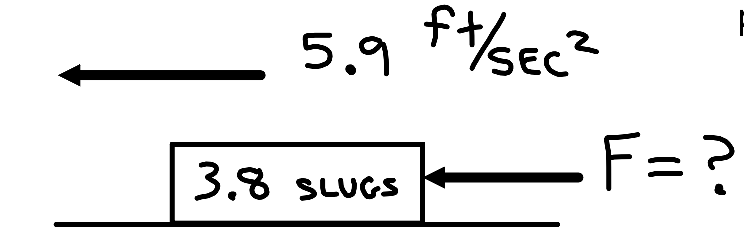
$$\boxed{\Sigma F = ma}$$

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. $\Sigma F_x = ma_x$
7. $\Sigma F_y = ma_y$
8. Solve for unknowns.

EXAMPLE 1:

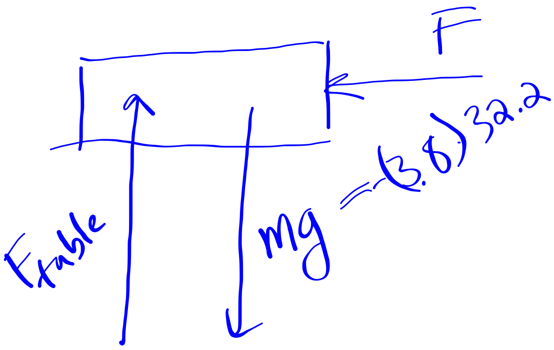
Assume there is no friction in this and all of the following problems



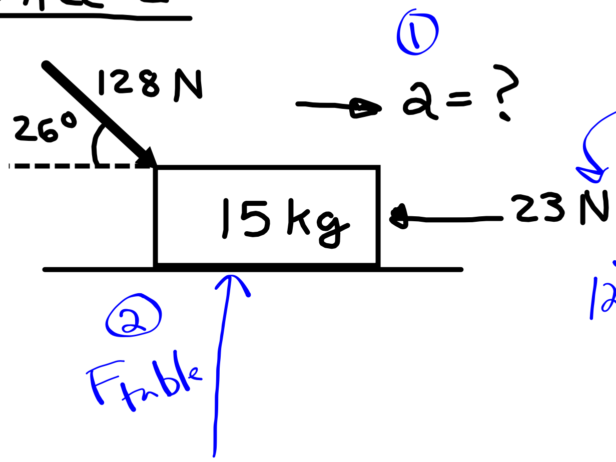
$$\Sigma F_x = m a_x$$

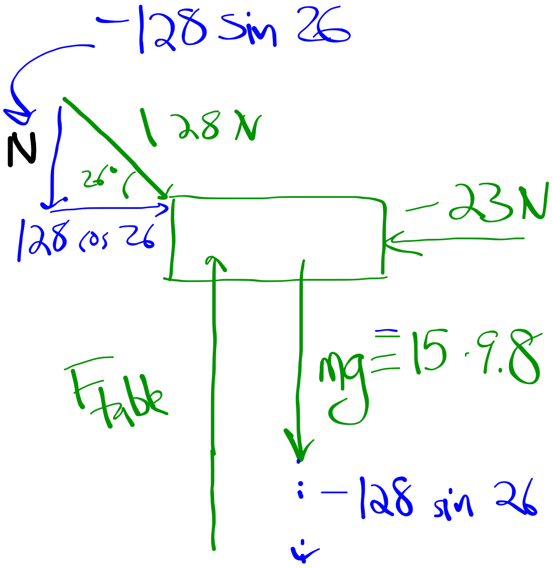
$$F = (3.8)(5.9)$$

$$= 22.42 \text{ lb}$$



Example 2:





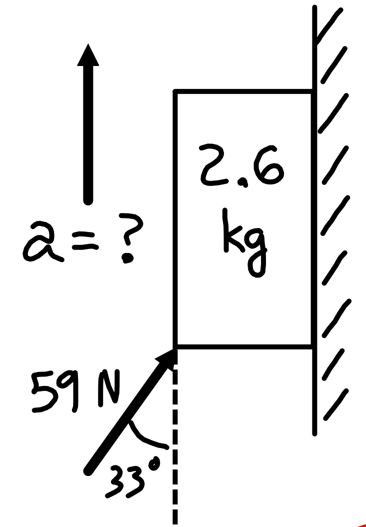
$$\Sigma F_x = ma_x$$

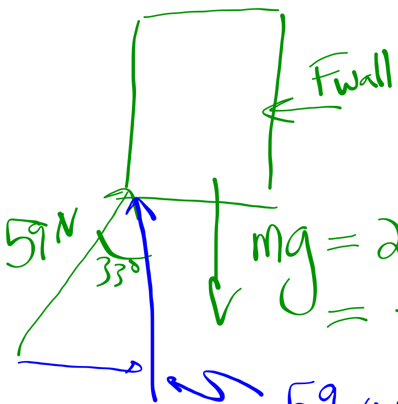
$$128 \cos 26 + {}^{-}23 = 15a$$

$$a = 6.14 \text{ m/s}^2$$

EXAMPLE 3 :

$a = 9.2\ m/s^2$ (15)





$mg = 2.6 \cdot 9.8$
$= -25.48\ N$

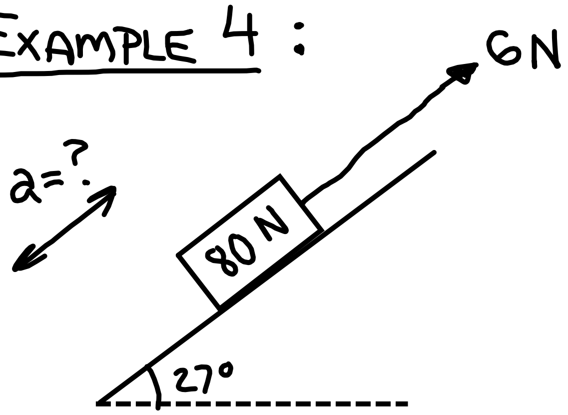
$59 \cos 33 = 49.48\ N$

$$\Sigma F_y = m a_y$$

$$49.48 + -25.48 = 2.6a$$

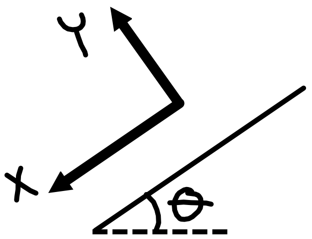
$$a = 9.2\ m/s^2$$

Example 4:

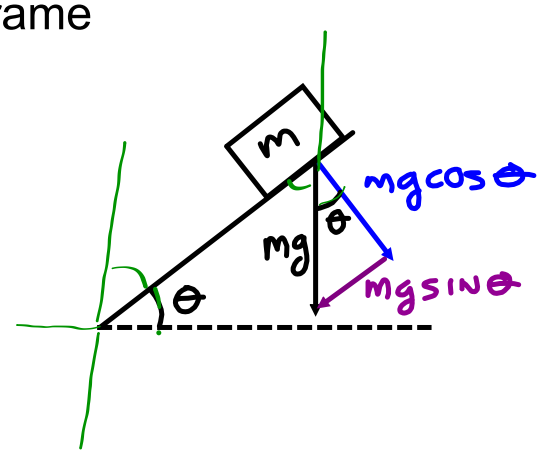


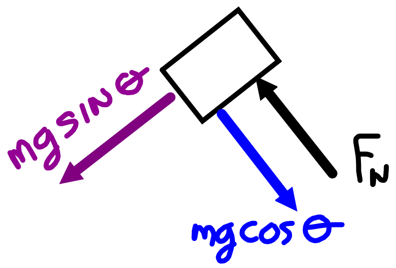
How should we handle inclines?

Use this reference frame . . . because motion will be along the incline

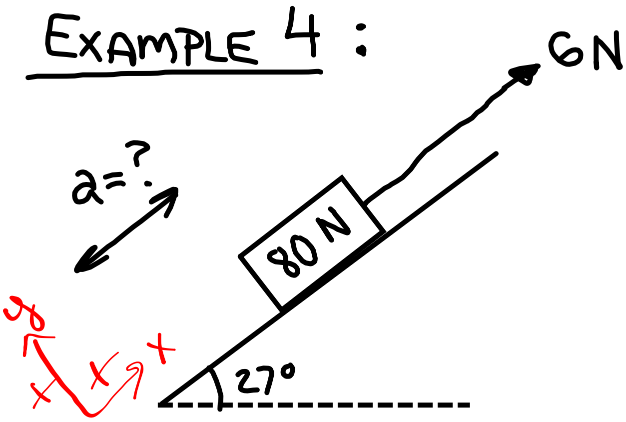


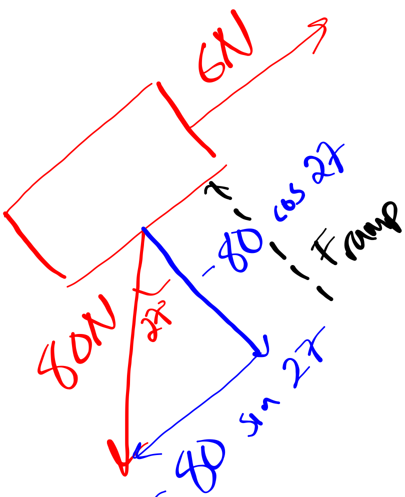
We need the force of gravity, which is vertically down, resolved into X and Y components for this new reference frame





EXAMPLE 4 :





$$\Sigma F_x = m a_x$$

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

$$a = \boxed{-3.71 \text{ m/s}^2}$$

EXAMPLE 5: