Steps to Solving Mechanics Problems

1) Visualize
2) Identify system(s) of interest
3) Interaction w/ system or systems (external forces)

4) Draw Free-Body Diagram of system(s)
   a) Labeling $\vec{F}$ type acting on object (F.P.)

5) Identify Newton's 3rd Law force pairs
   + requires a FBD for each object
   + in two F.P. on same FBD

6) Apply 2nd Law Algebraically using force on FBD
7) Solve -- connect to kinematics via $\vec{a}$

Ex. outer space

Start w/ equilibrium $\sum \vec{F} = 0 \quad \Rightarrow \quad \vec{a} = 0$

* $\vec{F}_{rope}$ is negligible

Constraint

Now rope breaks

$\sum \vec{F} = \sum \vec{F}_1 + \sum \vec{F}_2 = \sum \vec{F}_{\text{2nd}}$

So ... $\sum \vec{F}_1 = - \sum \vec{F}_2 \quad \leftarrow \text{3rd Law}$
Felix Baumgartner recently sky dived from the stratosphere. After reaching speeds greater than the speed of sound, air resistance eventually slowed his fall and even caused a period of time where he was weightless.

Example: Three wolves pull on a very light dead carcass. The first wolf pulls with a 10 N force in a direction 30° north of east. The second with a force of 6 N in a direction 40° west of north. What magnitude and direction must the third wolf pull if the carcass is to not accelerate? (Answer: 10.7 N, 26.6° west of south)
Felix Baumgartner recently sky dived from the stratosphere. After reaching speeds greater than the speed of sound, air resistance eventually slowed his fall and even caused a period of time where he was not accelerating. Assume he had two ropes attached to the chute, they each made an angle of 75° from the horizontal, and he is moving with a constant velocity. If the tension in each rope is 507.2 N what is the mass of Felix and his suit? Ignore the air resistance on Felix himself. (Answer = 100 kg)

\[ \sum F_x = -F_{T} T \cos \theta = -F_{T} T \cos \theta = m \alpha_x \]

\[ \sum F_y = F_{T} T \sin \theta + F_{T} T \sin \theta - mg = m \beta_y \]

\[ F_{T} = \frac{2 F_{T} \sin \theta}{\gamma} = 100 \text{ kg} \]

Example: A 80 kg man, wearing skis on snow (no friction), is pulled via a rope from a truck on level ground. The magnitude of the force from the truck 800 N and is directed at an angle of 30° above the horizontal.
(a) What is the man's acceleration? (Answer = <8.66, 0>m/s²)
(b) How about his position and velocity as a function of time? (I'll use g = 10 m/s²)

Example: A 80 kg man, wearing skis on snow, is pulled via a rope from a truck on level ground. The magnitude of the force from the truck 800 N and is directed at an angle of 30° above the horizontal.
For part (c) and (d) consider friction present with \( \mu_s = 1/3 \) and \( \mu_k = 1/4 \).
(c) How much tension is required to get the skier to slip? (261 N)
(d) If the minimum slip tension is doubled, what will the acceleration be? (4.08 m/s²)