Today we learn:
How to combine everything!

The first day we learned that F=ma

- We only knew that force existed, we never dreamed there were so many…
- Last time we learned that there are F_f, F_N, W and F_a… all with the unit Newton (N)
- What do you get when you add up all the ones that affect the motion?
- F_{net}! Which is the sum of all the forces that affect the motion of an object. It is what is left over after the forces have battled it out.
- The F_{net} is the F in F = ma !
- i.e. the <u>net force</u> causes the acceleration!

What are the F_{net} formulas?

If we move horizontally, the two forces that battle it out are our applied force and _____!

If we move vertically, the two forces that battle it out are our applied force and _____!

Both <u>friction</u> and <u>weight</u> typically fight F_a.

When could they work together?

So our formulas look like:

$$\leftrightarrow F_{net} = F_a \pm F_f$$

$$\updownarrow F_{net} = F_a \pm W$$

All other formulas work as before!

Ricky shoves a 41.8 kg box with a μ of .378 across the floor with a 275 N force. What is the acceleration rate on the box?

We know:
41.8 kg =
.378 =
275 N =

Tony throws Sam up in the air with a big force. If her 38.6 kg mass accelerates at 14.83 m/s^2, how hard did he shove?

We know:
38.6 kg =
14.83 m/s^2 =

Things to remember:

F_N and F_{Net} look similar, but are not…

F_a is almost always the force either given or being solved for… and is almost always the biggest.

Most of the time, the forces subtract from each other, but if they are both opposing the motion (horizontally) or both going down (vertically) they add (but $^{(-)}$) to make the F_{net} <u>bigger</u> than F_a.

$v_f^2 = v_i^2 + 2ad$

$v_f = v_i + at$

$d = vt$

$d = 1/2\ at^2 + v_i t$

$d = 1/2\ (v_f + v_i)\ t$

$F_{net} = ma$

$\leftrightarrow F_{net} = F_a \pm F_f$

$F_f = \mu F_N$ or μmg

$\updownarrow F_{net} = F_a \pm W$

$W = mg$

$a = \mu g$ (skid)

$F = -F$ so $ma = -ma$

Freefall!

Freefall is a state in which the only forces acting on an object are

_____, _____

and _____ _____.

When an object falls the force pulling it down is it's _____ (the force caused by gravity).
Since it's going down, the air resistance pushes up, and the longer it falls, the faster it goes, so the air resistance force keeps growing larger until it matches the weight pulling down!

At that point the forces are balanced!

If the forces are then balanced, what happens to our motion?

No, you do NOT stop, you stop accelerating, and as Newton says, travel at a constant speed in a straight line (down) until you hit something (or open your parachute!)

We call this fastest falling speed possible the:

_____ _____,

which is a balance between what two forces?

Who has a faster terminal velocity, an elephant or a rabbit?

A hammer or a feather?

What if we removed air resistance?