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Physics 131

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# ■ Theme Music: Willie Nelson

*Still is still moving to me*

# ■ Cartoon: Jef Mallet

*Frazz*



9/23/15

Physics 131

I

## What have we learned so far, and what's next?

- Symbols in physics are not numbers but measurements – dimensional analysis.
- Different graphs each tell something different about a physical situation – and it takes attention to figure out what.
- A few core equations can do a lot for you if you know what they mean and how to use them.  $\langle v \rangle = \dots$ ,  $\langle a \rangle = \dots$
- A few core principles can do a lot for you if you know what they mean and how to use them.

# Foothold Principles

## Newton's Laws



- Newton 0:
  - An object responds to the forces it feels when it feels them.

- Newton 1:
  - An object that feels a net force of 0 keeps moving with the same velocity (which may = 0).

- Newton 2:
  - An object that is acted upon by other objects changes its velocity according to the rule

$$\vec{a}_A = \frac{\vec{F}_A^{net}}{m_A}$$

- Newton 3:
  - When two objects interact the forces they exert on each other are equal and opposite.

$$\vec{F}_{A \rightarrow B}^{type} = -\vec{F}_{B \rightarrow A}^{type}$$

# The Newtonian Framework helps us learn to see “hidden” Forces

- Contact forces are hard to measure directly.
- We infer them from Newtonian principles.
- Consistency is a good test as to whether our model of invisible forces is good (and sometimes we can actually measure them)

# Kinds of Forces

- Forces are what objects do to each other when they interact.
- Types of Force
  - Normal:  $N$
  - Tension:  $T$
  - Resistive:  $f, F^D, F^V$
  - Weight:  $W$
  - Electric:  $F^E$
  - Magnetic:  $F^M$
- Notation convention.

$\vec{F}$  type of force  
(object causing force) → (object feeling force)