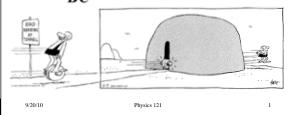
September 20, 2010

Physics 121

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- Theme Music: Soul II Soul Keep on Movin'
- <u>Cartoon:</u> Johnny Hart BC



Outline

- Quiz 2
- Acceleration recap
- Finish ILD #2
- Inventing a law of motion
- Newton 2
- Critical assumptions
- Defining force
 - operational definition
 - classifying forces

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What have we learned?



- Position
- $\hat{r} = x\hat{i}$ (where x is a signed length)
- Velocity
- $\langle \vec{v} \rangle = \frac{\Delta \vec{r}}{\Delta t}$
- $\vec{v} = \frac{d\vec{r}}{dt}$
- Acceleration
- $\langle \vec{a} \rangle = \frac{\Delta \vec{v}}{\Delta t}$
- $\vec{a} = \frac{d\vec{v}}{dt}$
- Seeing from the motion
- Seeing consistency (graphs & equations)

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ILD 2

What if something just doesn't make sense?

Acceleration at the peak

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What Causes Motion? Drawing experience

- What do the following motions feel like?
 - No motion (at rest).
 - Constant velocity.
 - Constant acceleration.
 - Changing acceleration (jerk)
- What produces motion?

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Causing Motion

■ How do we get something to move?

Block on a table

■ Crucial question: What happens to a moving object if nothing acts on it? (or if everything acting on it cancels?)

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One more icon: Shopping for Ideas

■ What we need to do here is consider some different possibilities and evaluate them to see how well they work for us.



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Alternative Laws of Motion



■ Redish's Law (from block on table)

$$\mathcal{T} = \Delta x$$

■ Newton's Law (from ball on hard floor)

$$\mathcal{T} = \Delta v$$

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Newton's law of motion

■ As a result of taps

$$T = \Delta v$$

■ Between taps

$$\Delta x = v \Delta t$$

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Is "tap" the right concept?

- Is a "tap" (𝒯) the right concept?
- Is it really something the hammer gives to the ball?

Or does the "tap" also depend on the ball?

 Consider multiple bowling balls ganged together with long bolts.



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Impulse

- We expect (and would find if we actually did the experiment) that the effect of a given "hit" with a hammer produces a smaller effect (less Δν) for more bowling balls.
- We therefore replace the "tap" by an "impulse" something delivered by the hammer to the object.

$$\mathscr{T} = \frac{\mathscr{I}}{m} \stackrel{\text{delivered by hammer to object}}{\longleftarrow} \text{number of bowling balls}$$

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Newton's 2nd Law

$$\Delta v = \frac{1}{m}$$

$$\Delta x = v \Delta t$$

- Where
 - Is the "impulse" (something delivered to the object by another object touching it)
 - m is the "mass" (a property of the object that says how many bowling balls it is equivalent to)

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A More Familiar Form

■ If the object that is causing the change of velocity by touching our object doesn't "tap" it but touches it continually, it's more convenient to extract a time by writing

$$\mathcal{I} = F\Delta t$$

· then we get

we get
$$\Delta v = \left(\frac{F}{m}\right) \Delta t$$

$$\Delta x = v \Delta t$$

$$a = \frac{F}{m}$$

Two Important Principles



- Newton 1:
 - If all the influences (forces) acting on an object are balanced (or zero) the object keeps whatever velocity it has.
- Newton 0:
 - An object responds to the forces that act on it at the instant considered. (Objects have no long range sensors and no memory for anything except their velocity.)

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Newton 0: Thinking inside the box



- · "Physics by empathy"
- "Method acting" an acting technique in which actors try to replicate real life emotional conditions under which the character operates, in an effort to create a life-like, realistic performance.
 - "What's my motivation?"



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