

September 19, 2016

Physics 131 Prof. E. F. Redish

- **Theme Music: When Push Comes to Shove**  
*Greatful Dead*
- **Cartoon: Rick deTorie**  
*One Big Happy*



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## Outline

- Quiz 3
- Kinematics recap
- Kinematics examples
- What causes motion?
- System schema

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## What have we learned? Representations & consistency



- Position  $\hat{r} = x\hat{i} + y\hat{j}$   
(where  $x$  and  $y$  are signed lengths)
- 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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## Multiple ways of looking at the math

- Look at the full time interval

$$\langle v \rangle = \frac{\Delta y}{\Delta t} \qquad \langle a \rangle = \frac{\Delta v}{\Delta t}$$

- Look at it instantaneously  
and integrate the derivatives

$$v(t) = \frac{dy}{dt} \qquad a(t) = \frac{dv}{dt}$$

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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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## What Causes Motion? Drawing experience

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

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## What's wrong with this?

**FUNKY WINKERBEAN** **BY TOM BATIUK**

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## What causes motion?



- Do you need an outside influence to start motion, to maintain it, or to change it?

