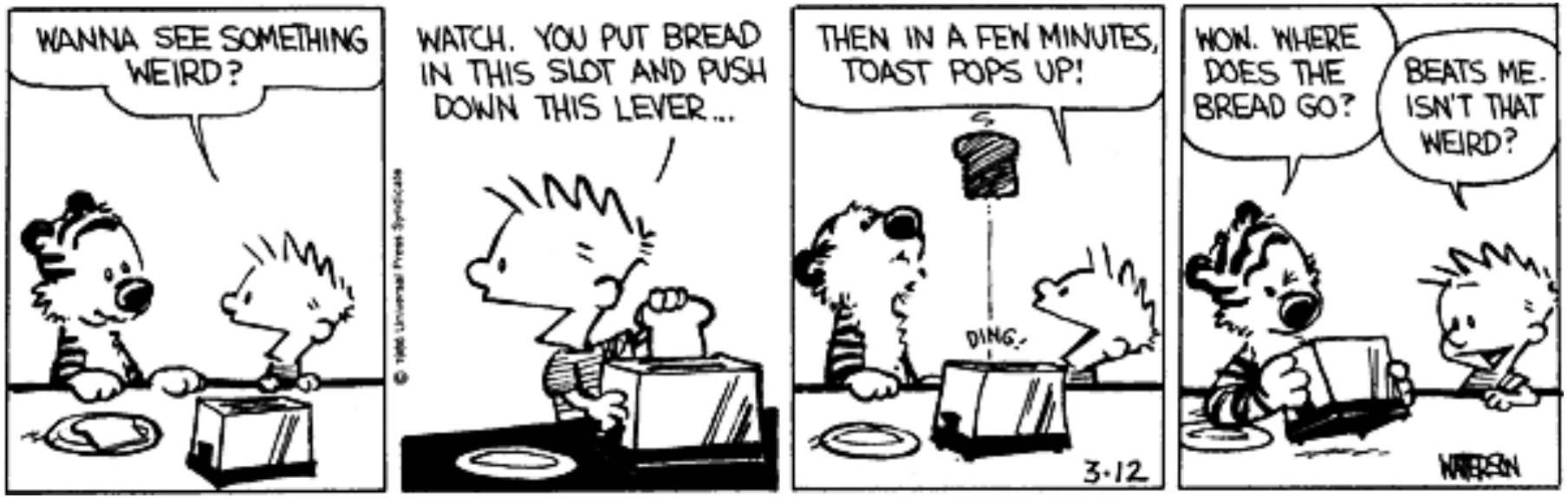
Today's Topics: Work & Energy

Cartoon: Bill Watterson

Calvin & Hobbes



The diagram depicts two pucks on a frictionless table. Puck II is four times as massive as puck I. Starting from rest, the pucks are pushed across the table by two equal forces.

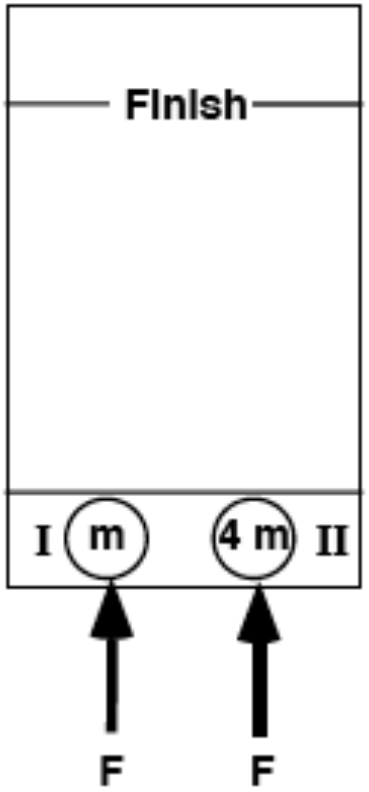
Which puck will have the greater momentum upon reaching the finish line?

A. Puck I

B. Puck II

C. Both will have the same.

D. There is not enough information to decide.



The diagram depicts two pucks on a frictionless table. Puck II is four times as massive as puck I. Starting from rest, the pucks are pushed across the table by two equal forces.

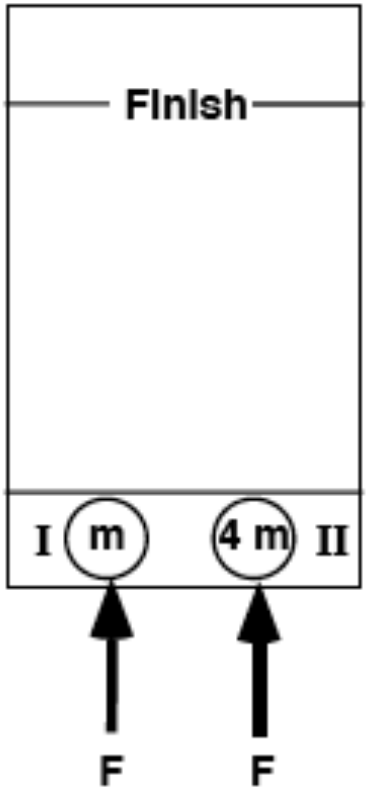
Which puck reach the finish line first?

A. Puck I

B. Puck II

C. Both will have the same.

D. There is not enough information to decide.



The diagram depicts two pucks on a frictionless table. Puck II is four times as massive as puck I. Starting from rest, the pucks are pushed across the table by two equal forces.

Which puck will have the greater KE upon reaching the finish line?

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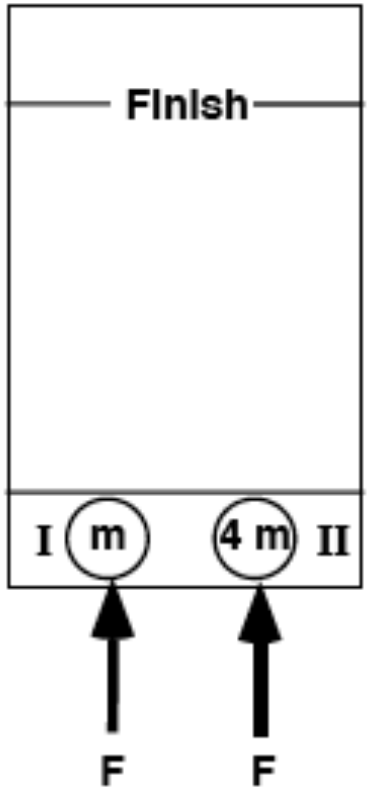

The diagram depicts two pucks on a frictionless table. Puck II is four times as massive as puck I. Starting from rest, the pucks are pushed across the table by two equal forces.

Which puck will have the greater KE upon reaching the finish line?

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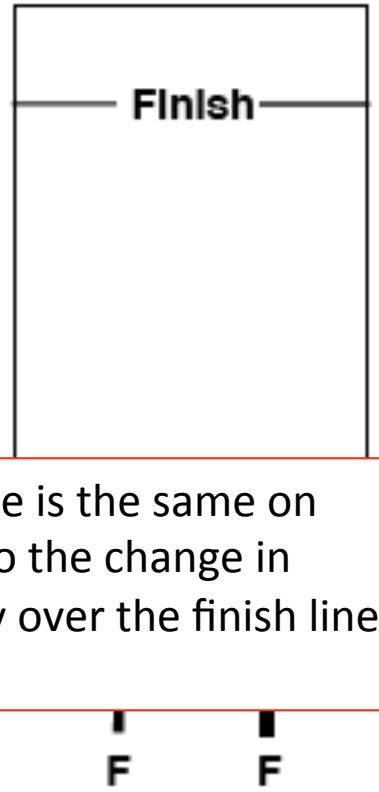
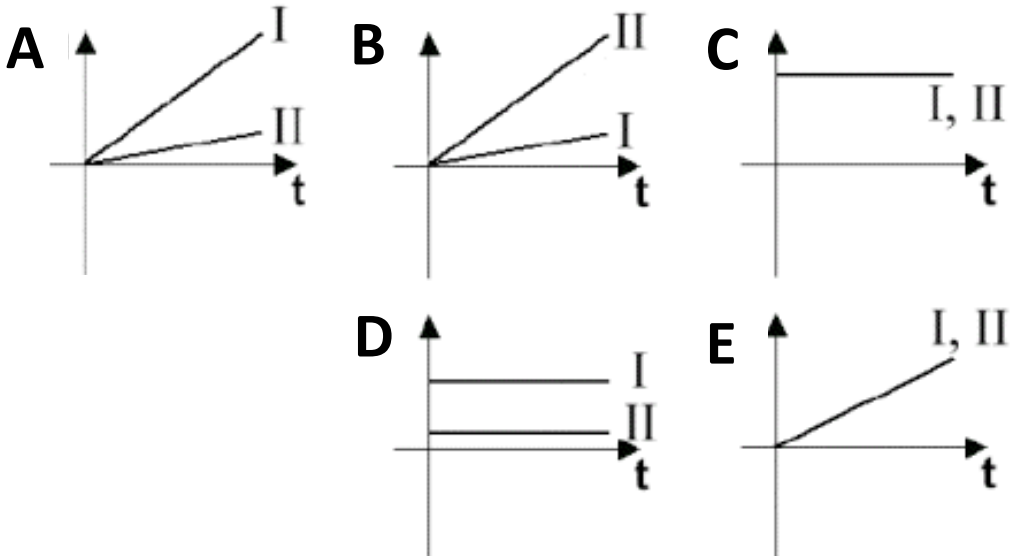
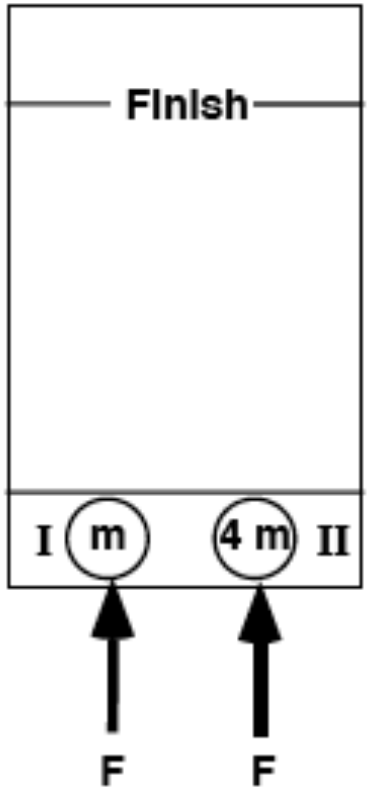


The work done is the same on both pucks. So the change in kinetic energy over the finish line is the same.

The diagram depicts two pucks on a frictionless table. Puck II is four times as massive as puck I. Starting from rest, the pucks are pushed across the table by two equal forces. Which graph might show the **speed** of the two pucks.





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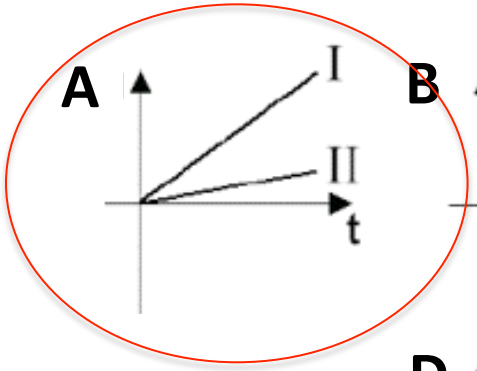
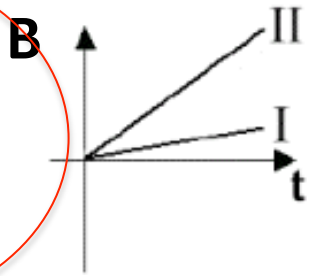
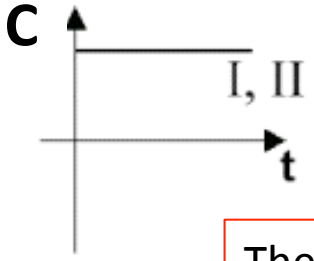
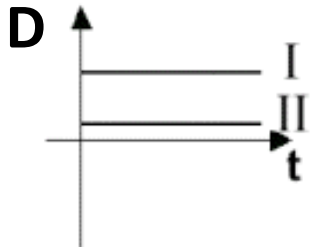
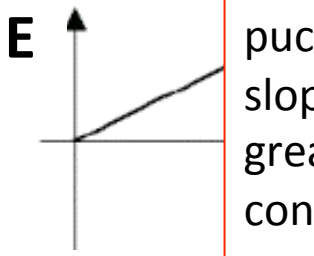
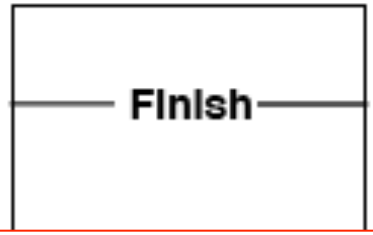




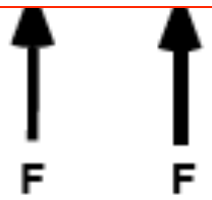








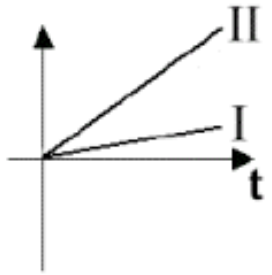
The speed at any given time for puck I is larger than puck II so the slope of the line should be greater. But there is also a constant force, so I know the speed must be changing.



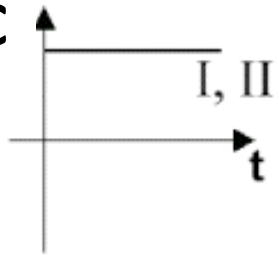
The diagram depicts two pucks on a frictionless table. Puck II is four times as massive as puck I. Starting from rest, the pucks are pushed across the table by two equal forces. Which graph might show the **momentum** of the two pucks.

A

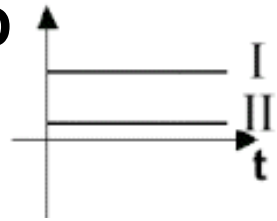
B



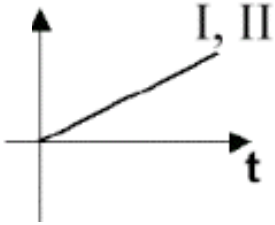
C

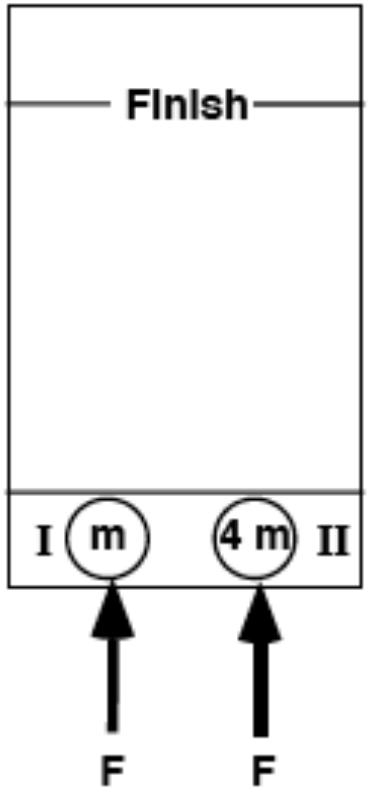


D



E





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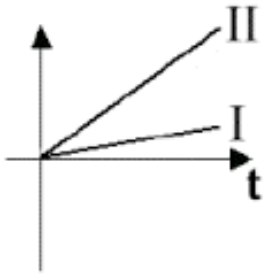

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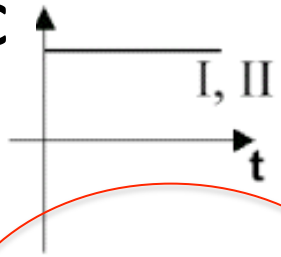

D

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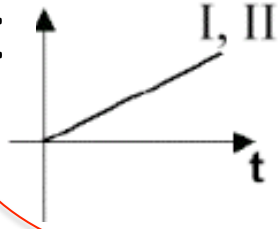
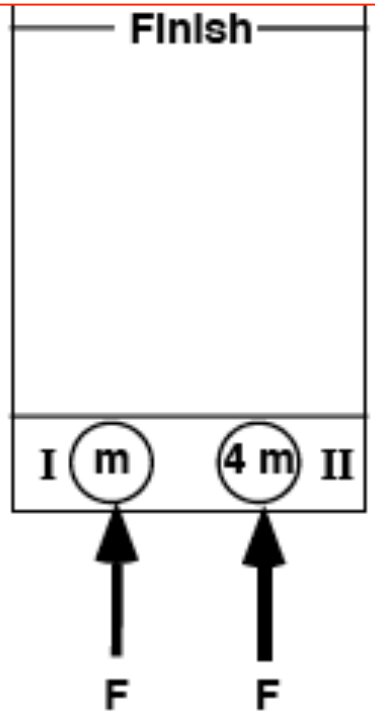


The momentum vs time graph is given to us by the momentum principle ($dp/dt = F_{net}$), so the slopes must be the same since the force on both pucks in the same.

NOTE: I made a mistake on this one in class, and confused the time axis for the position axis.



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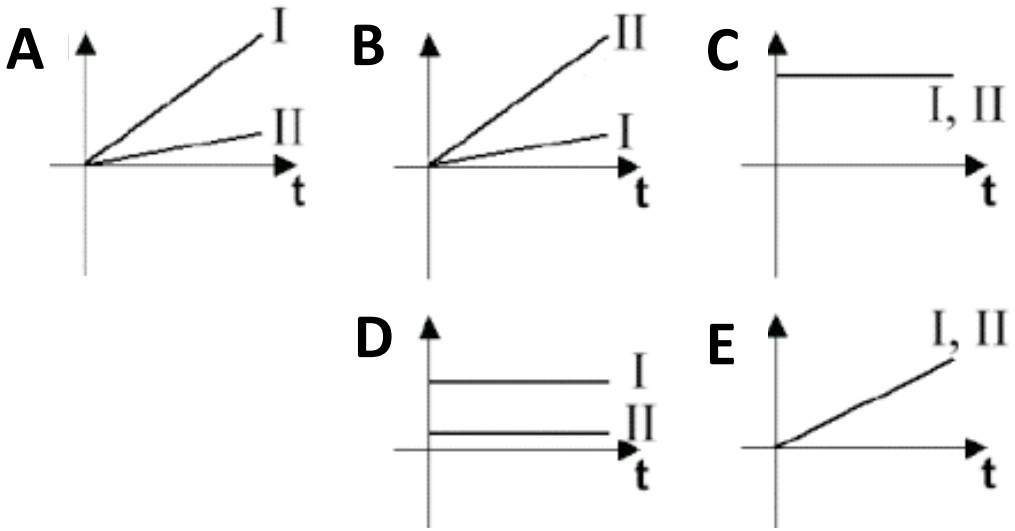

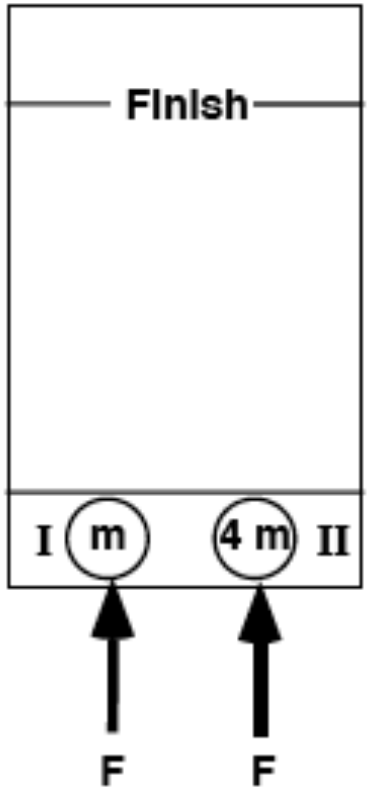

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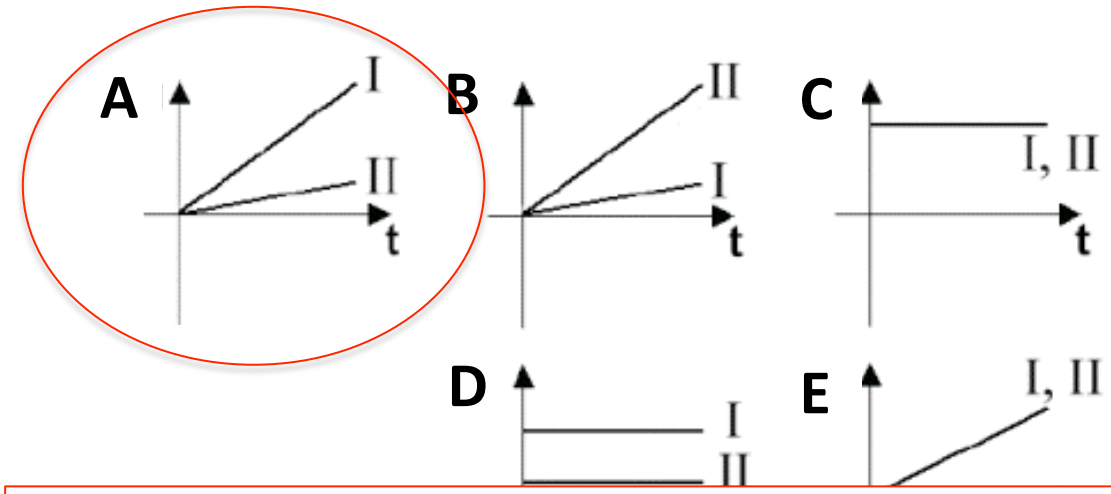
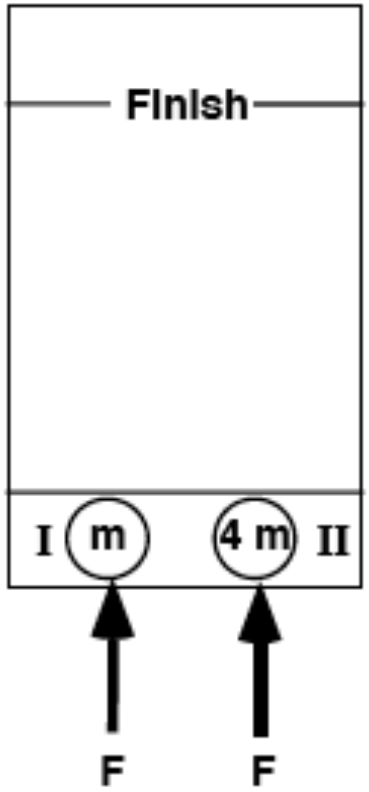


The kinetic energy of puck I changes more with each second passing than the kinetic energy of puck II because it speeds up more with each second. So since for the same amount of distance traveled they have the same amount of change in kinetic energy, but it takes puck II longer to travel that distance.



Announcements

- Homework Ch 8&9 due tonight at midnight
- Reading questions (only MC) on 8.3 & 9.5 due tomorrow night at midnight
- Bring TUTORIAL book to class on Wednesday
- Review session in C-104 from 7:30-8:30pm on Wednesday
- Extra office hours on Thursday 6:30 – 7:30pm

Dimensions and Units of Energy

- $[1/2\ mv^2] = \text{M-(L/T)}^2 = \text{ML}^2/\text{T}^2$
- 1 kg-m^2 /s^2 = 1 N-m = 1 Joule
- Other units of energy are common (and will be discussed later)
  - Calorie
  - eV (electron Volt)
  - erg (=1 g-cm^2/s^2)

But we don't ever buy 1 J of energy from BWL or from the local Shell station; so is this energy we've been talking about different from real life energy?

Power

- Power is a way for us to think about how much energy we use for a unit of time

$$P = \frac{\text{Energy change}}{\text{Time to make the change}} \qquad P = \frac{[J]}{[s]} \qquad [W] = \frac{[J]}{[s]}$$

- Unit of power

$$1 \text{ Joule/sec} = 1 \text{ Watt}$$

A typical electric bill shows our household using about 600 kWh of "energy" every month. What does this really mean?

A. My family uses about 600 J of energy every month
B. For every hour spent in our about 600 J of energy
C. For every hour spent in our about 600 $x10^3$ J of energy
D. My family uses about 600 $x10^3$ * 3600 J of energy every month

We need to go from kWh hours to joules, which means taking kW and going to 10^3Wh, then taking hours to get to sec which is 3600 sec/hr so we'd get 10^3*3600Ws, but a W*s = J.

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Ch10
What Could Happen:
The work of conservative forces and potential energy

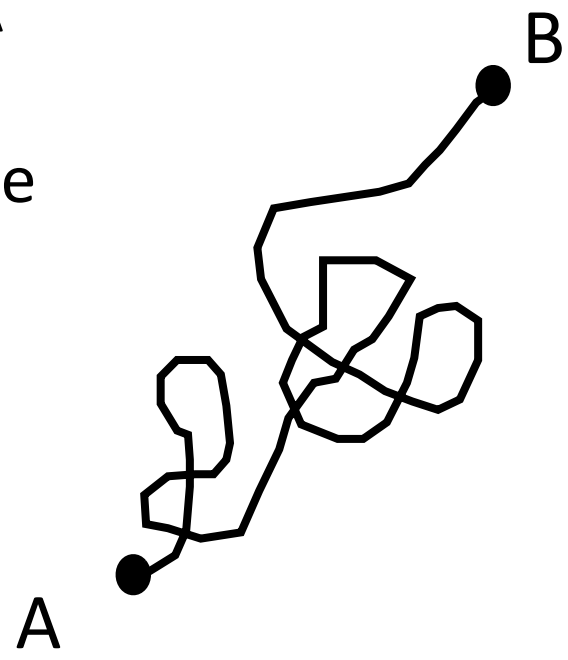
Write down as many forms of energy as you can

- Kinectic
- Thermal
- Potential (stored in position/configuration)
  - Gravitational
  - Electrostatic
    - Elasticc
    - Chemical
    - Nuclear
- Radiant = energy of light
- Mass energy ($E=mc^2$)

Feynman on Energy

- “It is important to realize that in physics today we have no knowledge of what energy is.”
- “Energy is a numerical quantity that does not change when something happens…”
- “For those who want some proof that physicists are human, the proof is in the idiocy of all the different units which they use for measuring energy.”

Consider an object moved from point A to point B, as shown. Gravity points down and exerts a constant force on the object. Which of the following statements is true regarding the work done **by gravity**?



A. The x component of the work is always zero, but the y component of the work may not be zero.
B. Gravity must do non-zero work when A and B are not coincident (meaning, not at the same point in space)
C. All that matters when calculating work is the net displacement in the y direction
D. None of the above is true **or** more than one of the above is true

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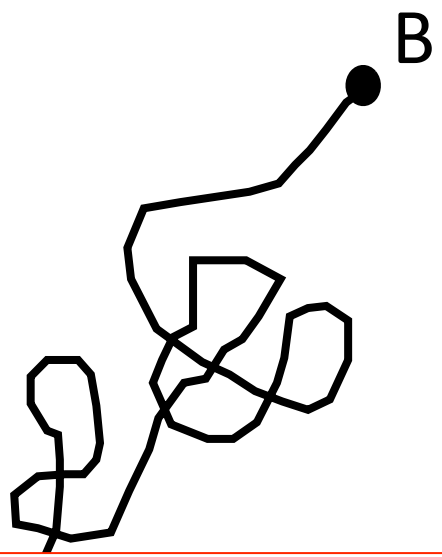

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Work is not a vector, it is a scalar so it's not A. Not B because if A & B are moved horizontally it doesn't have to be gravity that did the work.
C is true because the work is calculated by the force that is parallel with the displacement, or the part of the displacement that is parallel to the force.