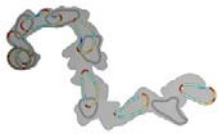
Physics 131- Fundamentals of Physics for Biologists I



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11/21/2012

http://www.youtube.com/watch?v=qybUFnY7Y8w

Review Quiz 8

Energy

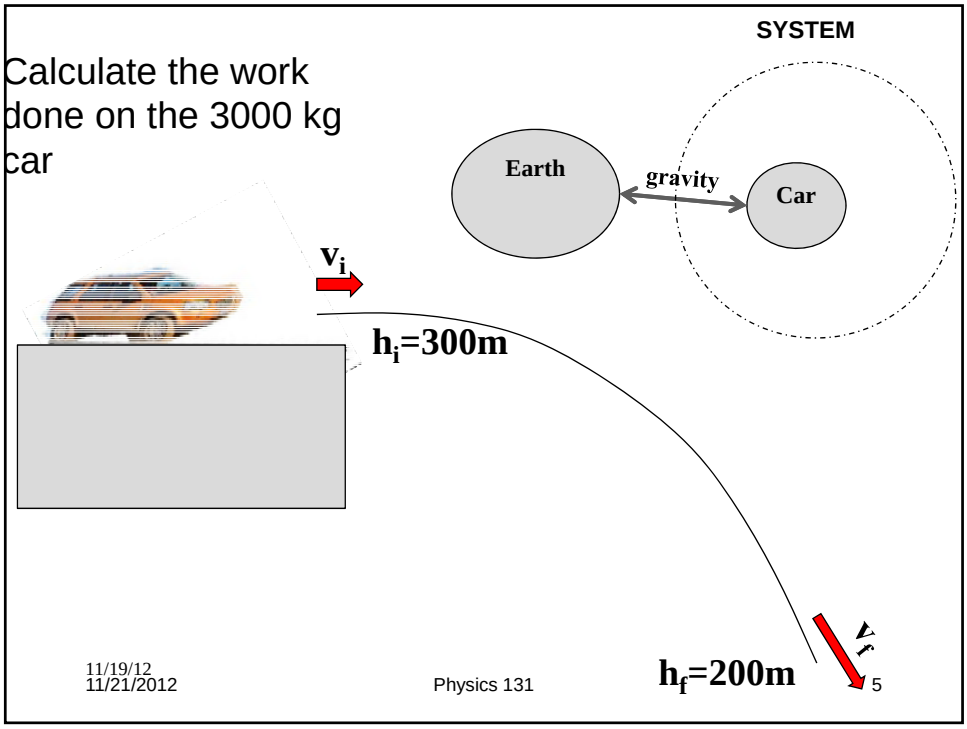
- Work Energy Theorem
- Conservative and non-conservative forces
- Potential Energies

Quiz 8
Avg 6

CORRECT	C	C	A	A	16
other	A	A	D	B	4

Foothold ideas:
Kinetic Energy and Work

- Newton's laws tell us how velocity changes. The Work-Energy theorem tells us how speed (independent of direction) changes.
- Kinetic energy = $\frac{1}{2}mv^2$
- Work done by a force = $F_x \Delta x$ or $F_{||} \Delta r$ (part of force || to displacement)
- Work-energy theorem: $\Delta(\frac{1}{2}mv^2) = F_{||}^{net} \Delta r$


SYSTEM
Calculate the work done on the 3000 kg car
Earth
gravity
Car
v_i
h_i=300m
h_f=200m
v_f
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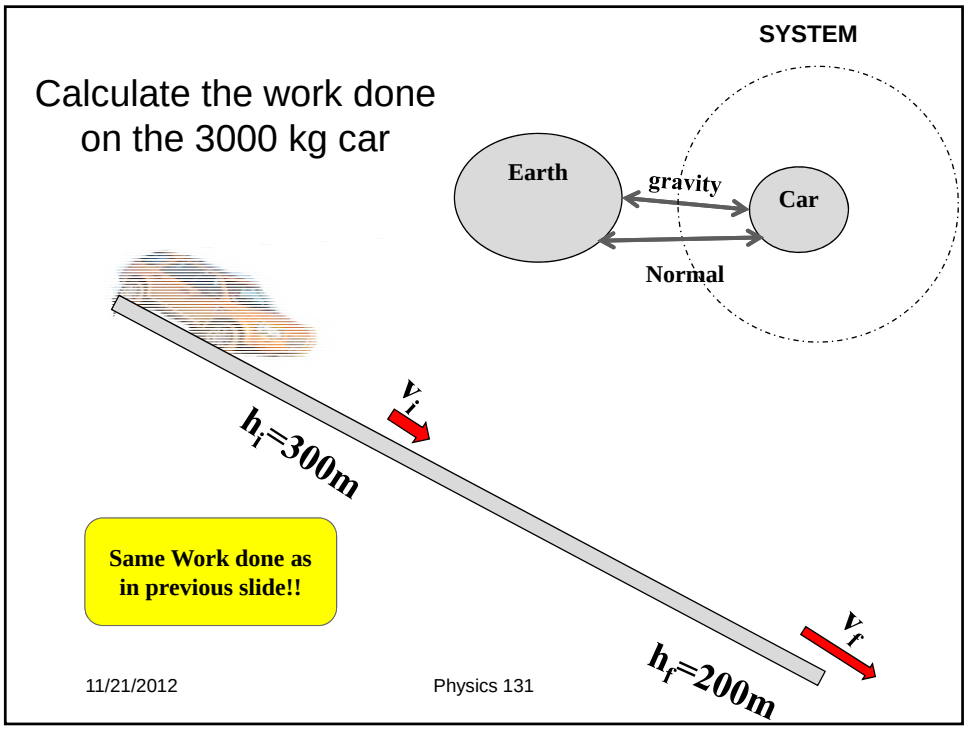
SYSTEM
Calculate the work done on the 3000 kg car
Earth
gravity
Car
Normal
v_i
h_i=300m
Same Work done as in previous slide!!
v_f
h_f=200m
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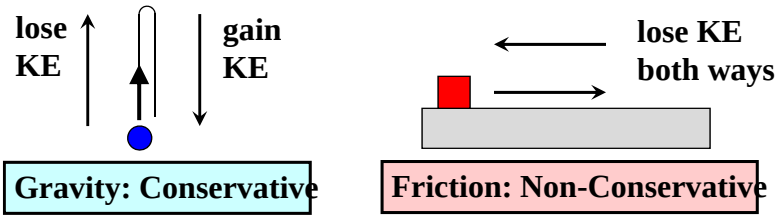
Conservative forces

- Forces (like gravity or springs) are conservative if when the force takes KE away, you can get it back when you go back to where you started.
- If the kinetic energy that a force takes away can't be restored by going back to where you started it is called non-conservative.
- Compare gravity and friction:



Non-conservative forces/situations

- Friction / drag
  - Three kinds of forces drain ME: friction (indep. of v), viscous force (prop. to v), drag (prop. to v^2)
- Breaking / crushing
  - Normal forces are typically springy and conservative.
  - If an object is deformed too much, the structure can change (break) and drain ME.
- Chemical reactions
  - Chemical structure is another kind of potential energy that can be stored. It can create or drain ME.

Foothold ideas: Potential Energy

For some forces (gravity, electricity, springs) work only depends of the change in position. Such forces are called conservative.

For these forces the work done by them is written

$$\vec{F} \cdot \Delta\vec{r} = -\Delta U$$

U is called a *potential energy*.

For gravity, $U_{gravity} = mgh$

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Energy Conservation

- Total of kinetic and potential energy are conserved
- normal forces do no work
- Examples:
  - Drive off cliff
  - Drive down hill

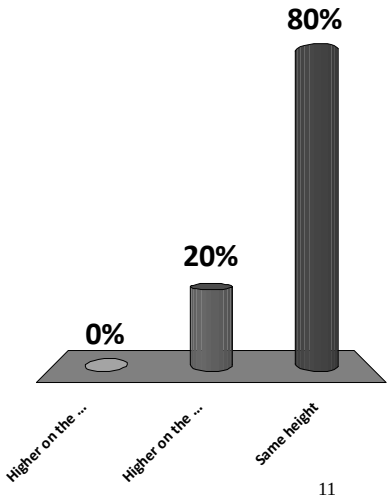
$$\Delta(\tfrac{1}{2}mv^2) = mg\Delta h$$

$$\Delta(\tfrac{1}{2}mv^2 + mgh) = 0$$

$$\tfrac{1}{2}mv_i^2 + mgh_i = \tfrac{1}{2}mv_f^2 + mgh_f$$

The pendulum will go

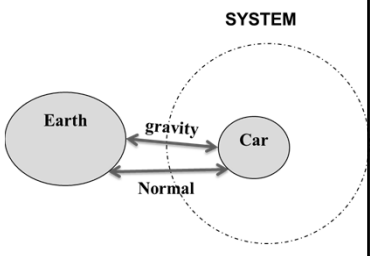
1. Higher on the left side (from your perspective)
2. Higher on the right side (from your perspective
3. Same height

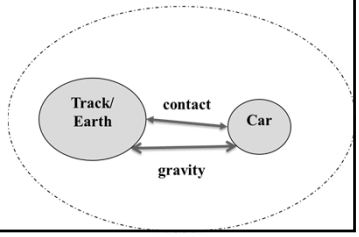


Energy Conservation or Change in Energy through Work?

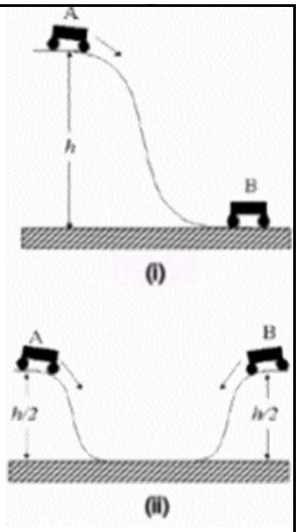
-> It depends on how we define our “system”

- Work changes energy of system
  - Gravitational force does work on system
- Energy of system conserved
  - Total energy includes potential energy of Earth - Car gravitational interaction





Two identical carts A and B roll down a hill and collide as shown in the figures at the right.
(i): A starts from rest. It rolls down and collides head-on with B which is initially at rest on the ground. The two carts stick together.
(ii): A and B are at rest on opposite. They roll down, collide head-on and stick together.



Which statement is true about the two-cart system <u>just before</u> the carts collide in the two cases?

1. The kinetic energy of the system is zero in case (ii).
2. The kinetic energy of the system is greater in case (i) than in case (ii).
3. The kinetic energy of the system is greater in case (ii) than in case (i).
4. The kinetic energy of the system is the same in both cases (but not 0).
5. More than one statement is true.