Last class, we learned...

**Chapter 8. Potential Energy and Conservation of Energy**

If non-conservative forces do work on an object, in addition to conservative force,

→ Mechanical energy changes by the amount of work done by the non-conservative force.

\[ \Delta E_{\text{mech}} = \left( K_f + U_f \right) - \left( K_i + U_i \right) = W_{\text{non-conservative}} \]

that is, \[ U_{gi} + U_{si} + K_i + W_{nc} = U_{sf} + U_{sf} + K_f \]

For a constant non-conservative force,

\[ W_{nc} = |\vec{F}_{nc}|d \cos (\vec{F}_{nc} \cdot \vec{d}) = F_{nc}d \cos \theta \]
Sample Problem 8-7
In Figure, a 2.0 kg package of tamale slides along a floor with speed $v_1 = 4.0 \text{ m/s}$. It then runs into and compresses a spring, until the package momentarily stops. Its path to the initially relaxed spring is frictionless, but as it compresses the spring, a kinetic frictional force from the floor, of magnitude 15 N, acts on the package. If $k = 10 000 \text{ N/m}$, by what distance $d$ is the spring compressed when the package stops?

Work and energy for System of objects
Example: Atwood Machine (HW9 Prob2)  
Example: two blocks in touch

System : m1, m2, rope

Horizontal surface
System : m1 and m2
**Work and Energy for System of objects**

External forces: Forces from outside the system

Internal forces: Forces between objects within the system
- Apply Newton's 3rd law
- Action and Reaction Forces have equal magnitudes & opposite directions.

Analysis of the system as a whole
- Consider external forces only

Analysis of each object within the system
- Consider both external and internal forces

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**Example: Atwood Machine (HW9 Prob2)**

- **System:** m1, m2, rope
- **External force:**
  - Gravity, Normal force from pulley
- **Internal force:**
  - Tensions between rope and objects
**Work and energy for System of objects**

Example: two blocks in touch

Horizontal surface

External force: $F$, Gravity, Normal force from surface, Friction force

Internal force: Normal force between $m_1$ and $m_2$

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**HW9 002 (part 1 of 2) 10 points**

A simple Atwood’s machine uses two masses $m_1$ and $m_2$. Starting from rest, the speed of the two masses is 7.6 m/s at the end of 2.7 s. At that time, the kinetic energy of the system is 51 J and each mass has moved a distance of 10.26 m.

The acceleration of gravity is 9.81 m/s².

External force: Gravity, Normal force from pulley

Internal force: Tensions between rope and objects

Find the value of heavier mass. Answer in units of kg.

**003 (part 2 of 2) 10 points**

Find the value of lighter mass. Answer in units of kg.

Extra problem: Find the work done on $m_2$ by Tension