HW hints are posted on course web (http://web.njit.edu/~kenahn)

**Common exam 3**
Nov. 21st, Friday
8:30 – 9:45 am (arrive by 8:15 am) at Kupfrian Hall 209
Bring your ID and scientific calculator

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**Work and Energy**

Conservative vs. Non-conservative forces
Gravitational Potential Energy
Conservation of Mechanical Energy
Work by Non-conservative force
Spring force and spring potential energy

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Summary
Examples
**Gravitational Potential Energy**

- Mass \( m \)
- Height \( h \)

Gravitational Potential Energy:

\[
U_g = mgh
\]

(Note: Height, \( h \), should be measured along vertical direction.)

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**Spring force**

Hooke’s law:

\[
F_{spring}(x) = -kx
\]

- \( x \): displacement from relaxed position
- \( k \): spring constant (N/m)

**Spring Potential Energy**

Spring (elastic) potential energy:

\[
U_{spring}(x) = U_s = \frac{1}{2}kx^2
\]
Conservation of Mechanical Energy with spring and gravity

Work-Energy Theorem: \( K_f - K_i = W_{net} \)

Mechanical energy:
\[
E_{mech} \equiv K + U_g + U_s = \frac{1}{2}mv^2 + mgh + \frac{1}{2}kx^2
\]

If \( W_{net} = W_g + W_s \)

or, if gravity and spring are the only forces that do work,

\[
\Rightarrow E_{mech,f} = E_{mech,i}
\]

"Conservation of mechanical energy"

Mechanical Energy and Non-conservative force

If both non-conservative and conservative forces do work,

(conservative forces: gravity, spring)

(non-conservative forces:
Friction, Normal force, Tension, Other applied forces)

then

\[
E_{mech,f} - E_{mech,i} = \Delta E_{mech} = W_{nc}
\]

(Work by non-conservative force) = (Change in mech. E.)
iClicker Quiz

A person throws a ball 30 degree from horizontal from the top of a 20 m high building. Neglect the air resistance.

True or false?

(1) The ball has zero kinetic energy at the maximum height.
   (a) True     (b) False

(2) If he throws the ball at a different angle but with the same speed, the ball would hit the ground at a different speed.
   (a) True     (b) False

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iClicker Quiz

You need 4 N force to stretch a spring by 0.1 m. How large force you would need to stretch the same spring 0.2 m?

   a) 2 N
   b) 4 N
   c) 8 N
   d) 16 N
iClicker Quiz 2

A spring stretched by 0.1 m has 1 J spring potential energy. What would be the spring potential energy if the same spring is compressed by 0.2 m?

a) 2 J
b) 4 J
c) -2 J
d) -4 J