HW: Power and energy (Due 11 pm central time, 11/18, Tuesday).
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

Exam covers B1: Ch. 5 Sec.1-5 and B2: Ch. 7 & 8

To combat cheating, the provost has stipulated while students are taking their exams
1) students must show their ID upon entering the classroom,
2) there is no cell phone use,
3) if a student leaves the room during test time, e.g. Men's/Ladies' room, he/she forfeits finishing the exam.

Review Session : during lecture on 11/17, Tuesday

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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

More Examples
Power

Today...
iClicker Quiz

As a sled moves across a flat, snow-covered field at a constant velocity, net work done on the sled is _______.
    a) Positive
    b) Zero
    c) Negative
...and work done by the air resistance is _______.
    a) Positive
    b) Zero
    c) Negative

iClicker Quiz

When the block is momentarily stopped by the spring, the spring is compressed by distance d.

1. If the mass is doubled, what would be the compressed distance?
   (a) 0.5d  (b) d  (c) \( \sqrt{2}d \) (d) 2d (e) 4d

2. If the initial speed is doubled, what would be the compressed distance?
   (a) 0.5d  (b) d  (c) \( \sqrt{2}d \) (d) 2d (e) 4d
Example: Spring potential
A block of mass $m = 0.40 \text{ kg}$ slides across a horizontal frictionless counter with a speed of $v = 0.50 \text{ m/s}$. It runs into and compresses a spring of spring constant $k = 750 \text{ N/m}$. When the block is momentarily stopped by the spring, by what distance $d$ is the spring compressed?

![Diagram of a block sliding over a spring](image)

Power

Work doesn't depend on the time interval

- Work to climb a flight of stairs: $3000 \text{ J}$
- $10 \text{ s}$
- $1 \text{ min}$
- $1 \text{ hour}$

Power is work done per unit time

- Average Power $P_{\text{avg}} = \frac{W}{\Delta t}$
- Instantaneous Power $P = \frac{dW}{dt} = F \frac{dx}{dt} = Fv$

(in 1D)

Units

<table>
<thead>
<tr>
<th>Work</th>
<th>time</th>
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| $1 \text{ J}$ | $1 \text{ s}$ | 1 Watt | 1 hp = $746 \text{ W}$

In 2D & 3D, Power: $P = \vec{F} \cdot \vec{v} = |\vec{F}| |\vec{v}| \cos \theta_{F,v}$
Work done by a force

\[ W = \left| \vec{F} \right| \left| \vec{d} \right| \cos \theta_{F,d} \equiv \vec{F} \cdot \vec{d} \]

Force

Displacement

Power done by a force

\[ P = \left| \vec{F} \right| \left| \vec{v} \right| \cos \theta_{F,v} \equiv \vec{F} \cdot \vec{v} \]

Force

Velocity

iClicker Quiz

An older model car accelerates from 0 to speed \( v \) in 10 second. A newer, more powerful sports car accelerates from 0 to \( 2v \) in the same time. What is the ratio of the power expended by the two cars? Assume the energy comes from the engine appears only as kinetic energy of the car.

- a) 2 to 1
- b) 4 to 1
- c) 1 to 1
- d) 1 to 2
- e) 1 to 4