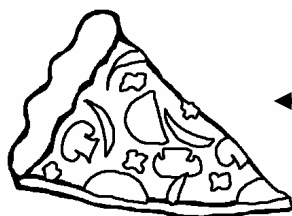


SPS Lunchbox Seminar

“The Pierre Auger Observatory: Capturing Messengers from Outer Space ”

Gregory R. Snow, University of Nebraska



← only \$1 a slice!

Monday, October 22nd, 12:30 pm

SPS Lounge (B135)

Abstract: Large-aperture cosmic ray observatories are opening a new window to the cosmos. A broad-based international collaboration has come together to build the world's largest air shower detector to make an all-sky study of cosmic rays at energies above 10^{19} eV. As yet there are no known sources and no known mechanism for accelerating particles to the highest energies. Energy, direction, and composition measurements will illuminate the mysteries of these particles, the most energetic in nature. The southern hemisphere site of the Auger Observatory is now approaching completion in Mendoza Province, Argentina. Progress and first results will be reported, as well as plans for the northern hemisphere site. Complementary projects (in Nebraska, Seattle, and elsewhere) which enlist high school science teachers and students in the study of extensive cosmic ray air showers will also be described.

Exam solutions are posted on the class website:

<http://faculty.washington.edu/storm/121C/>

Expect to return graded exams Friday.

**Homework assignment – lighter than usual.
Is posted now on Tycho.
Still due Wed before midnight.**

Chapter 5.5 Center of Mass

With $M = \sum_i m_i$ being the total mass, we define

the **center of mass position** \vec{r}_{cm} by

$$M\vec{r}_{cm} = \sum_i m_i \vec{r}_i$$

Examples

Extended objects: $M\vec{r}_{cm} = \int \vec{r} dm$

Examples

Combining systems by C.M.

Examples

C.M. is useful because the sum of all the external forces on the system causes the C.M.

to move according to $\vec{F}_{ext} = M\vec{a}_{cm}$

Example

Chapter 6.1 and 6.2 **Work**

By a constant force

$W = F_x \Delta x$ where the displacement is Δx .

Force **IN THE DIRECTION OF DISPLACEMENT** times Displacement.

Can be positive or negative. Because of Newton's 3rd, work by A on B is opposite sign from work by B on A at same time.

Examples

Work – Kinetic Energy:

start with $v_f^2 = v_i^2 + 2a_x \Delta x$ and then $a_x = \frac{F_x}{m}$

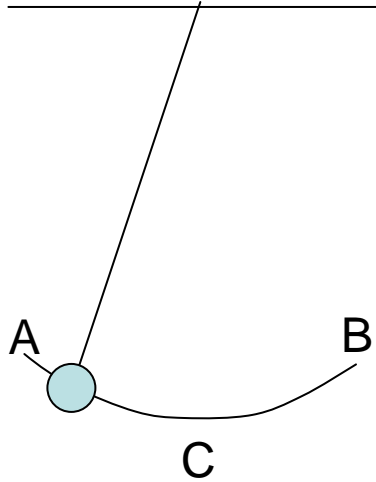
so $v_f^2 = v_i^2 + 2\frac{F_x}{m} \Delta x$ solve this for work

$$W = F_x \Delta x = \frac{mv_f^2}{2} - \frac{mv_i^2}{2} \text{ note } v^2 = v_x^2 + v_y^2 + v_z^2$$

$$K = \frac{mv^2}{2} \text{ is Kinetic Energy (definition)}$$

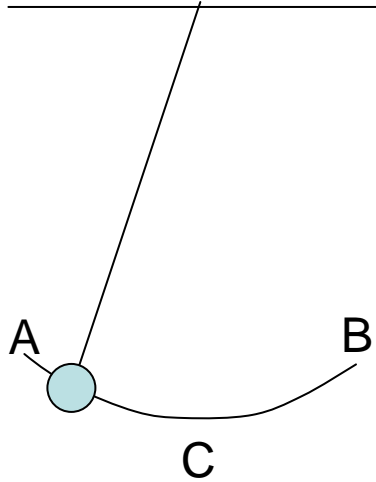
Positive **NET** work on a thing increases its K.
Negative NET work **on** a thing is positive NET work **by** the thing. It decreases the thing's K.
Demo.

In which situation is net work being done.



- A. A laborer carries a box of bricks along a level path.
- B. A student does homework correctly.
- C. A car goes around a curve at constant speed.
- D. The Olympic crew rows their shell through the water at constant speed.
- E. The pendulum swings from A to C.

In which situation is no work being done.



- A. A laborer carries a box of bricks along a level path.
- B. An airplane takes off.
- C. A car goes around a curve at constant speed, in the real world (there is rolling friction and air drag).
- D. The Olympic crew rows their shell through the water at constant speed.
- E. The pendulum swings from A to C.