Common Exam 3

April 11th, 2008, Friday

Time: 8:30-9:45 am (Arrive by 8:15 am)
Room: KUPF 205
Bring your scientific calculators

B1. Ch.5 and B2. Ch.7-8

Review session: During class on Thursday before exam

HW due every Monday

http://web.njit.edu/~kenahn/08spring/phy105.htm

Work and Energy

(Work, Work-Energy Theorem)

Conservative vs. Non-conservative forces

Gravitational Potential Energy

Conservation of Mechanical Energy

Work by Non-conservative force — Last class…

(more example) — Today…

Spring force and spring potential energy

Motivation

Do we really have to learn about energy and work???

Yes. See Pepsi Pinball Movie

Energy changes its form, for example,
potential, kinetic, mechanical, thermal, electric, magnetic, light, sound, chemical, biological, and so on,
but it is a conserved quantity.

Example: Kinetic energy and projectile motion

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?

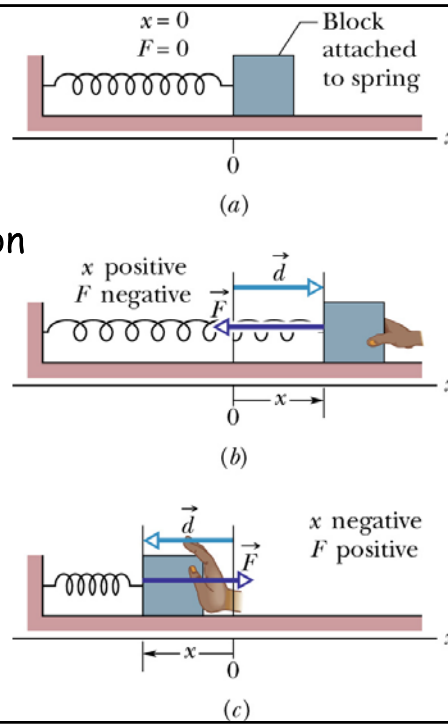
(a) The ball has zero kinetic energy at the maximum height.

False

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

False

Spring force



Spring force:

restoring force

changes with position

Hooke's law:

$$F_{spring}(x) = -kx$$

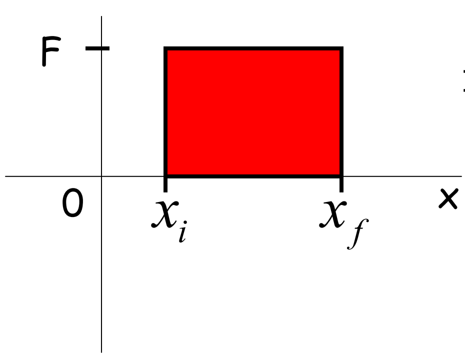
x: displacement from relaxed position

k: spring constant (N/m)

Work done by a constant force (ex: gravity force)

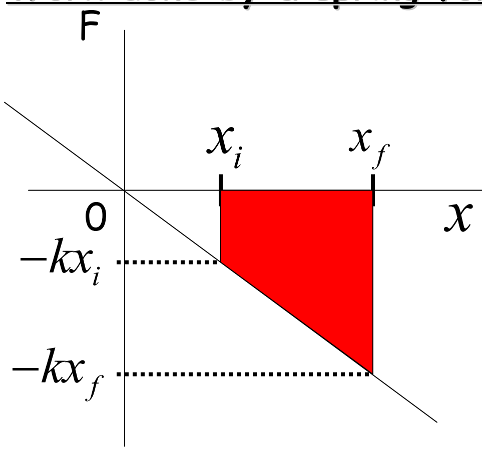
$W = Fd\cos\theta$: work done by a "*constant*" force

For 1D: $W = F\Delta x = F(x_f - x_i)$



$\pm$ (Area in F vs. x graph) = (Work done by F)

Work done by a spring force



$\pm$ (Area in F vs. x graph) = (Work done by F)

→ $$W_{spring} = \frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2$$

(see text for proof)

depends only on initial and final position

Spring force: conservative force

Spring Potential Energy

$$W_{spring} = \frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2 = U_{s,i} - U_{s,f}$$

where

Spring (elastic) potential energy :

$$U_{spring}(x) = U_s = \frac{1}{2}kx^2$$

$$W_s = U_{s,i} - U_{s,f} = -(U_{s,f} - U_{s,i}) = -\Delta U_s$$

→Work done by spring is negative of spring P.E. change

Quick Quiz 1

You need 4 N force to stretch a spring by 0.1 m.

How much force you would need to stretch the same spring 0.2 m?

8 N

Quick 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?

4 J

<u>Conservation of Mechanical Energy with spring and gravity</u>

Work-Energy Theorem: $K_f - K_i = W_{net}$

Mechanical energy :

$$E_{mech} \equiv K + U_g + U_s \quad = \frac{1}{2}mv^2 + mgh + \frac{1}{2}kx^2$$

If $W_{net} = W_g + W_s$

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

→ $$E_{mech,f} = E_{mech,i}$$

"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)

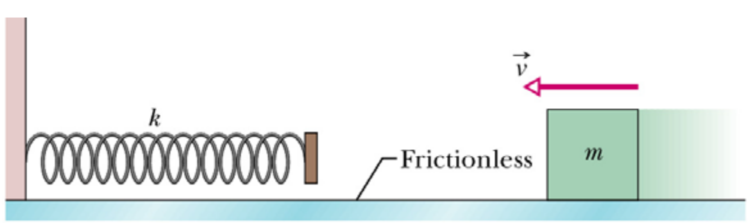
then

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

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

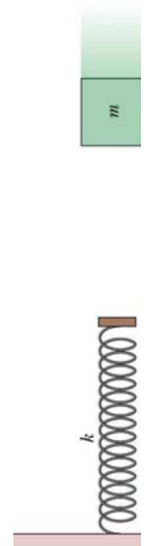
Example: Spring potential

A block of mass $m = 0.40\ kg$ slides across a horizontal frictionless counter with a speed of $v = 0.50\ m/s$. It runs into and compresses a spring of spring constant $k = 750\ N/m$. When the block is momentarily stopped by the spring, by what distance ***d*** is the spring compressed?



Example: Spring potential and Gravitational potential

A block of mass $m = 0.40\ kg$ drops vertically and encounter the spring with a speed of $v = 0.50\ m/s$. It compresses a spring of spring constant $k = 750\ N/m$. When the block is momentarily stopped by the spring, by what distance ***d*** is the spring compressed?



Common Exam 3

April 11th, 2008, Friday

Time: 8:30-9:45 am (Arrive by 8:15 am)
Room: KUPF 205
Bring your scientific calculators

B1. Ch.5 and B2. Ch.7-8

Review session: During class on Thursday before exam

HW due every Monday

http://web.njit.edu/~kenahn/08spring/phy105.htm