NO Reading assignment

H.W Due today

Grp 6 on D2L

Exam 2 Monday 7:30 A.M - 9:20 A.M

Ch 4-5 only

16 Questions 1 free

Exact same format as exam 1

* DST Sunday

Spring forward ⇒ clocks 1 hour ahead

Interactive Question

A weightlifter lifts a heavy weight over his head and then sets it back down. The work that the weightlifter does on the bar is:

A) Greater than 0 since he applies a force in the direction of the displacement

B) Equals 0 since the change in Kinetic Energy = 0

C) Equals 0 since he does not apply any force while lifting the bar

D) Less than 0 since the force he applies is opposite in direction to the displacement

E) Equals 0 since the work he does in lifting the bar up is equal and opposite to the work he does setting it down

WE found a relationship between work and kinetic energy

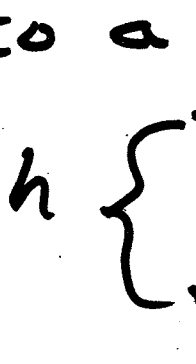
$W_{net} = \Delta K$

2 forms of energy, kinetic and potential

→ Relationship between work and potential energy

Gravity

Suppose I raise a ball to a height $h = y_f - y_i$



How much work has been done by me on the ball?

$W = F d \cos\theta$

$W_{mE} = mgh = mg(y_f - y_i)$

$\Delta K = 0$ so net work $= 0$

Only me and gravity are doing work on the ball and net work $= 0$ so work done by gravity must be <u>equal</u> and <u>opposite</u> to work I have done.

$W_{mg} = mgh = mg(y_f - y_i)$

therefore

$W_G = -mgh = mg(y_i - y_f)$

$W_G = mgy_i - mgy_f$

$= U_i - U_f$

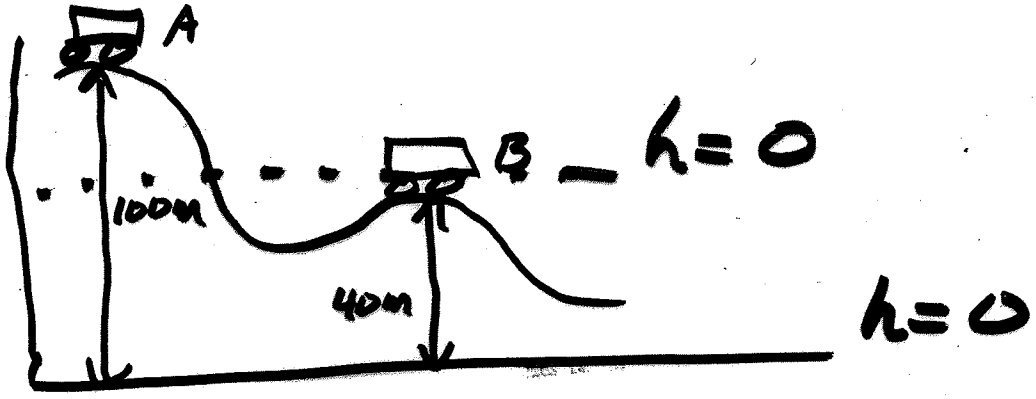
Define as potential energy (U)

$$\boxed{U_G = mgh}$$

Define $\Delta U = U_f - U_i$

$W_G = -\Delta U$

ex) A roller coaster car slides down a frictionless track



What is the change in potential energy of the car if it has a mass of 100 kg?

A) $U_A = mgh_A = (100kg)(9.8m/s^2)(100m)$

$98,000J$

B) $U_B = mgh_B = (100kg)(9.8m/s^2)(40m)$

$39,200J$

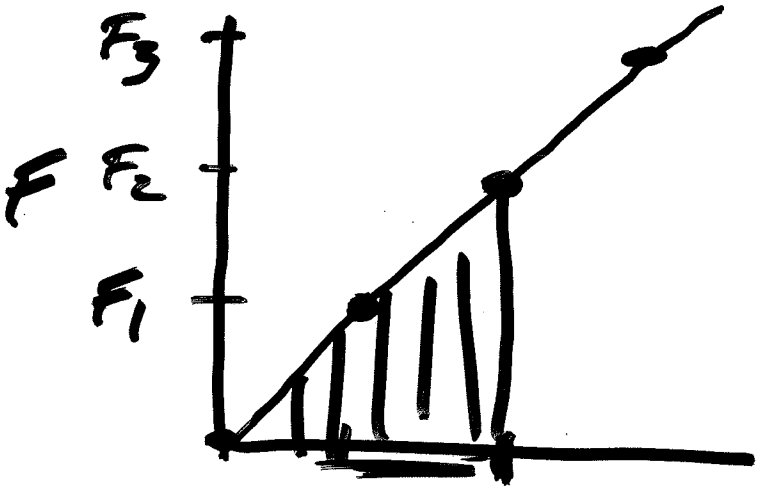
$U_A - U_B =$ $58,800J$

$U_A = mg \cdot 60m = 58,800J$

$U_B = mg \cdot 0 = 0J$

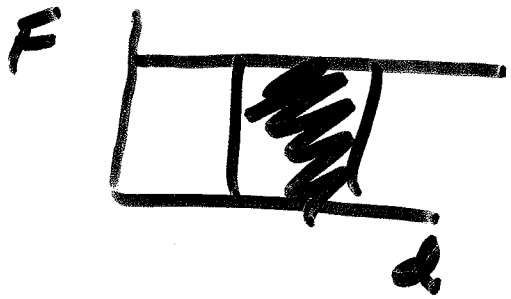
$U_A - U_B =$ $58,800J$

Spring



x distance stretched

$F = kx$ k = slope spring constant



Area under curve = $F \cdot d \equiv$ work

Area of triangle = $\frac{1}{2}bh$

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

work = $\frac{1}{2}kx^2$

potential energy of a spring $\frac{1}{2}kx^2$

Gravity

Work done in a gravitational field does not depend on path taken.

=> Gravitational potential energy is always the same at the same height regardless of path taken

If work done is independent of path taken → conservative force

Spring, gravity → conservative

Friction → not conservative

$W_{net} = \Delta K = W_c + W_{nc}$

we found earlier $W_c = -\Delta U$ (gravity)

$\Delta K = -\Delta U + W_{nc}$

$W_{nc} = \Delta K + \Delta U$

If we only have conservative forces $W_{nc} = 0$

$\Rightarrow \Delta K + \Delta U = 0$

$\frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 + U_f - U_i = 0$

$\frac{1}{2} m v_f^2 + U_f - \left(\frac{1}{2} m v_i^2 + U_i\right) = 0$

Total energy = kinetic + potential

$E_f = K_f + U_f \qquad E_i = K_i + U_i$

$E_f - E_i = 0 \Rightarrow E_f = E_i$

Energy is conserved (mechanical)

Potential Energy

Potential of an object to do work

→ spring

→ Gravity

For Gravity

→ No absolute scale for potential energy. Something that is higher has a higher potential energy than something that is lower

Interactive Question

Two marbles, one twice as heavy as the other, are dropped to the ground from the roof of a building. Just before hitting the ground, the heavier marble has

A) as much kinetic energy as the lighter one.
B) twice as much kinetic energy as the lighter one.
C) half as much kinetic energy as the lighter one.
D) four times as much kinetic energy as the lighter one.
E) impossible to tell.

Interactive Question

In which system is there a decrease in potential energy?

A) A boy stretches a spring.
B) A child slides down a sliding board.
C) A crate rests at the bottom of an inclined plane.
D) A car ascends up a steep hill.
E) More than one of the above