Force, Work, and Potential Energy

Pre-Lecture Questions

Problem Set #22 (due next time)

Lecture Outline

1. Conservative and Non-conservative forces.
2. Gravitational Potential Energy
3. Spring Potential Energy
4. The Law of Conservation of Energy

Pre-Class Summary:

Conservative forces do no work around a closed loop so the work they do depends only on the initial and final position. This fact allowed us to establish the

Definition of Potential Energy $\Delta U \equiv -W_c$

We applied this definition to two conservative forces to get specific expressions for

Gravitational Potential Energy $U_g = mgy$ and Spring Potential Energy $U_s = \frac{1}{2}kx^2$.

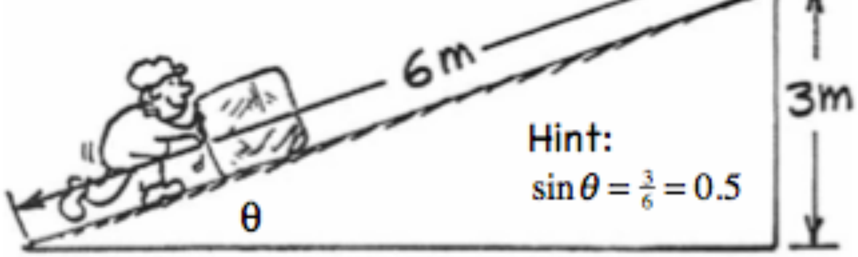
For systems with only conservative forces acting we have a preliminary statement of

The Law of Conservation of Energy

"Energy may be transformed from one type to another, but the total energy always remains constant."

written mathematically as $\Delta K + \Delta U = 0$.

Workin' for a Livin'



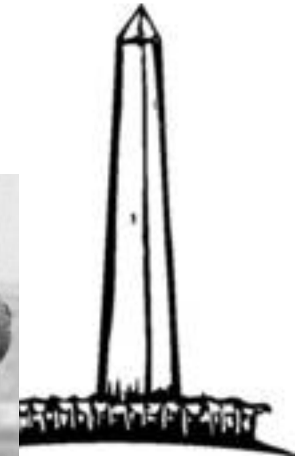
A worker pushes a block 6m up an incline.
1. Draw the free body diagram for the block.
2. Find the component of the gravitational force along the incline.
3. Find the work done by gravity on the block.

Suppose the worker just lifted the block straight upward 3m.
1. Draw the free body diagram for the block.
2. Find the vertical component of the gravitational force along the motion.
3. Find the work done by gravity on the block.

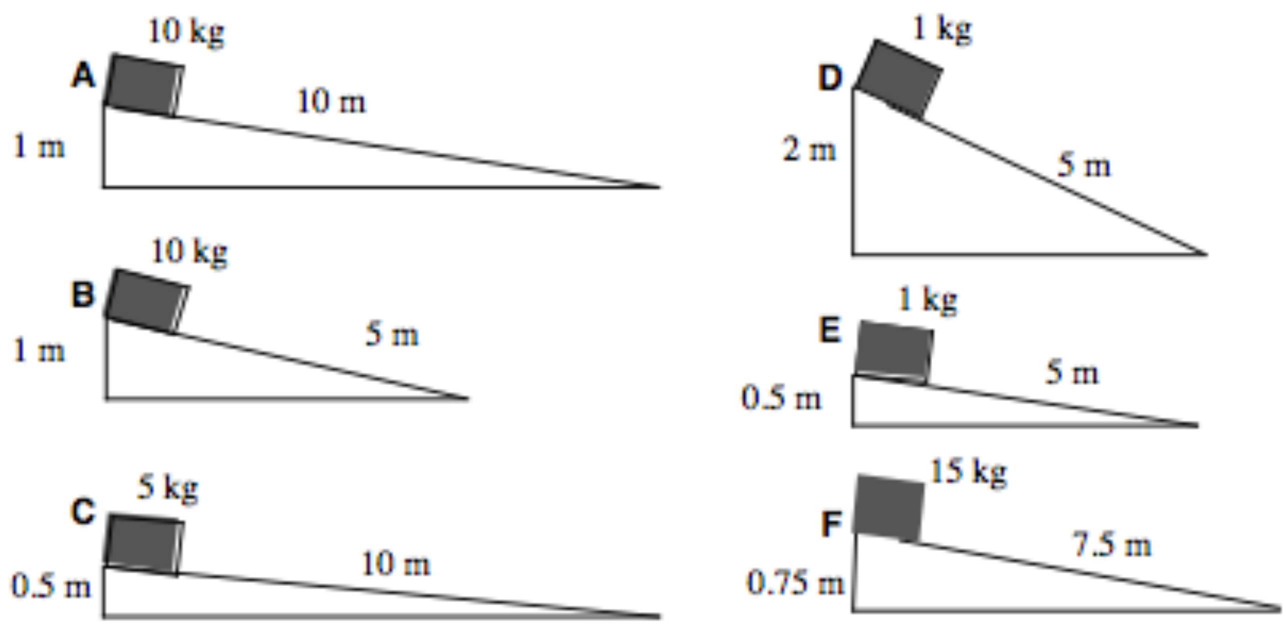
Compare this answer to the one above. What does it tell you about the gravitational force?

Revisiting an old problem…

Example 1: Gabby Street was a catcher for the Washington Senators from 1909 to 1911. He reputedly caught a baseball (m = 150g) dropped from the top of the Washington Monument known to be 555ft (170m) tall. Assume there is no air resistance. Find (a)the gravitational potential energy of the ball at the top, (b)the kinetic energy of the ball at the bottom, and (c) the speed of the ball when he caught it.

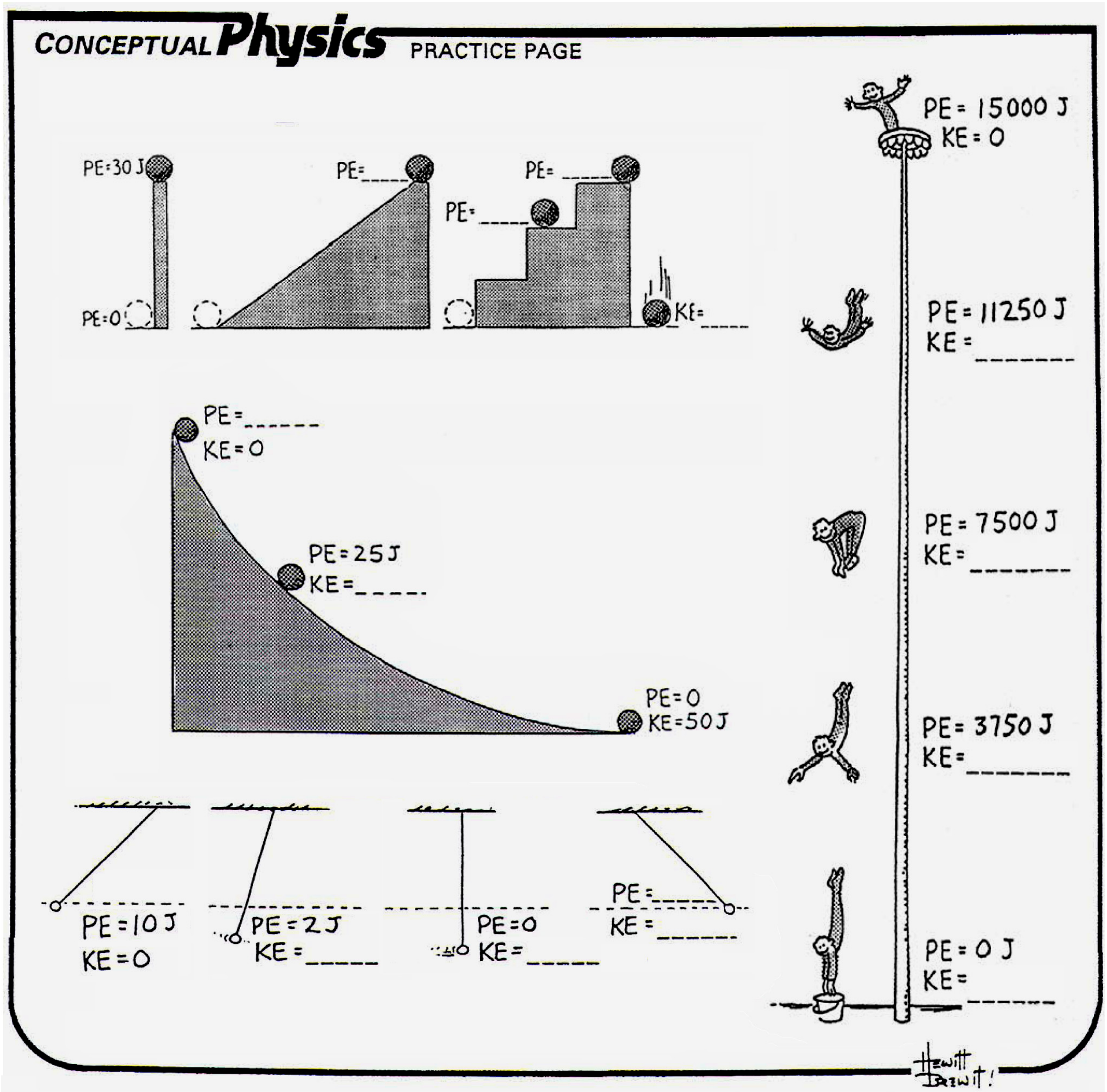


Rank from greatest to least, the magnitude of the change in potential energy of the sliding masses as the move from the top of the incline to the bottom.



Example 2: A 1000kg car traveling at 25m/s is thrown upward 35m by the springs which were originally compressed 1.0m. Find (a)the gravitational potential when the car is at the top of its flight, (b)the potential energy stored in the springs, and (c) the spring constant of the contraption.

http://www.youtube.com/watch?v=I6GWTzdPdqw


CONCEPTUAL Physics PRACTICE PAGE
PE=30 J
PE=0
PE=____
PE= ____
PE= ____
KE= ____
PE=____
KE=0
PE=25 J
KE=____
PE=0
KE=50 J
PE=10 J
KE=0
PE=2 J
KE=____
PE=0
KE=____
PE=____
KE=____
PE= 15000 J
KE= 0
PE= 11250 J
KE= ______
PE= 7500 J
KE= ______
PE= 3750 J
KE= ______
PE= 0 J
KE= ______

Lecture 22 - Summary

Conservative forces do no work around a closed loop so the work they do depends only on the initial and final position. This fact allowed us to establish the

Definition of Potential Energy $\Delta U \equiv -W_c$

We applied this definition to two conservative forces to get specific expressions for

Gravitational Potential Energy $U_g = mgy$ and Spring Potential Energy $U_s = \frac{1}{2}kx^2$.

For systems with only conservative forces acting we have a preliminary statement of

The Law of Conservation of Energy

"Energy may be transformed from one type to another, but the total energy always remains constant."

written mathematically as $\Delta K + \Delta U = 0$.