Name ____________________________ Class ____

Conservation of Energy

http://jersey.uoregon.edu/vlab/PotentialEnergy/

Potential energy exists whenever an object with mass has a position within a force field. The most everyday example of this is the position of objects in the earth's gravitational field. The potential energy of an object in this case is given by the formula:

$E_g = mgh$
where

* E_g = Gravitational Potential Energy (in Joules)
* m = mass (in kilograms)
* g = gravitational acceleration of the earth (9.8 m/sec^2)
* h = height above earth's surface (in meters)

Kinetic energy exists whenever an object with mass is in motion with some velocity. Everything you see moving about has kinetic energy. The kinetic energy of an object in this case is calculated with the formula:

$E_k = ½ mv^2$
where

* E_k = Energy (in Joules)
* m = mass (in kilograms)
* v = velocity (in meters/sec)

Conservation of Energy asserts that in a closed system energy is conserved. This principle will be tested by you, using the Virtual Simulation Applet. In the case of an object in free fall. When the object is at rest at some height, h, then all of its energy is E_g. As the object falls and accelerates due to the earth's gravity , E_g is converted into E_k. When the object strikes the ground, h=0 so that E_g =0, the all of the energy has to be in the form of E_k and the object is moving it at its maximum velocity. (In this case we are ignoring air resistance).

Experimental Apparatus

This applet simulation will drop a mass from different heights. When the mass strikes the ground, some percentage of its original energy will be absorbed by the ground. The parameters you control are:

* The Total Energy (Energy)
* The mass of the object (Mass)
* The percentage of the energy which is absorbed by the surface on each "bounce" (EAS)

In addition you can measure the height of the object above the surface by clicking on the black platform upon which the object rests. The impact velocity of the object will also be given at each bounce.

The functionality of the buttons are as follows:

* Start = Drop the ball after Energy, Mass and EAS have been set; resume after step or pause has been selected
* Step = Drop the ball once and it rebounds to its maximum height and then pauses
* Reset = Reset experiment to initial values
* Pause = Pause the animation at any point

Experimental Procedure

Initial Values:

1. Select a Mass of 5 kg
2. Select an Energy of 200 J
3. Select EAS = 50%
4. Record all data in the table provided.

1. What is the height of the ball? Show how you can get this from the initial potential energy of 200 J. (Verify by measuring it.)

2. How high will the ball bounce on the first bounce? Why do you think so? (Activate the step button to run the experiment and check your answer.)

3. What will be the impact velocity of the ball on the first bounce? Why do you think so? (Hint: energy is conserved so the kinetic energy when it hits the ground is equal to the initial potential energy of 200 J.) (Activate the step button to run the experiment and check your answer.)

4. Reset the experiment and change EAS to 100%. What do you expect will happen? Why? Verify your answer.

5. Reset the experiment and change EAS to 25%. What will be the height of the ball on the first bounce? Why? Verify your answer.

6. Reset the experiment and change Energy to 400 J and answer questions 1-3 above again.

7. Reset the experiment and change the mass of the ball to 2 kg. How much higher did the ball rise?

8. Will the ball have a different velocity on initial impact as in the previous case? If so, how come? If not, why not?

9. Which combination of parameters do you think will allow the ball to bounce the most number of times? ______

Try your guesses.

Which combinations of parameters produce the lowest and highest initial heights?

Lowest "Height Parameters" Mass = _________ Energy = _________
Highest "Height Parameters" Mass = _________ Energy = _________

Mass	Initial Height (H_1)	Energy	Initial Impact Velocity	First Bounce Height (Ho)	Number of Bounces	EAS	Ratio of H_o/H_i	Acceleration (g)
5 kg	m	200 J	m/s	m		50%		9.81 m/s^2
5 kg	m	200 J	m/s	m		100%		9.81 m/s^2
5 kg	m	200 J	m/s	m		25%		9.81 m/s^2
5 kg	m	400 J	m/s	m		50 %		9.81 m/s^2
5 kg	m	400 J	m/s	m		100%		9.81 m/s^2
5 kg	m	400 J	m/s	m		25%		9.81 m/s^2
2 kg	m	400 J	m/s	m		50%		9.81 m/s^2
2 kg	m	400 J	m/s	m		100%		9.81 m/s^2
2 kg	m	400 J	m/s	m		25%		9.81 m/s^2

Summary:

1. Why does a 2kg mass need to be placed at a higher elevation to have the same potential energy as a 5 kg mass?

2. Why does a 2kg mass have a larger impact velocity than a 5kg mass when their gravitational potential energy is the same?

3. Name a common object that has an EAS near 20%.

4. Name a common object that has an EAS near 100%.

5. What does the ratio of H_1/H_o indicate about the bounce energy?

6. What would be the number of bounces be for an object with an EAS of 0.0%? Does such an object exist?