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To: Fall 2013 IDE20 Students
From: IDE20 Instructors
Re: Models/Experiments Lab
Date: 10/9/2013 (Wednesday Lab), 10/11/2013 (Friday Lab)

Use the model spreadsheet posted at the Lab 8 page and current project description on IDE20.com to answer the following questions:

1. Assuming no air resistance and a ballistic trajectory, what is the minimum amount of energy required to launch a 4g marble into each of the three targets? Assume the marbles would be launched from the surface of the table.
2. How fast and at what angle would the marbles in part 1 need to be launched?
3. How much energy would it take to lift 100 4g marbles 72" vertically?
4. If you let the marbles in part 3 slide down a ramp under gravity and into the targets, what is their maximum speed once they reach the target, assuming no friction or other energy losses?

Supplemental Equations:

Flight time for a projectile: $t = \frac{v_y + \sqrt{v_y^2 - 2gh}}{g}$

Distance travelled: $d = v_x t$

Where:

- t=flight time (s)
- v_y=initial vertical component of speed (m/s)
- g=acceleration due to gravity (magnitude, m/s^2), **use 9.81 m/s^2**
- h=target height (m)
- d=distance travelled (m)
- v_x=initial horizontal component of speed (m/s)

Gravitational potential energy of an object: $E = mgh$

Where:

- E=potential energy (J)
- m=mass of object (m)
- g=acceleration due to gravity (magnitude, m/s^2), **use 9.81 m/s^2**
- h=height of object above reference plane (m)

Kinetic energy of a translating object: $E = \frac{1}{2}mv^2$

Where:

- E=kinetic energy (J)
- v=speed of object (m/s)
- m=mass of object (m)

Points: 10 (assessed as part of Memo 3)