Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Due Date Friday May 24

Catapult Lab – Option 2

This project is the alternative project to the physical construction of a catapult. A simulation program is used to create a virtual catapult and investigate its performance.

There are three stages to the project:

1. Learn how to use the Interactive Physics Program by following a tutorial.
2. Create a catapult simulation and collect data for three experiments using the simulation.
3. Analyze the data by creating and interpreting graphs.

Start this assignment early. Allow time for all stages of the project.

1. Work through the tutorial at the site (reproduced below)

<http://www.design-simulation.com/documents/ip/ipintroductorytutorial.pdf>







1. Print out a copy of your screen after completing step 13 of the tutorial. (file print)
2. Now it is time to build your own catapult using what you have learned about using Interactive Physics. Think and plan what you would like to build, but we **strongly suggest** that you keep the design **SIMPLE**. A basic catapult will include:
	1. A base/frame
	2. Arm on a pivot point
	3. Energy storage (such as a spring)
	4. “cup” to hold the ball
3. Insert a ball into the catapult and make sure you are happy with your catapult behavior before beginning the data acquisition step.
4. Click on the ball, then measure, then position, then all. This will bring up a box which tells you the coordinates of the ball.
5. Run the simulation – note that you can step slowly through time so that you can determine exactly when the ball hits the ground! (Use the controls on the bottom of the screen like a video player.)

Experiment 1: Measure the effect of spring constant on the range of the ball.

1. Write down the initial coordinate (X i) of the ball
2. Write down the value of the spring constant, gravity (must be 9.81 m/s2), and ball mass.
3. Run the experiment
4. Write down the coordinate of the point where the ball first touches the ground (X­­­f)
5. Change and record the value of the spring constant
6. Repeat steps C-E for at least 5 values of the spring constant
7. Print a single screen shot of the experiment with the spring parameter dialog box open.
8. Complete the data table (columns labeled and units included)
9. Graph the range of the ball (vertical axis) verses spring constant (horizontal axis). Make sure you title the graph, the axes, and include units

\*You may choose to use Excel to generate a graph and tables. (The tables must be in the same format as the sample data tables attached.)

Experiment 2: Measure the effect of gravity on the range of the ball.

1. Write down the initial coordinate (Xi) of the ball
2. Write down the value of the spring constant, gravity, and ball mass.
3. Run the experiment
4. Write down the coordinate of the point where the ball first touches the ground (Xf)
5. Change and record the value of the gravitational field strength (this is done via the world button)
6. Repeat C-E for at least 5 values of the gravitational field strength
7. Print a single screen shot of the experiment with the gravity dialog box open.
8. Complete the data table (columns labeled and units included)
9. Graph the range of the ball (vertical axis) verses gravitational field strength (horizontal axis). Make sure you title the graph, the axes, and include units

Experiment 3: Measure the effect of mass on the range of the ball.

1. Write down the initial coordinate (Xi) of the ball
2. Change gravity back to 9.81 m/s2
3. Write down the value of the spring constant, gravity, and ball mass.
4. Run the experiment
5. Write down the coordinate of the point where the ball first touches the ground
6. Change and record the value of the ball’s mass
7. Repeat C-E for at least 5 values of the mass.
8. Print a single screen shot of the experiment with the ball parameter dialog box open.
9. Complete the data table (columns labeled and units included)
10. Graph the range of the ball (vertical axis) verses mass (horizontal axis.) Make sure you title the graph, the axes, and include units.

Catapult Project - Hand in

1. A screen shot after step 13 of the tutorial
2. A LABELED DVD or Memory Stick with your simulation stored on it. (Only a single catapult simulation with one set of conditions is required.)
3. Experiment 1 – spring constant
	1. a screen shot of the experiment with the spring parameter dialog box open
	2. Completed data sheet
	3. a graph with the range of the ball (vertical axis) verses spring constant (horizontal axis)
	4. Question: Does the range depend on the spring constant? What does your data indicate about the effect of spring constant on the range of the ball launched by your catapult? (3-4 sentences)
4. Experiment 2 – gravitational field strength
	1. a screen shot of the experiment with the gravity dialog box open
	2. Completed data sheet
	3. a graph with the range of the ball (vertical axis) verses gravitational field strength (horizontal axis)
	4. Question: Does the range depend on the gravitational field strength? What does your data indicate about the effect of gravitational field strength on the range of the ball launched by your catapult? (3-4 sentences)
5. Experiment 3 - Mass
	1. a screen shot of the experiment with the ball parameter dialog box open
	2. Completed data sheet
	3. a graph with the range of the ball (vertical axis) verses mass (horizontal axis)
	4. Question: Does the range depend on the mass ? What does your data indicate about the effect of mass on the range of the ball launched by your catapult? (3-4 sentences)

Note: All your graphs must have titles, clearly labeled axes, and units. The range of the axes must be appropriate for the data. Each graph should be about ¾ of a page

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| Experiment 1: Spring Constant |  |  |  |  |  |
| Initial conditions: |  |  | Spring Constant | X initial | X final | Range (Xf-Xi) |
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|  |  |   |   |   |   |
| gravitational field strength  |  |   |   |   |   |
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| mass  |  |  |  |   |   |   |   |
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| Experiment 2: Gravitational Field Strength |  |  |  |  |
|  |  |  |  | Gravitational Field Strength | X initial | X final | Range (Xf-Xi) |
|  |  |  |  |   |   |   |   |
| Initial conditions: |  |  |   |   |   |   |
| spring constant |  |  |   |   |   |   |
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| Experiment 3: Mass |  |  |  |  |  |  |
|  |  |  |  | Mass | X initial | X final | Range (Xf-Xi) |
|  |  |  |  |   |   |   |   |
| Initial conditions: |  |  |   |   |   |   |
| spring constant |  |  |   |   |   |   |
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| gravitational field strength  |  |   |   |   |   |
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