**SPH3U Conservation of Energy Activity**

Go to <http://mattcraig.space/energy/index.html>

Play around with the simulation. Notice that hovering your mouse near the left gives you several options, and hovering near the bottom gives you different options. For this activity, reset your simulation to the initial setting before you proceed.

**Part A: Analyzing Energy Transformations**

**Purpose:** to analyze the energy transformations taking place as a ball travels up and down an incline and to determine how the position of the ball affects the total mechanical energy in the system.

**Hypothesis:** Complete the following statements, remembering to give a reason for each of your predictions.

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| Gravitational potential energy will be highest at |
| Kinetic Energy will be highest at |
| Total mechanical energy will |

**Procedure:**

1. In the simulation, place the ball at some height on the incline and click “play”. Make some qualitative observations about the ball’s motion in the space provided under “observations”.

2. Pause the ball at a location near the top of the incline. Record the height and speed of the ball in the observations data table below.

3. Continue “playing ” the same simulation again. Pause it at a location near the lowest point on the incline. Record the height and speed in the data table.

4. Continue playing the same simulation one more time. Pause the ball at a location approximately halfway up the incline. Record the height and speed in the data table.

**Observations:**

Qualitative Observations:

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Quantitative Observations: (Perform the necessary calculations to complete the table)

Mass of the ball = 1 kg

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Height (m) | Gravitational Potential Energy (J) | Speed (m/s) | Kinetic Energy (J) | Total Mechanical Energy (J)  (Ek + Eg) |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

**Analysis**:

1. Where is GPE the highest? Is this what you expected? Explain.

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3. Where is KE the highest? Is this what you expected? Explain.

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4. What do you notice about the total mechanical energy in the system? Is this what you would expect? Explain.

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5. Why does KE reach a value of zero, but GPE does not?

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6. When you run the simulation, how does the starting height compare to the max height reached on the other side of the track? Is this what you would expect? Why?

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7. What must you do to the ball in the simulation to cause the ball to reach a higher speed? Explain.

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**Conclusion:**

**Part B: Analyzing the Effect of Friction on the Mechanical Energy of a Moving Object**

**Purpose:** to determine if the presence of friction has any effect on the energy transformations when a ball travels up and down an incline.

**Hypothesis:**

**Procedure:**

Prepare to run the simulation again, but, this time, turn on friction. Measure the height at the start of the simulation and the max height on the other side, and record the data in the table below.

**Observations:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Height (m) | Gravitational Potential Energy (J) | Speed (m/s) | Kinetic Energy (J) | Total Mechanical Energy (J)  (Ek + Eg) |
| At start of simulation |  |  |  |  |  |
| At max height on the other side |  |  |  |  |  |

**Analysis:**

Unlike in Part A, you should notice a significant discrepancy in the total mechanical energy at each of these “max height” points.

You can describe the “efficiency” of the system by calculating its percent efficiency. This number indicates how well your system performs its function given that some of the initial energy in the system is transformed to waste forms, such as thermal (i.e., negative work done by friction)

1. Calculate the percent efficiency of your system using the mechanical energies from your observations table.

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| --- |
| Given:  Initial mechanical energy =  Final mechanical energy (at max height on other side) =  Required: % efficiency  Analysis and Solution:  % efficiency = (final mechanical energy/ initial mechanical energy) x 100  % efficiency =  % efficiency = |

2. Describe the type of “mechanical work” being done by friction on the ball and explain the effect of this on the total mechanical energy in the system. Is this what you expected? Explain.

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Conclusion:

**Part C: Extension**

Run the simulation again, and while it is running, switch the environment to the “moon”. What do you notice about speed and energies? Explain why this happens.