**Time to explore potential energy, kinetic energy and conservation of energy.**

* Click the Energy box in the upper left corner to bar graph, click the box next to pie chart, drag the skater to the top of the ramp and release the skater.
	1. Discuss the changes in the bar graph as the skater moves on the track

* 1. Use the symbols to fill in the data table:

**(↑ increases, ↓ decreases, S for stays the same)**

|  |  |  |  |
| --- | --- | --- | --- |
| Skater’s movement  | Potential energy**( ↑ ↓ S )** | Kinetic energy**( ↓ ↑ S )** | Total energy**( ↑ ↓ S )** |
| Down the hill |  |  |  |
| Up the hill |  |  |  |

**Time to explore friction!**

1. Add some friction by moving the Friction slider to the right.

 Discuss the changes in the bar graph as the skater moves up and down on the track.

1. Use the symbols to fill in the data table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Skater’s movement  | Potential energy**( ↑ ↓ S )** | Kinetic energy**( ↓ ↑ S )** | Total energy **( ↑ ↓ S )** | Thermal Energy**( ↑ ↓ S )** |
| Down hill |  |  |  |  |
| Up the hill |  |  |  |  |

(**↑** increases, **↓** decreases, **S** stays the same)

* Change the mass of the skater with the slider. Is the law of conservation of energy affected by the mass of the skater? \_\_\_\_\_\_\_\_\_\_\_
* Does mass of the skater affect the **magnitudes** of the kinetic and potential energy? \_\_\_\_\_\_\_\_\_
* Click the Graphs button at the bottom and get the skater going. Up top, choose the time option. Use color pens or pencils and draw the Graphs for KE, Ugrav and Total Energy vs time below:
* Pause the sim when the skater is at the top. Click the Reference Line option in the bottom left and move the line up to the top of the ramp. This changes where we call our 0 height. Run the sim again and use color pens or pencils and draw the Graphs for KE, Ugrav and Total Energy vs time below:

When is all the energy in the form of Kinetic? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the relationship between KE and Ugrav in this setup? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Data Collection and Analysis:** Go back to the Intro option at the bottom.

1. Select the half pipe track and turn on Grid and Speed. Start with NO Friction
2. You will calculate the changes in energy- total, kinetic, and potential over time. To do this, we need to define our system. **This is a skater-earth system**.
3. Choose “Slow Motion.” Place the skater at 6-m. Pause the sim when the skater is at the grid lines. **Record** the height, speed and then **calculate** the Gravitational Potential, Kinetic and Mechanical energies at those points.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Height (m)** | **Velocity (m/s)** | **Ugrav (J)** | **K (J)** | **Mechanical Energy (J)** |
| 6 | 0 |  |  |  |
| 5 |  |  |  |  |
| 4 |  |  |  |  |
| 3 |  |  |  |  |
| 2 |  |  |  |  |
| 1 |  |  |  |  |
| 0 |  |  |  |  |

 Mass of skater (kg): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What do you notice about the Mechanical Energy of the system throughout the run with no friction? Explain why this happens.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Height (m)** | **Velocity (m/s)** | **Ugrav (J)** | **K (J)** | **Mechanical Energy (J)** |
| 6 | 0 |  |  |  |
| 5 |  |  |  |  |
| 4 |  |  |  |  |
| 3 |  |  |  |  |
| 2 |  |  |  |  |
| 1 |  |  |  |  |
| 0 |  |  |  |  |

1. Now turn on Friction to **LOTS** and retake the data. Make sure you are taking data when the skater goes down the ramp the FIRST time!!

Mass of skater (kg): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What do you notice about the Mechanical Energy of the system throughout the run with friction? Explain why this happens.

**Playground**

Create the skate paths as shown. If the skater starts on the left side, will he have enough energy to make it all the way to the right side? \_\_\_\_\_\_\_\_\_ Why or why not?

If the skater starts on the left on the path here, match the letter here with the following conditions:

C

1. Maximum kinetic energy \_\_\_\_\_\_\_\_\_\_

D

1. Maximum potential energy \_\_\_\_\_\_\_\_\_
2. Two locations where the skater has about the same speed \_\_\_\_\_

B

 If the skater starts at the top of the ramp on the left, show how high will he be on the right side of the ramp. Let the skater go down the ramp. Does she get back to the original height? Explain why this happens in terms of types of energy.

**Conclusion Calculations: *use g = 10.0 m/s2***

Complete the table of kinetic and potential energies:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Mass of skater (kg) | Height (m) | Velocity (m/s) | K (J) | Ugrav (J) | Mechanical Energy (J) |
| 20 | 14 |  |  |  | 4240 |
| 60 | 6.0 |  | 1920 |  |  |
| 0.20 | -18 |  |  |  | 4 |
|  | 6.0 | 5.0 |  | 600 |  |

Work is the amount of energy added or removed from a system. Most of the time, to find the work, it is easiest to focus on the energy that is being changed, instead of going straight to the work equation.

1. Shown below are graphs of velocity versus time for six identical objects of mass 5 kg, that move along a straight, horizontal surface. A single external force acts on each object.



Rank (from greatest to least) the work done on the objects by the external force during the 4-second time interval shown. HINT: The Work is turning into Kinetic Energy.

 Greatest 1 \_\_\_\_\_\_\_ 2 \_\_\_\_\_\_\_ 3 \_\_\_\_\_\_\_ 4 \_\_\_\_\_\_\_ 5 \_\_\_\_\_\_\_ 6 \_\_\_\_\_\_\_ Least

If given a Force vs displacement graph, to find the work done on the system, W = FΔx, which of the 3 aspects of a graph (coordinates, slope or area) would we focus on?

1. The graph below shows the force that an employee exerts on a cart loaded with wood at a lumberyard. This force varies as a function of position. Six segments are marked in the graph.



Rank these segments from greatest to least on the basis of the energy the employee transfers to the cart.

Greatest 1 \_\_\_\_\_\_\_ 2 \_\_\_\_\_\_\_ 3 \_\_\_\_\_\_\_ 4 \_\_\_\_\_\_\_ 5 \_\_\_\_\_\_\_ 6 \_\_\_\_\_\_\_ Least