

Name(s): \_\_\_\_\_

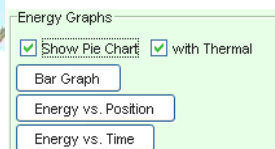
**The Skate Park – Intro to Energy and Work PhET Lab****Introduction:**

When Tony Hawk wants to launch himself as high as possible off the half-pipe, how does he achieve this? The skate park is an excellent example of the conservation of energy. The law of conservation of energy tells us that we can never create or destroy energy, but we can change its form. In this lab, we will look at the conversion of energy between *gravitational-potential* energy, work, and *kinetic* (or moving) energy. This conversion is *work*. (Realize though, that in real life, skateboard wheels have friction. In our experiments, we ignore friction) Energy is measured in units of **Joules**.

**Energy Skate Park**

**Important Formulas:**  $KE = \frac{1}{2}mv^2$   $PE = mgh$   $q = \text{heat loss}$

**Procedure:** *PhET Simulations* → *Play With Sims* → *Energy Skate Park* **Run Now!**



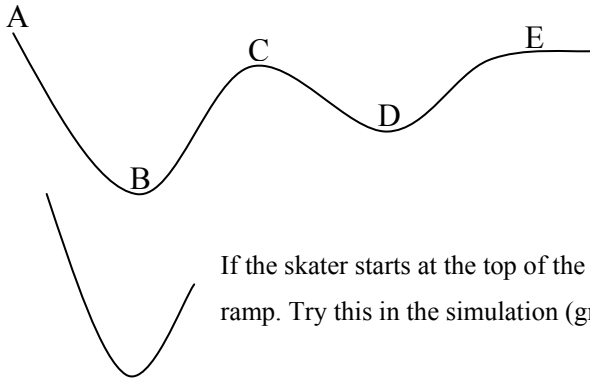
- Take some time and play with the skater and his track.
- Click on the buttons to show the energy graphs and the pie graphs. These graphs show the conversion between *kinetic energy (green)* and *potential energy (blue)*. If any energy is lost, it will be shown with a *red* bar (*thermal energy lost*).
- Reset the skater to the standard half-pipe and observe the energy bars as he moves back and forth (without friction).
- As the skater descends his kinetic energy (green) \_\_\_\_\_ and his potential energy (blue) \_\_\_\_\_. The change in kinetic energy is always \_\_\_\_\_ to the change in potential energy. How can you increase the “green?” **Have Mr. Bean sign-off** \_\_\_\_\_
- Change the skater with . Is the law of conservation of energy affected by the mass of the skater? \_\_\_\_\_
- Select: “Edit Skater” and manipulate the mass. Does mass of the skater affect the **magnitudes** of the kinetic and potential energy? \_\_\_\_\_, (hint PE = KE) Explain

Reset and drag the bottom on the half pipe to the bottom of the grid to set the lowest height to zero.

- Turn on the grid. Set the PhET skater (about 75kg) at 5.0m above the zero and allow him to skate.
- How much potential energy does he have at 5.0m? \_\_\_\_\_ How much kinetic energy at 0.0m? \_\_\_\_\_
- A 20.0 kg skater that starts his skate 10m high (on the earth) would have a potential energy of \_\_\_\_\_ and a kinetic energy of \_\_\_\_\_ before his skate. At the lowest point, the skater would have a potential energy of \_\_\_\_\_ and a kinetic energy of \_\_\_\_\_. (hint: use the important formula for potential energy)



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? / Why not? \_\_\_\_\_




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

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

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. Try this in the simulation (grid on). Explain

**Part II: Gravity's affect on Energy**

Reset the skater and turn on the "pie chart" & "Energy vs. Position" to show kinetic and potential energy.

- Move the skater to Jupiter, where acceleration due to gravity is 26m/s<sup>2</sup>! Describe what happens to the skater's potential and kinetic energy. \_\_\_\_\_
- Quickly select "Earth's" gravity. What happens? \_\_\_\_\_
  - Mr. Bean Check \_\_\_\_\_
- Move the skater to the moon (g = 1.6 m/s<sup>2</sup>). Why is he moving like he is (you might have to re-set the skater)? \_\_\_\_\_
- Zoom out , increase the size of the ramp, and move the skate to SPACE! Press the arrow keys on your keyboard. Zoom out some more. Have fun.

How does Newton's 1<sup>st</sup> Law apply? \_\_\_\_\_

Is there potential (mgh) energy in space? \_\_\_\_\_ Why / Why not? \_\_\_\_\_

Is there kinetic ( $\frac{1}{2}mv^2$ ) energy in space? \_\_\_\_\_ Why / Why not? \_\_\_\_\_



**Conclusion Calculations:** (1 pt each) use  $g = 10 \text{ m/s}^2$ 

Complete the table of kinetic and potential energies:

Mass of skater (m)	height (h)	velocity (v)	Kinetic Energy (KE)	Potential Energy (PE)
20. kg	14 m	12 m/s	1.	2.
60. kg	0.0 m	3.	1470 J	4.
0.20 kg	18 m	0.0 m/s	5.	6.
7.	6.0 m	5.0 m/s	8.	600. J
5.0 kg	9.	10.	160 J	850 J

**Conclusion Questions:** (1 pt each) use  $g = 10. \text{ m/s}^2$  Show work on attached sheet, use correct units.

- [Circle] At the highest point kinetic energy is *zero / maximum* while the potential energy is *zero / maximum*.
- [Circle] At the lowest point kinetic energy is *zero / maximum* while potential energy is *zero / maximum*.
- [Circle] Mass *affects / does not affect* the conservation of energy.
- How much potential energy does the 60. kg skater have before she starts her ride, 12 m above the ground? \_\_\_\_\_
- How much kinetic energy does a 60.0 kg skater have traveling with a velocity of 4 m/s? \_\_\_\_\_
- How fast must a 20. kg skater travel to have a kinetic energy of 360 Joules? \_\_\_\_\_
- How high must a 2.0 kg basketball be thrown so it has a potential energy of 160 J? \_\_\_\_\_
- How fast must the 2.0 kg basketball be thrown upward to achieve the same 160 J? \_\_\_\_\_
- If a 75kg skater starts his skate at 8.0m, at his lowest point, he will have a velocity of \_\_\_\_\_
- Suppose PE does not equal KE. What happened? \_\_\_\_\_

**Honors Physics (Extra-credit for physics students) Note:**  $J = \text{kg m}^2/\text{s}^2$  and  $N = \text{kg m/s}^2$ 

- Why is the mass of the object not a factor in the conservation of energy? Assume no friction.
- Show that  $PE = mgh$ ,  $KE = 1/2mv^2$ , and  $E = mc^2$  are proper equations for energy.
- Show that the equation  $P = Fv$  is a proper equation of power.
- What must the power output of an elevator motor that can lift a total mass of 1000 kg and provide the elevator with a constant speed of 8.0 m/s?