The Skate Basic Park – Intro to Energy Potential and Kinetic 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.

Use the internet, your textbook, or notes to define the following key terms:

Kinetic Energy
_____

Potential Energy
_____

Mechanical Energy
_____

Joule
_____

State, in **your own words**, the **Law of the Conversation of Energy**.

Procedure: *PheT Simulations* → *Play With Sims* → *Physics* → *Energy Skate Park: **Basics*** `Run Now!`

Take some time and play with the skater.   Turn on the Bar Graph, Pie Chart, and Speed options.

How does increasing skater's **mass** change the skater's….
Kinetic Energy? _____Potential Energy? _____Total Energy? _____

How does the skater's **kinetic energy** change as he moves **down** the ramp? _____

How does the skater's **kinetic energy** change as he moves **up** the ramp? _____

How does the skater's **potential energy** change as he moves **down** the ramp? _____

How does the skater's **potential energy** change as he moves **up** the ramp? _____

How does the skater's **total energy** change as he moves **down** the ramp? _____

How does the skater's **total energy** change as he moves **up** the ramp? _____

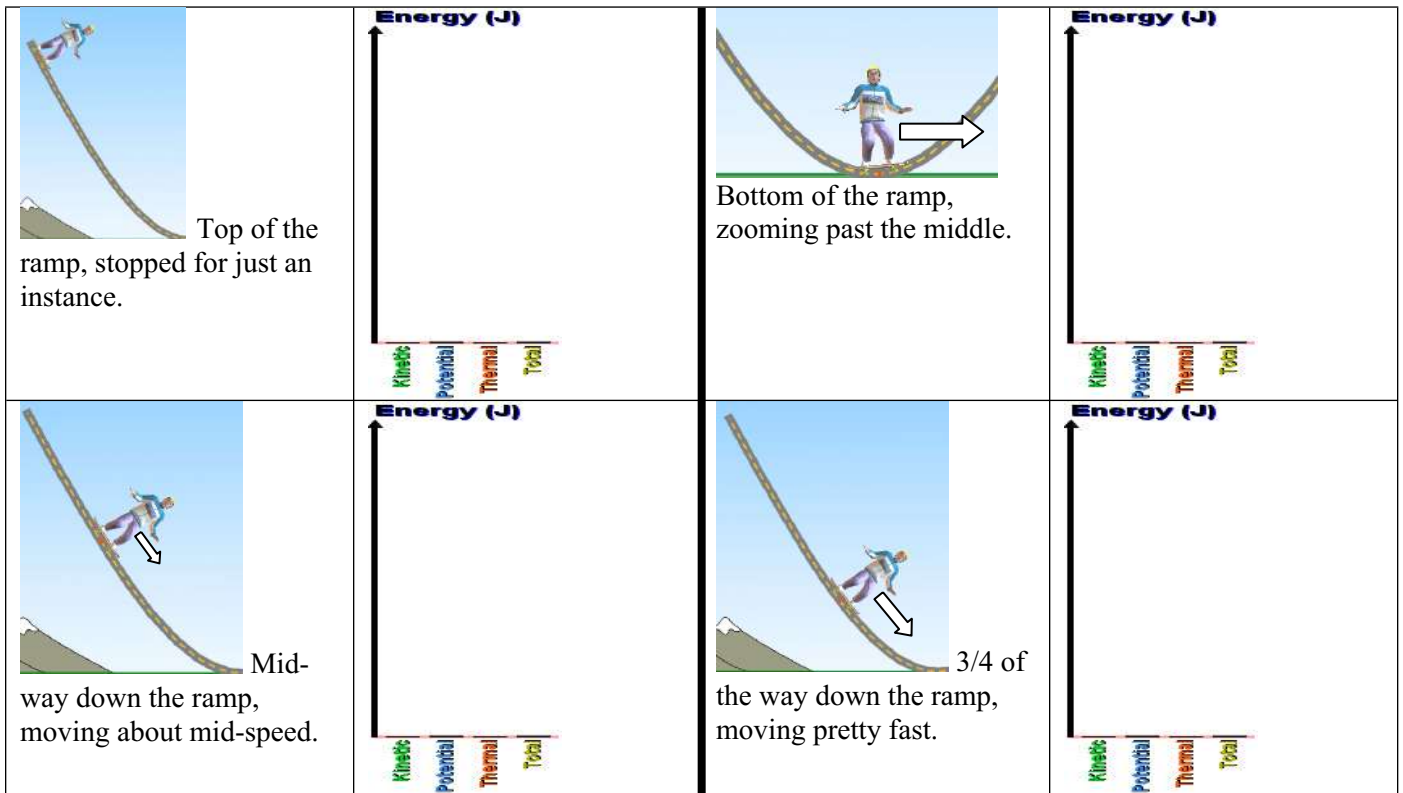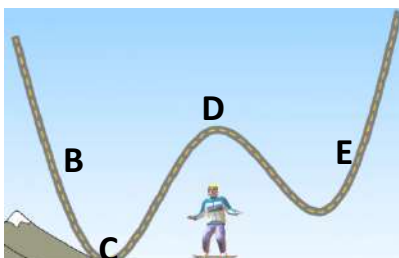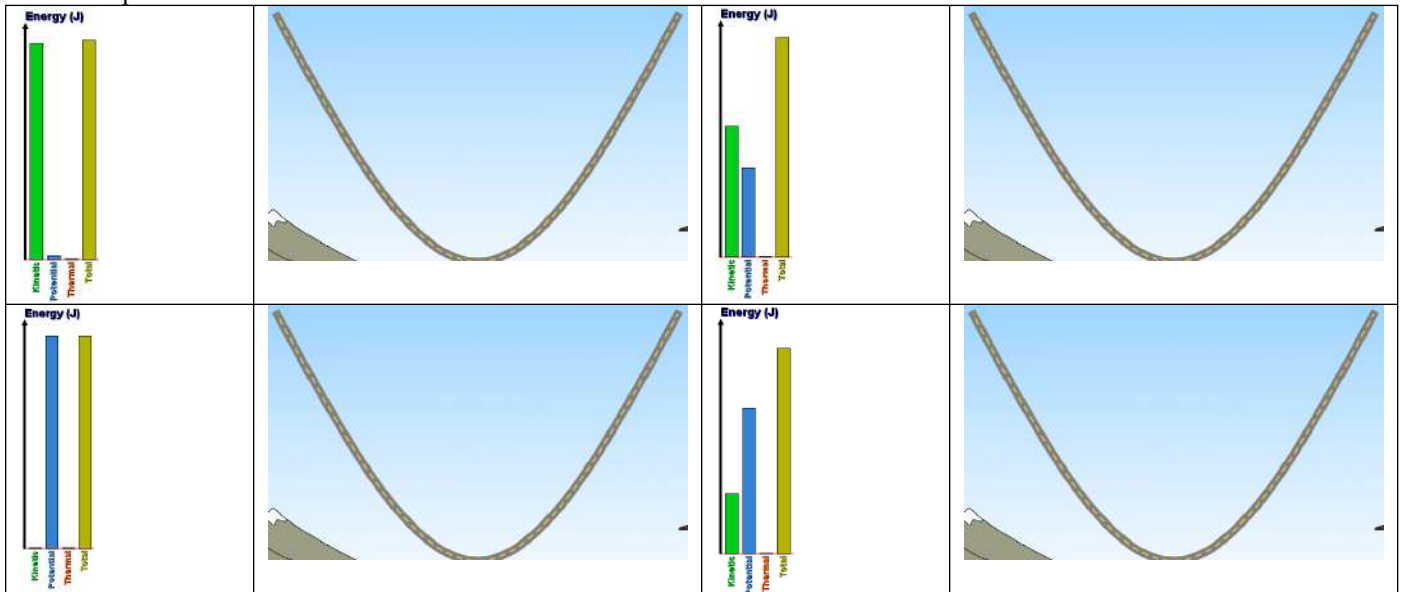Describe the skater's **kinetic** energy at the bottom of the ramp.
_____

Describe the skater's **potential** energy at the bottom of the ramp. _____

What happens when the skater is dropped onto the ramp from above the ramp? _____

Observe the following situations. Draw the possible bar graphs for the situation shown. Compare your results with a nearby lab group, AFTER you have completed this section.

	Energy (J)		Energy (J)
Top of the ramp, stopped for just an instance.	Kinetic Potential Thermal Total	Bottom of the ramp, zooming past the middle.	Kinetic Potential Thermal Total
Mid-way down the ramp, moving about mid-speed.	Kinetic Potential Thermal Total	3/4 of the way down the ramp, moving pretty fast.	Kinetic Potential Thermal Total

Draw where the skater might be based on the bar graphs shown. Compare your results with a nearby lab group, AFTER you have completed this section.

Energy (J)		Energy (J)	
Kinetic Potential Thermal Total		Kinetic Potential Thermal Total	
Energy (J)		Energy (J)	
Kinetic Potential Thermal Total		Kinetic Potential Thermal Total	

← Consider this zany track. What point or points on this track would the skater have ...

The most kinetic energy? ☐   The most potential energy? ☐

The same kinetic energy (two points) ☐ and ☐

Conclusion Questions: (*circle the correct answers*)

1. At the highest point kinetic energy is *zero / maximum* while the potential energy is *zero / maximum*.

2. At the lowest point kinetic energy is *zero / maximum* while potential energy is *zero / maximum*.

3. Mass *affects / does not affect* the amount of energy.

4. As an object falls in gravity, kinetic energy *increases / decreases / remains the same*.

5. As an object falls in gravity, potential energy *increases / decreases / remains the same*.

6. As an object falls in gravity, total energy *increases / decreases / remains the same*.

7. An object travelling faster and faster has a kinetic energy that *increases / decreases / remains the same*.

8. An object travelling faster and faster has a potential energy that *increases / decreases / remains the same*.

9. As an object speeds up, the total energy *increases / decreases / remains the same.*

10. As an object slows down, the total energy *increases / decreases / remains the same.*

The Skate Park – Intro to Energy and Work PhET Lab

Introduction:
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 **J**oules.

Important Formulas: $KE = \frac{1}{2}mv^2 \quad PE = mgh \quad W = \Delta E$

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.

- Change the skater with Choose Skater... . 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? _____
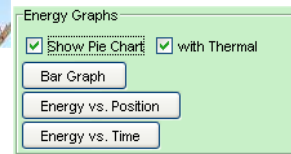
Reset and drag the bottom on the half pipe to the bottom of the grid to set the lowest height to zero.
- Turn on the grid. Set the PhET skater (75kg) at 5.0m above the zero and allow him to skate.

- 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? _____
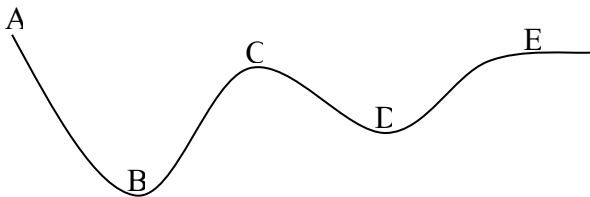
If the skater starts on the left on the path here, match the letter here with the following conditions:
1. Maximum kinetic energy _____
2. Maximum potential energy _____
3. Two locations where the skater has about the same speed _____

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. Press [🔍] to zoom out and increase the size of the ramp.

Part II: Gravity's affect on Energy

Reset the skater and turn on the pie chart to show kinetic and potential energy.

- Move the skater to Jupiter, where acceleration due to gravity is 26m/s²! Describe what happens to the skater's potential and kinetic energy. _____

- Move the skater to the moon (g = 1.6 m/s²). Why is he moving like he is? _____
_____

- 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.

Is there potential (mgh) energy in space? _____Why / Why not? _____

Is there kinetic (½mv²) energy in space? _____Why / Why not? _____

Conclusion Calculations: **(½ pt each) *use g = 10. m/s²***
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: **(½ pt each) *use g = 10. m/s²***
11. At the highest point kinetic energy is *zero / maximum* while the potential energy is *zero / maximum*.

12. At the lowest point kinetic energy is *zero / maximum* while potential energy is *zero / maximum*.

13. Mass *affects / does not affect* the conservation of energy.

14. How much potential energy does the 60. kg skater have before she starts her ride, 12 m above the ground? _____

15. How much kinetic energy does a 60.0 kg skater have traveling with a velocity of 4 m/s? _____

16. How fast must a 20. kg skater travel to have a kinetic energy of 360 Joules? _____

17. How high must a 2.0 kg basketball be thrown so it has a potential energy of 160 J? _____

18. How fast must the 2.0 kg basketball be thrown upward to achieve the same 160 J? _____

19. If a 75kg skater starts his skate at 8.0m, at his <u>lowest</u> point, he will have a <u>velocity</u> of _____

20. In the above question, all the potential energy became kinetic energy. How much work was done? _____