Phet Energy Lab 2018 Name: Key

Objective: Using two phet simulators (skate park and pendulum lab), investigate the relationship between kinetic energy, potential energy, thermal energy, and total mechanical energy within a system.

Part 1: Energy skate park:

1. Do a google search for "energy skate park basics phet." Click the first search result (will open to a colorado.edu web page) and launch the simulator.

2. Click "intro" and take some time to play with the skater and her track. Click the pie chart and bar graph buttons to display these.

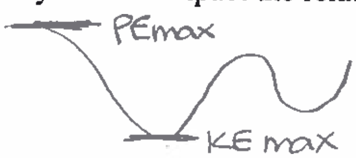
3. What is the relationship between the variables:
   a) If you increase the skater's height ➔ the total energy of the system ↑.
   b) If you increase the skater's mass ➔ the total energy of the system ↑.
   c) The skater's height and the mass of the skater? independent of one another
   d) The kinetic energy and potential energy of the system? complimentary – when KE ↑ ⇒ PE ↓, vice versa

4. How does the total energy of the system change as the skater moves? Total E doesn't change

5. Click the "friction" button at the bottom of the page. Set the skater to moving again in a half pipe.

6. Now that there is friction in the system, how does the total energy of the system change? How does the friction impact the kinetic and potential energy in the system?
Total E doesn't change. As thermal E ↑ ⇒ KE & PE ↓

7. Click on "playground" at the bottom of the page. Build a custom skate track for your skater and sketch it below. Label the points at which the skater has the most KE, the most PE, and equal KE/PE. How does the shape of the track you built impact the relationships between kinetic, potential, thermal and total energy in the system?



Total E = KE + PE + Thermal E

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

Mass of skater (m)	height (h)	velocity (v)	Kinetic Energy (KE)	Potential Energy (PE)
20. kg	14 m	12 m/s	1. 1400 J	2. 2800 J
60. kg	0.0 m	3. 7.0 m/s	1470 J	4. 0 J
0.20 kg	18 m	0.0 m/s	5. 0 J	6. 35 J
7. 10. kg	6.0 m	5.0 m/s	8. 130 J	600. J
5.0 kg	9. 17 m	10. 8.0 m/s	160 J	850 J

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 conservation of energy.
4. How much potential energy does the 60. kg skater have before she starts her ride, 12 m above the ground? 7,100 J
5. How much kinetic energy does a 60.0 kg skater have traveling with a velocity of 4 m/s? 500 J

$KE = \frac{1}{2}mv^2$ $\frac{1}{2}(60.0\ kg)(4\ m/s)^2 = 480 \rightarrow 500$

$360\ J = \frac{1}{2}(20.\ kg)(v^2)$

6. How fast must a 20. kg skater travel to have a kinetic energy of 360 Joules? 6.0 m/s
7. How high must a 2.0 kg basketball be thrown so it has a potential energy of 160 J? 8.2 m — $160\ J = mgh$
8. How fast must the 2.0 kg basketball be thrown upward to achieve the same 160 J? 13 m/s — $160J = \frac{1}{2}(2.0kg)(v^2)$
9. If a 75kg skater starts his skate at 8.0m, at his lowest point, he will have a velocity of 13 m/s — $PE_{max} = KE_{max}$
10. In the above question, all the potential energy became kinetic energy. How much work was done? 5900J

ALL!

$(75kg)(9.8m/s^2)(8.0m) = \frac{1}{2}(75kg)(v^2)$

$5880\ J = (37.5)(v^2)$

Part 2: Pendulum lab

1. Do a google search for "phet pendulum lab." Click the first search result (will open a colorado.edu web page) and launch the simulator.

2. Click "lab" button and spend a bit of time playing with the simulator. Make sure to open the energy graph and to click the "velocity" and "acceleration" buttons in the top left.

3. Like you did for the energy skate park portion, explain the relationship between kinetic energy, potential energy, thermal energy, and total energy of the pendulum. Are these relationships different for the pendulum than they were for the skater? Explain. Total E = KE + PE + Thermal
   As KE ↑ ⇒ PE ↓

4. Change the length of the rope. Make it both longer, then shorter.
   a) If you increase the rope length ➔ the swing height of the pendulum ↑.
   b) If you increase the rope length ➔ the period (time of one full swing) of the pendulum ↑. (.80m = T: 2.1[illegible], .40m = T: 1.49[illegible])
   c) If you increase the rope length ➔ the total energy of the pendulum ↑.

5. Change the mass of the pendulum. Make it both heavier, then lighter.
   a) If you increase the mass of the pendulum ➔ the swing height doesn't change (1.20 kg = T: 1.834s, .60 kg = T: 1.827[illegible])
   b) If you increase the mass of the pendulum ➔ the period (time of one full swing) doesn't change
   c) If you increase the mass of the pendulum ➔ the total energy of the pendulum ↑.

6. Change the gravity of the system. Make it less (moon), then more (Jupiter).
   a) If you increase the gravity ➔ the swing height of the pendulum doesn't change
   b) If you increase the gravity ➔ the period (time of one full swing) ↓ (v ↑).
   c) If you increase the gravity➔ the total energy of the pendulum ↑.

7. How does adding friction to the system affect the above situations?
   Friction doesn't change the total E like m, g, h do. Thermal E ↑ as pendulum swings, lowering KE & PE

Conclusion: Using your experiences with the phet simulators, answer the following:

1. Explain the concept of kinetic energy. What gives an object more or less KE?
   m & v affect E - KE is E of motion
2. Explain the concept of potential energy. What gives an object more or less PE?
   mgh affect PE - PE is stored E from position or compositio[n]
3. In your own words, explain the Law of Conservation of Energy
   E cannot be created or destroyed. Within the system, it can be converted from one form to another.