4) When you use a slingshot to fire a rock you stretch the rubber band storing potential energy. If you stretched the rubber band so that it had 100-J of potential energy,

   a) with how much kinetic energy will the rock leave the slingshot?

   \[ KE = \text{KE} = 100 \text{ J} \]

   b) with how much kinetic energy will the rock leave the slingshot if it loses 10-J to heat & sound?

   \[ KE = PE - \text{loss} \]

5) A pendulum has 15-J of potential energy at the top of its swing.

   a) What is its kinetic energy at the bottom of its swing?

   \[ KE = 15 \text{ J} \]

   b) At another time the pendulum has 8-J of potential energy. What is its kinetic energy?

   \[ KE = 7 \text{ J} \]

   c) For the pendulum in “b”, what will its kinetic energy be if it loses 2-J to heat?

   \[ 7 \text{ J} - 2 \text{ J} = 5 \text{ J} \]

6) A 1-kg ball is 10-m above a table when it is dropped. It bounces to a height of 7-m.

   a) How much energy is transferred to heat & sound during the bounce?

   \[
   \begin{align*}
   \text{Original} & = (1 \text{ kg})(9.8 \text{ m/s}^2)(10 \text{ m}) = 98 \text{ J} \\
   \text{Bounced back to} & = (1 \text{ kg})(9.8 \text{ m/s}^2)(7 \text{ m}) = 68.6 \text{ J} \\
   \end{align*}
   \]

   \[ 29.4 \text{ J is transferred to heat & sound} \]

   b) Explain why this ball cannot bounce to a height of 12-m if it is dropped.

   \[ \text{The total energy in a system does not change according to the law of conservation of energy, so if it started with 98J, it should end with 98J; bouncing to 12m implies more than 98J} \]

   c) What could you do to make the ball bounce to a height of 12-m?

   \[ \text{Have a spring at the bottom, so that the spring can transfer more energy as it falls, the ball would fall on the spring, the spring will retract and use its own potential energy to make the ball go higher. Or simply drop the ball from an elevation higher than 12m.} \]
Conservation of Energy Worksheet

Name: KEY

1) State the law of conservation of energy.

Energy, total energy in a system cannot change, total energy does not change, but the energy may be converted into other forms.

2) A 200-kg boulder is 1000-m above the ground.
   a) What is its potential energy when it is 1000-m above the ground?
      \[ PE = mgh = (200\text{kg})(9.8\text{m/s}^2)(1000\text{m}) = 1,960,000\text{ J} \]
   b) What is its kinetic energy when it is 1000-m above the ground?
      \[ KE = 0 \text{ because there is no motion} \]
   c) The boulder begins to fall. What is its potential energy when it is 500-m above the ground? Where did the “lost” potential energy go?
      \[ PE = mgh = (200\text{kg})(9.8\text{m/s}^2)(500\text{m}) = 980,000\text{ J} \]
      The potential energy was converted into kinetic energy.
   d) What is the kinetic energy of the boulder when it has fallen 500-m?
      \[ KE = \frac{1}{2}mv^2 \quad v = \sqrt{2gh} \quad v = \sqrt{2(9.8\text{m/s}^2)(500\text{m})} = 98.99\text{ m/s} \]
      \[ KE = \frac{1}{2}(200\text{kg})(98.99\text{m/s})^2 \quad KE = 980,000\text{ J} \]
   e) What is the kinetic energy of the boulder just before it hits the ground?
      Just before, all potential is turned into all kinetic
      \[ KE = 1,960,000\text{ J} \]

3) A rollercoaster is designed as shown below. If the rollercoaster starts at the top of the first hill from rest, describe what will happen to the rollercoaster. How could you fix this problem?

![Diagram of rollercoaster](image)

the second hill is taller than the first, so, the rollercoaster will not make it through the second hill, it will reach a maximum height as the first hill.

If we want to fix this we have 2 options

i) make the 1st hill taller than the second or
ii) make the 2nd hill shorter than the first.