Name _____ **Section** _____

Period 6 Activity Sheet: Energy and Work

6.1 How Do We Measure Work and Energy?

a) Work is done when a force moves an object.

Work and energy are measured in units of joules. 1 joule = 1 kg m^2/s^2

Force is measured in units of newtons. 1 newton = 1 kg m/s^2

Explain why a joule can also be called a newton meter.

b) This activity illustrates the amount of energy in one joule.

Lift the 1 newton plastic apple up a distance of 1 meter. How much work did you do on the apple? _____

How much energy did you exert? (Assume no energy was wasted.) _____

6.2 How Does the Work Done Compare to Potential Energy Gained?

a) **Work:** Your instructor will demonstrate potential energy with a model pile driver.

1) The pile driver mass is 4 kilograms. What is its weight in newtons?

_____

2) How much force is necessary to raise the mass at a constant velocity? _____

3) To what height was the pile driver mass raised? _____

4) How much work was done to raise the mass to this height?

_____

b) **Potential Energy:**

1) How much potential energy did the mass have before it was raised? _____

2) How much potential energy does the mass store when it is raised? _____

3) The mass is now allowed to drop. What form of energy does the mass have just before it hits the metal stand at the bottom? _____

c) Group discussion question: Is the amount of energy the mass had just before it hits the same as the amount of gravitational potential energy it had when it was raised? Why or why not?

6.3 What Happens to Stored Potential Energy?

a) Your instructor will demonstrate the pile driver mass hitting a nail into a board.

1) If this pile driver exerts a force of 500 N to drive a nail into a board a distance of 3 cm, how much work does has the pile driver done on the nail?

_____

2) If the 4 kg mass is raised to a height of 0.75 meters, how much potential energy does it store?

_____

3) Is the work done by the mass to pound the nail into the board the same, more, or less than the stored gravitational potential energy? _____

4) Explain what happens to the rest of the stored potential energy when the mass falls and hits the nail.

b) Your instructor will demonstrate the pile driver mass hitting a soda can. List the energy transformations that take place starting with the mass at rest at the top and ending with the mass at rest at the bottom.

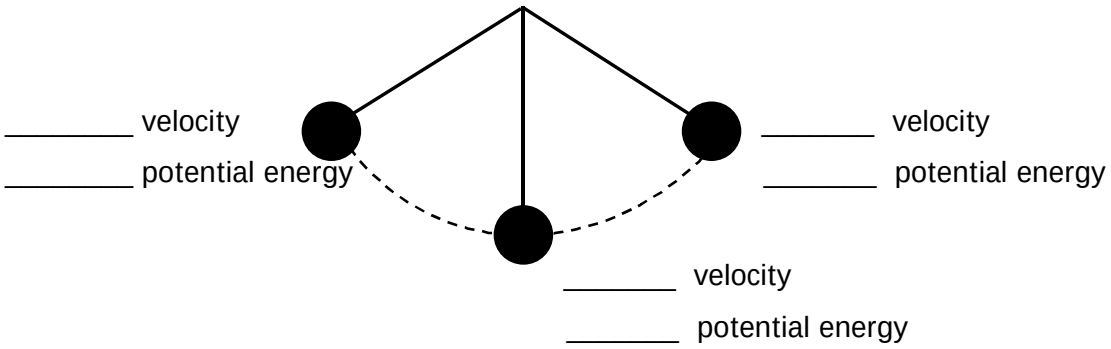
c) When the pile driver mass falls and hits the empty metal stand, what happens to the potential energy the mass had before it fell?

d) Group Discussion Question: You have seen the pile driver mass strike a nail, a soda can, and the empty metal stand. In which of these cases did the mass do work? Explain your answer.

6.4 Kinetic Energy ⟺ Potential Energy Conversions

a) Your instructor will demonstrate a pendulum, in which a ball swings freely.

1) On the sketch of below, fill in the blanks with "MOST" or "LEAST" to indicate the ball's velocity and gravitational potential energy in each position.



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b) Your instructor will discuss the gravitational potential energy of a swinging ball.

1) If you release the ball from the height of your nose, why doesn't it swing back and hit you in the nose?

2) The click-clack machine has 5 balls. What happens to the balls' gravitational potential energy when 1, 2, 3, or 4 balls are raised and dropped? List the series of energy conversions that occur when one ball is raised and released.

3) Would the click-clack balls swing forever? Does a swinging click-clack ball reach the same height with each swing? What eventually happens to the gravitational potential energy the ball started with?

c) Use the curved plastic track to roll or slide the toy car, marble, ping pong ball, and a wooden block with smooth and rough sides. Make predictions first.

1) Which object wastes **the most** energy overcoming the force of friction?
Prediction: _____ **Answer:** _____

2) Which object wastes **the least** energy overcoming the force of friction?
Prediction: _____ **Answer:** _____

d) Group Discussion Question: Would it ever be possible for an object to roll higher than its original starting position? Explain why or why not.

6.5 How Is Energy Conserved?

a) Your instructor will demonstrate two rolling carts colliding with a barrier. Both carts have the same mass and the same frictional force with the table top.

1) Compare the velocities and the distances each cart travels after hitting the barrier.

2) Which cart has more kinetic energy after it hits the barrier – the cart that rolls a shorter distance or a longer distance? _____ How do you know?

3) Watch the carts, without their outer covers, collide with the barrier. How can you explain the difference in the behavior of the carts after they hit the barrier?

4) Explain how energy was conserved when each cart collided with the barrier.

6.6 How Is Friction Involved in Conservation of Energy?

a) In this activity, we measure the work done against the force of friction by a toy truck pulling a block connected to a spring scale.

1) Once the truck and block are moving at a constant velocity, how much force does the truck exert on the block? _____

2) Once the truck reached a constant velocity, how far did the truck pull the block?

_____

3) Calculate the amount of work the truck did to pull the block that distance.

_____

4) Place a 1 kilogram mass on top of the block. How much force does the truck exert on the moving block with the 1 kg mass on it? _____

5) How much work must the truck do to move the block with the 1 kg mass the same distance as in question 2?

_____

6) Why does the truck do more work when the 1 kg mass is added?

b) Group Discussion Question: When an object moves at a constant velocity across a level surface, all the work done is done against the force of friction. When the truck pulled the block at a constant velocity on the level floor, how much of the truck's work went into wasted energy? Would your answer change if the truck accelerated the block?

6.7 More Examples of Energy Storage

a) Examine the spring wound toys on your table.

1) What form of energy do they store?

2) Squeeze a small spring with your fingers. Describe the energy transformations that take place.

3) The batteries on your table store potential energy in another form. What form of energy does a battery store? _____

b) Your instructor will demonstrate a water wheel. List the energy conversions that take place when the water flows over the wheel.

c) How is thermal energy involved in the examples of the spring and the water wheel?