

Period 2 Activity Sheet Solutions: Forms of Energy

2.1 How are Forms of Energy Defined?

Your instructor will discuss the forms of energy that we will study in the World of Energy. Give an example of each form of energy listed below.

- a) Mechanical Energy of Motion
Energy exhibited by objects in motion. Example: any moving object.
- b) Thermal Energy
Unorganized energy of motion exhibited by vibrations of atoms and molecules. Example: rub hands together.
- c) Sound Energy
Organized energy of motion exhibited by vibrations of atoms and molecules. Example: any sound.
- d) Electrical Energy
Energy resulting from the forces between charged particles. Example: Electrical energy from a hand-cranked generator lights a bulb.
- e) Magnetic Energy
Energy resulting from the forces between magnets, causing the magnets to attract or repel. Example: one magnet floats above another magnet.
- f) Radiant Energy
Energy resulting from the vibrations of charges, such as radio waves, microwaves, light rays, and X-rays. Example: radiant energy from a floodlight shining on a solar cell powers the free play radio.
- g) Gravitational Potential Energy
Energy stored in raised objects, which have the potential to fall. Examples: water wheel or any raised object.
- h) Strain Potential Energy
Energy stored in stretched or compressed objects, such as springs. Examples: music box and wind-up toys.
- i) Electrical Potential Energy
Energy stored in the separation of static (not moving) electric charges. Example: capacitor
- j) Chemical Potential Energy
Energy available in the chemical bonds between atoms or molecules. Example: battery
- k) Nuclear Energy
Energy available in the nucleus of atoms that can decay. Examples: smoke detector, the Sun

2.2 What Happens When Energy Is Converted from One Form to Another?

- a) Observe the demonstration of an exercise bicycle connected to large light bulbs. List the energy conversions that occur when the bulbs light.

chemical potential energy \Rightarrow **mechanical energy of motion** \Rightarrow **electrical energy, thermal energy, and sound energy** \Rightarrow **radiant energy**

- b) Connect the hand-cranked generator to the solar cell. Shine the flood light onto the solar cell. List the energy conversions that take place.

electrical energy \Rightarrow **radiant energy** \Rightarrow **electrical energy** \Rightarrow **mechanical energy of motion, thermal energy, and sound energy**

- c) Observe the demonstration of the toy train. List the energy conversions that occur when the train goes uphill.

electrical energy \Rightarrow **mechanical energy of motion, thermal energy, and sound energy** \Rightarrow **gravitational potential energy**

List the energy conversions when the train coasts downhill.

gravitational potential energy \Rightarrow **mechanical energy of motion, thermal energy, and sound energy**

- d) Arrange two square magnets on the wooden stick so that one magnet floats above the other. Press the floating magnet down and then release it. List the energy conversions that occur.

While pressing down the magnet: chemical potential energy (from your body) \Rightarrow **mechanical energy of motion** \Rightarrow **magnetic potential energy**

When the magnet is released: magnetic energy \Rightarrow **mechanical energy of motion** \Rightarrow **gravitational potential energy**

- e) Your instructor will explain the electric drill activity. Be sure to hold the cardboard tube over the end of the drill while you perform this activity. List the energy conversions that occur.

electrical energy \Rightarrow **mechanical energy of motion of the drill** \Rightarrow **thermal energy (water heats and turns to steam)** \Rightarrow **mechanical energy of motion (cork pops off)** \Rightarrow **gravitational potential energy (cork flies up)** \Rightarrow **mechanical energy of motion (cork falls back down)**

2.3 Which Devices Involve These Energy Conversions?

Identify devices that illustrate a conversion from the initial to the final energy forms.

- 1) Chemical Energy \Rightarrow Electrical Energy
batteries
- 2) Chemical Energy \Rightarrow Radiant Energy
chemiluminescence
- 3) Chemical Energy \Rightarrow Thermal Energy
burning any substance

- 4) Electrical Energy \Rightarrow Mechanical Energy of Motion
toy train engine, any electric motor
- 5) Electrical Energy \Rightarrow Radiant Energy
light bulb (visible light and infrared radiation)
- 6) Electrical Energy \Rightarrow Thermal Energy
toaster, hair dryer, any electrical device
- 7) Mechanical Energy of Motion \Rightarrow Electrical Energy
hand-cranked generator, electric generating plant
- 8) Mechanical Energy \Rightarrow Radiant Energy
spark generator
- 9) Mechanical Energy of Motion \Rightarrow Thermal Energy
friction
- 10) Nuclear Energy \Rightarrow Electrical Energy
nuclear power plant
- 11) Radiant Energy \Rightarrow Chemical Energy
photosynthesis
- 12) Radiant Energy \Rightarrow Electrical Energy
solar cell
- 13) Thermal Energy \Rightarrow Mechanical Energy of Motion
bimetallic strips
- 14) Thermal Energy \Rightarrow Radiant Energy
lantern mantle

2.4 How Is Energy Stored?

List devices that store the forms of energy listed below.

- 1) Gravitational Potential Energy **any raised object with the potential to fall**
- 2) Strain Potential Energy **a wound spring**
- 3) Chemical Potential Energy **a battery**
- 4) Electrical Potential Energy **a capacitor**
- 5) Thermal Energy **a hot water tank**

2.5 What Is the Efficient of a Series of Energy Conversions?

- a) Connect a small light bulb to a solar cell. Shine the large flood light onto the solar cell so that the small bulb lights.

*(Next, you will try to light the small bulb by shining another small bulb onto the solar cell. But before you try this activity, make a prediction of what you think will happen when the small bulb shines on the solar cell. Making predictions can help you learn physics by identifying your ideas about how the world works, as well as make the course more interesting. An incorrect prediction does **not** hurt your grade.)*

Predict whether the small light bulb will light when another small bulb shines on the solar cell. Then try the activity and write the outcome in the answer blank.

Will the small bulb light? **Prediction:** _____ **Answer:** _____

- 1) Explain why the small bulb did or did not light when a small bulb shines on the solar cell.

In every energy conversion some energy is wasted. Therefore, the amount of useful energy from the small bulb is not sufficient to cause the solar cell to supply the electrical energy required to light another small bulb.

- 2) What form of energy goes into the solar cell? __Radiant energy__
- 3) What form of energy lights the bulb? __Electrical energy__
- 4) What form of energy is wasted when the bulb lights? __Thermal energy__
- b) Find the efficiency of the conversion process that turns radiant energy shining on the solar cell into visible light from the small bulb.
- 1) If the solar cell requires 100 joules of radiant energy to produce 25 joules of electrical energy, find the efficiency of this step of the conversion process.
- $$\text{Eff} = \frac{\text{Useful Energy Out}}{\text{Total Energy In}} = \frac{25 \text{ J}}{100 \text{ J}} = 0.25 = 25\%$$
- 2) If 25 joules of electrical energy are converted into 5 joules of visible light in the small bulb, find the efficiency of this step of the process.
- $$\text{Eff} = \frac{5 \text{ J}}{25 \text{ J}} = 0.20 = 20\%$$
- 3) Use the answers to parts 1) and 2) to find the overall efficiency when this solar cell is used to light the small bulb.
- $$\text{Overall efficiency} = \text{Eff}_1 \times \text{Eff}_2 = 0.25 \times 0.20 = 0.05 = 5\%$$
- c) Group Discussion Question: When the solar cell lights the small bulb, the majority of the radiant energy shining on the solar cell is wasted. List the places where energy is wasted. Which forms of energy are wasted?