

Preview of Period 2: Forms of Energy

2.1 Forms of Energy

How are forms of energy defined?

2.2 Energy Conversions

What happens when energy is converted from one form into another form?

2.3 Efficiency of Energy Conversions

How efficient are energy conversions?

2.4 Energy Storage

How is energy stored?

Act 2.1: Forms of Energy

Forms of energy related to the **energy of motion** are associated with moving objects, atoms, and molecules.

Mechanical Energy of Motion:

- ◆ Moving objects exhibit mechanical energy of motion, also called kinetic energy.

Thermal Energy:

- ◆ Energy of motion occurs within an object as its atoms and molecules vibrate randomly.
- ◆ Thermal energy is the unorganized energy of motion of vibrating objects too small to see.

Sound Energy:

- ◆ When atoms and molecules vibrate in an organized way, their vibrations may travel as a sound wave.
- ◆ Sound is the transmission of vibrations through a solid, liquid, or gas by vibrating atoms or molecules.

Forms of Energy, Continued

Matter contains positive and negative charges. Energy that results from the forces between these charges is called **electromagnetic energy**.

Electrical Energy:

- ◆ Electrical energy results from forces between charged particles.
- ◆ These particles may be in motion or at rest (static).

Magnetic Energy:

- ◆ Charges moving within some types of materials produce magnetic forces.
- ◆ Magnetic energy results from the forces between magnetic materials.

Radiant Energy:

- ◆ Radiant energy results from vibrations of charges, such as radio waves, microwaves, light rays, and X-rays.
- ◆ Radiant energy is another name for electromagnetic energy.

Forms of Energy, Continued

Stored energy, which can be used to do work, is called **potential energy**.

Gravitational Potential Energy:

Energy stored in a raised object that has the potential to fall.

Strain Potential Energy:

Energy stored in a stretched or compressed spring.

Chemical Potential Energy:

Energy existing because atoms and molecules can take in or give off energy when their chemical bonds are formed or broken.

Electrical Potential Energy:

Energy stored when static positive and negative charges are separated.

Nuclear Energy:

Energy available in the nuclei of atoms that are radioactive and undergo nuclear changes.

Summary of Forms of Energy

Mechanical Energy of Motion: The energy exhibited by objects in motion.

Thermal Energy: The unorganized energy of motion of vibrating atoms and molecules.

Sound Energy: The organized energy of motion of vibrating atoms and molecules.

Electrical Energy: The energy resulting from forces between charged particles.

Magnetic Energy: The energy resulting from the forces between magnets.

Radiant Energy: The energy resulting from vibrations of charges, such as radio waves, microwaves, or visible light.

Gravitational Potential Energy: The energy stored in raised objects, which could fall.

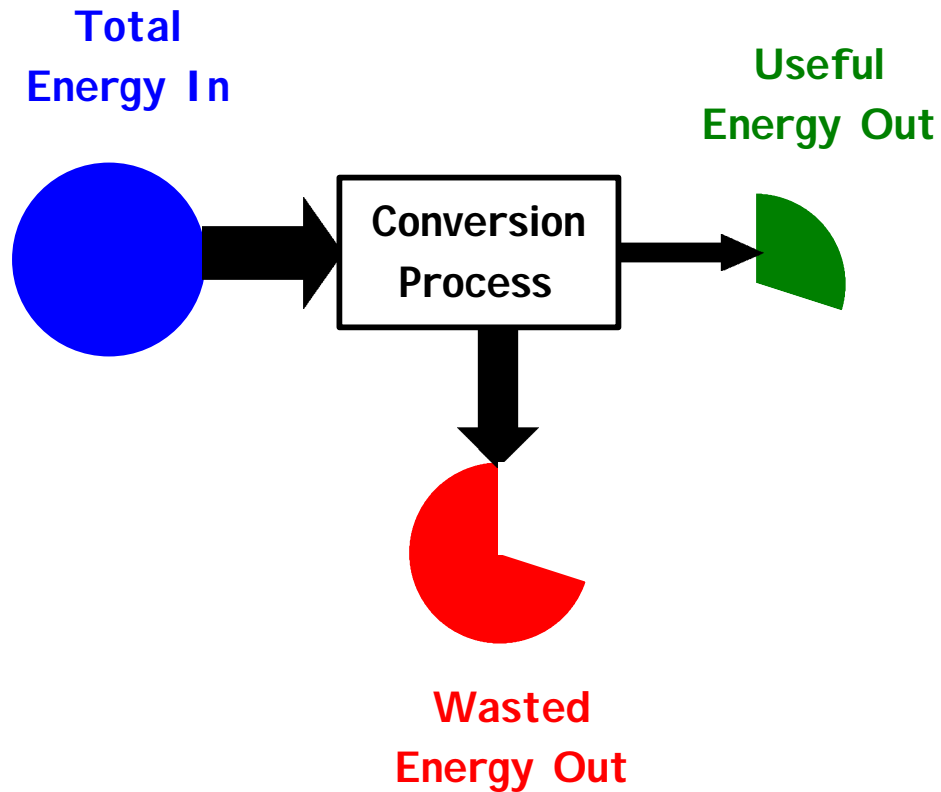
Strain Potential Energy: The energy stored in a stretched or compressed spring.

Chemical Potential Energy: The energy available in the chemical bonds binding atoms together.

Electrical Potential Energy: The energy stored by static electric charges.

Nuclear Energy: Energy available in the nuclei of radioactive atoms.

Act 2.3: Efficiency of Energy Conversions



$$\text{Total Energy In} = \text{Useful Energy Out} + \text{Wasted Energy Out}$$

How to Find the Efficiency of Energy Conversions

$$\text{Efficiency} = \frac{\text{Useful Energy Out}}{\text{Total Energy In}}$$

What happens to the wasted energy?

Example

What is the efficiency of an energy conversion that requires 600 joules of energy to produce 150 joules of useful energy?

$$\frac{\text{Useful Energy Out}}{\text{Total Energy In}} = \frac{150 \text{ joules}}{600 \text{ joules}} = 0.25 = 25 \%$$

What is the Efficiency of a Series of Energy Conversions?

The overall efficiency is the **product of the efficiencies** of each step in the process.

$$\text{Overall Efficiency} = \text{Eff}_1 \times \text{Eff}_2 \times \text{Eff}_3 \times \dots$$

(Example 2.2)

The efficiency of a hand cranked generator is 40%. The efficiency of a generator converting mechanical energy into electrical energy is 50%. The efficiency of a light bulb converting electrical energy into visible light is 20%. What is the overall efficiency of this series of energy conversions?

$$\text{Overall Eff} = \text{Eff}_{\text{hand}} \times \text{Eff}_{\text{generator}} \times \text{Eff}_{\text{bulb}} =$$

$$0.40 \times 0.50 \times 0.20 = 0.04 = 4\%$$

Period 2 Summary

2.1: Energy provides the ability to do work.

Work is done when forces act on an object to move it over a distance.

2.2: Energy is often converted from its most available form, such as chemical potential energy, into a more useful form, such as electrical energy.

Converting energy into the desired form may require a series of conversions.

In each step in the conversion process, some **energy is wasted**.

2.3: Although energy is wasted, it is not lost.

The total amount of energy into a process must equal the total amount of energy out.

$$\text{Efficiency} = \frac{\text{Useful Energy Out}}{\text{Total Energy In}}$$

$$\text{Overall Eff} = \text{Eff}_1 \times \text{Eff}_2 \times \text{Eff}_3 \times \dots$$

2.4: Energy can be stored in various ways, such as chemical potential, electrical potential, nuclear, gravitational potential, or strain potential energy.

Period 2 Review Questions

- R.1** Describe the energy conversions that occur when you ride the exercise bicycle and light the bulbs connected to it. Which conversions provide the useful energy you want?
- R.2** Give examples of storing different forms of energy.
- R.3** How does the total amount of energy put into a conversion process compare to the total amount of energy out of that process? How does the total amount of energy put into the process compare to the useful energy out?
- R.4** Describe the efficiency of an energy conversion process in words and with an equation.
- R.5** If energy is conserved, how can we say that energy is wasted in energy conversion processes?