LESSON

4

PHYSICAL SCIENCE

The Nature of Energy

Key Ideas

- Anything that can force matter to move, change direction, or change speed has energy.
- Energy comes in many forms and can be converted from one form to another.
- The law of conservation of energy states that energy can neither be created nor destroyed, only changed in form.

ON THE GED® TEST

Since many Science Test *questions are based on diagrams and graphs, it is important to carefully read the titles and all of the other information on all graphics. Make sure you understand a graphic before answering questions based on it.*

Energy is defined as the capacity to do work. **Work** is done whenever a force is applied to an object to set it in motion. Thus, anything that can force matter to move, change direction, or change speed has energy.

Energy comes in many forms. **Heat energy** can change a solid to a liquid and a liquid to a gas. It is also involved in most chemical reactions. **Light energy** can create an image by causing the chemicals on a piece of film to react. It provides the energy needed for the process of photosynthesis in green plants. **Electrical energy** can turn a motor, plate a set of flatware with a layer of silver, or store data on a hard drive. **Chemical energy** in food provides the energy humans need for life functions. It heats our buildings when we burn oil, gas, coal, or wood. Chemical energy in batteries provides electricity when the batteries are connected in a circuit. **Nuclear energy** from breaking apart the nuclei of atoms provides energy to produce electricity or power a submarine. **Mechanical energy** turns the axles of a car or the blades of a fan.

Energy can be converted from one form to another. Consider the production and use of electricity. In most electric plants, a fossil fuel (chemical energy) is burned, producing heat energy that turns water to steam. The energy in the steam turns the blades of a turbine, producing mechanical energy. The turbine powers the generator, which produces electrical energy. Electrical energy is used in homes to provide heat energy (in stoves and toasters), light energy (in light bulbs), sound energy (in the stereo), and mechanical energy (in a blender). Even though energy undergoes changes in form, the amount of energy in a closed system remains the same. This principle is known as the **law of conservation of energy**.

Two basic types of energy are **potential energy** and **kinetic energy**. An object has potential energy because of its position; it has kinetic energy when it moves. For example, when you raise a hammer, at the top of your upswing the hammer has potential energy. When you lower the hammer to hit a nail, the hammer has kinetic energy, the energy of motion. When the hammer hits the nail, it transfers energy to the nail. The energy transferred is equal to the work done by the hammer on the nail, and it can be measured in **joules**. The rate of doing work or consuming energy is called **power**, and it can be measured in horsepower (in the English system) or **watts** (joules per second in the metric system).

Physicist Albert Einstein discovered the relationship between energy and mass and expressed it in the equation $E = mc^2$, in which E represents energy, m represents mass, and c represents the speed of light. Since the speed of light is a very large number, the equation indicates there is a great deal of energy in even the tiniest bit of matter. So, for example, in nuclear bombs and nuclear power plants, mass is changed to energy when large atoms are split into two or more smaller atoms with less mass than the original large atom.

PRACTICE 4

Questions 1 through 4 are based on the information on page 558.

1. Which of the following states the law of conservation of energy?

   A. Potential energy is the energy of position; kinetic energy is the energy of motion.
   B. Energy can be created and destroyed as well as changed in form.
   C. Energy cannot be created or destroyed, but can only change in form.
   D. Energy cannot be created, destroyed, or changed in form.

2. During a power outage, George relied upon his flashlight to move around his home. The flashlight is constructed with wires and a lightbulb enclosed in a plastic casing. It requires batteries to operate.

   Write in the three types of energy involved in turning on and using the flashlight.

Options:

sound	light
nuclear	electrical
chemical	

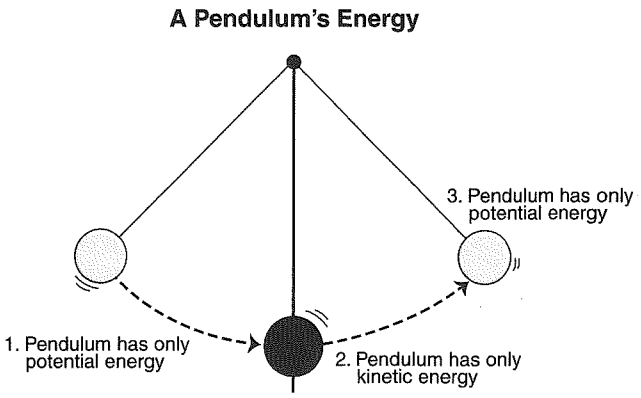
3. An oak tree may grow very tall very slowly. It may take the tree a hundred years to absorb light energy and store it as chemical energy, yet only a single winter to be turned into heat energy in someone's wood stove. Which concept does this fact best relate to?

   A. work
   B. power
   C. force
   D. kinetic energy

4. What does Einstein's equation $E = mc^2$ express?

   A. the relationship between electricity and magnetism
   B. the relationship between energy and mass
   C. the speed of light in a vacuum
   D. the relationship between electrical energy and nuclear energy

Question 5 refers to the following diagram.



5. Which of the following statements is supported by the information in the diagram?

   A. At the high point of its swing, a pendulum has kinetic energy.
   B. At the high point of its swing, a pendulum has potential energy.
   C. As a pendulum swings through one arc, it loses all its energy.
   D. A pendulum can swing forever because of kinetic energy.

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6. Heat energy is present in all matter in the form of the kinetic energy of its atoms and molecules. Heat energy can pass from one place to another through conduction: the transfer of kinetic energy from molecules in greater motion (hot areas) to molecules of lesser motion (cold areas). Solid metals like silver and copper are good conductors of heat energy; gases like air are poor conductors.

   What is the reason that air is a poor conductor of heat?

   A. The molecules in air are far apart.
   B. The molecules in air are very large.
   C. The molecules in air do not move.
   D. The molecules in air are very small.

Answers and explanations start on page 709.