LESSON 11

Interpret Observations

Use with *Student Book* pp. 62–63

SCIENCE CONTENT TOPICS: P.a.2, P.a.3
SCIENCE PRACTICES: SP.1.a, SP.1.b, SP.1.c, SP.3.a, SP.3.b, SP.7.a

1 Review the Skill

An **observation** is something perceived directly with the body's senses. Science is based on careful observations. A scientific observation is a more disciplined perception than a casual observation. A scientific observation may involve taking measurements, and it certainly involves recording and documenting what is observed.

Interpreting an observation is a means of explaining what has been observed. As you learn about science, you have opportunities to interpret observations that you make or read about in presentations of scientific information.

2 Refine the Skill

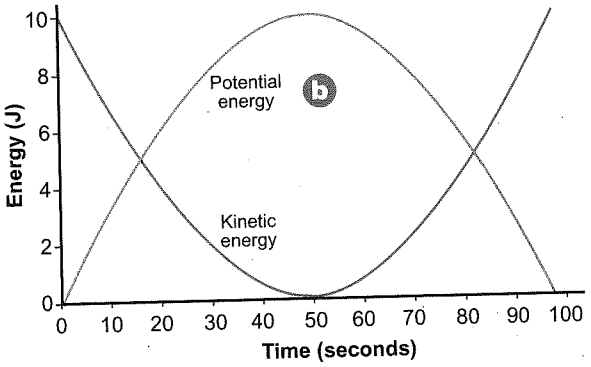
By refining the skill of interpreting observations, you will improve your study and test-taking abilities, especially as they relate to the GED® Science Test. Study the information and graph below. Then answer the questions that follow.

LAW OF CONSERVATION OF ENERGY

The law of conservation of energy states that energy cannot be created or destroyed. It can only change form. Energy changes from potential to kinetic energy and vice versa. Potential energy is stored energy. A ball that is sitting on the edge of a desk has potential energy. Kinetic energy is the energy of motion. As the ball falls off the desk, its potential energy changes to kinetic energy. The total amount of energy is always equal to the sum of the potential energy and the kinetic energy. The graph below shows how energy, measured in joules (J), changes in a model rocket that is launched.

a Read the passage before trying to interpret the graph. The text may provide information about data contained in the graph. The text here tells you how the two data sets are related.

b Graphs, which can aid in interpreting observations, do not always contain legends or keys. This graph identifies the data sets next to the lines. Bar graphs may identify the data sets in the bars.



1. Which statement describes the total energy of the rocket?

   A. It always equals twice the kinetic energy.
   B. It decreases and then increases again.
   C. It is equal to 10 J.
   D. It is equal to 0 J.

2. What happens to the rocket's kinetic energy at 50 seconds?

   A. It is at maximum.
   B. It is greater than the total amount of energy.
   C. It is equal to the amount of potential energy.
   D. It changes completely into potential energy.

USING LOGIC

Questions based on data in graphs often require you to interpret the trends shown in the graphs. In multi-line graphs, it is helpful to look at the trend of each individual data set before comparing them.

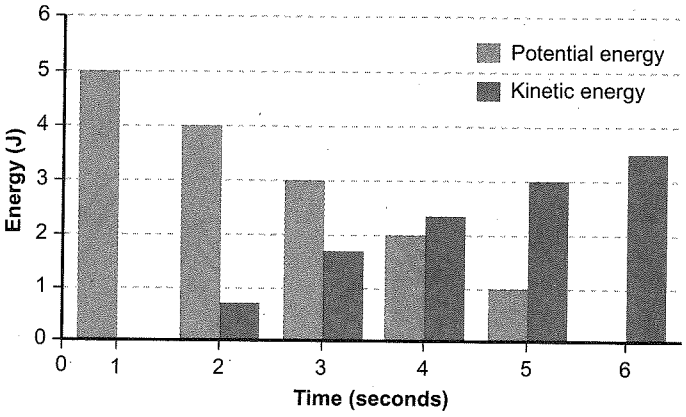
3 Master the Skill

DIRECTIONS: Study the information and graph, read each question, and choose the **best** answer.

TOY CAR INVESTIGATION

A group of students tests the law of conservation of energy by measuring the potential energy and kinetic energy of a toy car rolling down a ramp. The graph shows the results of their investigation. At the top of the ramp, the car has only potential energy. The potential energy changes to kinetic energy as the car rolls down the ramp. At the bottom of the ramp, all the potential energy should be changed into kinetic energy. However, forces such as friction change some energy into thermal energy.

POTENTIAL ENERGY AND KINETIC ENERGY OF A TOY CAR



3. What interpretation can be made about the potential energy and kinetic energy of the toy car?

   A. The toy car's potential energy at the top of the ramp equals its kinetic energy at the bottom of the ramp.
   B. As the toy car's potential energy decreases, its kinetic energy increases.
   C. The students proved that sometimes a system's energy is not conserved.
   D. The car had more energy at the end of the ramp than it did at the top of the ramp.

4. What conclusion can be drawn about the investigation?

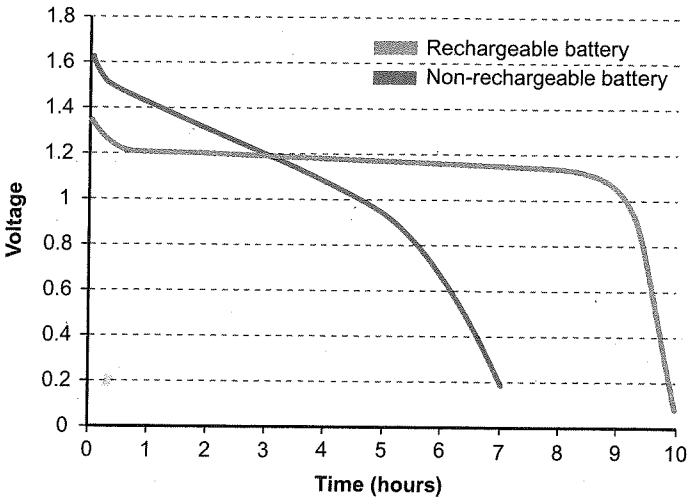
   A. About 1.5 J of energy changed into thermal energy during the investigation.
   B. About 1.5 J of energy were destroyed during the investigation.
   C. The students did not measure the kinetic energy correctly.
   D. The car had a total energy of about 8.5 J.

DIRECTIONS: Study the information and graph, read each question, and choose the **best** answer.

RECHARGEABLE VERSUS NON-RECHARGEABLE BATTERIES

Batteries contain stored chemical energy. The chemical energy in batteries changes to electrical energy when a battery-powered device is turned on. When rechargeable batteries are recharged, electrical energy is changed back into chemical energy. The voltage of a battery is a measure of the potential energy stored in the battery.

VOLTAGE CHANGE DURING THE LIFETIMES OF TWO BATTERIES



5. The graph supports the interpretation that the non-rechargeable battery has more potential energy when the batteries are new by showing that its voltage

   A. decreases more rapidly.
   B. reaches 0.2 first.
   C. is greater at zero hours.
   D. is greater after two hours.

6. What interpretation can be made about the rechargeable battery?

   A. Its voltage after five hours is about the same as its voltage after one hour.
   B. It always has more voltage than the non-rechargeable battery.
   C. The change in voltage is relatively constant during the 10-hour period.
   D. It does not last as long as the non-rechargeable battery.

Spotlighted Item: **HOT SPOT**

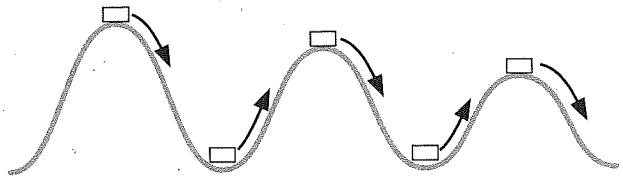
DIRECTIONS: Read the passage. Then read each question, and answer by marking the appropriate hot spot or hot spots.

PHYSICS OF ROLLER COASTERS

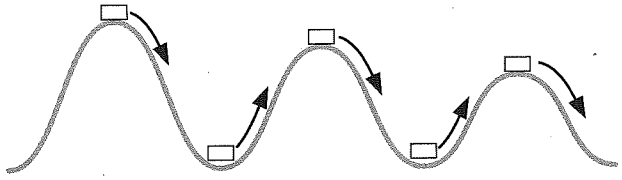
Mechanical energy is the energy a mechanical system or machine has because of its motion or its position. Mechanical energy is the sum of the system's potential and kinetic energy. Any machine with mechanical energy is able to do work. That is, mechanical energy makes it possible for the system to apply a force to and move an object or another system. In most mechanical systems, potential and kinetic energy are continually changing from one into the other. In an "ideal" machine, this process would go on forever, but in reality it does not because the system loses energy to friction.

An example that illustrates mechanical energy is a roller coaster. The observation can be made that a chain mechanism pulls the cars to the top of the first hill, and then the only force working on the cars is gravity. As the roller coaster moves over the track, its energy is constantly changing from potential to kinetic and back again.

7. On the diagram below, mark an *X* on the point or points where potential energy is the greatest on the roller coaster.



8. On the diagram below, mark an *X* on the point or points where energy is beginning to change from kinetic to potential.



DIRECTIONS: Read the passage. Then read each question, and choose the **best** answer.

CHEMICAL BONDS

Chemical energy is energy stored in the bonds formed between atoms and molecules. It takes energy to form the bonds, but it also takes energy to break them apart; otherwise, no stable molecules would exist.

All chemical reactions need energy to make atoms go from one molecular configuration to another. In some reactions, the products contain more energy than the reactants. This type of reaction is endothermic. The reaction, in effect, absorbs energy from the environment to form the product. Sometimes, however, a chemical reaction results in a product that has less energy than the reactants, indicating that energy was released into the surroundings during the reaction. This type of reaction is exothermic. Combustion is a type of exothermic reaction that produces light and heat.

Hot or cold packs used to reduce swelling exemplify endothermic and exothermic reactions. The pouch of the hot or cold pack contains a dry chemical and an inner pouch of water. A reaction is started when the seal on the pouch of water is broken, mixing the water with the chemical.

9. What kind of reaction makes a cold pack feel cold?

   A. energetic
   B. endothermic
   C. combustion
   D. exothermic

10. What kind of reaction makes a hot pack feel hot?

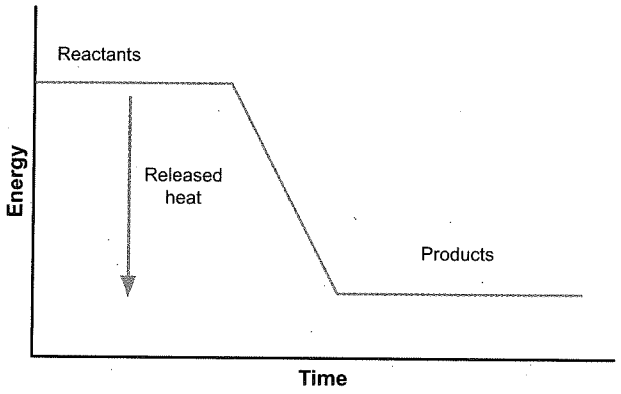
    A. energetic
    B. endothermic
    C. combustion
    D. exothermic

DIRECTIONS: Study the information and graph, read each question, and choose the **best** answer.

CHEMICAL REACTIONS

Some chemical reactions produce energy, and others absorb it. An exothermic chemical reaction produces heat, or thermal energy. For example, when a match burns, it releases heat. Chemical energy changes to thermal energy. An endothermic chemical reaction absorbs heat, or thermal energy. Often this heat comes from the surroundings. For example, when citric acid and baking soda react, energy is absorbed from the surroundings to drive the reaction. Thermal energy changes to chemical energy.

ENERGY DURING A CHEMICAL REACTION



11. The graph shows how the energy of a reaction system changed over time. What interpretation of the data explains why this is an exothermic reaction?

    A. The reactants had more energy than the products have.
    B. The products have more energy than the reactants had.
    C. The reactants and products gained energy during the reaction.
    D. The reactants and products lost energy during the reaction.

12. If a student put his hand around a beaker containing citric acid and baking soda, the solution would feel cold. Why?

    A. Energy is going into his hand.
    B. The solution is generating an electrical charge.
    C. Liquids are always cooler than their surroundings.
    D. Energy is being drawn from his hand.

DIRECTIONS: Read the passage. Then read each question, and choose the **best** answer.

PHOTOSYNTHESIS

Plants make their own food through a process called photosynthesis. This process changes one form of energy—light—to another form of energy—chemical energy. The energy from sunlight is used in the leaves of a plant to combine carbon dioxide and water to produce sugar and oxygen. The plant stores the sugar in its tissues and releases oxygen into the air as a waste product. The reaction can be written as:

$$6CO_2 + 6H_2O \text{ (+ light energy)} \rightarrow C_6H_{12}O_6 + 6O_2$$

When another organism eats the plant, the organism's cells convert chemical energy stored in the plant's sugar to mechanical energy (used for motion) and thermal energy (used for other life processes). The conversion of chemical energy to other usable forms of energy in an organism's cells is called respiration. The reaction can be written as:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{mechanical and thermal energy}$$

13. What interpretation can be made about photosynthesis and respiration?

    A. Photosynthesis is exothermic, and respiration is endothermic.
    B. Photosynthesis is endothermic, and respiration is exothermic.
    C. Both photosynthesis and respiration are endothermic.
    D. Both photosynthesis and respiration are exothermic.

14. While changing energy from one form to another, both photosynthesis and respiration reactions yield waste products. A waste product is something that a cell releases instead of using. What are the waste products of respiration?

    A. carbon dioxide and water
    B. carbon dioxide, water, and energy
    C. carbon dioxide, oxygen, and energy
    D. carbon dioxide and oxygen