Answer Key

Directed Reading A

SECTION: WHAT IS ENERGY?

1. B
2. energy
3. from the first object to the second object
4. joules
5. C
6. C
7. The greater the mass, the greater its kinetic energy.
8. Speed has a greater effect on kinetic energy than mass.
9. potential
10. gravitational potential energy
11. height
12. gravitational energy = weight × height
13. weight
14. An object's height is a measure of how far the object has to fall.
15. A
16. mechanical energy = potential energy + kinetic energy
17. kinetic
18. potential
19. The pin slows down as it moves upward.
20. A
21. C
22. G
23. E
24. B
25. D
26. Particles move faster at higher temperatures than at lower temperatures.
27. potential
28. Generators turn magnets inside loops of wire. This makes electrical energy move through the wire.
29. potential energy
30. kinetic energy
31. light energy
32. Fusion is when two or more nuclei join together. Fission is when the nucleus of a large atom splits apart.

SECTION: ENERGY CONVERSIONS

1. energy conversion
2. C
3. B
4. D
5. kinetic
6. potential
7. A
8. A
9. B
10. C
11. sun
12. Photosynthesis is the process in which plants use light energy from the sun to make new substances that have chemical energy.
13. The chemical energy is converted to thermal energy when wood from the tree is burned.
14. Electrical energy is converted into kinetic energy when the fan blades spin. Electrical energy is converted to thermal energy when the wires heat up.
15. Answers may vary. Sample answer: electrical energy, to sound energy with an alarm clock; electrical energy to light energy with a lamp
16. machine
17. kinetic
18. radiometer
19. The dark side absorbs more light energy, causing the gases to heat and make the molecules move faster. This causes the vanes to turn.

SECTION: CONSERVATION OF ENERGY

1. A
2. C
3. C
4. between the cars and the track and the cars and the air
5. on the top of the first hill
6. potential
7. closed system
8. thermal
9. kinetic, thermal, sound
10. law of conservation of energy
11. energy

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12. thermal
13. thermal
14. friction
15. It leaves through the radiator and exhaust pipe.
16. perpetual motion machine
17. a constant supply of energy
18. thermal energy
19. Energy efficiency is a comparison of the amount of useful energy before and after a conversion.
20. shape
21. energy efficiency
22. conversions

SECTION: ENERGY RESOURCES

1. energy resource
2. sun
3. C
4. A
5. coal, petroleum, natural gas
6. energy
7. electrical energy
8. gas, kerosene, wax
9. Answers may vary. Sample answer: heating systems, vehicles
10. electrical generator
11. electric current
12. thermal
13. kinetic
14. radioactive
15. nuclear fission
16. The supply of uranium is limited.
17. D
18. Answers may vary. Sample answer: solar energy; water energy; wind energy
19. solar cells
20. large windows
21. kinetic
22. Falling water turns a turbine in the dam. The turbine is connected to a generator that changes the kinetic energy into electric energy.
23. The uneven heating of Earth's surface causes wind.
24. kinetic
25. electrical
26. geothermal energy
27. rock
28. biomass
29. Answers may vary. Sample answer: Fossil fuels pollute the air.
30. Answers may vary. Sample answer: It is difficult to generate large amounts of solar energy.
31. Answers may vary. Sample answer: The dams can affect the ecology of a river.

Directed Reading B

SECTION: WHAT IS ENERGY?

1. B
2. C
3. C
4. A
5. A
6. B
7. C
8. B
9. D
10. D
11. C
12. A
13. B
14. B
15. B
16. A
17. C
18. B
19. A
20. C
21. fusion
22. fission

SECTION: ENERGY CONVERSIONS

1. B
2. C
3. B
4. D
5. A
6. C
7. B
8. kinetic
9. thermal
10. light
11. photosynthesis
12. chemical
13. C
14. C
15. kinetic
16. machine
17. sound
18. A

SECTION: CONSERVATION OF ENERGY

1. A
2. C
3. B
4. closed system
5. energy
6. law of conservation of energy
7. thermal
8. A
9. B
10. B
11. A
12. C

SECTION: ENERGY RESOURCES

1. B
2. A
3. fossil fuels
4. nonrenewable resources
5. energy
6. D

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7. A
8. B
9. C
10. A
11. B
12. nuclear fission
13. thermal
14. uranium
15. B
16. A
17. C
18. D
19. C
20. B
21. A
22. B
23. A
24. B

Vocabulary and Section Summary

SECTION: WHAT IS ENERGY?

1. energy: the capacity to do work
2. kinetic energy: the energy of an object that is due to the object's motion
3. potential energy: the energy that an object has because of the position, shape, or condition of the object
4. mechanical energy: the amount of work an object can do because of the object's kinetic and potential energies

SECTION: ENERGY CONVERSIONS

1. energy conversion: a change from one form of energy to another

SECTION: CONSERVATION OF ENERGY

1. friction: a force that opposes motion between two surfaces that are in contact
2. law of conservation of energy: the law that states that energy cannot be created or destroyed but can be changed from one form to another

SECTION: ENERGY RESOURCES

1. nonrenewable resource: a resource that forms at a rate that is much slower than the rate at which it is consumed
2. fossil fuel: a nonrenewable energy resource formed from the remains of organisms that lived long ago
3. renewable resource: a natural resource that can be replaced at the same rate at which the resource is consumed

Section Review

SECTION: WHAT IS ENERGY?

1. Sample answer: Energy is the ability to do work.
2. Sample answer: Mechanical energy can consist of kinetic energy, potential energy, or both.
3. A
4. Energy is the ability to do work.
5. weight and height
6. It depends on the position of atoms in a molecule.
7. Kinetic energy is used to nail the hammer into the board, and that energy becomes thermal energy.
8. A vehicle moving at high speed has a lot more kinetic energy than a vehicle moving at low speed does, so the high-speed vehicle is able to cause more damage in a collision.
9. potential energy

SECTION: ENERGY CONVERSIONS

1. Sample answer: a change from one kind of energy to another
2. B
3. Sample answer: a space heater, whose heating coils are given thermal energy from electrical energy when the heater is plugged in
4. Your body gets its energy from chemical energy found in food.
5. Machines can convert energy into more useful forms of energy.
6. The potential energy of a basketball is at a maximum when the ball is at its greatest height. The potential energy becomes converted to kinetic energy as the ball falls to the ground, and kinetic energy is at a maximum as the ball reaches the ground. When the ball bounces back up again, its kinetic energy is once again converted into potential energy, and so on.
7. No, the sound produced by screeching brakes is not a useful form of energy, because it does not contribute to stopping the car.
8. potential energy
9. It is converted to kinetic energy.

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SECTION: CONSERVATION OF ENERGY

1. Sample answer: According to the law of conservation of energy, energy is not lost, although kinetic energy can be converted into thermal energy by friction.
2. D
3. Sample answer: At the top of a "hill", a roller-coaster car has maximum potential energy. As the car rolls down the hill, its potential energy is turned into kinetic energy as well as thermal energy due to friction. Because the car "loses" energy because of friction, the next hill that the car climbs must be lower than the first one, and so on.
4. 80 J – 60 J = 20 J
5. The energy that the ball had initially is not "gone" but was converted into thermal energy and sound energy.
6. No, efficiency depends on the ratio of energy input to energy output, and you do not know the energy input. If the energy input is much higher than the energy output, the car is not efficient.

SECTION: ENERGY RESOURCES

1. Sample answer: fuel from decomposed organic matter from plants and animals that lived millions of years ago
2. renewable resources
3. nonrenewable resources
4. A
5. Both fossil fuels and biomass come from organic matter, are burned to generate energy, and cause air pollution when used. Biomass is renewable, whereas fossil fuels are nonrenewable.
6. Sample answer: Electrical energy comes from power generators, which may be run by burning fossil fuels, which carry stored energy from the sun harnessed in plants and animals. (Other answers are possible based on other methods of generating electricity, including wind, solar, and biomass.)
7. A hydroelectric dam and a wind turbine both harness renewable sources of energy. Neither causes air pollution. However, a hydroelectric dam can disrupt river life, whereas a wind turbine has hardly any effect on the environment.
8. Possible answers include: geothermal energy and nuclear energy.
9. The pie chart indicates that nonrenewable resources currently represent a large portion of U.S. energy sources. This use of fossil fuels, which are nonrenewable, for such a large proportion of its energy may make the United States run out of fossil fuels. Therefore, renewable resources will become increasingly important in the future.

Chapter Review

1. Sample answer: Potential energy is the energy of position of an object. Kinetic energy is the energy of motion of an object.
2. Sample answer: Mechanical energy is the total kinetic and potential energy of an object. Energy conversion is the change of energy from one form to another.
3. Sample answer: Friction is a force that opposes motion between two surfaces that are in contact. The law of conservation of energy states that energy is never created or lost; it simply changes form.
4. Sample answer: Renewable resources are replaced naturally more quickly than they are used up. Nonrenewable resources are not replaced—or are replaced very slowly—after they are used up.
5. Sample answer: Energy resources are natural sources of energy that can be converted into other forms of energy to do useful work. Fossil fuels are energy resources that come from the decayed organic matter from plants and animals that lived millions of years ago.
6. D
7. B
8. B
9. D
10. C
11. Sample answer: Thermal energy depends partly on the kinetic energy of the particles that make up an object. Chemical energy is a kind of potential energy because it depends on the arrangement of atoms in a molecule, which is energy of position.

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12. Sample answer: When a person jumps off a diving board, his or her potential energy is converted into kinetic energy. When steam turns the blades of a turbine, the thermal energy of the steam is converted into the kinetic energy of the moving turbine. When a hair dryer is turned on, electrical energy is converted into kinetic energy of the turning fan and thermal energy of the hot coils inside the hair dryer.
13. Within a closed system, objects transfer energy only to each other. Energy is conserved in a closed system because energy only changes form and is neither created nor destroyed.
14. Fossil fuels formed from decayed organic matter of plants and animals, which was subjected to millions of years of pressure under Earth's crust.
15. a. 400 J; b. 400 J ÷ 100 N = 4 m
16. An answer to this exercise can be found at the end of the Teacher Edition.
17. The compression of the air in the balloon is a kind of potential energy, which is released in the form of kinetic energy when you let the balloon go.
18. As the potential energy you had on top of the hill is converted into kinetic energy, some of the kinetic energy is converted to thermal energy because of friction, so you eventually come to a stop. In the same way, perpetual motion is impossible because energy conversions always result in energy being "lost" as heat.
19. We would no longer have a source of solar, wind, or hydroelectric energy.
20. The food that the pole-vaulter ate for breakfast contained chemical energy, which his body turned into a different kind of chemical energy, which was then used as kinetic energy when he pole-vaulted.
21. Sample answer: One car may be more aerodynamic than the other, causing less energy to be lost because of friction. One car may have fewer moving parts than the other does, causing less energy to be lost because of friction. (Other answers, including a difference in weight, are possible.)
22. Sample answer: To test the effect of aerodynamics, measure the efficiency of a slower car that has the more aerodynamic design and compare it with the efficiency of a slower car that has the less aerodynamic design. (Answers should include controlled experiments.)
23. 500 N × 10 m = 5,000 J
24. 500 N × 5 m = 2,500 J
25. 5,000 J - 2,500 J = 2,500 J

Reinforcement

SEE WHAT I SAW

1. C
2. D
3. A
4. The mechanical energy of the boy stays the same.

ENERGETIC COOKING

1. Light energy is converted to electrical energy in the solar panel, and electrical energy is converted to mechanical energy in the juicer.
2. Electrical energy from the outlet is converted into thermal energy in the frying pan.
3. Electrical energy from the outlet is converted into light energy.
4. Thermal energy from the frying pan is converted into sound.
5. Thermal energy in the frying pan is converted into chemical energy.
6. Thermal energy in the frying pan is converted into sound energy.Bonus Question: Chemical energy is converted into thermal energy and kinetic energy.

Critical Thinking

1. Answers may vary. Sample answer: Slick could use a sail to catch the wind or a bicycle-pedal system to provide energy to the "Slick Special."
2. Answers may vary. Sample answer: The solar cells used to provide energy to the chair can work only in direct sunlight. The chair will need another energy source if clouds block the sunlight.
3. Answers may vary. Sample answer: Gravitational potential energy equals weight multiplied by height. Because

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Flash weighs more, he has more gravitational potential energy.

4. Answers may vary. Sample answer: Kinetic energy equals mass multiplied by velocity. Their velocities are the same, but Flash has a greater mass than Slick..Therefore, Flash has more kinetic energy.
5. Answers may vary. Sample answers: My chair would include a low-friction electric engine run by solar panels and bicycle pedals. The chair would be streamlined to reduce air resistance. The tires would be narrow to reduce the friction with the road.

Section Quizzes

SECTION: WHAT IS ENERGY?

1. B
2. E
3. C
4. A
5. D
6. B
7. C
8. D
9. C

SECTION: ENERGY CONVERSIONS

1. C
2. B
3. B
4. A
5. C
6. D

SECTION: CONSERVATION OF ENERGY

1. E
2. A
3. B
4. D
5. C
6. A
7. C
8. B

SECTION: ENERGY RESOURCES

1. D
2. F
3. A
4. C
5. B
6. E
7. C
8. A
9. C

Chapter Test A

1. B
2. B
3. C
4. A
5. C
6. D
7. C
8. D
9. B
10. E
11. G
12. A
13. H
14. F
15. I
16. C
17. A
18. B
19. B
20. D
21. C
22. A
23. C
24. B

Chapter Test B

1. potential energy
2. renewable
3. energy conversion
4. fossil fuels
5. kinetic energy
6. C
7. D
8. B
9. B
10. C
11. thermal, chemical, light, electrical, sound, nuclear
12. Answers may vary. Sample answer: A reaction called fusion occurs and gives off a large amount of energy. The sun's light and heat come from the energy of this reaction.
13. Answers may vary. Sample answer: Coal is burned to produce the steam used to run electric generators. Petroleum is used to make gasoline used to fuel cars. Natural gas is used in heating systems and stoves.
14. Answers may vary. Sample answer: The nuclear plant generates thermal energy that boils water to produce steam. The steam turns a turbine, which rotates a generator. The generator spins to convert kinetic energy to electrical energy.
15. Answers may vary. Sample answer: Fossil fuels pollute the air and may eventually be used up. Generating a large amount of energy from solar energy is difficult.
16. Answers may vary. Sample answer: The gravitational potential energy of the boxes will increase because she needs to raise the boxes to a higher shelf.
17. Answers may vary. Sample answer: Some wasted thermal energy always results from energy conversions. The only way to keep a machine moving is to have a constant supply of energy.
18. Answers may vary. Sample answer: Photosynthesis uses light energy from the sun to make the tree. The chemical energy from a tree can be converted to thermal energy when you burn the tree's wood.

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19. The pendulum has maximum potential energy at points A and E.
20. The pendulum has maximum kinetic energy at point C.

Chapter Test C

1. B
2. C
3. C
4. D
5. B
6. B
7. A
8. C
9. D
10. B
11. A
12. C
13. energy
14. fusion
15. electrical energy
16. light energy
17. fission
18. potential energy
19. gravitational potential energy

Standardized Test Preparation

READING

Passage 1

1. D
2. G
3. C
4. G

Passage 2

1. C
2. F
3. A
4. G

INTERPRETING GRAPHICS

1. D
2. F
3. B

MATH

1. D
2. F
3. C
4. H

Vocabulary Activity

1. friction
2. fossil fuels
3. kinetic
4. photosynthesis
5. nonrenewable
6. law of conservation of energy
7. closed system
8. mechanical
9. gravitational
10. energy
11. renewable
12. potential
13. conversion
14. nuclear energy
15. energy resource
16. energy efficiency

Quotation: Conservation is humanity caring for the future.

SciLinks Activity

1. Answers may vary. Sample answer: Chemical energy from the food we eat gives us energy to complete daily activities. Electrical energy operates appliances in our home. Thermal energy heats our food and homes.
2. Answers may vary. Sample answer: The fossils or remains of plants and animals are buried under dirt and rock. The heat and pressure from Earth change the fossils into oil, natural gas, and coal.
3. Answers may vary. Sample answer: When a lot of the sun's energy reaches Earth, it transmits energy to the atoms and molecules in the air and ground. The molecules heat up and make us feel hotter.
4. Answers may vary. Sample answer: Solar energy is a renewable resource and is beneficial because the sun is renewable and free. It can be used to heat homes. Wind energy is a renewable resource that can be used to generate electricity.
5. Sample drawings may include a sun and tree, showing how the tree uses light energy to produce fruit and chemical energy.

Performance-Based Assessment

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FORM A HYPOTHESIS

1 Answers may vary. Sample answer: The table-tennis ball will move

TEST THE HYPOTHESIS

2. The table-tennis ball moves when struck by the tennis ball
3. The tennis ball does not move much when struck by the table-tennis ball
4. The tennis ball and the table-tennis ball did not rebound to their original heights

ANALYZE THE RESULTS

5. Answers may vary. Sample answer: The tennis ball is heavier and has more potential energy than the table-tennis ball when raised to the same height.The greater potential energy will be converted to kinetic energy and cause the table-tennis ball to move a greater distance when struck by the tennis ball
6. Answers may vary. Sample answer: No; the tennis ball is much heavier than the table-tennis ball and therefore has a greater potential energy.

DRAW CONCLUSIONS

7. Answers may vary. Sample answer: No; the tennis ball has greater kinetic energy. It has greater mass than the table-tennis ball and therefore has greater momentum. Greater momentum increases kinetic energy.Finding Energy

Finding Energy

FORM A HYPOTHESIS

2. Sample answer: from the potential energy you had at the top of the hill.[accept all testable hypotheses]

DRAW CONCLUSIONS

3. The magnitude of the cart's gravitational potential energy at the top of the ramp is nearly identical to its kinetic energy at the bottom of the ramp.Whether this finding supports the original hypothesis will depend on the original hypothesis.
4. The cart's gravitational potential energy at the top of the ramp is slightly greater than its kinetic energy at the bottom of the ramp because some of the energy is used to do work against friction. Without friction, the two energy measurements would be the same.
5. You would have a greater final speed at the bottom of the large hill than at the bottom of the small hill. The amount of gravitational potential energy depends on the height of the starting position. Starting from a greater height means starting with more gravitational potential energy, which is converted into kinetic energy as you coast down the hill.

Hear That Energy!

PROCEDURES

2. Sample answer: a sound something like a drum
3. Sample answer: The sound was louder when I tapped harder. The paper has a larger vibration when it is hit harder. This louder vibration causes the air particles near the paper to vibrate more. More energy is transmitted by the air particles, so the sound is louder.
4. Sample answer: The paper was not able to vibrate as much when it was held still, so the sound was more muffled. Sound energy is a form of mechanical energy because vibration involves a change of position and changes in back-and-forth motion.

Energy of a Pendulum

ANALYZE THE RESULTS

1 Accept all reasonable answers.

2 slowest when it is first released and when it is at the top of the opposite side; fastest at the bottom of its swing during each trial.

DRAW CONCLUSIONS

3. greatest potential energy at the greatest height on either side; smallest potential energy at the bottom of its swing
4. greatest kinetic energy at the bottom of its swing (moving fastest); smallest kinetic energy at the top of its swing (moving slowest)

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5. The pendulum's kinetic energy increases on its way down (as the pendulum speeds up). As the pendulum moves from its highest point to its lowest point, potential energy decreases.
6. Accept all reasonable answers.

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