

Chapter 9 Energy

Exercises

9.1 Work (pages 145–146)

1. Circle the letter next to the correct mathematical equation for work.
 - a. $\text{work} = \text{force} \div \text{distance}$
 - b. $\text{work} = \text{distance} \div \text{force}$
 - c. $\text{work} = \text{force} \times \text{distance}$
 - d. $\text{work} = \text{force} \times \text{distance}^2$
2. You can use the equation in Question 1 to calculate work when the force is _____ and the motion takes place in _____.
3. You do work if you lift a book one meter above the ground. How does the amount of work change in each of the following cases?
 - a. You lift the book twice as high. _____
 - b. You lift two identical books one meter above the ground. _____
4. Complete the table by naming the two general categories of work and giving an example of each.

| Category of Work | Example |
|------------------|---------|
| | |
| | |

5. The unit of work is the _____.
6. Suppose that you apply a 50-N horizontal force to a 25-kg box, pushing the box 6 meters across the floor. How much work do you do on the box?

9.2 Power (pages 146–147)

7. Power is the rate at which _____ is done.
8. Power equals _____ divided by _____.
9. The unit of power is the _____.
10. One megawatt (MW) equals _____ watts.
11. In the United States, we customarily rate engines in units of _____, which is equivalent to _____ kilowatt.

9.3 Mechanical Energy (page 147)

12. Define energy.

13. What is the SI unit of energy? _____

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9.6 Work-Energy Theorem (pages 151–152)

25. Express the work-energy theorem.

26. Explain this equation: $Work = \Delta KE$.

27. Is the following sentence true or false? If you push against a heavy refrigerator, and it doesn't slide, then you are not doing work on the refrigerator.

28. Suppose you push against a box so that it moves across a horizontal surface. Explain how to determine the change in kinetic energy in each of the following cases.
- a. The surface has no friction. _____

 - b. The surface has some friction. _____

 - c. The box moves at a constant speed across a surface that has some friction.

29. Is the following sentence true or false? The maximum friction that the brakes of a car can supply is nearly the same whether the car moves slowly or quickly.

Match each form of hidden kinetic energy with its description.

| Form of Kinetic Energy | Description |
|-------------------------------|---|
| _____ 30. heat | a. consists of molecules vibrating in rhythmic patterns |
| _____ 31. sound | b. produced by electrons in motion |
| _____ 32. electricity | c. results from random molecular motion |

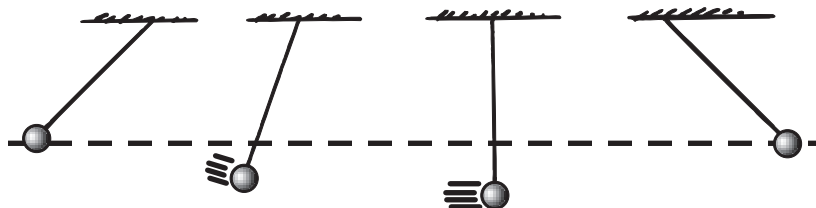
9.7 Conservation of Energy (pages 153–154)

33. The energy an arrow delivers to a target is slightly less than the energy it had when it was flying toward the target. What happened to the lost energy?

34. Express the law of conservation of energy.

35. The wound spring of a toy car has 10 J of potential energy. Only 8 J of this energy changes to kinetic energy as the car moves. What happens to the remaining 2 J of energy?

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36. The figure above shows the energy of a swinging pendulum bob at different points along its path.

a. If you ignore friction, how does the energy of the bob at the highest points of its path compare to the energy at the lowest point of its path?

b. How does friction affect the pendulum?

37. The sun shines because some of its nuclear energy is transformed into _____ energy.

38. In nuclear reactors, nuclear energy is transformed into _____.

39. Suppose a person in distress leaps from a burning building onto a firefighter's trampoline near the ground.

a. Describe the change in potential energy, kinetic energy, and total energy as the person falls.

b. Suppose the person has 10,000 J of potential energy just before jumping. What are the person's potential energy and kinetic energy upon reaching the trampoline?

9.8 Machines (pages 155–157)

40. A machine is a device used to _____ or _____.

41. Circle each letter that describes something a machine can do.

- a. puts out more energy than is put into it
- b. transfers energy from one place to another
- c. transforms energy from one form to another
- d. destroys or creates energy

42. Describe a lever.

43. Complete the following mathematical equation for a lever.

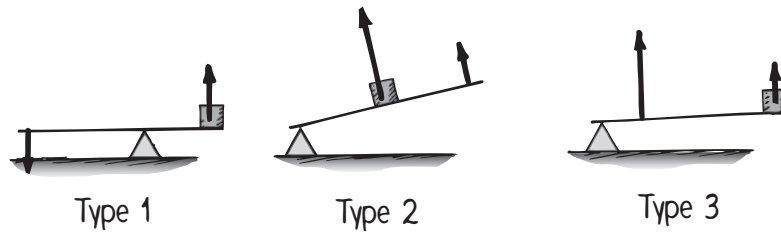
$$\left(\frac{\text{_____}}{\text{_____}} \times \text{_____} \right)_{\text{input}} = \left(\frac{\text{_____}}{\text{_____}} \times \text{_____} \right)_{\text{output}}$$

44. The pivot point of a lever is called a _____.

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45. What are two ways to calculate the mechanical advantage of a machine?

- a. _____
- b. _____



46. The figures above show three types of levers. Give an example of each type.

- a. Type 1: _____
- b. Type 2: _____
- c. Type 3: _____

47. Describe a pulley.

48. Complete the table about pulleys.

| Type of Pulley | Changes direction of the input force? | Multiplies the input force? | Mechanical Advantage |
|---------------------------------|---------------------------------------|-----------------------------|----------------------|
| Single pulley with fixed axis | | | |
| Single pulley with movable axis | | | |
| System of pulleys | | | |

9.9 Efficiency (pages 158–160)

49. Is the following sentence true or false? No real machine can be 100% efficient.

50. When a simple lever rocks about its fulcrum, or a pulley turns about its axis, a small fraction of input energy is converted into _____ energy.

51. What are two ratios used to relate the efficiency of a machine to energy and work?

- a. _____
- b. _____

52. Suppose you put in 100 J of work on a lever and get out 93 J of work.

- a. What is the efficiency of the lever? _____
- b. How much of the work input is lost as heat? _____

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53. Is the following sentence true or false? The lower the efficiency of a machine, the greater the amount of energy wasted as heat. _____
54. Which requires less force: sliding a load up an incline or lifting the load vertically?

55. The length of an incline is 8 m. The height of the elevated end is 2 m. Circle the letter of the inclined plane's theoretical mechanical advantage.
a. 2 b. 4
c. 8 d. 16
56. If the friction of an object against an inclined plane increases, the actual mechanical advantage _____ and the efficiency _____.
57. What ratio can you use to relate the efficiency of a machine to its mechanical advantage?

58. The efficiency of a machine is always less than _____.
59. How can you convert efficiency to percent?

60. Is the following sentence true or false? An automobile engine is a complex machine that transforms mechanical energy into chemical energy.

9.10 Energy for Life (page 160)

61. Most living organisms on this planet feed on various _____ compounds that release energy when they react with _____.
62. Is the following sentence true or false? The amount of energy stored in gasoline is greater than the amount of energy in the products of its combustion.

63. Is the following sentence true or false? There is less energy stored in the molecules of food than there is in the reaction products after the food is metabolized.

64. How does the metabolism of food in the body compare to the burning of fossil fuels in mechanical engines? How are the processes different?

65. What makes life possible on Earth?

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9.11 Sources of Energy (pages 161–162)

66. _____ is the source of practically all our energy on Earth.
67. Sunlight is directly transformed into electricity by _____.
68. Sequence the steps by which sunlight can be used indirectly to generate electricity.
- a. _____
 - b. _____
 - c. _____
 - d. _____
69. Wind can be considered a type of solar power because wind is caused by _____.
70. Circle the letter of each correct statement about wind energy.
- a. Wind is a steady form of energy.
 - b. Wind power can provide all of our energy needs.
 - c. Wind can make a substantial contribution to the energy we use.
 - d. Wind energy is practical when the energy is stored for future use.
71. Is the following sentence true or false? Hydrogen is a source of energy.

72. In a _____, hydrogen and oxygen gas are compressed at electrodes to produce water and electric current.
73. Earth's interior is kept hot by _____.
74. _____ energy is held in underground reservoirs of hot water.