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Unit IV  
Work, Power, and Machines  
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## Unit IV Study Guide

### Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

- \_\_\_\_ 1. In which of the following is no work done?  
a. climbing stairs  
b. lifting a book  
c. pushing a shopping cart  
d. none of the above
- \_\_\_\_ 2. A force acting on an object does no work if  
a. a machine is used to move the object.  
b. the force is not in the direction of the object's motion.  
c. the force is greater than the force of friction.  
d. the object accelerates.
- \_\_\_\_ 3. What is the unit of work?  
a. joule  
b. newton/meter  
c. watt  
d. all of the above
- \_\_\_\_ 4. If you exert a force of 10.0 N to lift a box a distance of 0.9 m, how much work do you do?  
a. 0.1 J  
b. 9.0 J  
c. 10.9 J  
d. 90.0 J
- \_\_\_\_ 5. If you perform 40 joules of work lifting a 10-N box from the floor to a shelf, how high is the shelf?  
a. 0.3 m  
b. 20 m  
c. 4.0 m  
d. 400 m
- \_\_\_\_ 6. The SI unit of power is the  
a. joule.  
b. newton.  
c. newton-meter.  
d. watt.
- \_\_\_\_ 7. The power of a machine measures  
a. its rate of doing work.  
b. its strength.  
c. the force it produces.  
d. the work it does.
- \_\_\_\_ 8. If you exert a force of 700 N to walk 6 m up a flight of stairs in 6 s, how much power do you use?  
a. 19 W  
b. 25,200 W  
c. 700 W  
d. 4200 W
- \_\_\_\_ 9. 3730 watts equals about how many horsepower?  
a. 5  
b. 10  
c. 20  
d. 30
- \_\_\_\_ 10. A machine is a device that can multiply  
a. force.  
b. power.  
c. work.  
d. all of the above

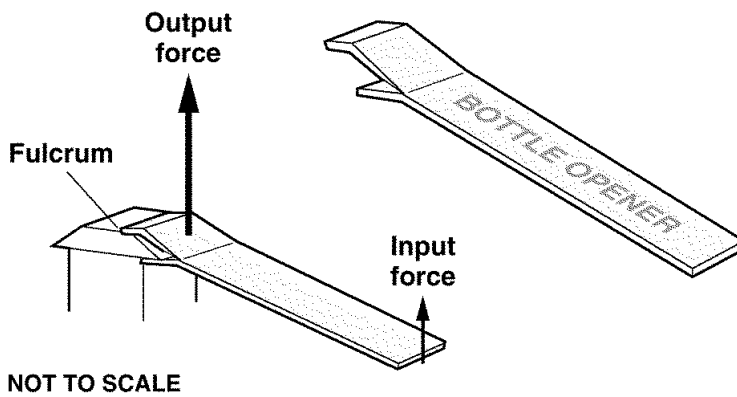
- \_\_\_\_ 11. Which of the following statements is true?
- To increase power, you can decrease the amount of work you do in a given amount of time, or you can do a given amount of work in less time.
  - To increase power, you can decrease the amount of work you do in a given amount of time, or you can do a given amount of work in more time.
  - To increase power, you can increase the amount of work you do in a given amount of time, or you can do a given amount of work in less time.
  - To increase power, you can increase the amount of work you do in a given amount of time, or you can do a given amount of work in more time.
- \_\_\_\_ 12. A 750-W motor might also be rated as a
- 0.5-horsepower motor.
  - 1-horsepower motor.
  - 2-horsepower motor.
  - 10-horsepower motor.
- \_\_\_\_ 13. When a machine does work, it cannot do which of the following?
- change the direction of a force.
  - increase a force and change the distance a force moves.
  - increase the distance a force moves and change the direction of a force.
  - increase a force and increase the distance a force moves an object.
- \_\_\_\_ 14. How can a machine make work easier for you?
- by decreasing the amount of work you do
  - by changing the direction of your force
  - by increasing the work done by the machine
  - none of the above
- \_\_\_\_ 15. How can you make the work output of a machine greater than the work input?
- by decreasing friction
  - by increasing the input force
  - by increasing the output distance
  - none of the above
- \_\_\_\_ 16. The actual mechanical advantage of a machine
- cannot be less than 1.
  - decreases as the input distance increases.
  - increases with greater friction.
  - is less than the ideal mechanical advantage of the machine.
- \_\_\_\_ 17. If you know the input distance and output distance of a machine, which of the following can you calculate?
- work
  - actual mechanical advantage
  - efficiency
  - ideal mechanical advantage
- \_\_\_\_ 18. If you have to apply 40 N of force on a crowbar to lift a rock that weights 400 N, what is the actual mechanical advantage of the crowbar?
- 0.1
  - 10
  - 360
  - 16,000
- \_\_\_\_ 19. A 120-m long ski lift carries skiers from a station at the foot of a slope to a second station 40 m above. What is the IMA of the lift?
- 0.3
  - 3
  - 40
  - 160

- \_\_\_\_ 20. Reducing friction in a machine
- decreases its actual mechanical advantage.
  - decreases the work output.
  - increases its efficiency.
  - increases its ideal mechanical advantage.
- \_\_\_\_ 21. The efficiency of a machine is always less than 100 percent because
- a machine cannot have an IMA greater than 1.
  - some work input is lost to friction.
  - the work input is too small.
  - the work output is too great.
- \_\_\_\_ 22. A mechanical device requires 420 J of work to do 230 J of work in lifting a crate. What is the efficiency of the device?
- |         |         |
|---------|---------|
| a. 0.5% | c. 55%  |
| b. 190% | d. 183% |
- \_\_\_\_ 23. A motor with an efficiency of 75 percent must supply 240 J of useful work. What amount of work must be supplied to the motor?
- |          |          |
|----------|----------|
| a. 75 J  | c. 320 J |
| b. 180 J | d. 420 J |
- \_\_\_\_ 24. An inclined plane reduces the effort force by
- increasing the distance through which the force is applied.
  - increasing the work.
  - reducing the effort distance.
  - reducing the work.
- \_\_\_\_ 25. An ax is an example of a(an)
- |                    |                    |
|--------------------|--------------------|
| a. inclined plane. | c. wedge.          |
| b. lever.          | d. wheel and axle. |
- \_\_\_\_ 26. Which of the following is an example of a wheel and axle?
- |                                 |              |
|---------------------------------|--------------|
| a. hammer                       | c. a jar lid |
| b. an automobile steering wheel | d. a pencil  |
- \_\_\_\_ 27. The ideal mechanical advantage of a pulley system is equal to the
- distance the load has to move.
  - length of the rope.
  - number of rope segments supporting the load.
  - weight of the object being lifted.
- \_\_\_\_ 28. The ideal mechanical advantage of a wheel and axle is found by
- multiplying the circumference of the wheel by the radius of the axle.
  - dividing the radius of the wheel by the radius of the axle.
  - dividing the radius of the axle by the radius of the wheel.
  - multiplying the radius of the wheel by the radius of the axle.
- \_\_\_\_ 29. An example of a compound machine is a
- |             |            |
|-------------|------------|
| a. crowbar. | c. ramp.   |
| b. bicycle. | d. seesaw. |
- \_\_\_\_ 30. A machine is classified as a compound machine if it
- |                               |   |
|-------------------------------|---|
| a. has moving parts.          | c. is made up of two or more simple machines that operate together. |
| b. has an IMA greater than 1. | d. is very efficient.   |

**Completion**

*Complete each sentence or statement.*

31. For work to be done on the object, the object has to \_\_\_\_\_.
32. Any part of a force that does not act in the direction of an object's motion does no \_\_\_\_\_ on an object.
33. The SI unit of work is the \_\_\_\_\_.
34. You calculate work by multiplying the force acting in the direction of \_\_\_\_\_ by the distance the object moves.
35. The rate at which work is done is called \_\_\_\_\_.
36. The SI unit of power is the \_\_\_\_\_.
37. The watt and the horsepower are both units of \_\_\_\_\_.
38. A machine is a device that changes a(an) \_\_\_\_\_.
39. A device that changes the size or direction of force used to do work is called a(an) \_\_\_\_\_.
40. The force that is exerted on a machine is called the \_\_\_\_\_ force.
41. Besides a reduction in friction, the only way to increase the amount of work output of a machine is to \_\_\_\_\_ the work input.
42. The \_\_\_\_\_ of a machine is the number of times that the machine increases the input force.
43. The mechanical efficiency of any machine is always \_\_\_\_\_ than 100 percent.
44. A(An) \_\_\_\_\_ can be described as an inclined plane wrapped around a cylinder.
45. The ideal mechanical advantage of a third-class lever is always \_\_\_\_\_ than 1.
46. As the thickness of a wedge of given length increases, its IMA \_\_\_\_\_.
47. Two or more simple machines working together make up a(an) \_\_\_\_\_ machine.
48. A watch consists of a complex systems of gears. Each gear acts as a continuous \_\_\_\_\_.
49. The fulcrum is always between the effort force and the resistance force in a(an) \_\_\_\_\_-class lever.

**Figure 14-1**

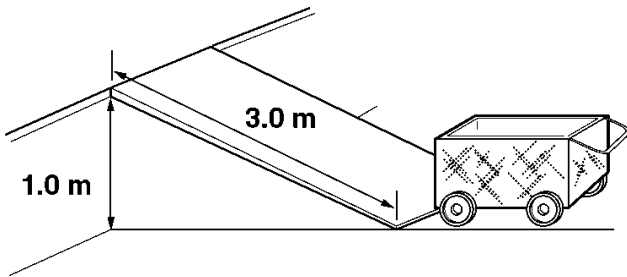
50. The bottle opener shown in Figure 14-1 is a(an) \_\_\_\_\_-class lever.

**Short Answer**

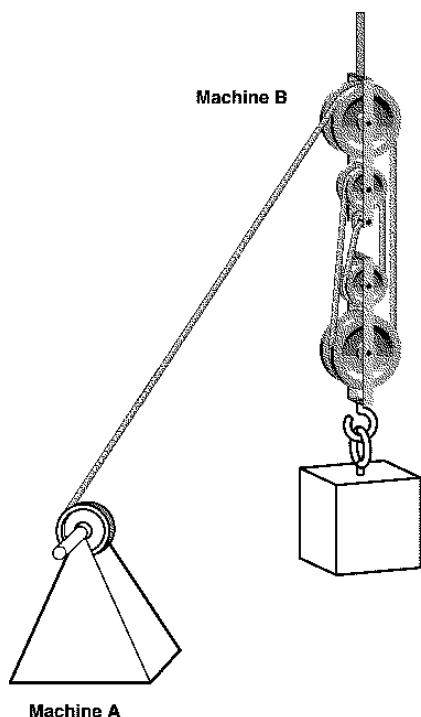
51. Compare the size and direction of the input and output forces shown in Figure 14-1.
52. Why don't you do work as you hold a book motionless over your head?
53. If two swimmers compete in race, does the faster swimmer develop more power?
54. If a simple machine provides an increased output force, what happens to the output distance?
55. Why is the work output of a machine never equal to the work input?
56. If you grease a ramp to make a box slide more easily, what happens to the ramp's mechanical advantage? Explain your answer.
57. If a simple machine could be frictionless, how would its IMA and AMA compare?
58. How does friction affect the calculation of the IMA of a simple machine? Explain your answer.
59. How will a lubricant affect the efficiency of a simple machine such as a pulley?
60. What is the equation for calculating a machine's efficiency?
61. How is work done when you lift a book?
62. Which has the greater IMA—a screw with closely spaced threads or a screw with threads spaced farther apart?
63. Compare the effects of a fixed pulley and a movable pulley on the size and direction of the input force.
64. How is a pair of scissors a compound machine? Explain your answer.
65. In a compound machine made up of two simple machines, how is the work output of the first simple machine related to the work input of the second simple machine?

**Problem**

66. A worker uses a cart to move a load of bricks weighing 680 N a distance of 10 m across a parking lot. If he pushes the cart with a constant force of 209 N, what amount of work does he do? Show your work.
67. A girl lifts a 160-N load a height of 1 m in a time of 0.5 s. What power does the girl produce? Show your work.
68. The input force of a pulley system must move 8.0 m to lift a 3000-N engine a distance of 2.0 m. What is the IMA of the system? Show your work.
69. A 20-N force applied to the handle of a door produces a 44-N output force. What is the AMA of the handle? Show your work.
70. A force of 11 N is applied to the handle of a screwdriver being used to pry off the lid of a paint can. As the input force moves through a distance 0.3 m, the screwdriver does 3 J of work on the lid. What is the efficiency of the screwdriver? Show your work.

**Other****USING SCIENCE SKILLS****Figure 14-2**

71. **Calculating** What is the IMA of the ramp in Figure 14-2? Show your work.
72. **Applying Concepts** If the ramp shown in Figure 14-2 was coated with a smoother surface, how would the AMA of the ramp change?
73. **Applying Concepts** If the ramp shown in Figure 14-2 was coated with a smoother surface, how would the ramp's efficiency change? Explain your answer.
74. **Classifying** What type of simple machine is the ramp shown in Figure 14-2?
75. **Comparing and Contrasting** In a post office, a 3-m long ramp is used to move carts onto a dock that is higher than 1 m. How does the IMA of this ramp compare with the IMA of the ramp shown in Figure 14-2?



**Figure 14-3**

76. **Applying Concepts** Look at Figure 14-3. If Machine A moves through an input distance of 4.0 m, what is the output distance of Machine B?

77. **Classifying** What type of simple machine is Machine A in Figure 14-3?

78. **Interpreting Graphics** What is the IMA of Machine B in Figure 14-3?

79. **Interpreting Graphics** As shown in Figure 14-3, Machines A and B operate together as what type of machine?

80. **Comparing and Contrasting** In Figure 14-3, how does the work input of Machine B compare with the work output of Machine A?