1. How much work is required to lift a 2-kilogram mass to a height of 10 meters?
   A. 5 joules  
   B. 20 joules  
   C. 100 joules  
   D. 200 joules

2. Four machines do the amounts of work listed in the table shown. The time they take to do the work is also listed. Which machine develops the most power?

<table>
<thead>
<tr>
<th>Machine</th>
<th>Work</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1,000 joules</td>
<td>5 sec</td>
</tr>
<tr>
<td>B</td>
<td>1,000 joules</td>
<td>10 sec</td>
</tr>
<tr>
<td>C</td>
<td>2,000 joules</td>
<td>5 sec</td>
</tr>
<tr>
<td>D</td>
<td>2,000 joules</td>
<td>10 sec</td>
</tr>
</tbody>
</table>

   A. A  
   B. B  
   C. C  
   D. D

3. A garden tractor drags a plow with a force of 500 newtons a distance of 10 meters in 20 seconds. How much work is done?
   A. 25 joules  
   B. 1,000 joules  
   C. 2,500 joules  
   D. 5,000 joules

4. A machine is able to do 30 joules of work in 6.0 seconds. The power developed by the machine is
   A. 0.20 watt  
   B. 0.50 watt  
   C. 5.0 watts  
   D. 180 watts

5. Car A and car B of equal mass travel up a hill. Car A moves up the hill at a constant speed that is twice the constant speed of car B. Compared to the power developed by car B, the power developed by car A is
   A. the same  
   B. twice as much  
   C. half as much  
   D. four times as much

6. One joule is equivalent to one
   A. \( \text{newton} \cdot \text{meter}^3 \)  
   B. \( \text{kilogram} \cdot \text{meter}^3 \)  
   C. \( \text{watt}^2 \cdot \text{newton} \)  
   D. \( \frac{\text{kilogram} \cdot \text{meter}^2}{\text{second}^2} \)

7. A 20-newton block is at rest at the bottom of a frictionless incline as shown in the diagram. How much work must be done against gravity to move the block to the top of the incline?
   A. 10 J  
   B. 60 J  
   C. 80 J  
   D. 100 J
8. Work is being done when a force
   A. acts vertically on a cart that can only move horizontally
   B. is exerted by one team in a tug of war when there is no movement
   C. is exerted while pulling a wagon up a hill
   D. of gravitational attraction acts on a person standing on the surface of the Earth

9. The graph shows the force exerted on a block as a function of the block’s displacement in the direction of the force. How much work did the force do in displacing the block 5.0 meters?
   A. 0 J  B. 20 J  C. 0.80 J  D. 4.0 J

10. Which term represents a vector quantity?
    A. work    B. power
    C. force    D. distance

11. How much work is done on a downhill skier by an average braking force of $9.8 \times 10^2$ newtons to stop her in a distance of 10 meters?
    A. $1.0 \times 10^1$ J  B. $9.8 \times 10^1$ J
    C. $1.0 \times 10^3$ J  D. $9.8 \times 10^3$ J

12. A motor having a maximum power rating of $8.1 \times 10^4$ watts is used to operate an elevator with a weight of $1.8 \times 10^4$ newtons. What is the maximum weight this motor can lift at an average speed of 3.0 meters per second?
    A. $6.0 \times 10^3$ N  B. $1.8 \times 10^4$ N
    C. $2.4 \times 10^4$ N  D. $2.7 \times 10^4$ N

13. Which action would require no work to be done on an object?
    A. lifting the object from the floor to the ceiling
    B. pushing the object along a horizontal floor against a frictional force
    C. decreasing the speed of the object until it comes to rest
    D. holding the object stationary above the ground
14. A 5.0 × 10²-newton girl takes 10. seconds to run up two flights of stairs to a landing, a total of 5.0 meters vertically above her starting point. What power does the girl develop during her run?

A. 25 W  
B. 50 W  
C. 250 W  
D. 2,500 W

15. Which pair of quantities can be expressed using the same units?

A. work and kinetic energy  
B. power and momentum  
C. impulse and potential energy  
D. acceleration and weight

16. A box is pushed to the right with a varying horizontal force. The graph below represents the relationship between the applied force and the distance the box moves.

What is the total work done in moving the box 6.0 meters?

A. 9.0 J  
B. 18 J  
C. 27 J  
D. 36 J

17. As shown in the diagram below, a child applies a constant 20.-newton force along the handle of a wagon which makes a 25° angle with the horizontal.

How much work does the child do in moving the wagon a horizontal distance of 4.0 meters?

A. 5.0 J  
B. 34 J  
C. 73 J  
D. 80 J
18. Student A lifts a 50.-newton box from the floor to a height of 0.40 meter in 2.0 seconds. Student B lifts a 40.-newton box from the floor to a height of 0.50 meter in 1.0 second. Compared to student A, student B does

A. the same work but develops more power
B. the same work but develops less power
C. more work but develops less power
D. less work but develops more power

19. Base your answer(s) to the following question(s) on the information below.

A boy pushes his wagon at constant speed along a level sidewalk. The graph below represents the relationship between the horizontal force exerted by the boy and the distance the wagon moves.

![Force vs. Distance graph](image)

What is the total work done by the boy in pushing the wagon 4.0 meters?

A. 5.0 J  B. 7.5 J  C. 120 J  D. 180 J

20. Which is an SI unit for work done on an object?

A. \( \frac{\text{kg} \cdot \text{m}^2}{\text{s}^2} \)  B. \( \frac{\text{kg} \cdot \text{m}^2}{\text{s}} \)
C. \( \frac{\text{kg} \cdot \text{m}}{\text{s}^2} \)  D. \( \frac{\text{kg} \cdot \text{m}}{\text{s}} \)

21. The diagram here shows a 1-kilogram aluminum sphere and a 3-kilogram copper sphere of equal radius located 20 meters above the ground.

If the two spheres are allowed to fall freely to the ground, they will experience the same

A. acceleration
B. decrease in potential energy
C. increase in kinetic energy
D. specific gravity
22. A pendulum swings as shown in the diagram. At which position is the kinetic energy of the pendulum bob least?

A. A  B. B  C. C  D. D

23. A 75-kilogram boy initially at rest skis down the slope as shown. Assuming no frictional loss, what will be his kinetic energy at the bottom of the slope?

A. 1,500 joules  B. 7,500 joules  C. 15,000 joules  D. 75,000 joules

24. As a falling apple approaches the ground, its potential energy

A. decreases  B. increases  C. remains the same

25. A cart weighing 10 newtons is pushed 10 meters on a level surface by a force of 5 newtons. What is the increase in its potential energy?

A. 1 joule  B. 50 joules  C. 100 joules  D. 0 joules

26. The diagram shows a cart at four positions as it moves along its track. At which positions is the sum of the potential energy and kinetic energy of the cart the same?

A. A and B, only  B. B and C, only  C. C and D, only  D. all positions, A through D
27. Each of the blocks in the diagrams is lifted vertically for the distance indicated. Which block will gain the most gravitational potential energy?

A.  

\[ \begin{align*} &\text{4 meters} \\
&\text{2 Newtons} \end{align*} \]

B.  

\[ \begin{align*} &\text{3 meters} \\
&\text{4 Newtons} \end{align*} \]

C.  

\[ \begin{align*} &\text{3 meters} \\
&\text{3 Newtons} \end{align*} \]

D.  

\[ \begin{align*} &\text{2 meters} \\
&\text{5 Newtons} \end{align*} \]

28. The kinetic energy of a 10.0-kilogram mass moving at a speed of 5.00 meters per second is

A. 50.0 J  B. 2.00 J  C. 125 J  D. 250 J

29. A 0.10-meter spring is stretched from equilibrium to position A and then to position B as shown in the diagram. Compared to the spring’s potential energy at A, what is its potential energy at B?

A. the same  B. twice as great  
C. half as great  D. four times as great

30. Which terms represent scalar quantities?

A. power and force  
B. work and displacement  
C. time and energy  
D. distance and velocity
31. Which graph best represents the relationship between the kinetic energy (KE) of a moving object as a function of its velocity (v)?

A.  
B.  
C.  
D.  

32. If the speed of an object is doubled, its kinetic energy will be

A. halved  
B. doubled  
C. quartered  
D. quadrupled  

33. As an object falls freely near the Earth’s surface, the loss in gravitational potential energy of the object is equal to its

A. loss of height  
B. loss of mass  
C. gain in velocity  
D. gain in kinetic energy  

34. The diagram shown represents a frictionless track. A 10-kilogram block starts from rest at point A and slides along the track.

As the block moves from point A to point B, the total amount of gravitational potential energy changed to kinetic energy is approximately

A. 5 J  
B. 20 J  
C. 50 J  
D. 500 J  

35. What is the approximate potential energy of the block at point C?

A. 20 J  
B. 200 J  
C. 300 J  
D. 500 J  

36. Spring A has a spring constant of 140 newtons per meter, and spring B has a spring constant of 280 newtons per meter. Both springs are stretched the same distance. Compared to the potential energy stored in spring A, the potential energy stored in spring B is

A. the same  
B. twice as great  
C. half as great  
D. four times as great
37. In the accompanying diagram, an average force of 20 newtons is used to pull back the string of a bow 0.60 meter.

As the arrow leaves the bow, its kinetic energy is

A. 3.4 J  B. 6.0 J  C. 12 J  D. 33 J

38. Two vacationers walk out on a horizontal pier as shown in the accompanying diagram.

As they approach the end of the pier, their gravitational potential energy will

A. decrease  B. increase  
C. remain the same

39. The accompanying diagram shows block A, having mass 2m and speed v, and block B having mass m and speed 2v.

Compared to the kinetic energy of block A, the kinetic energy of block B is

A. the same  B. twice as great
C. one-half as great  D. four times as great

40. A student throws a stone upward at an angle of 45°. Which statement best describes the stone at the highest point that it reaches?

A. Its acceleration is zero.
B. Its acceleration is at a maximum.
C. Its potential energy is at a minimum.
D. Its kinetic energy is at a minimum.
1. Answer: D
2. Answer: C
3. Answer: D
4. Answer: C
5. Answer: B
6. Answer: D
7. Answer: B
8. Answer: C
9. Answer: B
10. Answer: C
11. Answer: D
12. Answer: D
13. Answer: D
14. Answer: C
15. Answer: A
16. Answer: C
17. Answer: C
18. Answer: A
19. Answer: C
20. Answer: A
21. Answer: A
22. Answer: D
23. Answer: C
24. Answer: A
25. Answer: D
26. Answer: D
27. Answer: B
28. Answer: C
29. Answer: D
30. Answer: C
31. Answer: C
32. Answer: D
33. Answer: D
34. Answer: D
35. Answer: B
36. Answer: B
37. Answer: C
38. Answer: C
39. Answer: B
40. Answer: D