1. Using ground level as the reference height with zero potential energy, which object has the greatest gravitational potential energy?

A. a 2-kg mass at 60-m height
B. a 5-kg mass at 5-m height
C. a 20-kg mass at 50-m height
D. a 40-kg mass at 2-m height

2. A 12.5-kg glider is observed flying at an altitude of 1,510 m at a constant velocity of 18.0 m/s. The glider dives to a new altitude of 1,250 m. Neglecting the effects of air resistance, what is its change in potential energy?

A. 31,900 J
B. 153,000 J
C. 185,000 J
D. 338,000 J
3. This graph shows the force vs. stretch relationship for a spring.

How much work would be done in stretching the spring 0.25 m from its equilibrium position?

A   1.3 J  
B   3.6 J  
C   5.0 J  
D   10. J

4. A person strikes a ball with a bat. The temperature of the ball increases by 0.06°C. What accounts for the increase?

A   The kinetic energy of the moving bat was used to increase the thermal energy of the ball.  
B   The thermal energy of the bat was transferred to the ball.  
C   The kinetic energy of the moving bat was converted to the chemical energy of the ball.  
D   The thermal energy of the bat was converted to potential energy in the ball.
5. A father (100 kg) and his son (50 kg) are jogging at the same speed. Which statement is true about the kinetic energies (KE) of the father and the son?

A \( KE_f = 2 KE_s \)

B \( KE_f = \frac{1}{2} KE_s \)

C \( KE_f = 4 KE_s \)

D \( KE_f = \frac{1}{4} KE_s \)

6. A diver with a mass of 80.0 kg dives off the 10.0 m platform. His velocity just before striking the water is 14.0 m/s. What is his kinetic energy at that moment?

A \( 8.00 \times 10^2 \) J

B \( 1.12 \times 10^3 \) J

C \( 7.84 \times 10^3 \) J

D \( 1.12 \times 10^4 \) J

7. A person weighing \( 6.0 \times 10^2 \) N falls a vertical distance of 20. m into soft snow. What is the average force exerted by the snow if the person stops in 0.15 s?

A \( 5.3 \times 10^8 \) N

B \( 8.0 \times 10^3 \) N

C \( 1.8 \times 10^4 \) N

D \( 8.0 \times 10^4 \) N

8. The spring in a dart gun has a spring constant of 20.0 N/m. The spring is compressed \( 8.00 \times 10^{-2} \) m from its equilibrium position and used to launch a \( 1.00 \times 10^{-2} \) kg plastic dart. Ignoring friction, what is the dart’s speed as it leaves the gun?

A \( 0.0640 \) m/s

B \( 3.58 \) m/s

C \( 7.21 \) m/s

D \( 12.8 \) m/s

9. A student eats a candy bar that can provide \( 1.57 \times 10^6 \) J of energy. If the student has a mass of 81.8 kg, how high will he have to climb a ladder to offset completely the energy contained in the candy bar?

A \( 1.96 \) m

B \( 1.96 \times 10^3 \) m

C \( 1.31 \times 10^3 \) m

D \( 1.44 \times 10^8 \) m
10. A city’s water tower has a capacity of $1.0 \times 10^3$ kg of water. A pump is filling the water tower to an average height of 50. m.

How much work is done by the pump to fill the $1.0 \times 10^3$-kg tower?

A $2.5 \times 10^4$ J  
B $5.0 \times 10^4$ J  
C $4.9 \times 10^5$ J  
D $2.5 \times 10^6$ J
11. In the diagram below, a wooden block slides from rest down a frictionless incline. The block attains a speed of 3 m/s at the bottom of the incline. How high is the incline?

A 0.21 m  
B 0.31 m  
C 0.46 m  
D 0.59 m

12. A piston, moving through a distance of 15 cm, pushes a box weighing 8.0 kg onto a conveyor belt with a force of 40 N. How much work is done by the piston on the box?

A 6.0 J  
B 120 J  
C 320 J  
D $6.0 \times 10^2$ J

13. How high can a worker lift a 40.00-kg bag of sand if he produces 4,000. J of energy? Assume no energy is used to overcome friction.

A 1.020 m  
B 10.20 m  
C 102.0 m  
D 1,020 m

14. A 3.0-kg mass slides down a 5.0-m-long frictionless, inclined plane.

How much work is needed to stop the mass at the bottom of the incline?

A 15 J  
B 74 J  
C 130 J  
D 150 J
15. Neglecting friction, if a child exerts a force of 85 N on the handle of a wagon that makes a 35° angle with the horizontal, how far is the wagon pulled when 280 J of work are done?
   
   A  \leq 5.0 \text{ m}  
   B  > 5.0 \text{ m but} \leq 10. \text{ m}  
   C  > 10. \text{ m but} \leq 15 \text{ m}  
   D  > 15 \text{ m but} \leq 20. \text{ m} 

16. If a forklift raises a 76-kg load a distance of 2.5 m, how much work has it done?
   
   A  80. \text{ J}  
   B  1.9 \times 10^1 \text{ J}  
   C  3.0 \times 10^2 \text{ J}  
   D  1.9 \times 10^3 \text{ J} 

17. The amount of power required to move an object can be increased without changing the amount of work required. How can this happen?
   
   A  increase the time required to do the work  
   B  increase the friction on the surface over which the object is moving  
   C  increase the weight of the object being moved  
   D  decrease the time required to do the work 

18. This is a graph representing work versus time.

   ![Graph: Work vs. Time]

   What does the slope of the graph represent?
   
   A  acceleration  
   B  impulse  
   C  power  
   D  velocity 

19. A block of mass 2.0 kg slides with a velocity of 10. m/s on a frictionless surface. It hits a horizontal massless spring (spring constant of 500 N/m). How much is the spring compressed when the block stops?
   
   A  0.040 \text{ m}  
   B  0.20 \text{ m}  
   C  0.40 \text{ m}  
   D  0.63 \text{ m}
20. A skateboarder with a mass of 50. kg is riding on a half-pipe as shown in the diagram below. He has a speed of 5.0 m/s at the bottom.

What vertical distance will the skateboarder climb?
A 0.25 m  
B 0.50 m  
C 1.3 m  
D 2.5 m

21. A woman driving a $2.0 \times 10^3$-kg car at 15 m/s fully applies the brakes 50. m from a stoplight.

If the car stops 5.0 m before the light, what is the magnitude of the average force applied by the brakes?
A $4.1 \times 10^3$ N  
B $4.5 \times 10^3$ N  
C $5.0 \times 10^3$ N  
D $4.5 \times 10^4$ N

End of Goal 6 Sample Items

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Sample Items Key Report

1  Objective:  6.01
Investigate and analyze energy storage and transfer mechanisms:
  a. Gravitational potential energy.
  b. Elastic potential energy.
  c. Thermal energy.
  d. Kinetic energy.
  e. Transfer of energy mechanisms.
Thinking Skill:    Organizing  Correct Answer:  C

2  Objective:  6.01
Investigate and analyze energy storage and transfer mechanisms:
  a. Gravitational potential energy.
  b. Elastic potential energy.
  c. Thermal energy.
  d. Kinetic energy.
  e. Transfer of energy mechanisms.
Thinking Skill:    Applying  Correct Answer:  A

3  Objective:  6.01
Investigate and analyze energy storage and transfer mechanisms:
  a. Gravitational potential energy.
  b. Elastic potential energy.
  c. Thermal energy.
  d. Kinetic energy.
  e. Transfer of energy mechanisms.
Thinking Skill:    Analyzing  Correct Answer:  A

4  Objective:  6.01
Investigate and analyze energy storage and transfer mechanisms:
  a. Gravitational potential energy.
  b. Elastic potential energy.
  c. Thermal energy.
  d. Kinetic energy.
  e. Transfer of energy mechanisms.
Thinking Skill:    Analyzing  Correct Answer:  A
Objective: 6.01
Investigate and analyze energy storage and transfer mechanisms:

- a. Gravitational potential energy.
- b. Elastic potential energy.
- c. Thermal energy.
- d. Kinetic energy.
- e. Transfer of energy mechanisms.

Thinking Skill: Applying
Correct Answer: A

Objective: 6.01
Investigate and analyze energy storage and transfer mechanisms:

- a. Gravitational potential energy.
- b. Elastic potential energy.
- c. Thermal energy.
- d. Kinetic energy.
- e. Transfer of energy mechanisms.

Thinking Skill: Applying
Correct Answer: C

Objective: 6.02
Analyze, evaluate, and apply the principle of conservation of energy.

Thinking Skill: Applying
Correct Answer: B

Objective: 6.02
Analyze, evaluate, and apply the principle of conservation of energy.

Thinking Skill: Applying
Correct Answer: B

Objective: 6.02
Analyze, evaluate, and apply the principle of conservation of energy.

Thinking Skill: Analyzing
Correct Answer: C

Objective: 6.02
Analyze, evaluate, and apply the principle of conservation of energy.

Thinking Skill: Analyzing
Correct Answer: C
12  **Objective: 6.03**  
Analyze, evaluate, and measure the transfer of energy by a force.  
a. Work.  
b. Power.  
c. Relationship of work and power.  
**Thinking Skill:** Applying  
**Correct Answer:** A

13  **Objective: 6.04**  
Design and conduct investigations of:  
a. Mechanical energy.  
b. Power.  
c. Relationship of mechanical energy and power  
**Thinking Skill:** Applying  
**Correct Answer:** B

14  **Objective: 6.03**  
Analyze, evaluate, and measure the transfer of energy by a force.  
a. Work.  
b. Power.  
c. Relationship of work and power.  
**Thinking Skill:** Applying  
**Correct Answer:** B

15  **Objective: 6.03**  
Analyze, evaluate, and measure the transfer of energy by a force.  
a. Work.  
b. Power.  
c. Relationship of work and power.  
**Thinking Skill:** Applying  
**Correct Answer:** A

16  **Objective: 6.03**  
Analyze, evaluate, and measure the transfer of energy by a force.  
a. Work.  
b. Power.  
c. Relationship of work and power.  
**Thinking Skill:** Applying  
**Correct Answer:** D

17  **Objective: 6.03**  
Analyze, evaluate, and measure the transfer of energy by a force.  
a. Work.  
b. Power.  
c. Relationship of work and power.  
**Thinking Skill:** Analyzing  
**Correct Answer:** D
18  **Objective: 6.04**
Design and conduct investigations of:
  a. Mechanical energy.
  b. Power.
  c. Relationship of mechanical energy and power

**Thinking Skill:** Applying

**Correct Answer:** C

19  **Objective: 6.04**
Design and conduct investigations of:
  a. Mechanical energy.
  b. Power.
  c. Relationship of mechanical energy and power

**Thinking Skill:** Applying

**Correct Answer:** D

20  **Objective: 6.04**
Design and conduct investigations of:
  a. Mechanical energy.
  b. Power.
  c. Relationship of mechanical energy and power

**Thinking Skill:** Applying

**Correct Answer:** C

21  **Objective: 6.04**
Design and conduct investigations of:
  a. Mechanical energy.
  b. Power.
  c. Relationship of mechanical energy and power

**Thinking Skill:** Applying

**Correct Answer:** C