

### 3. Work, Energy, and Power

#### Starter Quiz · 课前小测

AP Physics C: Mechanics

Name: \_\_\_\_\_ Score: \_\_\_\_\_

1. A 4 kg object moves at  $3 \frac{\text{m}}{\text{s}}$ . What is its kinetic energy (in J)?  
\_\_\_\_\_ J
2. A 10 N force pushes a box 4 m in the same direction. How much work is done (in J)?  
\_\_\_\_\_ J
3. Lift a 2 kg book 1.5 m ( $g = 9.8$ ). How much gravitational potential energy is stored (in J)?  
\_\_\_\_\_ J
4. A ball is dropped from 2 m (no air resistance,  $g = 10$ ). Its speed at the bottom (in m/s)?  
\_\_\_\_\_ m/s
5. A machine does 600 J of work in 3 s. What is its average power (in W)?  
\_\_\_\_\_ W
6. If a car's speed doubles, its kinetic energy becomes...  
☐ double  
☐ four times  
☐ the same  
☐ half
7. You carry a bag horizontally across a room. The work gravity does on the bag is...  
☐ large and positive  
☐ zero  
☐ large and negative  
☐ equal to the bag's weight
8. When friction acts, the mechanical energy  $K + U$  stays constant.  
☐ True    ☐ False
9. Kinetic energy can be negative if an object moves backward.  
☐ True    ☐ False
10. Friction, which opposes motion, does negative work on a sliding object.  
☐ True    ☐ False

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#### Answers · 答案

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1. **18 J**  
 $K = \frac{1}{2}mv^2 = \frac{1}{2}(4)(9) = 18 \text{ J}.$
2. **40 J**  
With  $\theta = 0$ ,  $W = Fd \cos 0 = 10 \times 4 \times 1 = 40 \text{ J}.$
3. **29.4 J**  
 $U_g = mgy = 2 \times 9.8 \times 1.5 = 29.4 \text{ J}.$
4. **6.32 m/s**  
 $mgh = \frac{1}{2}mv^2$ , so  $v = \sqrt{2gh} = \sqrt{2 \times 10 \times 2} = \sqrt{40} \approx 6.32 \frac{\text{m}}{\text{s}}.$
5. **200 W**  
 $P = W/t = 600/3 = 200 \text{ W}.$
6. **four times**  
 $K \propto v^2$ , so doubling  $v$  multiplies  $K$  by  $2^2 = 4$ .
7. **zero**  
Gravity points down, motion is horizontal – perpendicular, so  $\cos 90^\circ = 0$  and the work is zero.
8. **False**  
Friction is nonconservative – it drains mechanical energy into heat, so  $K + U$  decreases.
9. **False**  
The  $v^2$  makes  $K$  positive regardless of direction – kinetic energy is a scalar and never negative.
10. **True**  
The friction force points against the motion ( $\theta = 180^\circ$ ), so its work is negative – it removes energy.