Answer Key

AP Energy Multiple Choice Practice Questions

1.) Which of the following free body diagrams, all drawn to scale, would show a decrease in kinetic energy of the same 1 kg object, initially traveling with velocity, \( v \), in the direction of the velocity vector?

   a) \[
   \begin{array}{c}
   \text{F}_1 \\
   \text{v}
   \end{array}
   \quad \begin{array}{c}
   \text{F}_2 \\
   \text{v}
   \end{array}
   \]

   b) \[
   \begin{array}{c}
   \text{F}_2 \\
   \text{v}
   \end{array}
   \quad \begin{array}{c}
   \text{F}_2 \\
   \text{v}
   \end{array}
   \]

   c) \[
   \begin{array}{c}
   \text{F}_1 \\
   \text{v}
   \end{array}
   \quad \begin{array}{c}
   \text{F}_2 \\
   \text{v}
   \end{array}
   \]

   d) \[
   \begin{array}{c}
   \text{v} \\
   \text{F}_1
   \end{array}
   \]

   Explain your reasoning:

   \[ \Delta W = \Delta KE \]

   \( F_1 > F_2 \) means the net force and \( \Delta W \) net work is acting in the opposite direction of motion \( \Rightarrow \) slowing down the object.

2.) A mass on spring oscillates on a horizontal frictionless surface. The total energy of the mass-spring system can be expressed with which of the following? Select TWO choices.

   a) \( E_M = PE_k + KE \)

   b) \( E_M = \frac{1}{2} kx^2 + \frac{1}{2} mv^2 \)

   c) \( E_M = \frac{1}{2} kA^2 \)

   d) \( E_M = \frac{1}{2} kA^2 + \frac{1}{2} mv_{max}^2 \)

   Explain your reasoning:

   a) needs to have spring energy too
   d) the amplitude (A) and maximum velocity happen at different times in the oscillation

3.) What equipment could you not use to calculate the period of the oscillating spring in the previous question?

   a) Balance / spring scale

   b) Meterstick

   c) Masses

   d) Stopwatch

   e) Protractor

   Explain your reasoning:

   you can use the stopwatch to just measure the time or using the equation \( T = 2\pi \sqrt{\frac{m}{k}} \) you would need equipment to measure \( m \) and then determine \( k \) (mg=kx for a variety of masses, measure displacement).
Use the two pictures below, for the following three questions. An identical mass, m, attached to a string, of length, r, swing around in a horizontal and vertical circle.

4.) As the mass swings around Circle A at a constant speed, which of the following would be a correct expression for the amount of work done moving the mass around one complete circle?

   a) \( W = F_c \times 2\pi r \)  
   b) \( W = F_c \times r \)  
   c) \( W = T \times 2\pi r \)  
   d) \( W = \text{zero} \)

   Explain your reasoning: 
   traveling at a constant speed, no work is done. 
   Also \( F_c/T \) is \( \perp \) to \( d \) (\( \cos 90^\circ = 0 \))

5.) As the mass swings around Circle B, which of the following would be a correct expression for the change in kinetic energy, lowering the mass from its current position to the bottom of the circle?

   a) \( \Delta KE = W = F_c \times 2\pi r \)  
   b) \( \Delta KE = W = T \times 2r \)  
   c) \( \Delta KE = mg2r \)  
   d) \( \Delta KE = \text{zero} \)

   Explain your reasoning: 
   \( \Delta KE = \Delta PE = mg\Delta h \)  
   or  \( mg(ar) \)

6.) Which of the following is a correct explanation of why the tension at the bottom of Circle B is greater than the tension at the top of Circle B. Select TWO choices.

   a) The tension at the bottom is greater than at the top, because the tension is the only force acting at the bottom of the circle and has to be large enough to keep it moving in a circle.

   b) The tension at the bottom is greater than at the top, because at the bottom the tension has to counteract the force of gravity and produce a net force.

   c) The tension at the bottom is greater than at the top, because the mass is moving the fastest, so the net force is the greatest.

   d) The tension at the bottom is actually equal to the tension at the top, because its traveling at constant speed.