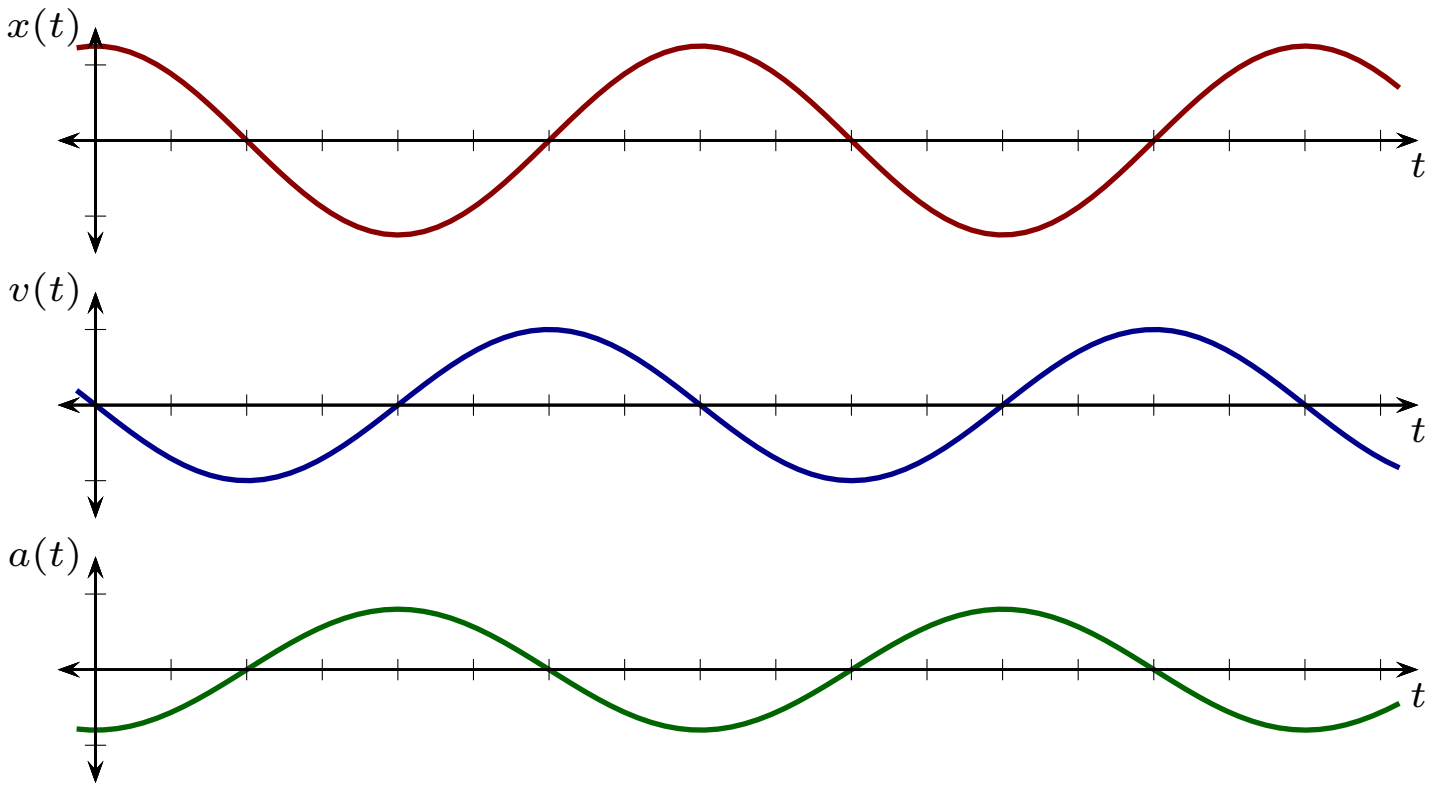
Simple Harmonic Motion: Velocity and Acceleration

For a solution of the form $x(t) = A\cos(\omega t)$ and $\omega < 1$.



Question 1

Suppose that a harmonic oscillator has displacement x_0 and velocity v_0 at $t = 0$. The general solution to the equation of motion for this oscillator is:

$$x(t) = A\cos(\omega t) + B\sin(\omega t).$$

Which of the following is true?

1. $A = x_0$
2. $B = x_0$
3. $A + B = x_0$
4. $A - B = x_0$

Question 2

Suppose that a harmonic oscillator has displacement x_0 and velocity v_0 at $t = 0$. The general solution to the equation of motion for this oscillator is:

$$x(t) = A\cos(\omega t) + B\sin(\omega t).$$

Which of the following is true?

1. $B = v_0$
2. $B = \omega v_0$
3. $B = -\omega v_0$
4. $B = \dfrac{v_0}{\omega}$
5. $B = -\dfrac{v_0}{\omega}$

Question 3

The general solution to the equation of motion for a simple harmonic oscillator is.

$$x(t) = C\cos(\omega t + \phi).$$

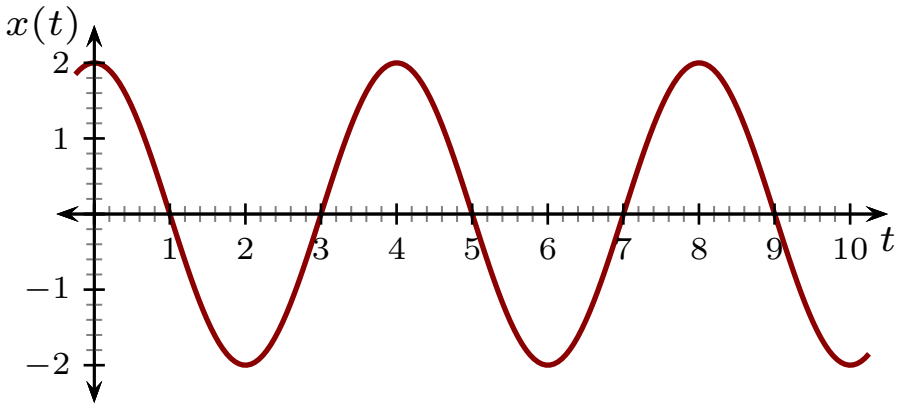
Consider this in the context of a spring with spring constant k and a block of mass m.

Which of the following is true regarding the energy of this oscillator?

1. $E = C$
2. $E = C^2$
3. $E = \frac{1}{2}kC$
4. $E = \frac{1}{2}kC^2$
5. $E = \frac{1}{2}mC^2$

Question 4

The position of a block of mass m attached to a spring of constant k is illustrated below:



Consider the object at $t = 2\,\text{s}$. Which of the following is true?

1. $K = 0$ and $U = 0$
2. $K = 0$ and $U > 0$
3. $K > 0$ and $U = 0$
4. $K > 0$ and $U > 0$