# Precalculus

## Topic: Modeling Harmonic Motion

**Instructions**

Solve the following problems related to modeling harmonic motion. Show all work clearly and check your solutions.

## Practice Problems

1. **Write the equation for simple harmonic motion:**

   (i) A mass attached to a spring oscillates with an amplitude of 5 cm and a period of 2 seconds. Write the equation modeling its motion, assuming the initial displacement is 0 and the initial velocity is 0.

   (ii) A pendulum swings with a maximum displacement of 3 meters and a period of 4 seconds. Write the equation for its motion assuming it starts from its maximum displacement.

   (iii) A tuning fork vibrates with a frequency of 512 Hz and an amplitude of 2 mm. Write the equation for its motion assuming the initial displacement is 0.

2. **Determine the amplitude, period, and phase shift:**

   (i) $y(t) = 6\sin\left(2\pi t - \frac{\pi}{4}\right)$

   (ii) $y(t) = 3\cos\left(\pi t + \frac{\pi}{3}\right)$

   (iii) $y(t) = 5\sin\left(4\pi t + \frac{\pi}{2}\right)$

   (iv) $y(t) = 7\cos\left(6\pi t - \frac{\pi}{6}\right)$

3. **Solve for the following based on the harmonic motion equation:**

   (i) The period of the function $y(t) = 2\sin\left(\frac{\pi}{3}t\right)$

(ii) The amplitude and period of the function $y(t) = 4\cos(\pi t + 2)$

(iii) The phase shift of the function $y(t) = 5\sin\left(6t - \frac{\pi}{4}\right)$

(iv) The amplitude and phase shift of the function $y(t) = 3\cos\left(2t + \frac{\pi}{6}\right)$

4. **Given the equation of motion, determine the displacement at a specific time:**

   (i) Find the displacement at $t = 2$ seconds for the motion modeled by $y(t) = 10\cos(2\pi t)$

   (ii) Find the displacement at $t = 3$ seconds for the motion modeled by $y(t) = 7\cos\left(2\pi t + \frac{\pi}{4}\right)$

   (iii) Find the displacement at $t = 5$ seconds for the motion modeled by $y(t) = 2\sin\left(4\pi t - \frac{\pi}{3}\right)$

5. **Given the period of harmonic motion, calculate the frequency and angular frequency:**

   (i) If the period of the motion is 4 seconds, calculate the frequency and angular frequency.

   (ii) If the period of the motion is 2 seconds, calculate the frequency and angular frequency.

   (iii) If the period of the motion is $\frac{\pi}{2}$ seconds, calculate the frequency and angular frequency.

## Multiple-Choice Questions

1. What is the period of the function $y(t) = 5\sin(6t)$?

   A. $\frac{\pi}{3}$ C. $\frac{\pi}{2}$

   B. 2 D. 1

2. What is the amplitude of the function $y(t) = 3\cos\left(4t - \frac{\pi}{3}\right)$?

   A. 3 C. 2

   B. 4 D. 5

3. What is the phase shift of the function $y(t) = 2\sin\left(3t + \frac{\pi}{4}\right)$?

   A. $-\frac{\pi}{4}$ C. $-\frac{\pi}{2}$

   B. $\frac{\pi}{4}$ D. $\frac{\pi}{2}$