

Homework 1

Gornain Aji
21/281767/TK/53170

You are an engineer working at a robotic company Boston Dynamics, are told to capture a broken robot which oscillates in Simple Harmonic Motion with a period of 5.0s and amplitudes of 5cm. Its equilibrium position is $x = 0$ cm. Suppose that the robot is now at $x = 0.0$ moving towards the direction of negative x . You have prepared a trap to capture the robot located at $x = + 2.5$ cm. At what time do you need to activate your trap in order to capture this robot.

Analyze : We know that

$$\frac{7\pi}{6} = \frac{2\pi}{5} \cdot t$$

Amplitude : 5 cm = A

$$\frac{35}{12} = t$$

Period : 5 second

Angular Velocity : $\frac{2\pi}{T} = \frac{2\pi}{5} = \omega$

$$t = 2.91667 \approx 2.9$$

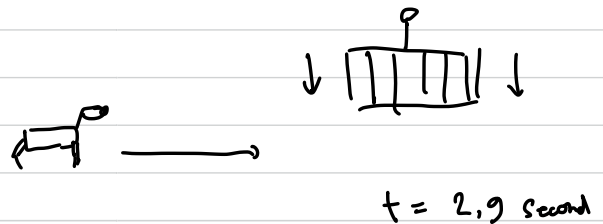
$$\begin{aligned} \text{Displacement} &= A \cos(\omega t + \theta) = x \\ x &= 5 \cos\left(\frac{2\pi}{5}t + \theta\right) \end{aligned}$$

So, the robot can be trap when t is equal to 2.9 second.

$$\text{when } x = 0 = 5 \cos\left(\frac{2\pi}{5}t + \theta\right)$$

$$\cos\left(\frac{2\pi}{5}t + \theta\right) = \cos \frac{\pi}{2}$$

$$\begin{aligned} t=0 &\rightarrow \cos(\theta) = \cos \frac{\pi}{2} \\ \theta &= \frac{\pi}{2} \end{aligned}$$



Now we know that displacement from the robot can be expressed as

$$x = 5 \cos\left(\frac{2\pi}{5}t + \frac{\pi}{2}\right)$$

or

$$x = -5 \sin\left(\frac{2\pi}{5}t\right)$$

When the robot is at position +2.5 cm, we can activate the trap and the expression is:

$$\begin{aligned} 2.5 &= -5 \sin\left(\frac{2\pi}{5}t\right) \\ -\frac{1}{2} &= \sin\left(\frac{2\pi}{5}t\right) \end{aligned}$$

$$\sin \frac{7\pi}{6} = \sin\left(\frac{2\pi}{5}t\right)$$