Simple Harmonic Motion

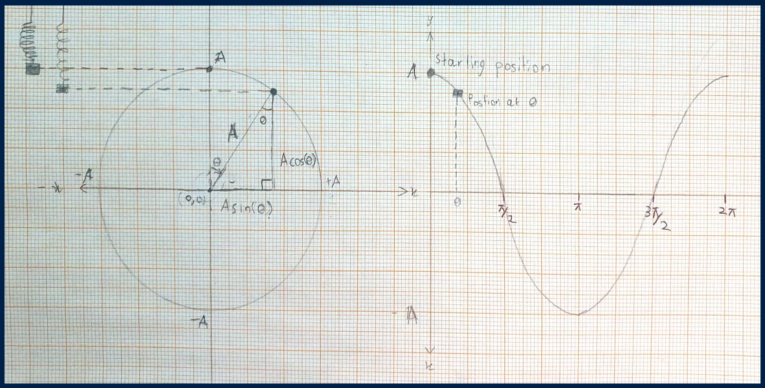
$$x = a\sin(\omega T)$$

$$x = a\cos(\omega T)$$

Swipe For Derivation

$$\Rightarrow$$

Below is an illustration that shows an object starting at a position of maximum amplitude.



when we define the amplitude or displacement from the equilibrium position using the circular approach we get:

$$x = a\cos(\theta) \tag{1}$$

Now as we are using uniform circular motion to describe the simple harmonic motion of the object we can represent theta in terms of angular velocity and time period.

$$\omega = \frac{\theta}{T} \rightarrow \omega T = \theta \tag{2}$$

substituting (2) in (1) gives us:

$$x = a\cos(\omega T)$$

Now if the object started it's motion from mean position at time t=0, we can use the cosine wave and move it $\frac{\pi}{2}$ radians or 90 degrees to the right hand side giving us or in other words you are simply taking theta to be the other angle and the variable x is just displacement from the center; we are just defining it in two different ways:

$$x = a\cos(\omega T - \frac{\pi}{2}) \tag{3}$$

Since $\sin(anything) = \cos(anything - \frac{\pi}{2})$, we can rewrite (3) as:

$$x = a\sin(\omega T)$$

Integrating these equations with respect to time gives you equations for velocity and if you integrate them twice then you get expressions for acceleration. Pretty neat isn't it?