Differentiation

Imagine a bug that moves with constant speed on a circular path of radius r around the origin. The angle of the bug's position vector with the $+x$ axis can be written as

$$\theta = \omega t + a.$$

Assume $a = 0$, so that the bug is on the $+x$ axis at time 0. Then the position vector of the bug is

$$X(t) = (r\cos(\omega t), r\sin(\omega t)).$$

Now imagine the bug lives in $\mathbb{R}^3$ with

$$X(t) = (\cos(t), \sin(t), t).$$

This lifts the circular path into a helix.