images/physics.png

The antiderivative is very helpful in physics problems. We already know that $x(t)$, $v(t)$, and $a(t)$ are all related through their rates (derivatives), so they must be related with their antiderivatives as well. There is no single antiderivative for a function, so instead of saying

$$\int v(t)dt = x(t)$$

which is false, we can say

$$\int v(t)dt = \text{change in } x(t)$$

or

$$\int v(t)dt = x(t) + x_0$$

At any point t, the change in $x(t)$ will be $\int v(t)dt$. This works for all relations as well:

$$\int \left(\int a(t)dt \right) dt = \int (v(t) + v_0)dt = x(t) + v_0 t + x_0$$

We are not using C as our constant of integration because the y-intercept has defined meaning in physics. We are instead using x_0 and v_0 as our constants to show initial conditions ($time = 0$)