Worksheet #7 - Integration and Basic Physics

In this worksheet, you will use indefinite integrals to calculate some basic quantities typically encountered in physics courses.

Recall that, if \( p(t) \) is a position function and \( t \) represents time, then \( v = p' \) is velocity and \( a = v' \) is acceleration.

1. The velocity of an object at time \( t \) is \( v(t) = e^{2t} \text{ mi/hr} \) and the position of the object at time \( t = 1 \text{ hr} \) is \( p(1) = e^{2} \text{ mi} \). Find the position at time \( t \). Include units in your answer.

2. The acceleration of an object at time \( t \) is \( a(t) = te^t \). The initial velocity and initial position are both 0. Find the position at time \( t \). (Don’t worry about units in this question.)
3. The acceleration of an object is constant: \( a(t) = a \). The initial velocity (at time \( t = 0 \)) is \( v(0) = v_0 \). Use integration to find a formula for \( v(t) \).

4. Use the same setup as in the previous question, but you also know the initial position of the object is \( p(0) = p_0 \). Use integration to find a formula for \( p(t) \).
The acceleration of an object is $a(t) = \cos(\omega t)$, where $\omega$ is some given nonzero constant. The initial position is $p(0) = 1$, and the initial velocity is $v(0) = 0$. Find the position at time $t = \pi$. 