Problem 2 (4 points) - Drag Race

The time derivative of the acceleration is called \( \text{“jerk”} \), i.e. \( j(t) = \frac{da(t)}{dt} \).

(a) (1 point) For motion under constant jerk \( j \), derive equations for the acceleration \( a(t) \), the velocity \( v(t) \), and the position \( x(t) \). Use \( x_0 \) for the initial position, \( v_0 \) for the initial velocity, and \( a_0 \) for the initial acceleration.

Two cars start a race at rest. Car A accelerates at constant rate \( a \), while Car J moves with constant jerk \( j \) and zero initial acceleration. Part way through the race, at \( t = 1 \) s, the cars are tied.

(b) (1 point) In a single graph, sketch \( x(t) \) for both Car A and Car J, and label the curves accordingly.

(c) (1 point) Who was ahead at \( t = 0.5 \) s?

(d) (1 point) Which car will win the race?