Monday warm-up: Kinematics, II

Prof. Jordan C. Hanson

September 8, 2025

1 Memory Bank

1. $v = \frac{\Delta x}{\Delta t}$ ... Average velocity.
2. $v = \frac{dx}{dt}$ ... Instantaneous velocity.
3. $a = \frac{\Delta v}{\Delta t}$ ... Average acceleration.
4. $a = \frac{dv}{dt}$ ... Average acceleration.
5. $x(t) = \frac{1}{2}at^2 + v_i t + x_i$ ... Position versus time, given constant acceleration
6. $v(t) = at + v_i$ ... Speed versus time, given constant acceleration
7. $v_f^2 = v_i^2 + 2a\Delta x$ ... Initial and final speeds, given constant acceleration and displacement

2 Chapter 3 - Kinematics, II

1. Suppose a runner accelerates at 3 m s^{-2} from rest. (a) *Where* will the runner reach a top speed of 10 m s^{-1}? (b) *When* does the runner reach top speed ?
2. Consider Fig. 1. The formula that describes the speed of the system between 0 and 20 seconds is
   - A: $v(t) = 3t$
   - B: $v(t) = 0.3t$
   - C: $v(t) = 20t$
   - D: $v(t) = 0.2t$
3. Using your formula for $v(t)$ from the previous exercise, what is the speed at $t = 10$ seconds?
4. Consider Fig. 1. Between 50 and 70 seconds, the system
   - A: has a positive acceleration
   - B: has a negative acceleration
   - C: has no acceleration
   - D: is not moving

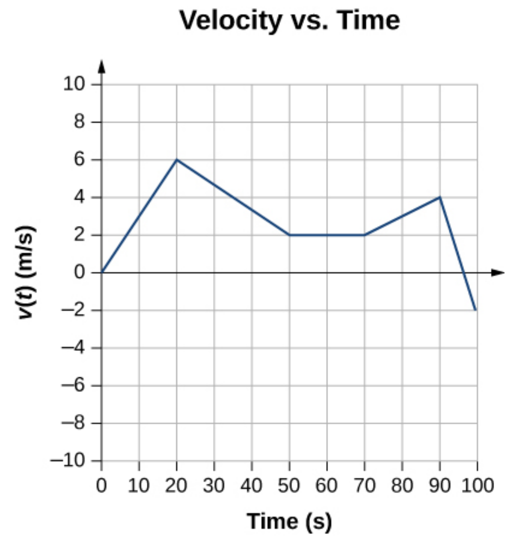

Figure 1: The velocity versus time for a system.

5. Examine Fig. 1, and determine the regions with the largest positive acceleration and the largest negative acceleration. Estimate them based on the graph.
6. The position of a system is $x(t) = 5.0t^2 - 4.0t^3$ m. Find (a) the velocity and acceleration of the particle as functions of time, (b) the velocity and acceleration at t = 2.0 s, (c) the time at which the velocity is zero, and (d) the maximum position.