# Friday warm-up: Kinematics, II

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## 1 Memory Bank

1. $v = \frac{\Delta \vec{x}}{\Delta t}$ ... Average velocity.
2. $v = \frac{d\vec{x}}{dt}$ ... Instantaneous velocity.
3. $a = \frac{\Delta \vec{v}}{\Delta t}$ ... Average acceleration.
4. $a = \frac{d\vec{v}}{dt}$ ... Instantaneous 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. $v_f^2 = v_i^2 + 2a\Delta x$ ... Velocity, displacement, acceleration

## 2 Chapter 2 - Kinematics, II

1. In a 100-m race, the winner is timed at 11.2 s. The second-place finisher's time is 11.6 s. How far is the second-place finisher behind the winner when she crosses the finish line? Assume the velocity of each runner is constant throughout the race.

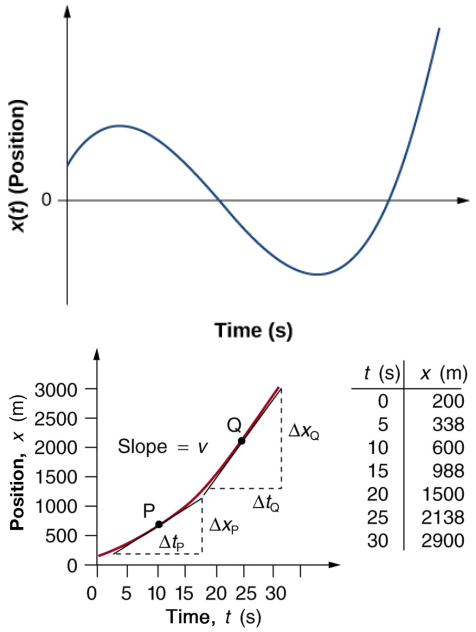


Figure 1: (Top) A system moves with constant velocity. Velocity is the slope on this plot. (Bottom) A system moves with non-constant velocity.

2. Consider the motion of the system depicted in Fig. 1 (top). Which of the following is true?
   - A: $v < 0$, then $v > 0$, then $v < 0$
   - B: $v > 0$, then $v < 0$, then $v > 0$
   - C: $v > 0$, then $v < 0$
   - D: $v < 0$, then $v > 0$
3. Consider the motion depicted in Fig. 1 (top). Which of the following is true?
   - A: $a > 0$, then $a < 0$
   - B: $a < 0$, then $a > 0$
   - C: $a > 0$
   - D: $a < 0$
4. Suppose a cyclist has a velocity of 15 m s$^{-1}$ at $t = 0$. If the acceleration is 3 m s$^{-2}$, (a) what is the velocity at $t = 4$ seconds? (b) What is the displacement of the cyclist at $t = 4$ seconds? (c) Is the average velocity different from the instantaneous velocity at $t = 0$ or $t = 4$ seconds?
5. Consider the motion of the sytem depicted in Fig. 1 (bottom). (a) From the given data, calculate the speed of the system at points P and Q. (b) Is the acceleration of the sytem positive or negative? Estimate the acceleration.