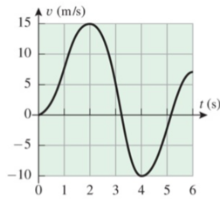
Section 4.6 – Rectilinear Motion



7. The accompanying figure shows the graph of velocity versus time for a particle moving along a coordinate line. Make a rough sketch of the graphs of speed versus time and acceleration versus time.

15. The function $s(t) = \sin \frac{\pi t}{4}$ describes the position of a particle moving along a coordinate line, where *s* is in meters and *t* is in seconds.

   a. Make a table showing the position, velocity, and acceleration to two decimal places at times t=1, 2, 3, 4, 5.
   b. At each of the times in part (a), determine whether the particle is stopped; if it is not, state the direction of motion.
   c. At each of the times in part (a), determine whether the particle is speeding up, slowing down, or neither.

The following functions s(t) describes the position of a particle moving along a coordinate line, where *s* is in feet and t is in seconds.

   a. Find the velocity and acceleration functions.
   b. Find the position, velocity, speed, and acceleration at time t=1.
   c. At what times is the particle stopped?
   d. When is the particle speeding up? Slowing down?
   e. Find the total distance traveled by the particle from t=0 to time t=5.

17. $s(t) = t^3 - 3t^2, t \geq 0$

19. $s(t) = 9 - 9\cos\left(\frac{\pi}{3}t\right), 0 \leq t \leq 5$

23. Let $s(t) = \frac{t}{t^2+5}$ be the position function of a particle moving along a coordinate line, where *s* is in meters and *t* is in seconds. Use a graphing utility to generate the graphs of s(t), v(t), and a(t) for t≥0, and use those graphs where needed.

   a. Use the appropriate graph to make a rough estimate of the time at which the particle first reverses the direction of its motion; and then find the time exactly.
   b. Find the exact position of the particle when it first reverses the direction of its motion.
   c. Use the appropriate graphs to make a rough estimate of the time intervals on which the particle is speeding up, and on which it is slowing down; and then find those time intervals exactly.

27. A position function of a particle moving along a coordinate line is $s(t) = t^3 - 9t^2 + 24t$. Use the method of Example 6 to analyze the motion of the particle for t≥0, and give a schematic picture of the motion (as in Figure 4.6.8)

33. Let $s(t) = 5t^2 - 22t$ be the position function of a particle moving along a coordinate line, where *s* is in feet and *t* is in seconds.

   a. Find the maximum speed of the particle during the time interval 1≤t≤3.
   b. When, during the time interval 1≤t≤3, is the particle farthest from the origin? What is its position at that instant?

39. Suppose that the position functions of two particles, P_1 and P_2, in motion along the same line are $s_1(t) = \frac{1}{2}t^2 - t + 3$ and $s_2(t) = -\frac{1}{4}t^2 + t + 1$, respectively, for t≥0.

   a. Prove that P_1 and P_2 do not collide.
   b. How close do P_1 and P_2 get to each other?
   c. During what time intervals are the moving in opposite directions?