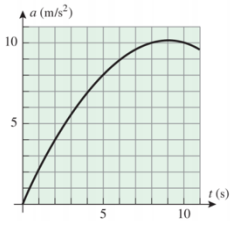
Sections 5.7-5.8: Rectilinear Motion with Integration & Average Value



3. The accompanying figure shows the acceleration versus time curve for a particle moving along a coordinate line. If the initial velocity of the particle is 20 m/s, estimate
   a. the velocity at time t = 4 sec.
   b. the velocity at time t = 6 sec.

5. A particle moves along an *s*-axis. Use the given information to find the position function of the particle.
   a. $v(t) = 3t^2 - 2t;\ \ s(0) = 1$
   b. $a(t) = 3\sin 3t\,;\ \ v(0) = 3;\ \ s(0) = 3$

9. A particle moves with a velocity of v(t) m/s along an *s*-axis. Find the displacement and the distance traveled by the particle during the given time interval.
   a. $v(t) = \sin t\,;\ \ 0 \le t \le \pi/2$
   b. $v(t) = \cos t\,;\ \pi/2 \le t \le 2\pi$

13. A particle moves with acceleration $a(t)$ m/s^2 along an *s*-axis and has velocity v_0 m/s at t=0. Find the displacement and the distance traveled by the particle during the given time interval.
   $a(t) = 3;\ \ v_0 = -1;\ \ 0 \le t \le 2$

29. For the velocity function $v(t) = 0.5 - te^{-t}; 0 \le t \le 5$
   a. Generate the velocity versus time curve and use it to make a conjecture about the sign of the displacement over the given time interval.
   b. Use a graphing utility to find the displacement.

32. A car traveling 60 mi/hr along a straight road decelerates at a constant rate of 11 ft/s^2.
   a. How long will it take until the speed is 45 mi/h?
   b. How far will the car travel before coming to a stop?

35. A motorcycle, starting from rest, speeds up with a constant acceleration of 2.6 m/s^2. After it has traveled 120 m, it slows down with a constant acceleration of -1.5 m/s^2 until it attains a speed of 12 m/s. What is the distance traveled by the motorcycle at that point?

39. A projectile is launched vertically upward from the ground level with an initial velocity of 112 ft/s.
   a. Find the velocity at t=3 s and t=5 s.
   b. How high will the projectile rise?
   c. Find the speed of the projectile when it hits the ground.

42. In 1939, Joe Sprinz of the San Francisco Seals Baseball Club attempted to catch a ball dropped from a blimp at a height of 800 ft to break a world record.
   a. How long will it take for the ball to drop 800 ft?
   b. What is the velocity of a ball in miles per hour after an 800 ft drop?

FYI the speed of the ball made his glove hit his face and broke his jaw and teeth. He dropped the ball!

1. a. Find f_{avg} of $f(x) = 2x$ over [0,4]
   b. Find a point c in [0,4] such that $f(c) = f_{avg}$
   c. Sketch a graph of $f(x) = 2x$over [0,4], and construct a rectangle over the interval whose area is the same as the area under the graph of *f* over the interval.

Find the average value of the function over the given interval.

7. $f(x) = \frac{1}{x}$; $[1, e]$

9. $f(x) = \frac{1}{1+x^2}$; $[1, \sqrt{3}]$

17. Suppose that *f* is a linear function. Using the graph of *f*, explain why the average value of *f* on [*a*,*b*] is $f\left(\frac{a+b}{2}\right)$.

25. Water is run at a constant rate of $1\ \text{ft}^3/\text{min}$ to fill a cylindrical tank of radius 3 ft and height 5 ft. Assuming that the tank is initially empty, make a conjecture about the average weight of the water in the tank over the time period required to fill it, and then check your conjecture by integrating. [Take the weight density of water to be 62.4 lb/ft^3.]

27. A traffic engineer monitors the rate at which cars enter the main highway during the afternoon rush hour. From her data she estimates that between 4:30 PM and 5:30 PM the rate $R(t)$ at which cars enter the highway is given by the formula $R(t) = 100(1 - 0.0001t^2)$ cars per minute, where *t* is the time (in minutes) since 4:30 PM. Find the average rate, in cars per minute, at which cars enter the highway during the first half hour of rush hour.

29. A large juice class containing 60 mL of orange juice is replenished by a server. The accompanying figure shows the rate wat which orange juice is poured into the glass in milliliters per second (mL/s). Show that the average rate of change of the volume of juice in the glass during these 5 s is equal to the average value of the rate of flow of juice into the glass.