


**•3** **SSM** **WWW** An automobile travels on a straight road for 40 km at 30 km/h. It then continues in the same direction for another 40 km at 60 km/h. (a) What is the average velocity of the car during the full 80 km trip? (Assume that it moves in the positive  $x$  direction.) (b) What is the average speed? (c) Graph  $x$  versus  $t$  and indicate how the average velocity is found on the graph.

•5 **SSM** The position of an object moving along an  $x$  axis is given by  $x = 3t - 4t^2 + t^3$ , where  $x$  is in meters and  $t$  in seconds. Find the position of the object at the following values of  $t$ : (a) 1 s, (b) 2 s, (c) 3 s, and (d) 4 s. (e) What is the object's displacement between  $t = 0$  and  $t = 4$  s? (f) What is its average velocity for the time interval from  $t = 2$  s to  $t = 4$  s? (g) Graph  $x$  versus  $t$  for  $0 \leq t \leq 4$  s and indicate how the answer for (f) can be found on the graph.

••11 You are to drive to an interview in another town, at a distance of 300 km on an expressway. The interview is at 11:15 A.M. You plan to drive at 100 km/h, so you leave at 8:00 A.M. to allow some extra time. You drive at that speed for the first 100 km, but then construction work forces you to slow to 40 km/h for 40 km. What would be the least speed needed for the rest of the trip to arrive in time for the interview?

**H.W/ 1.1** •15  (a) If a particle's position is given by  $x = 4 - 12t + 3t^2$  (where  $t$  is in seconds and  $x$  is in meters), what is its velocity at  $t = 1$  s? (b) Is it moving in the positive or negative direction of  $x$  just then? (c) What is its speed just then? (d) Is the speed increasing or decreasing just then? (Try answering the next two questions without further calculation.) (e) Is there ever an instant when the velocity is zero? If so, give the time  $t$ ; if not, answer no. (f) Is there a time after  $t = 3$  s when the particle is moving in the negative direction of  $x$ ? If so, give the time  $t$ ; if not, answer no.

••17 The position of a particle moving along the  $x$  axis is given in centimeters by  $x = 9.75 + 1.50t^3$ , where  $t$  is in seconds. Calculate (a) the average velocity during the time interval  $t = 2.00$  s to  $t = 3.00$  s; (b) the instantaneous velocity at  $t = 2.00$  s; (c) the instantaneous velocity at  $t = 3.00$  s; (d) the instantaneous velocity at  $t = 2.50$  s; and (e) the instantaneous velocity when the particle is midway between its positions at  $t = 2.00$  s and  $t = 3.00$  s. (f) Graph  $x$  versus  $t$  and indicate your answers graphically.

**•18** The position of a particle moving along an  $x$  axis is given by  $x = 12t^2 - 2t^3$ , where  $x$  is in meters and  $t$  is in seconds. Determine (a) the position, (b) the velocity, and (c) the acceleration of the particle at  $t = 3.0$  s. (d) What is the maximum positive coordinate reached by the particle and (e) at what time is it reached? (f) What is the maximum positive velocity reached by the particle and (g) at what time is it reached? (h) What is the acceleration of the particle at the instant the particle is not moving (other than at  $t = 0$ )? (i) Determine the average velocity of the particle between  $t = 0$  and  $t = 3$  s.

**•30** The brakes on your car can slow you at a rate of  $5.2 \text{ m/s}^2$ . (a) If you are going  $137 \text{ km/h}$  and suddenly see a state trooper, what is the minimum time in which you can get your car under the  $90 \text{ km/h}$  speed limit? (The answer reveals the futility of braking to keep your high speed from being detected with a radar or laser gun.) (b) Graph  $x$  versus  $t$  and  $v$  versus  $t$  for such a slowing.

**•45 SSM WWW** (a) With what speed must a ball be thrown vertically from ground level to rise to a maximum height of 50 m? (b) How long will it be in the air? (c) Sketch graphs of  $y$ ,  $v$ , and  $a$  versus  $t$  for the ball. On the first two graphs, indicate the time at which 50 m is reached.



**••53** **SSM** **ILW** A key falls from a bridge that is 45 m above the water. It falls directly into a model boat, moving with constant velocity, that is 12 m from the point of impact when the key is released. What is the speed of the boat?