

4. The accompanying figure shows the position versus time curve for a certain particle moving along a straight line. Estimate each of the following from the graph:
- the average velocity over the interval  $0 \leq t \leq 3$
  - the values of  $t$  at which the instantaneous velocity is zero
  - the values of  $t$  at which the instantaneous velocity is either a maximum or a minimum
  - the instantaneous velocity when  $t = 3$  s.

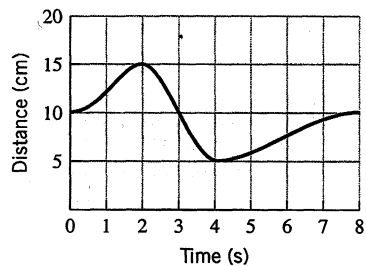


Figure Ex-4

5. The accompanying figure shows the position versus time curve for a certain particle moving on a straight line.
- Is the particle moving faster at time  $t_0$  or time  $t_2$ ? Explain.
  - The portion of the curve near the origin is horizontal. What does this tell us about the initial velocity of the particle?
  - Is the particle speeding up or slowing down in the interval  $[t_0, t_1]$ ? Explain.
  - Is the particle speeding up or slowing down in the interval  $[t_1, t_2]$ ? Explain.

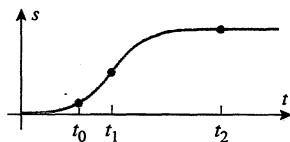


Figure Ex-5

6. An automobile, initially at rest, begins to move along a straight track. The velocity increases steadily until suddenly the driver sees a concrete barrier in the road and applies the brakes sharply at time  $t_0$ . The car decelerates rapidly, but it is too late—the car crashes into the barrier at time  $t_1$  and instantaneously comes to rest. Sketch a position versus time curve that might represent the motion of the car.

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17. Suppose that the outside temperature versus time curve over a 24-hour period is as shown in the accompanying figure.
- Estimate the maximum temperature and the time at which it occurs.
  - The temperature rise is fairly linear from 8 A.M. to 2 P.M. Estimate the rate at which the temperature is increasing during this time period.
  - Estimate the time at which the temperature is decreasing most rapidly. Estimate the instantaneous rate of change of temperature with respect to time at this instant.

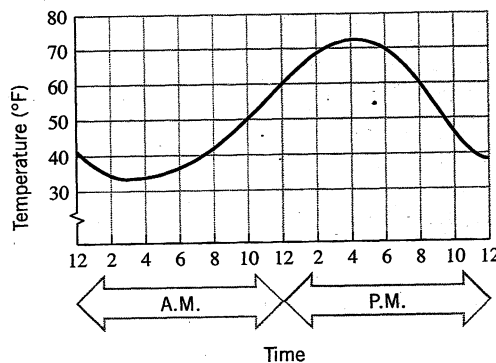


Figure Ex-17

18. The accompanying figure shows the graph of the pressure  $p$  in atmospheres (atm) versus the volume  $V$  in liters (L) of 1 mole of an ideal gas at a constant temperature of 300 K (kelvins). Use the line segments shown in the figure to estimate the rate of change of pressure with respect to volume at the points where  $V = 10$  L and  $V = 25$  L.

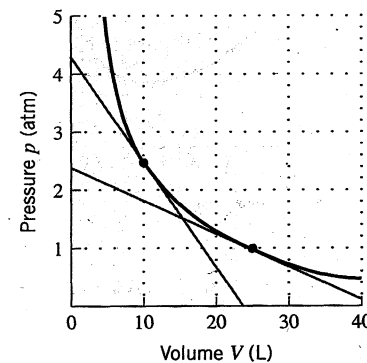


Figure Ex-18

19. The accompanying figure shows the graph of the height  $h$  in centimeters versus the age  $t$  in years of an individual from birth to age 20.
- When is the growth rate greatest?
  - Estimate the growth rate at age 5.
  - At approximately what age between 10 and 20 is the growth rate greatest? Estimate the growth rate at this age.
  - Draw a rough graph of the growth rate versus age.

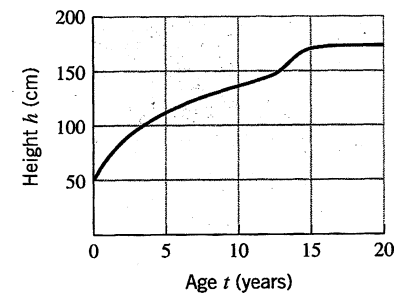


Figure Ex-19

20. A rock is dropped from a height of 576 ft and falls toward Earth in a straight line. In  $t$  seconds the rock drops a distance of  $s = 16t^2$  ft.
- How many seconds after release does the rock hit the ground?
  - What is the average velocity of the rock during the time it is falling?
  - What is the average velocity of the rock for the first 3 s?
  - What is the instantaneous velocity of the rock when it hits the ground?
21. During the first 40 s of a rocket flight, the rocket is propelled straight up so that in  $t$  seconds it reaches a height of  $s = t^3/\sqrt{10}$  ft.
- How high does the rocket travel in 40 s?
  - What is the average velocity of the rocket during the first 40 s?
  - What is the average velocity of the rocket during the first 135 ft of its flight?
  - What is the instantaneous velocity of the rocket at the end of 40 s?
22. An automobile is driven down a straight highway such that after  $0 \leq t \leq 12$  seconds it is  $s = 4.5t^2$  feet from its initial position.
- Find the average velocity of the car over the interval  $[0, 12]$ .
  - Find the instantaneous velocity of the car at  $t = 6$ .
23. A particle moves in the positive direction along a straight line so that after  $t$  minutes its distance is  $s = 6t^4$  feet from the origin.
- Find the average velocity of the particle over the interval  $[2, 4]$ .
  - Find the instantaneous velocity at  $t = 2$ .