







*Example:* [2003 AP Calculus AB #2 ... Calculator Allowed] A particle moves along the  $x$ -axis so that its velocity at time  $t$  is given by

$$v(t) = -(t+1)\sin\left(\frac{t^2}{2}\right).$$

At time  $t = 0$ , the particle is at position  $x = 1$ .

a) Find the acceleration of the particle at time  $t = 2$ . Is the speed of the particle increasing at  $t = 2$ ? Why or why not?

b) Find all times  $t$  in the open interval  $0 < t < 3$  when the particle changes direction. Justify your answer.

c) Find the total distance traveled by the particle from time  $t = 0$  until time  $t = 3$ .

d) During the time interval  $0 \leq t \leq 3$ , what is the greatest distance between the particle and the origin? Show the work that leads to your answer.

*Example:* [2002 AP Calculus AB #2 ... Calculator Allowed] The rate at which people enter an amusement park on a given day is modeled by the function  $E$  defined by

$$E(t) = \frac{15600}{t^2 - 24t + 160}.$$

The rate at which people leave the same amusement park on the same day is modeled by function  $L$  defined by

$$L(t) = \frac{9890}{t^2 - 38t + 370}.$$

Both  $E(t)$  and  $L(t)$  are measured in people per hour and time  $t$  is measured in hours after midnight. These functions are valid for  $9 \leq t \leq 23$ , the hours during which the park is open. At time  $t = 9$ , there are no people in the park.

a) How many people have entered the park by 5:00 pm ( $t = 17$ )? Round your answer to the nearest whole number.

b) The price of admission to the park is \$15 until 5:00 pm ( $t = 17$ ). After 5:00 pm, the price of admission to the park is \$11. How many dollars are collected from admissions to the park on the given day? Round your answer to the nearest whole number.

c) Let  $H(t) = \int_9^t (E(x) - L(x)) dx$  for  $9 \leq t \leq 23$ . The value of  $H(17)$  to the nearest whole number is 3725. Find the value of  $H'(17)$  and explain the meaning of  $H(17)$  and  $H'(17)$  in the context of the park.

d) At what time  $t$ , for  $9 \leq t \leq 23$ , does the model predict that the number of people in the park is a maximum?