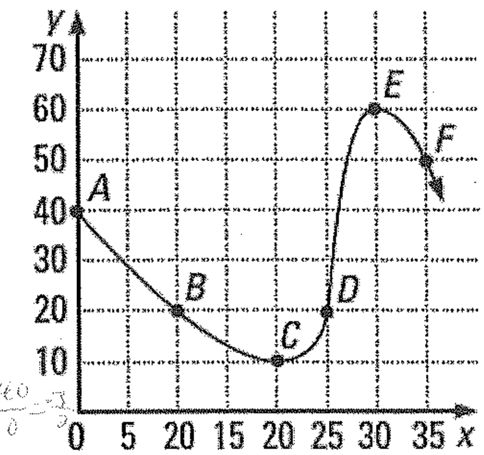
1. Find the average rate of change in $q(x) = x^2 + 12$ from $x = -1$ to $x = 4$.

$q(-1) = 13$ $q(4) = 28$ $\frac{28-13}{4-(-1)} = \frac{15}{5} = 3$

2. Find the average rate of change in $g(n) = 3n^3 - n^2 + 6$ over the interval $-2 \le n \le 2$.

$g(-2) = -22$ $g(2) = 26$ $\frac{26-(-22)}{2-(-2)} = \frac{48}{4} = 12$

3. Refer to the graph of g at the right. Find the average rate of change in g over each interval.



a. C to E $\frac{60-10}{30-20} = \frac{50}{10}$ 5

b. $0 \le x \le 35$ $\frac{50-40}{35-0} = \frac{10}{35} = \frac{2}{7}$ $\frac{2}{7}$

Over what interval does the average rate of change in g have the given value? $A \to C$ $\frac{10-40}{20-0} = -\frac{3}{2}$

c. 0 B to D

d. $-\frac{3}{2}$ $A \to C$

For Questions 4-6, find the derivative of the function at the given value of *x*.

4. $f(x) = 3x^2 + 4; x = 2$ $f' = 6x$ $f'(2) = \boxed{12}$

5. $g(x) = -12x + 8; x = .5$ $g'(x) = -12$ $g'(0.5) = \boxed{-12}$

6. $h(x) = 22; x = 7$ $h'(x) = 0$ $h(7) = 0$

7. Let $f(x) = -2x^2 + x - 3$ $f'(x) = -4x + 1$

a. Compute $f'(0)$.

$f'(0) = 1$

b. Compute $f'(3)$.

$f'(3) = -11$

8. The height h in feet of a small rocket t seconds after launch is approximated by $h(t) = 320t - 16t^2$. $h'(t) = 320 - 32t$

a. Find the instantaneous velocity at time $t = 5$. $160\ \frac{ft}{s} = h'(5)$

b. Find the instantaneous velocity at time $t = 14$. $-128\ \frac{ft}{s} = h'(14)$

c. Find the instantaneous velocity at time $t = 10$. $0\ \frac{ft}{s} = h'(10)$

d. At what time does the rocket reach its maximum height? 10 sec

9. A pebble is dropped from a cliff 60 feet high. The height of the pebble in feet above the ground at time t seconds is given by $h(t) = -16t^2 + 60$. $h'(x) = -32t$

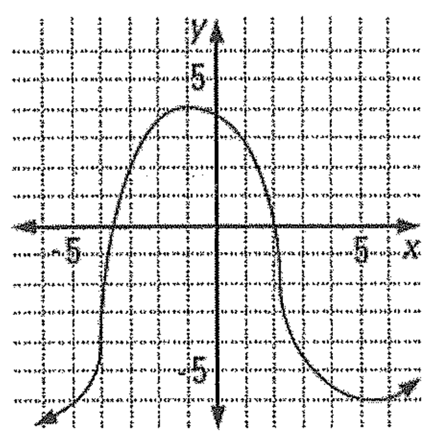
a. Find the instantaneous velocity of the pebble at time $t = 0.5$ second. $-16\ \frac{ft}{s}$

b. At what time does the pebble hit the ground? 1.936 sec

$0 = -16t^2 + 60$
$16t^2 = 60$
$t^2 = \frac{60}{16}$
$t = \pm\sqrt{\frac{60}{16}}$

c. Find the instantaneous velocity of the ball at the moment just before it hits the ground. -61.968 $h'(1.936)$

10. Refer to the graph of f at the right. Give a value of x for which $f'(x)$ is



a. positive. $(-\infty, -1) \cup (5, \infty)$

b. negative. $(-1, 5)$

c. zero. $\{-1, 5\}$

For questions 11-14, find the derivative of each function

11. $f(y) = 7y^2$ $14y$

12. $g(x) = 7x^2 - 3x$ $14x - 3$

13. $p(v) = -4.5v$ -4.5

14. $q(x) = 94$ 0

15. A particle moves so that the distance s traveled in meters at time t seconds is given by $s(t) = t^2 + 5t - 4$.

$s(4) = 32$

$s(3) = 20$

a. Find the average velocity between 3 and 4 seconds. $\underline{12 \frac{m}{s}}$ $\frac{32-20}{4-3} = 12$

b. Find the instantaneous velocity of the particle at time $t = 8$. $\underline{21 \frac{m}{s}}$ $s'(t) = 2t+5$ $s'(8) = 16+5$

c. What is the initial velocity of the particle (that is, at time $t = 0$ seconds)? $\underline{5 \frac{m}{s}}$

$s'(0) = 5$

16. A particle moves horizontally so that its position in feet to the right of the starting point at time t seconds is given by $f(t) = -t^2 + 5t + 6$.

v

$f'(t) = -2t+5$

$f'(8) = -11$

a. At time $t = 8$ seconds, is the particle moving to the right, to the left, or stationary? $f'(8) < 0$ $\underline{\text{LEFT}}$

a

$f''(t) = -2$

b. What is the speed of the object at time $t = 8$ seconds? $\underline{-11 \frac{ft}{sec}}$

c. What is the acceleration of the object at time $t = 8$ seconds? $\underline{-2}$

d. Is the acceleration increasing, decreasing, or staying the same at time $t = 8$ seconds? $\underline{\text{SAME}}$

$a(t) = f''(t) = -2$ always

17. A ball is thrown directly upward. Its height h in meters after t seconds is given by the equation $h(t) = -4.9t^2 + 28t + 2$. $h'(t) = v(t) = -9.8t + 28$

$a(t) = -9.8$

a. Find the instantaneous velocity at each time.

$h'(0) = 28$ $h'(3) = -1.4$

i. 0 seconds $\underline{28 \frac{m}{s}}$ ii. 3 seconds $\underline{-1.4 \frac{m}{s}}$

b. Find the instantaneous acceleration at each time.

i. 0 seconds $\underline{-9.8}$ ii. 3 seconds $\underline{-9.8}$

18. A rectangular pen adjacent to a shed is to be enclosed with 40 feet of fencing. What should the dimensions of the pen be in order to maximize the area?

x y x

$2x + y = 40$

$y = 40 - 2x$

$A = x(40 - 2x)$

$A = 40x - 2x^2$

$A' = 40 - 4x$

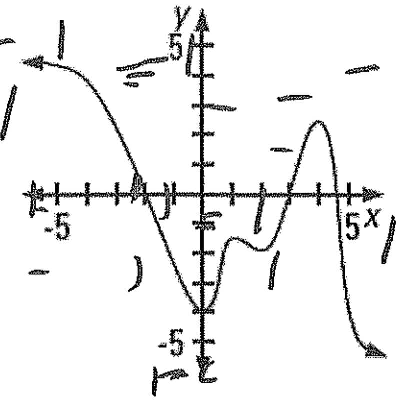
$0 = 40 - 4x$

$10ft = x$

$y = 40 - 2(10) = 20ft$

10ft x 20ft

19. Consider the function f graphed at the right.



a. On what interval(s) is $f'(x)$ positive?

$(0, 1) \cup (2, 4)$

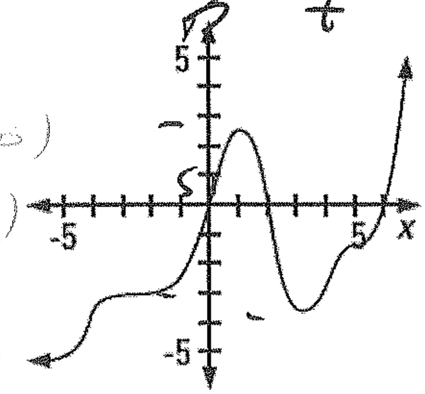
b. On what interval(s) is $f'(x)$ negative?

$(-\infty, 0) \cup (1, 2) \cup (4, \infty)$

c. For what values of x is $f'(x) = 0$?

$\{0, 1, 2, 4\}$

20. The derivative h' of a function h is graphed at the right. Describe the values of x where



a. h is increasing. $(0, 2) \cup (6, \infty)$

b. h is decreasing. $(-\infty, 0) \cup (2, 6)$

c. h has a relative maximum or minimum. $\{0, 2, 6\}$

21. Suppose g is a function such that $g(x) = -\frac{2}{3}x^3 + 5x^2 - 12x$. Then $g'(x) = -2x^2 + 10x - 12$. Use the first derivative to find each.

a. The interval(s) on which g is increasing. $(2, 3)$

b. The interval(s) on which g is decreasing. $(-\infty, 2) \cup (3, \infty)$

c. The points at which g may have a relative maximum or minimum. $\{2, 3\}$

$-2(-)(-)$ $\quad -2(+)(-)$ $\quad -2(+)(+)$

$- \quad + \quad -$

$2 \quad 3$

$-2x^2 + 10x - 12 = 0$

$-2(x^2 - 5x + 6) = 0$

$-2(x - 2)(x - 3)$