MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the average rate of change for the function over the given interval.
1) \( y = x^2 + 2x \) between \( x = 2 \) and \( x = 6 \)
   - A) 8
   - B) 12
   - C) \( \frac{20}{3} \)
   - D) 10

2) \( y = \sqrt{2x} \) between \( x = 2 \) and \( x = 8 \)
   - A) 7
   - B) \(-\frac{3}{10}\)
   - C) \( \frac{1}{3} \)
   - D) 2

3) \( y = 4x^2 \) between \( x = 0 \) to \( x = \frac{7}{4} \)
   - A) \(-\frac{3}{10}\)
   - B) 2
   - C) \( \frac{1}{3} \)
   - D) 7

4) \( y = x^3 + x^2 - 8x - 7 \) between \( x = 0 \) and \( x = 2 \)
   - A) \(-\frac{1}{6}\)
   - B) \( \frac{1}{2} \)
   - C) -28
   - D) -2

5) \( y = \frac{3}{x + 2} \) between \( x = 1 \) and \( x = 4 \)
   - A) -2
   - B) -28
   - C) \(-\frac{1}{6}\)
   - D) \( \frac{1}{2} \)

Suppose the position of an object moving in a straight line is given by the specified function. Find the instantaneous velocity at time \( t \).
6) \( s(t) = t^2 + 3t + 1 \), \( t = 5 \)
   - A) 41
   - B) 11
   - C) 25
   - D) 13

7) \( s(t) = 5t^2 - 8t - 1 \), \( t = 2 \)
   - A) 11
   - B) 2
   - C) 3
   - D) 12

8) \( s(t) = t^3 + 4t + 6 \), \( t = 1 \)
   - A) 13
   - B) 6
   - C) 7
   - D) 11

Find the instantaneous rate of change for the function at the given value.
9) \( F(x) = x^2 + 8x \) at \( x = 5 \)
   - A) 18
   - B) 13
   - C) 10
   - D) 65

10) \( s(t) = t^2 + 5t \) at \( t = 4 \)
    - A) 13
    - B) 9
    - C) 21
    - D) 3
11) $F(x) = 2x^2 + x - 3$ at $x = 4$
   A) 15  B) 17  C) 5  D) 19

12) $s(t) = 3t^2 + 5t - 7$ at $t = -2$
   A) -1  B) 1  C) -17  D) -7

Solve the problem.

13) A particular strain of influenza is known to spread according to the function $p(t) = \frac{1}{2}(t^2 + t)$, where $t$ is the number of days after the first appearance of the strain and $p(t)$ is the percentage of the population that is infected. Find the instantaneous rate of change of $p$ with respect to $t$ at $t = 3$.
   A) 6% per day  B) $\frac{7}{2}$% per day  C) 3% per day  D) 4% per day

14) The graph shows the population in millions of bacteria $t$ minutes after a bactericide is introduced into a culture. Find the average rate of change of population with respect to time for the time from 1 to 4 minutes.

   A) 3  B) $\frac{1}{3}$  C) 4  D) $\frac{1}{4}$

15) The size of a population of mice after $t$ months is $P = 100(1 + 0.2t + 0.02t^2)$. Find the growth rate at $t = 18$ months.
   A) 46 mice/month  B) 92 mice/month
   C) 192 mice/month  D) 184 mice/month
Estimate the slope of the tangent line to the curve at the given point.

16) A) 2  
   B) 1  
   C) $\frac{1}{2}$  
   D) $-1$

17) A) $-\frac{1}{2}$  
   B) $-1$  
   C) $-\frac{3}{2}$  
   D) 1
Find f'(x) at the given value of x.

19) \( f(x) = \sqrt{x} \); Find \( f'(81) \).
   A) 81       B) \( \frac{1}{18} \)       C) \( \frac{1}{9} \)       D) 9

20) \( f(x) = \sqrt{x + 6} \); Find \( f'(10) \).
   A) \( \frac{5\sqrt{5}}{8} \)       B) \( \frac{1}{8} \)       C) \( \frac{\sqrt{5}}{8} \)       D) \( \frac{5}{8} \)

21) \( f(x) = x^2 - 9x - 3 \); Find \( f'(-1) \).
   A) 7       B) -11       C) -2       D) -14

22) \( f(x) = -6x^2 + 4x + 5 \); Find \( f'(7) \).
   A) -56       B) 88       C) -75       D) -80

23) \( f(x) = -9x^2 + 6x \); Find \( f'(6) \).
   A) -102       B) -87       C) -72       D) -108

Find the equation of the secant line through the points where x has the given values.

24) \( f(x) = x^2 + 2x \); \( x = 4, x = 6 \)
   A) \( y = 12x \)       B) \( y = 24x - 12 \)       C) \( y = 12x - 24 \)       D) \( y = 12x + 24 \)

25) \( f(x) = \frac{3}{x} \); \( x = 3, x = 6 \)
   A) \( y = \frac{1}{6}x - \frac{3}{2} \)       B) \( y = -\frac{3}{x^2} \)       C) \( y = -\frac{1}{6}x + \frac{3}{2} \)       D) \( y = -\frac{1}{6}x \)

Find the equation of the tangent line to the curve when x has the given value.

26) \( f(x) = -4 - x^2 \); \( x = 4 \)
   A) \( y = 4x + 12 \)       B) \( y = -2x \)       C) \( y = 8x - 12 \)       D) \( y = -8x + 12 \)
27) \( f(x) = \frac{x^2}{2} ; x = 5 \)

A) \( y = 5x - 25 \)  
B) \( y = 5x - 12.5 \)  
C) \( y = 10x - 12.5 \)  
D) \( y = 5x + 12.5 \)

28) \( f(x) = \frac{x^3}{4} ; x = -4 \)

A) \( y = 12x + 32 \)  
B) \( y = 32x + 4 \)  
C) \( y = 32x + 12 \)  
D) \( y = 4x + 32 \)

29) \( f(x) = \frac{18}{x} ; x = 3 \)

A) \( y = -2x \)  
B) \( y = -4x + 18 \)  
C) \( y = -2x + 12 \)  
D) \( y = -2x + 6 \)

30) \( f(x) = x^2 + 3 ; x = -2 \)

A) \( y = -4x - 2 \)  
B) \( y = -4x - 5 \)  
C) \( y = -2x - 1 \)  
D) \( y = -4x - 1 \)

Find the \( x \)-values where the function does not have a derivative.

31)  

A) \( x = 1 \)  
B) \( x = 2 \)  
C) \( x = 0 \)  
D) \( x = -1 \)

32)  

A) \( x = 2 \)  
C) \( x = -2, x = 2 \)  
B) \( x = -2, x = 0, x = 2 \)  
D) \( x = 0 \)

33)  

A) \( x = 1, x = 3 \)  
C) \( x = 1, x = 2, x = 3 \)  
B) \( x = 2 \)  
D) Exists at all points
34) 
A) $x = -1, x = 1$
B) $x = 0$
C) $x = -1, x = 0, x = 1$
D) Exists at all points

35) 
A) $x = 3$
B) $x = 0$
C) $x = 0, x = 3$
D) Exists at all points

The graphs of a function $f(x)$ and its derivative $f'(x)$ are shown below. Decide which is the graph of $f(x)$ and which is the graph of $f'(x)$.

36) 
A) Either graph could be the derivative of the other.
B) $f(x)$ is the solid line; $f'(x)$ is the dashed line.
C) Neither graph could be the derivative of the other.
D) $f(x)$ is the dashed line; $f'(x)$ is the solid line.
A) Neither graph could be the derivative of the other.
B) f(x) is the solid line; f'(x) is the dashed line.
C) f(x) is the dashed line; f'(x) is the solid line.
D) Either graph could be the derivative of the other.
Sketch the derivative of the graph.

38)
Use the formula \( f'(x) = \lim_{z \to x} \frac{f(z) - f(x)}{z - x} \) to find the derivative of the function.

41) \( f(x) = \frac{3}{x+2} \)
A) \(-\frac{3}{(x+2)}\)  B) \(-\frac{3}{(x+2)^2}\)  C) \(-\frac{3}{x^2}\)  D) \(\frac{3}{(x+2)^2}\)

42) \( f(x) = 2x^2 - 3x + 5 \)
A) \(4x^2 - 3x\)  B) \(4x\)  C) \(2x - 3\)  D) \(4x - 3\)
43) \( g(x) = \frac{x}{x + 4} \)

A) \(-\frac{4}{(x + 4)^2}\)  B) \(\frac{4}{(x + 4)^2}\)  C) \(\frac{x}{(x + 4)^2}\)  D) \(\frac{x^2}{x + 4}\)

44) \( g(x) = 3x + \sqrt{x} \)

A) \(\frac{1}{2\sqrt{x}}\)  B) \(3 + \frac{1}{\sqrt{x}}\)  C) \(3 + \frac{1}{2\sqrt{x}}\)  D) \(3 - \frac{1}{2\sqrt{x}}\)
1) D
2) C
3) D
4) D
5) C
6) D
7) D
8) C
9) A
10) A
11) B
12) D
13) B
14) B
15) B
16) C
17) B
18) C
19) B
20) B
21) B
22) D
23) A
24) C
25) C
26) D
27) B
28) A
29) C
30) D
31) C
32) D
33) D
34) B
35) C
36) B
37) C
38) B
39) A
40) C
41) B
42) D
43) B
44) C