Ch. 2 The Derivative

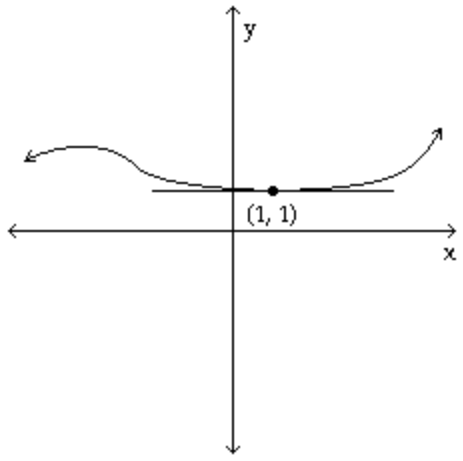
2.1 Two Problems with One Theme

1 Estimate Slope of Tangent Line at a Point

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

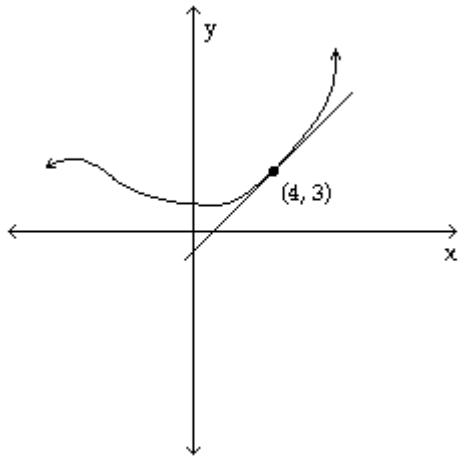
Estimate the slope of the tangent line to the curve at the indicated point.

1)



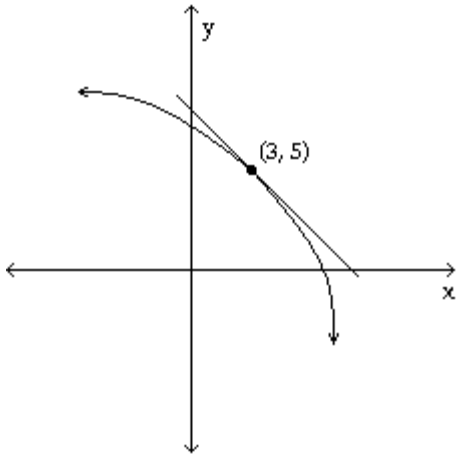
A) 0 B) 1 C) –1 D) Undefined

2)



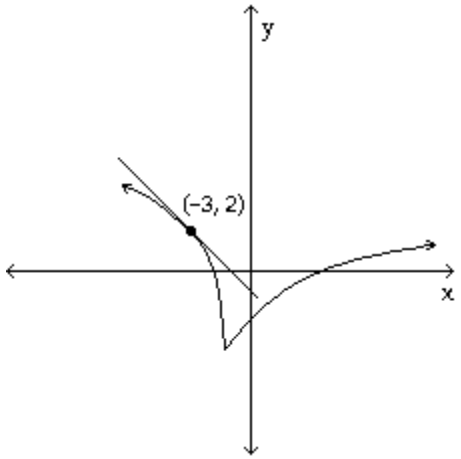
A) 1 B) –1 C) 0 D) Undefined

3)



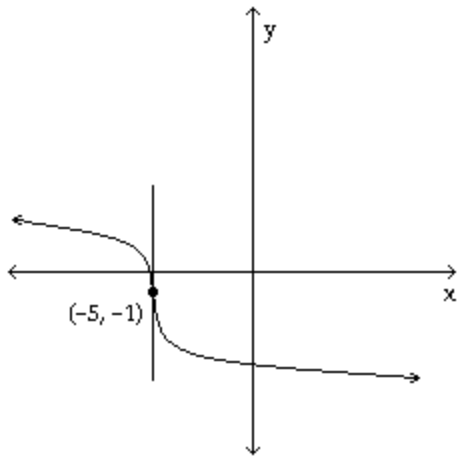
A) –1 B) 1 C) 0 D) Undefined

4)



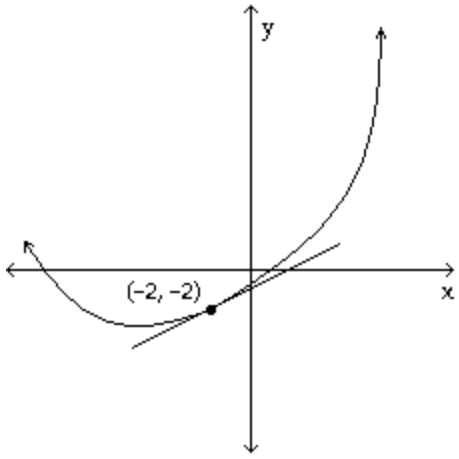
A) –1 B) 1 C) 0 D) Undefined

5)



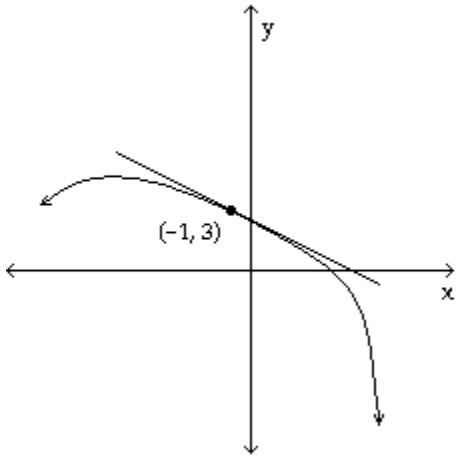
A) Undefined B) –1 C) 1 D) 0

6)



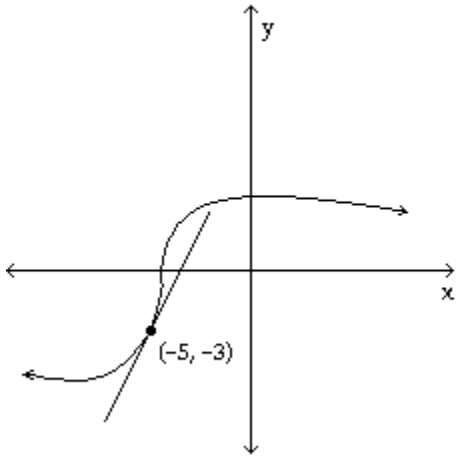
A) $\frac{1}{2}$ B) 2 C) $-\frac{1}{2}$ D) –2

7)



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

8)



A) 2 B) $-\frac{1}{20}$ C) $\frac{1}{20}$ D) –2

2 Find Slope of Tangent by Finding Limit of Slopes of Secant Lines

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

Find the slope of a line tangent to the given curve at the point P by finding the limit of the slopes of the secant lines PQ as Q approaches P.

1) $y = 5x^2 - 5$; P is (3, 40); let Q have x–values of 2.5, 2.9, 2.99, 2.999

A) Slopes: 27.5, 29.5, 29.95, 29.995
m = 30

B) Slopes: 22.5, 24.5, 24.95, 24.995
m = 25

C) Slopes: 12.5, 14.5, 14.95, 14.995
m = 15

D) Slopes: 7.5, 9.5, 9.95, 9.995
m = 10

2) $y = 9x - 8x^2$; P is (4, –92); let Q have x–values of 3.5, 3.9, 3.99, 3.999

A) Slopes: –51, –54.2, –54.92, –54.992
m = –55

B) Slopes: –24, –27.2, –27.92, –27.992
m = –28

C) Slopes: –24, –27.2, –27.92, –27.992
m = –23

D) Slopes: –60, –63.2, –63.92, –63.992
m = –64

3) $y = x^3 - 3x$; P is (–3, –18); let Q have x–values of –2.5, –2.9, –2.99, –2.999

A) Slopes: 19.75, 23.11, 23.9101, 23.991001
m = 24

B) Slopes: 22.75, 26.11, 26.9101, 26.991001
m = 27

C) Slopes: 1.75, 5.11, 5.9101, 5.991001
m = 6

D) Slopes: 10.75, 14.11, 14.9101, 14.991001
m = 15

3 Find Slope of Tangent Line at a Point

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

Find the slope of the line tangent to the curve at x.

1) $y = -7x^2 + 5x$; $x = 11$

A) –149 B) –99 C) –124 D) –363

2) $y = -\frac{8}{x}$; $x = 7$

A) $\frac{8}{49}$ B) $\frac{49}{8}$ C) $\frac{8}{7}$ D) $\frac{7}{8}$

3) $y = \sqrt{x}$; $x = 9$

A) $\frac{1}{6}$ B) $\frac{1}{3}$ C) 3 D) 9

4) $y = -3x^3 + 3x^2 - 4x + 4$; $x = -3$

A) –103 B) –99 C) –95 D) 124

5) $y = \frac{6}{x+2}$; $x = 3$

A) $-\frac{6}{25}$ B) $\frac{6}{25}$ C) 6 D) $-\frac{12}{25}$

4 Find Equation of Tangent Line at a Point

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

Find an equation for the line tangent to the given curve at the indicated point.

1) $y = x^2 - 4$ at $(-2, 0)$

A) $y = -4x - 8$ B) $y = -2x - 8$ C) $y = -4x - 12$ D) $y = -4x - 16$

2) $y = x^2 + 4$ at $(4, 20)$

A) $y = 8x - 12$ B) $y = 4x - 12$ C) $y = 8x - 28$ D) $y = 8x - 24$

3) $y = x^2 - x$ at $(-3, 12)$

A) $y = -7x - 9$ B) $y = -7x - 6$ C) $y = -7x + 9$ D) $y = -7x + 6$

4) $y = x^3 - 9x + 2$ at $(3, 2)$

A) $y = 18x - 52$ B) $y = 18x + 2$ C) $y = 20x - 52$ D) $y = 2$

5) $y = 6\sqrt{x} - x + 9$ at $(36, 9)$

A) $y = -\frac{1}{2}x + 27$ B) $y = \frac{1}{2}x - 27$ C) $y = -\frac{1}{2}x + 9$ D) $y = 9$

6) $y = \frac{10x}{x^2 + 1}$ at $(1, 5)$

A) $y = 5$ B) $y = x + 5$ C) $y = 5x$ D) $y = 0$

7) $y = \frac{36}{x^2 + 2}$ at $(1, 12)$

A) $y = -8x + 20$ B) $y = -8$ C) $y = 8x + 4$ D) $y = -4x + 16$

5 Calculate Instantaneous Velocity

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

Calculate the instantaneous velocity for the given value of t of an object moving with rectilinear motion according to the given function relating s (in feet) and t (in seconds).

1) $s = t^2 + 3t;\ t = 2$

A) 7 ft/s B) −4 ft/s C) 4 ft/s D) 6 ft/s

2) $s = 3t + 8;\ t = 2$

A) 3 ft/s B) 6 ft/s C) −6 ft/s D) 14 ft/s

3) $s = -7t^2 - t;\ t = -5$

A) 69 ft/s B) 70 ft/s C) 65 ft/s D) −65 ft/s

4) $s(t) = 3t^2 - 7t + 1;\ t = 4$

A) 17 ft/s B) −17 ft/s C) 7 ft/s D) −7 ft/s

5) $s = t^3 + t^2 - 3t - 7;\ t = -2$

A) 5 ft/s B) 8 ft/s C) 3 ft/s D) –3 ft/s

6) $s = 5t^3 - 4t^2 + 14;\ t = 2$

A) 44 ft/s B) 14 ft/s C) –14 ft/s D) 52 ft/s

7) $s = \frac{1}{t + 4};\ t = 4$

A) $-\frac{1}{64}$ ft/s B) $\frac{1}{64}$ ft/s C) $-\frac{1}{256}$ ft/s D) $\frac{1}{256}$ ft/s

6 Find Expression for Instantaneous Acceleration

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

Use the definition to find an expression for the instantaneous acceleration of an object moving with rectilinear motion according to the given function. The instantaneous acceleration is defined as the instantaneous rate of change of the velocity with respect to time.

1) $v = 3t^2 + 9t + 5$
[v is the velocity]

A) $6t + 9$ B) $3t^2 + 9$ C) $6t^2 + 9t$ D) $3t + 9$

2) $v = 4t + 7t^3$
[v is the velocity]

A) $4 + 21t^2$ B) $4t + 21t^2$ C) $4 + 7t^2$ D) $4t + 21t^3$

3) $v = 3t^4 + 8t^3 + 1$
[v is the velocity]

A) $12t^3 + 24t^2$ B) $3t^3 + 8t^2$ C) $12t^3 + 24t^2 + 1$ D) $3t^3 + 8t^2 + 1$

4) $v = 2\sqrt{7t - 3}$
[v is the velocity]

A) $\frac{7}{\sqrt{7t - 3}}$ B) $\frac{1}{\sqrt{7t - 3}}$ C) $7\sqrt{7t - 3}$ D) $\frac{7}{(7t - 3)^{3/2}}$

5) $s = 9t^2 + 6t - 8$
[s is the displacement. Find v, then find a]

A) 18 B) 9 C) $18t + 6$ D) 0

6) $s = 4t^4 - 2t^2 + 6$
[s is the displacement. Find v, then find a]

A) $48t^2 - 4$ B) $16t^2 - 4$ C) $48t^2 - 4t$ D) $16t^3 - 4t$

7) $s = 7t^3 - 4t^2 + 6$
[s is the displacement. Find v, then find a]

A) $42t - 8$ B) $28t - 8$ C) $8t - 42$ D) $8t - 28$

8) $s = t^2 + \frac{9}{t^2}$

[s is the displacement. Find v, then find a]

A) $2 + \frac{54}{t^4}$ B) $2t - \frac{18}{t^3}$ C) $2 - \frac{54}{t^4}$ D) $1 + \frac{54}{t^4}$

7 Tech: Find Slope of Tangent Line

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

The function s gives the displacement (in feet) of an object as a function of time (in seconds). Calculate values of the average velocity for the given values of t and find the instantaneous velocity at the indicated value of t by noting the limit of the average velocities.

1) $s = 7t - 7$; when $t = 4$;
use values of t of 3.5, 3.9, 3.99, 3.999

A) Average velocities: 7, 7, 7, 7
$\lim_{t \to 4} v = 7$ ft/s

B) Average velocities: 6.5, 6.9, 6.99, 6.999
$\lim_{t \to 4} v = 7$ ft/s

C) Average velocities: 28, 28, 28, 28
$\lim_{t \to 4} v = 28$ ft/s

D) Average velocities: 27.5, 27.9, 27.99, 27.999
$\lim_{t \to 4} v = 28$ ft/s

2) $s = 7t^2 - 8$; when $t = 6$;
use values of t of 5.5, 5.9, 5.99, 5.999

A) Average velocities: 80.5, 83.3, 83.93, 83.993
$\lim_{t \to 6} v = 84$ ft/s

B) Average velocities: 38.5, 41.3, 41.93, 41.993
$\lim_{t \to 6} v = 42$ ft/s

C) Average velocities: 83.5, 83.9, 83.99, 83.999
$\lim_{t \to 6} v = 84$ ft/s

D) Average velocities: 29.5, 29.9, 29.99, 29.999
$\lim_{t \to 5} v = 30$ ft/s

3) $s = 80t - 17t^2$; when $t = 0.5$;
use values of t of 0.45, 0.49, 0.499, 0.4999

A) Average velocities: 63.85, 63.17, 63.017, 63.0017
$\lim_{t \to 0.5} v = 63$ ft/s

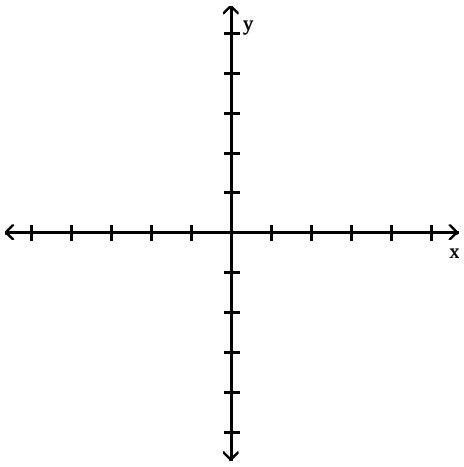
B) Average velocities: 23.85, 23.17, 23.017, 23.0017
$\lim_{t \to 0.5} v = 23$ ft/s

C) Average velocities: 46.85, 46.17, 46.017, 46.0017
$\lim_{t \to 0.5} v = 46$ ft/s

D) Average velocities: 6.85, 6.17, 6.017, 6.0017
$\lim_{t \to 0.5} v = 6$ ft/s

Draw the graph of the equation. Then find the slope of the tangent line at the value of x.

4) $y = f(x) = 2x^3 - 3x^2 + 1$ at –1, 0, 1, and 2.5



A) 12, 0, 0, 22.5 B) 0, 1, 12, 52.5 C) 6, 0, 0, 37.5 D) 12, 1, 6, 15

2.2 The Derivative

1 Evaluate Derivative at a Point

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

Use the definition $f'(c) = \lim_{h \to 0} \frac{f(c+h) - f(c)}{h}$ to find the derivative.

1) $f'(10)$ if $f(x) = 11x^2 + 9x$

A) 229 B) 310 C) 269.5 D) –300

2) $f'(-2)$ if $f(x) = -\frac{3}{x}$

A) $\frac{3}{4}$ B) $\frac{4}{3}$ C) $\frac{3}{2}$ D) $\frac{2}{3}$

3) $f'(49)$ if $f(x) = \sqrt{x}$

A) $\frac{1}{14}$ B) $\frac{1}{7}$ C) 7 D) 49

4) $f'(3)$ if $f(x) = 2 - 3x^2$

A) –18 B) 18 C) –16 D) 20

5) $f'(2)$ if $f(x) = x^3 + 3$

A) 12 B) 15 C) –12 D) 13

6) $f'(2)$ if $f(x) = -2 - x^2$

A) –4 B) 4 C) 2 D) –2

7) f'(2) if $f(x) = \frac{3}{x+2}$

A) $-\frac{3}{16}$ B) $\frac{3}{16}$ C) 3 D) $-\frac{3}{8}$

2 Find Derivative I

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

Use the definition $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ to find the derivative at x.

1) $f(x) = 21x - 3$

A) 21 B) 18 C) –21 D) 21x

2) $f(x) = 18 - 3x$

A) – 3 B) 15 C) 18 – 3x D) – 3x

3) $f(x) = x^2 + 5$

A) 2x B) $2x^2$ C) 2x + 5 D) x + 5

4) $f(x) = 4x^2 - 3$

A) 8x B) 4x C) $8x^2 - 3$ D) 8x – 3

5) $f(x) = 2x^2 + 4x$

A) 4x + 4 B) 4x C) $4x^2 + 4x$ D) 2x + 4

6) $f(x) = 8 - 4x^2$

A) –8x B) 8 – 8x C) 8 – 4x D) $-8x^2$

7) $f(x) = 5x^2 + 3x - 1$

A) 10x + 3 B) $5x^2 + 3$ C) $10x^2 + 3x$ D) 5x + 3

8) $f(x) = x^3 + 22x - 25$

A) $3x^2 + 22$ B) $3x^2 + 22x$ C) $3x^3 + 22$ D) $3x^2 + 22x - 25$

9) $f(x) = 4x + 4x^3$

A) $4 + 12x^2$ B) $4x + 12x^2$ C) $4 + 4x^2$ D) $4x + 12x^3$

10) $f(x) = 2 - 7x^3$

A) $-21x^2$ B) $2 - 21x^2$ C) –21x D) $2- 7x^2$

3 Find Derivative II

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

Use the definition $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ to find the derivative at x.

1) $f(x) = 3x^4 - 9x^3 + 4$

A) $12x^3 - 27x^2$ B) $3x^3 - 9x^2$ C) $12x^3 - 27x^2 + 4$ D) $3x^3 - 9x^2 + 4$

2) $f(x) = \frac{1}{4}x^4 + \frac{1}{3}x^3 - 8$

A) $x^3 + x^2$ B) $x^3 + x^2 - 8$ C) $\frac{1}{4}x^3 + \frac{1}{3}x^2 - 8$ D) $x^4 + x^3$

3) $f(x) = x^5 + 3x^3 + x^2 + 5$

A) $5x^4 + 9x^2 + 2x$ B) $5x^4 + 9x^2 + 2x + 5$

C) $x^4 + 3x^2 + x$ D) $5x^5 + 9x^3 + 2x^2 + 5$

4) $f(x) = \frac{8}{x + 9}$

A) $\frac{-8}{(x + 9)^2}$ B) $-\frac{8}{x^2}$ C) $\frac{8}{(x + 9)^2}$ D) $\frac{-8}{(x + 9)}$

5) $f(x) = \frac{x}{x + 4}$

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

6) $f(x) = \frac{2}{7x - 1}$

A) $-\frac{14}{(7x - 1)^2}$ B) $-\frac{2}{(7x - 1)^2}$ C) $-\frac{14}{7x - 1}$ D) $\frac{14}{(7x - 1)^2}$

7) $f(x) = x^4 + \frac{9}{x^2}$

A) $4x^3 - \frac{18}{x^3}$ B) $x^3 - \frac{9}{x^3}$ C) $4x^3 + \frac{18}{x^3}$ D) $4x^4 - \frac{18}{x^2}$

8) $f(x) = \frac{1}{2x} + \frac{1}{x^2}$

A) $-\frac{1}{2x^2} - \frac{2}{x^3}$ B) $-\frac{2}{x^2} - \frac{2}{x^3}$ C) $-\frac{1}{2x^2} + \frac{2}{x^3}$ D) $\frac{1}{2x^2} - \frac{1}{x^3}$

9) $f(x) = \frac{2}{x^2 + 4}$

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

10) $f(x) = 8x - \frac{7}{x}$

A) $8 + \frac{7}{x^2}$ B) $8 - \frac{7}{x^2}$ C) $8x + \frac{7}{x^2}$ D) $8 - \frac{7}{x}$

11) $f(x) = \sqrt{x^4 - 2x + 9}$

A) $\frac{4x^3 - 2}{2\sqrt{x^4 - 2x + 9}}$ B) $\sqrt{4x^3 - 2}$

C) $\frac{1}{2\sqrt{x^4 - 2x + 9}}$ D) $\sqrt{x^4 - 2x + 9}\,(4x^3 - 2)$

4 Use Definition of Derivative To Find Function

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

The given limit is a derivative, but of what function and at what point?

1) $\lim_{h \to 0} - \frac{8(2 + h)^3 - 8(2)^3}{h}$

A) $f(x) = 8x^3$ at $x = 2$ B) $f(x) = 2x^3$ at $x = 8$ C) $f(x) = 8x^3$ at $x = -2$ D) $f(x) = 2x^3$ at $x = -8$

2) $\lim_{x \to 8} \frac{x^2 - 64}{x - 8}$

A) $f(x) = x^2$ at $x = 8$ B) $f(x) = 2x$ at $x = 8$ C) $f(x) = x^2$ at $x = -8$ D) $f(x) = x^2$ at $x = 64$

3) $\lim_{x \to v} \frac{\frac{5}{x} - \frac{5}{v}}{x - v}$

A) $f(x) = \frac{5}{x}$ at $x = v$ B) $f(x) = \frac{5}{x}$ at $x = -v$ C) $f(x) = \frac{x}{5}$ at $x = v$ D) $f(x) = \frac{5}{x}$ at $x = 5$

4) $\lim_{r \to x} \frac{r^2 - x^2}{r - x}$

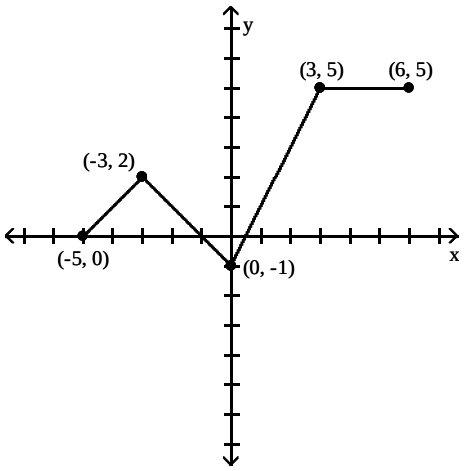
A) $f(r) = r^2$, at $r = x$ B) $f(r) = 2r^2$, at $r = x$ C) $f(r) = 2r$, at $r = x$ D) $f(r) = 2r$, at $r = -x$

5 Graph Derivative Given Graph of Function

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

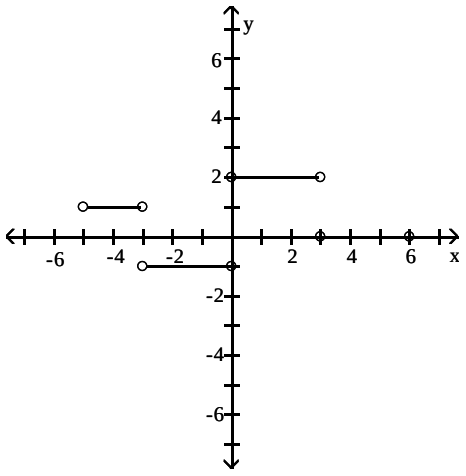
Solve the problem.

1) The graph of y = f(x) in the accompanying figure is made of line segments joined end to end. Graph the derivative of f.

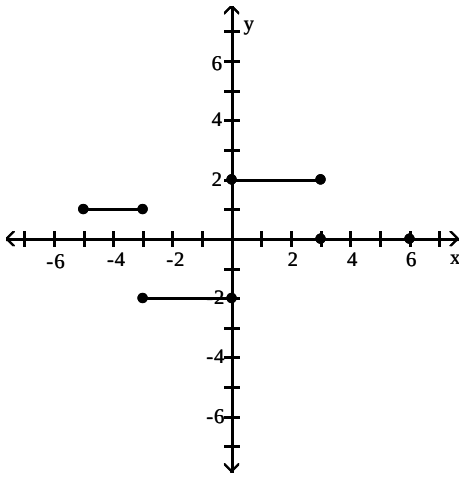


A)

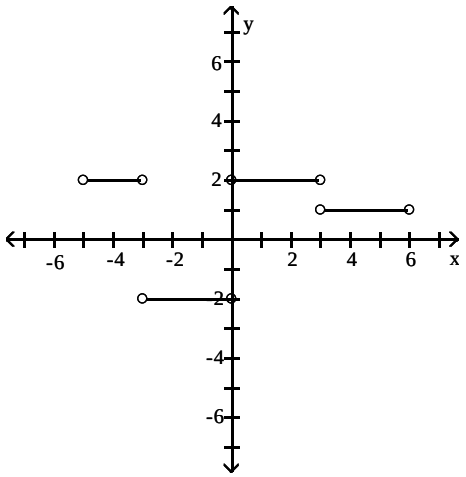
B)

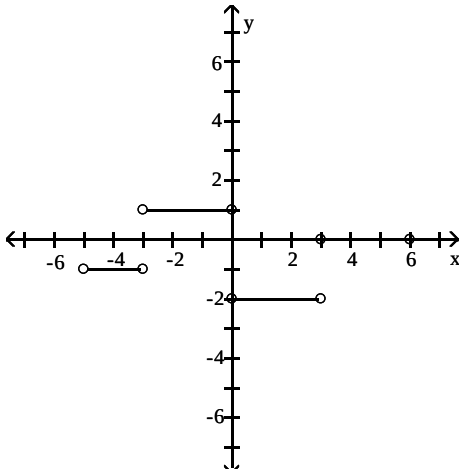


C)

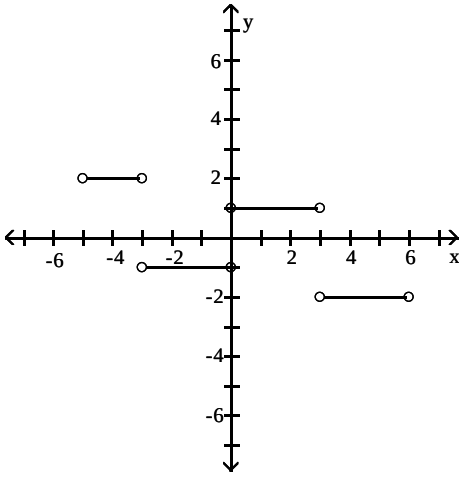


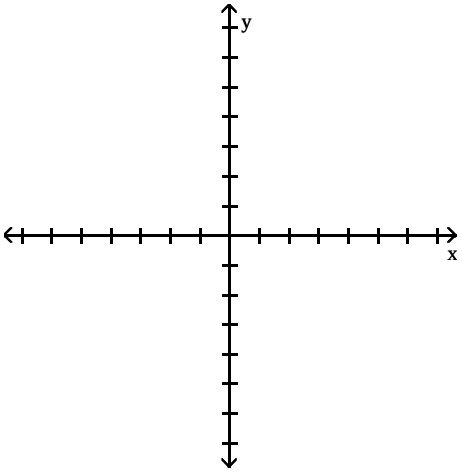
D)





2) Use the following information to graph the function f over the closed interval [−5, 6].
   i) The graph of f is made of closed line segments joined end to end.
   ii) The graph starts at the point (−5, 1).
   iii) The derivative of f is the step function in the figure shown here.





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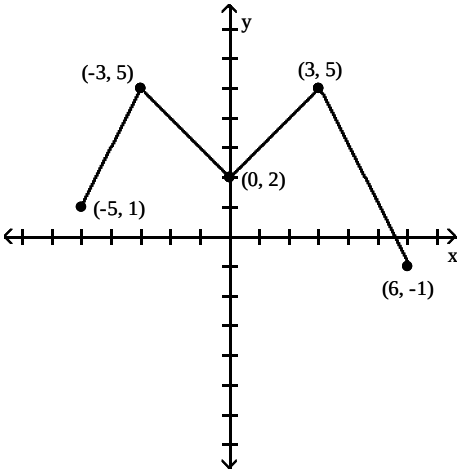

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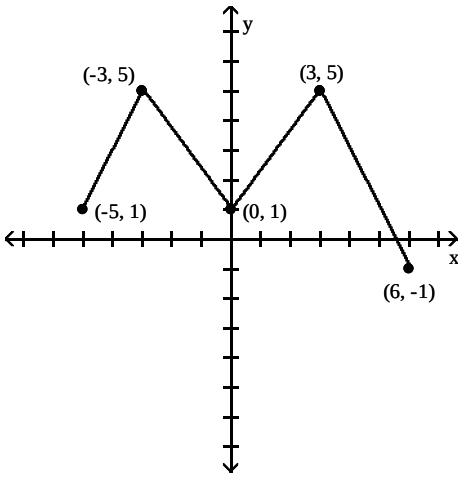

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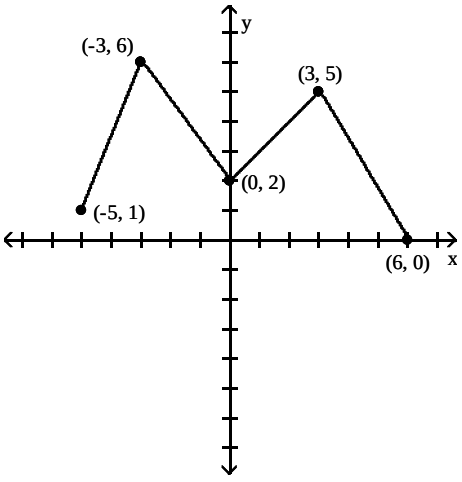

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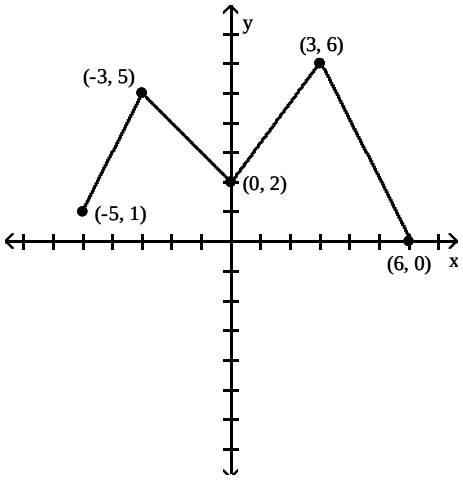
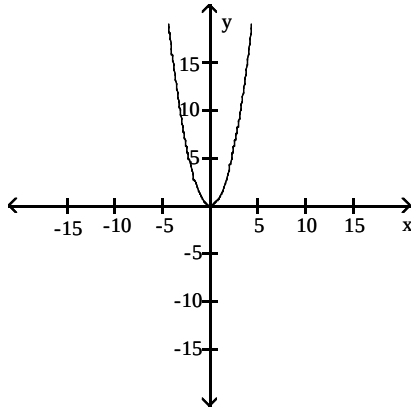


The graph of a function is given. Choose the answer that represents the graph of its derivative.

3)



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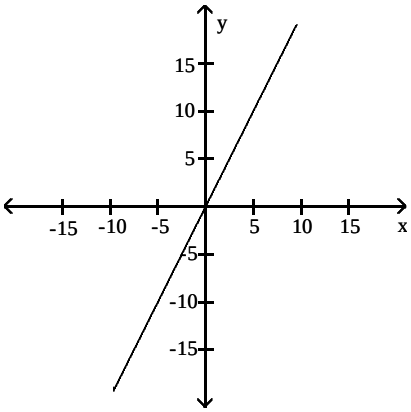

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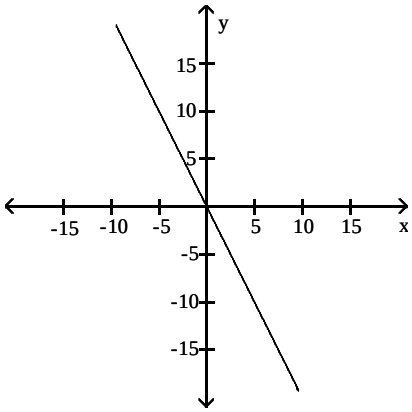

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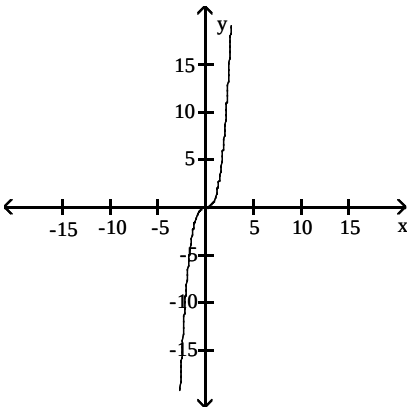

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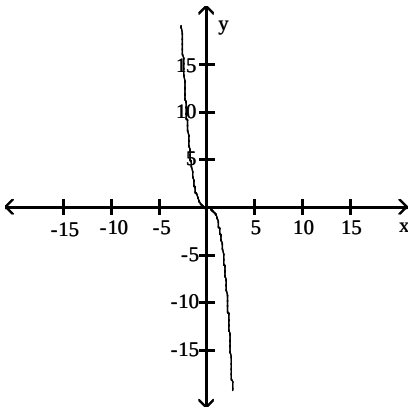

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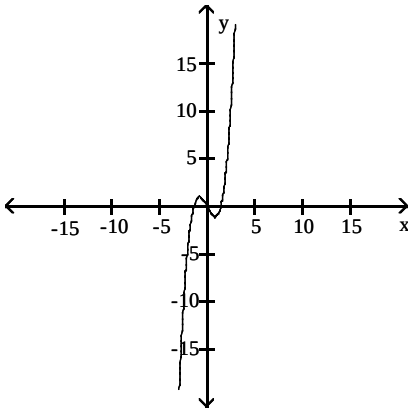

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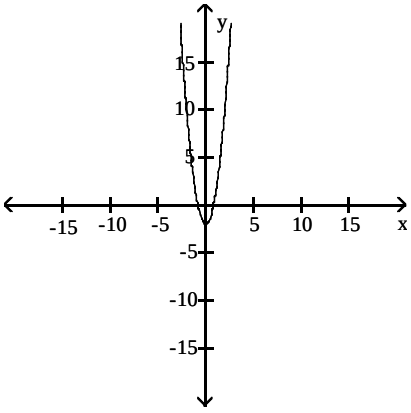

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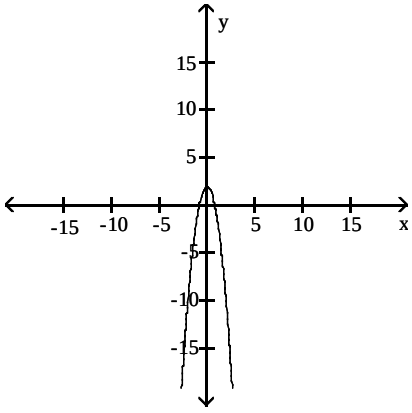

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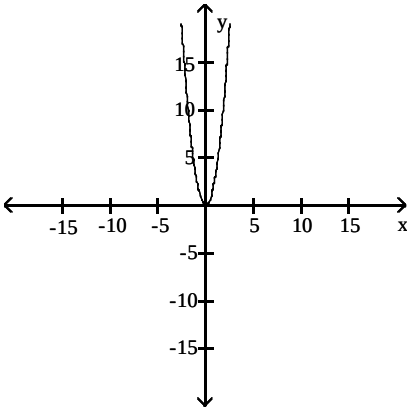

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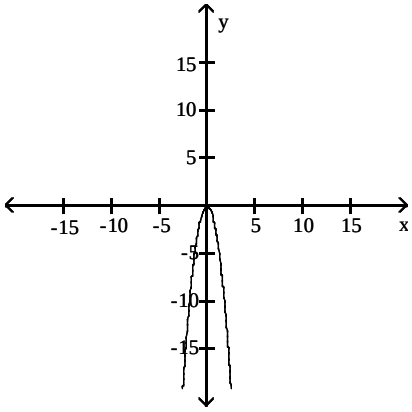

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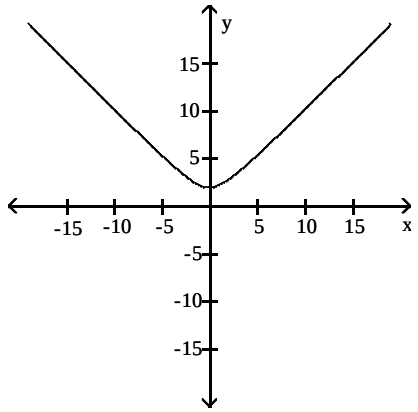

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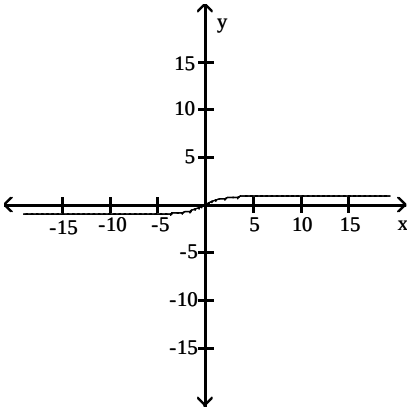

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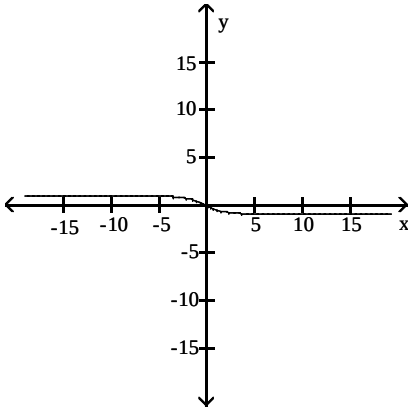

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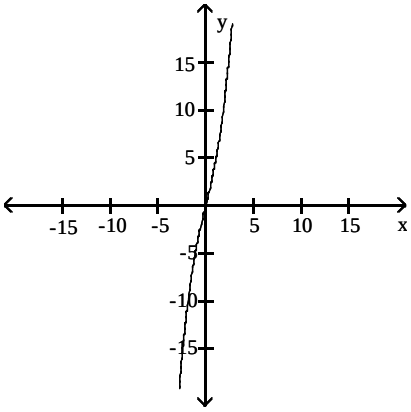

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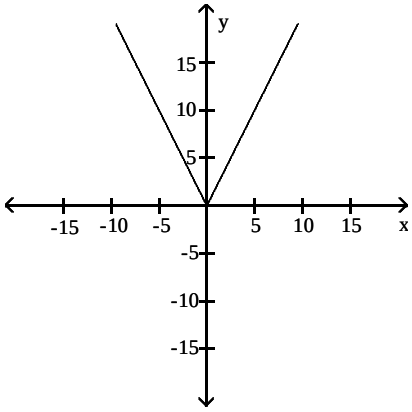

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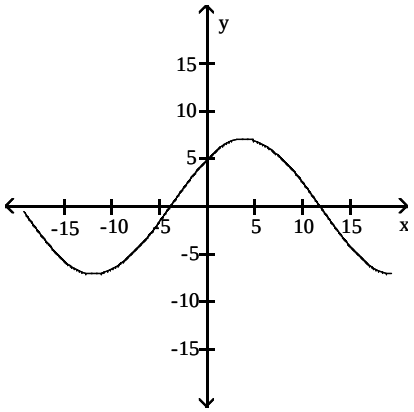

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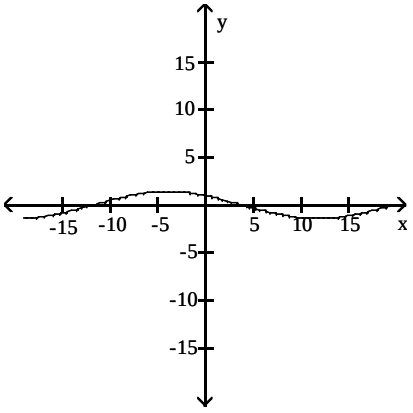

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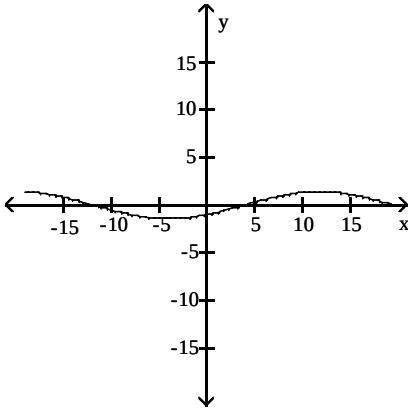

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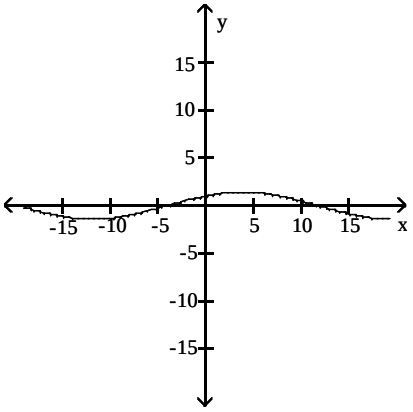

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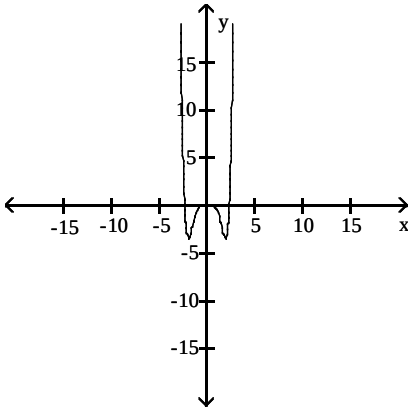

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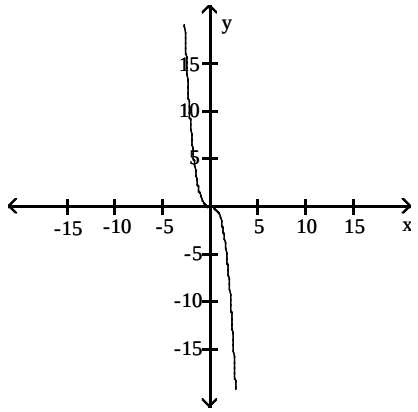

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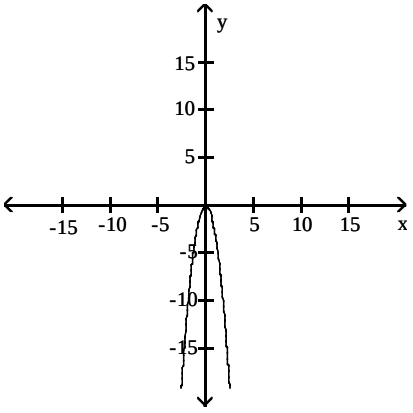

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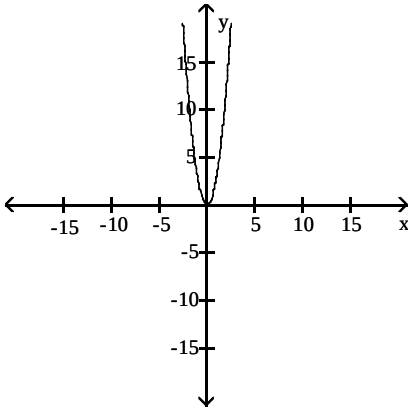

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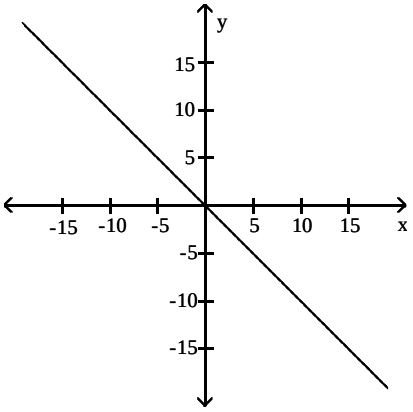

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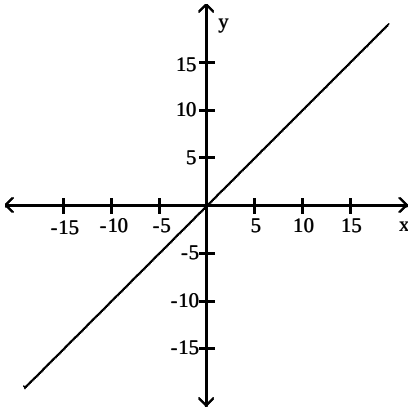

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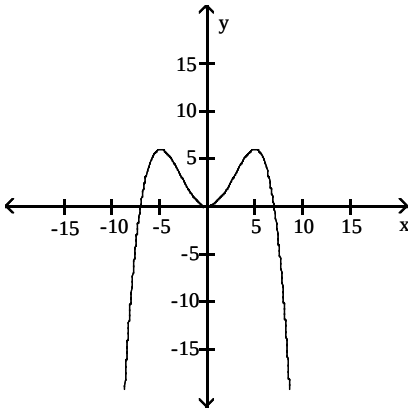

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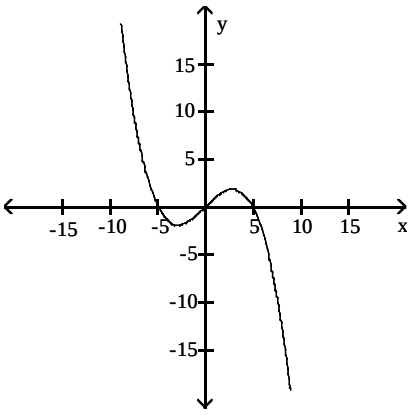

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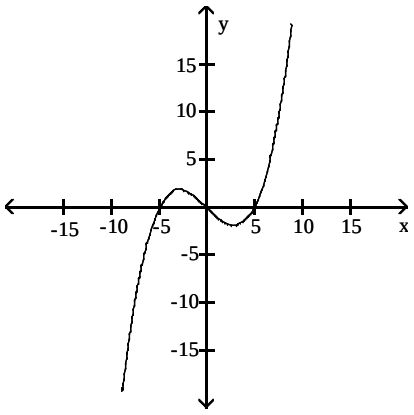

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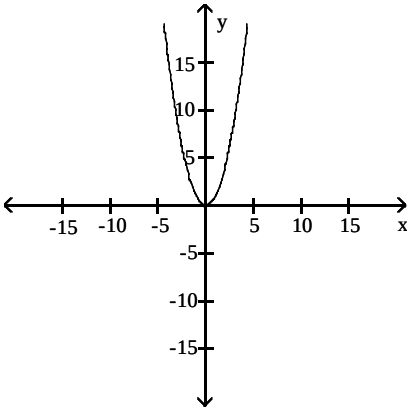

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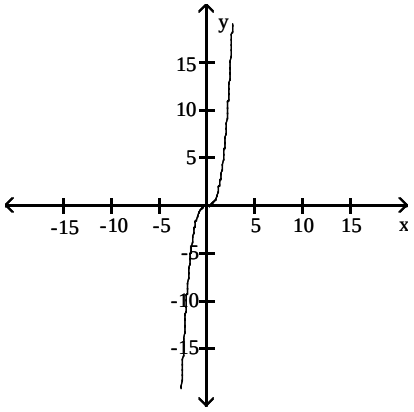


6 Find Delta y

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

Find $\triangle y$ for the given values of x_1 and x_2.

1) $y = 4x + 3;\ x_1 = 4.5, x_2 = 4$

A) –2 B) 2 C) –8 D) 4

2) $y = 4x^2 + 3x + 1;\ x_1 = 0.0, x_2 = 0.8$

A) 4.96 B) 5.96 C) 3.96 D) –4.96

3) $y = \frac{1}{2x}$; $x_1 = 1.0$, $x_2 = 1.6$

A) –0.1875 B) –0.0208 C) 0.1875 D) –0.375

4) $y = \frac{4}{x + 1}$; $x_1 = 1.0$, $x_2 = 3$

A) –1 B) 0 C) 1 D) –3

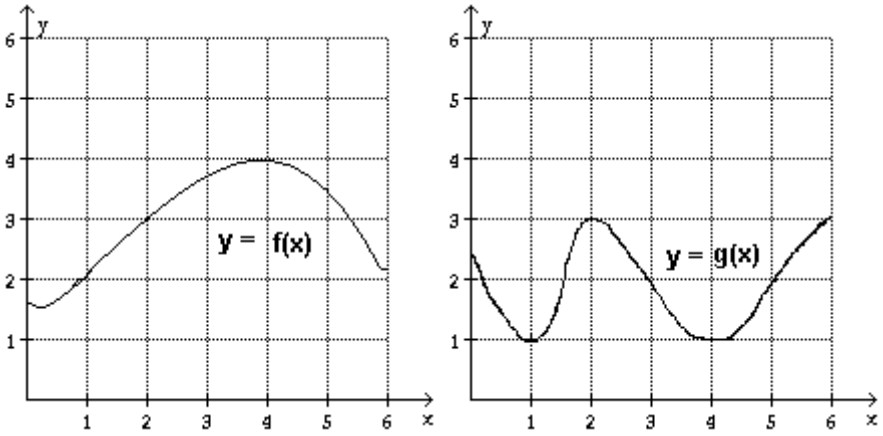
5) $y = \cos 3x$; $x_1 = 0.664$, $x_2 = 0.666$

A) –0.0055 B) 0.0055 C) –0.0012 D) 0.0012

7 Estimate Derivative at a Point

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

Use the figures below to approximate the indicated derivative.



1) f'(2)

A) 1 B) 2 C) 0 D) 3

2) g'(2)

A) 0 B) 2 C) 1 D) 3

3) g'(3)

A) –1 B) 2 C) 0 D) 1

4) g'(4)

A) 0 B) 2 C) 1 D) 4

5) f'(5)

A) –1 B) 3.5 C) 1 D) 2

6) f'(1)

A) 1 B) 2 C) 0 D) –1

7) f'(4)

A) 0 B) 4 C) 1 D) –1

8) g'(5)

A) 1 B) 2 C) 3.5 D) –1

8 *Know Concepts: The Derivative

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) What is the range of values of the slope of the curve $y = x^3 + 5x - 2$?

2) Over what intervals of x–values, if any, does the function $y = 2x^2$ increase as x increases? For what values of x, if any, is y' positive? How are your answers related?

3) Over what intervals of x–values, if any, does the function $y = \frac{x^5}{5}$ decrease as x increases? For what values of x, if any, is y' negative? How are your answers related?

4) Does the curve $y = \sqrt{x}$ ever have a negative slope? If so, where? Give reasons for your answer.

5) Does the curve $y = (x + 3)^3$ have any horizontal tangents? If so, where? Give reasons for your answer.

6) Does the curve $y = x^3 + 4x - 10$ have a tangent whose slope is –2? If so, find an equation for the line and the point of tangency. If not, why not?

7) Can a tangent line to a graph intersect the graph at more than one point? If not, why not. If so, give an example.

8) If g(x) = 2f(x) + 3, find g'(4) given that f'(4) = 5.

9) If g(x) = – f(x) – 3, find g'(4) given that f'(4) = 5.

10) Is there any difference between finding the derivative of f(x) at x = a and finding the slope of the line tangent to f(x) at x = a? Explain.

2.3 Rules for Finding Derivatives

1 Find Derivative Using Power/Sum/Difference Rules

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

Find $D_x y$.

1) $y = x^{14}$

A) $14x^{13}$ B) $14x^{14}$ C) $13x^{13}$ D) $13x^{14}$

2) $y = -6x^5$

A) $-30x^4$ B) $-6x^4$ C) $-30x^5$ D) $-30x^6$

3) $y = 2x^2 + 8x - 9$

A) $4x + 8$ B) $2x^2 + 8$ C) $4x^2 + 8x - 9$ D) $2x + 8$

4) $y = x^8 + e^8$

A) $8x^7$ B) $8x^7 + 8e^7$ C) $8x^8 + 8e^8$ D) $8x^9$

5) $y = x + \pi^7$

A) 1 B) $1 + 7\pi^6$ C) $x + 7\pi^6$ D) $1 + 7\pi^8$

6) $y = 3x^4 - 4x^3 + 8$

A) $12x^3 - 12x^2$ B) $3x^3 - 4x^2$ C) $12x^3 - 12x^2 + 8$ D) $12x^4 - 12x^3 + 8$

7) $y = -3x^4 - 3x - 9$

A) $-12x^3 - 3$ B) $-3x^3 - 3$ C) $-12x^3 - 3x - 9$ D) $-3x^3 - 3x - 9$

8) $y = 5x^2 - 2.1x$

A) $10x - 2.1$ B) $5x - 2.1$ C) $10x^2 - 2.1x$ D) $5x^2 - 2.1$

9) $y = x^8 - 6x^7 - 8x^6 + x$

A) $8x^7 - 42x^6 - 48x^5 + 1$ B) $x^7 - 6x^6 - 8x^5 + 1$

C) $8x^8 - 42x^7 - 48x^6 + x$ D) $8x^9 - 42x^8 - 48x^7$

10) $y = \frac{1}{2}x^{10} - \frac{1}{3}x^3$

A) $5x^9 - x^2$ B) $\frac{1}{2}x^9 - \frac{1}{3}x^2$ C) $5x^{10} - x^3$ D) $5x^{11} - x^4$

2 Find Derivative of Product

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

Find $D_x y$.

1) $y = (6x - 4)(6x + 1)$

A) $72x - 18$ B) $36x - 18$ C) $72x - 9$ D) $72x - 30$

2) $y = 8x(6x^4 - 5x)$

A) $240x^4 - 80x$ B) $192x^4 - 80x$ C) $240x^4 - 40x$ D) $192x^4 - 40x$

3) $y = (1 - 3x^2)(3x^2 - 36)$

A) $-36x^3 + 222x$ B) $-36x^4 + 222x^2$ C) $-36x^3 + 222$ D) $9x^3 + 111x$

4) $y = (2x - 3)(5 - 7x^3)$

A) $-56x^3 + 63x^2 + 10$ B) $-56x^4 + 63x^3 + 10x$

C) $-14x^3 + 21x^2 + 10$ D) $-56x^3 + 63x^2 + 10x - 15$

5) $y = (2x - 5)(5x^3 - x^2 + 1)$

A) $40x^3 - 81x^2 + 10x + 2$ B) $10x^3 + 27x^2 - 81x + 2$

C) $40x^3 - 27x^2 + 81x + 2$ D) $30x^3 + 81x^2 - 27x + 2$

6) $y = (x^2 - 5x + 2)(4x^3 - x^2 + 5)$

A) $20x^4 - 84x^3 + 39x^2 + 6x - 25$ B) $4x^4 - 84x^3 + 39x^2 + 6x - 25$

C) $20x^4 - 80x^3 + 39x^2 + 6x - 25$ D) $4x^4 - 80x^3 + 39x^2 + 6x - 25$

7) $y = (5x + 4)^2$

A) $50x + 40$ B) $10x + 8$ C) $25x + 20$ D) $25x + 16$

8) $y = (2x^3 + 5)(4x^7 - 8)$

A) $80x^9 + 140x^6 - 48x^2$ B) $8x^9 + 140x^6 - 48x^2$

C) $80x^9 + 140x^6 - 48x$ D) $8x^9 + 140x^6 - 48x$

9) $y = (3x^4 + 8)^2$

A) $72x^7 + 192x^3$ B) $6x^4 + 16$ C) $9x^{16} + 64$ D) $144x^{15} + 96x^3$

3 Find Derivative of Quotient

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

Find $D_x y$.

1) $y = \dfrac{x - 3}{x + 3}$

A) $\dfrac{6}{(x + 3)^2}$ B) $\dfrac{6}{(x - 3)^2}$ C) $\dfrac{3}{(x + 3)^2}$ D) $\dfrac{2}{x + 3}$

2) $y = \dfrac{x}{6x - 4}$

A) $-\dfrac{4}{(6x - 4)^2}$ B) $\dfrac{12x - 4}{(6x - 4)^2}$ C) $-\dfrac{4}{6x - 4}$ D) $-\dfrac{4x}{(6x - 4)^2}$

3) $y = \dfrac{\pi}{7x^2 - 8}$

A) $-\dfrac{14\pi x}{(7x^2 - 8)^2}$ B) $\dfrac{7\pi x^2 - 14\pi x - 8\pi}{(7x^2 - 8)^2}$ C) $\dfrac{8\pi - 14\pi x}{(7x^2 - 8)^2}$ D) $-\dfrac{14\pi x}{7x^2 - 8}$

4) $y = \dfrac{6x + 9}{9x - 8}$

A) $-\dfrac{129}{(9x - 8)^2}$ B) $\dfrac{108x + 33}{(9x - 8)^2}$ C) $-\dfrac{129x}{(9x - 8)^2}$ D) $\dfrac{33}{9x - 8}$

5) $y = \dfrac{x^2}{3 - 5x}$

A) $\dfrac{-5x^2 + 6x}{(3 - 5x)^2}$ B) $\dfrac{5x^3 - 10x^2 + 6x}{(3 - 5x)^2}$ C) $\dfrac{-15x^2 + 6x}{(3 - 5x)^2}$ D) $\dfrac{3x}{(3 - 5x)^2}$

6) $y = \dfrac{7x - 7}{3x^2 + 3}$

A) $\dfrac{-21x^2 + 42x + 21}{(3x^2 + 3)^2}$ B) $\dfrac{-21x^2 + 21x + 42}{(3x^2 + 3)^2}$ C) $\dfrac{21x^3 - 42x^2 + 63x}{(3x^2 + 3)^2}$ D) $\dfrac{63x^2 - 42x + 21}{(3x^2 + 3)^2}$

7) $y = \dfrac{5x - 8}{x^2 - 6x + 4}$

A) $\dfrac{-5x^2 + 16x + -28}{(x^2 - 6x + 4)^2}$ B) $\dfrac{5x^3 - 40x^2 + 66x - 48}{(x^2 - 6x + 4)^2}$

C) $\dfrac{15x^2 - 76x + 68}{(x^2 - 6x + 4)^2}$ D) $\dfrac{5x^2 + 16x - 28}{x^2 - 6x + 4}$

8) $y = \dfrac{6x^2 + x - 1}{x^3 - 9x^2}$

A) $\dfrac{-6x^4 - 2x^3 + 12x^2 - 18x}{(x^3 - 9x^2)^2}$ B) $\dfrac{30x^4 - 216x^3 + 12x^2 - 18x}{(x^3 - 9x^2)^2}$

C) $\dfrac{-6x^4 - 3x^3 + 21x^2 - 18x}{(x^3 - 9x^2)^2}$ D) $\dfrac{30x^4 - 2x^3 + 12x^2 - 18x}{x^3 - 9x^2}$

4 Find Derivative Given Numerical Values

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

Solve the problem.

1) If $f(1) = 4$, $f'(1) = -7$, $g(1) = 6$, $g'(1) = -4$., find $(f \cdot g)'(1)$

A) −58 B) 26 C) 58 D) −52

2) If $f(2) = 6$, $f'(2) = 2$, $g(2) = -2$, $g'(2) = -4$, find $(f \cdot g)'(2)$

A) −28 B) −20 C) 28 D) 20

3) If $f(1) = 3$, $f'(1) = -7$, $g(1) = 6$, $g'(1) = -2$, find $(f/g)'(1)$

A) − 1 B) $-\dfrac{4}{3}$ C) − 6 D) − 9

4) If $f(2) = 7$, $f'(2) = 2$, $g(2) = -1$, $g'(2) = -5$, find $(f/g)'(2)$

A) 33 B) − 37 C) − 33 D) $\dfrac{33}{25}$

5) If f(1) = 5, f'(1) = –7, g(1) = 6, g'(1) = –2, find (g/f)'(1)

A) $\frac{32}{25}$ B) $-\frac{52}{25}$ C) $\frac{32}{5}$ D) $-\frac{32}{25}$

6) If f(2) = 9, f'(2) = 3, g(2) = –2, g'(2) = –5, find (g/f)'(2)

A) $-\frac{13}{27}$ B) $-\frac{17}{27}$ C) $-\frac{13}{3}$ D) $\frac{13}{27}$

7) If f(1) = 2, f'(1) = –6, g(1) = 7, g'(1) = –2, find (3g – f)'(1)

A) 0 B) –12 C) 19 D) 23

8) If f(2) = 10, f'(2) = 2, g(2) = –3, g'(2) = –5, find (3g – f)'(2)

A) –17 B) –13 C) –19 D) 1

9) If f(1) = 2, f'(1) = –6, g(1) = 6, g'(1) = –4, find (2f – 4g)'(1)

A) 4 B) –28 C) –20 D) 28

10) If f(2) = 7, f'(2) = 4, g(2) = –2, g'(2) = –5, find (2f – 4g)'(2)

A) 28 B) –12 C) 22 D) 6

5 Find Equation of Tangent Line at a Point

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

Find the equation of the tangent line to the equation at the point where x has the given value.

1) $y = (2x^2 + 3x + 4)(2x - 3);\ x = 0$

A) y = –1x – 12 B) y = –1x + 12 C) y = – 1x – 12 D) y = – 1x + 12

2) $y = \frac{2x^2 - 4}{-2x - 2};\ x = 0$

A) y = – 2x + 2 B) y = 2x + 2 C) y = – 2x – 2 D) y = 2x – 2

3) $y = \frac{6x}{x^2 + 1};\ x = 1$

A) y = 3 B) y = x + 3 C) y = 3x D) y = 0

4) $y = \frac{27}{x^2 + 2};\ x = 1$

A) y = –6x + 15 B) y = –6 C) y = 6x + 3 D) y = –3x + 12

6 Find Points at Which Tangent Line Has Given Slope

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

Solve the problem.

1) Find all points of the graph of $y = 5x^2 + 5x$ whose tangent lines are parallel to the line y – 55x = 0.

A) (5, 150) B) (6, 210) C) (7, 280) D) (0, 0)

2) Find all points of the graph of $y = 7x^2 + 7x$ whose tangent lines are perpendicular to the line $-49y = x$.

A) (3, 84) B) (4, 140) C) (5, 210) D) (0, 0)

3) At what points on the graph of $y = 2x^3 - 3x^2 - 34x$ is the slope of the tangent line 2?

A) (–2, 40), (3, –75) B) (–2, 40), (1, –35) C) (2, –64), (40, 21) D) (0, 0), (3, –75)

4) For what value of x is the tangent to the curve of $y = 15x - x^2$ parallel to the x–axis?

A) $x = 7.5$ B) $x = 7$ C) $x = 1$ D) $x = 14$

5) For what points on the curve of $y = 5x - x^2$ is the slope of a tangent line equal to 1?

A) (2, 6) B) (4, 12) C) (2.5, 6.25) D) (1, 4)

6) For what value of x is the slope of a line tangent to the curve of $y = 17x - x^2$ equal to the slope of a line tangent to the curve of $y = 16x - \frac{1}{2}x^2$?

A) $x = 1$ B) $x = 0$ C) $x = -1$ D) $x = 8$

7) For what point(s) on the curve of $y = -0.25x^2 + 3x$ is the slope of a tangent line equal to 1?

A) (4, 8) B) (6, 9) C) (0, 0) D) (1, 2.75)

8) For what point(s) on the curve of $y = -0.5x^2 + 19x$ is the slope of a tangent line equal to 1?

A) (18, 180) B) (9, 90) C) (0, 0) D) (1, 18.5)

9) Find the value of a if the tangent to the curve of $y = -0.5x^2 + ax$ has a slope of 1 for $x = 10$.

A) 11 B) 10 C) –10 D) –11

10) For what point(s) on the curve of $y = \frac{1}{3}x^3 - \frac{5}{2}x^2 + x$ is the slope of a tangent line equal to 1?

A) (0, 0), $\left(5, -\frac{95}{6}\right)$ B) (0, 0), $\left(5, -\frac{31}{2}\right)$ C) (1, 0), $\left(5, -\frac{95}{6}\right)$ D) $\left(5, -\frac{95}{6}\right)$

7 Solve Apps: Derivative Rules

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

Solve the problem.

1) For a motorcycle traveling at speed v (in mph) when the brakes are applied, the distance d (in feet) required to stop the motorcycle may be approximated by the formula $d = 0.050\ v^2 + v$. Find the instantaneous rate of change of distance with respect to velocity when the speed is 47 mph.

A) 5.7 f/mph B) 4.7 f/mph C) 48 f/mph D) 11.4 f/mph

2) The energy loss E (in joules/kilogram) due to friction when water flows through a pipe is given by $E = 0.020(L/D)v^2$. In the formula, L is the pipe length (in m), D is the pipe diameter (in m), and v is the water velocity (in m/s). Find a formula for the instantaneous rate of change of energy with respect to velocity.

A) $dE/dv = 0.040(L/D)v$ B) $dE/dv = 0.020(L/D)v$

C) $dE/dv = 0.040(L/D)v^2$ D) $dE/dv = (L/D)v$

3) A balloon used in surgical procedures is cylindrical in shape. As it expands outward, assume that the length remains a constant 60.0 mm. Find the rate of change of surface area with respect to radius when the radius is 0.030 mm. (Answer can be left in terms of π).

A) 120.12π mm^2/mm B) 60.12π mm^2/mm C) 120.0π mm^2/mm D) 60.06π mm^2/mm

4) A cubic salt crystal expands by accumulation on all sides. As it expands outward find the rate of change of its volume with respect to the length of an edge when the edge is 0.450 mm.

A) 0.608 mm^3/mm B) 60.80 mm^3/mm C) 0.27 mm^3/mm D) 6.08 mm^3/mm

5) For what value(s) of t is the instantaneous velocity of an object moving according to $s = 21t - 2t^2$ equal to the instantaneous velocity of an object moving according to $s = 5t^2 + 14$?

A) $t = \frac{3}{2}$ B) $t = 3$ C) $t = \frac{1}{2}$ D) $t = \frac{17}{10}$

6) The electric power P (in W) as a function of the current i (in A) in a certain circuit is given by $P = 25i^2 + 54i$. Find the instantaneous rate of change of P with respect to i for $i = 0.6$ A.

A) 84 W/A B) 69 W/A C) 41.4 W/A D) 62.4 W/A

7) The torque T on the arm of a robotic control mechanism varies directly as the cube of the diameter d of the arm. If T = 1010 lb • in. for d = 0.98 in., find the expression for the instantaneous rate of change of T with respect to d.

A) $3219d^2$ lb • in./in. B) $1073d^2$ lb • in./in. C) $3219d^3$ lb • in./in. D) $1073d^3$ lb • in./in.

8) The deflection d (in m) of a diving board x m from the fixed end at the pool side is given by $d = kx^2(3L - x)$, where L is the length of the diving board and k is a positive constant. Find the instantaneous rate of change of d with respect to x for x = 1.7 m. Give your answer in terms of k and L.

A) (10.2kL – 8.67k) m/m B) (8.67kL – 4.913k) m/m

C) (17.34kL – 8.67k) m/m D) (5.1kL – 1) m/m

9) A tank containing 7 L of water drains out in 40 min. The volume V of water in the tank after t min of draining is $V = 7(1 - t/40)^2$. Find the instantaneous time rate of change of V after 16 minutes of draining.

A) –0.21 L/min B) 8.4 L/min C) 2.52 L/min D) –0.105 L/min

10) The force F (in N) exerted by a cam on a lever is given by $F = x^4 - 11x^3 + 45x^2 - 63x + 22$, where x ($1 \le x \le 5$) is the distance (in cm) from the center of rotation of the cam to the edge of the cam in contact with the lever. Find the instantaneous rate of change of F with respect to x when x = 2 cm.

A) 17 N/cm B) 4 N/cm C) –9 N/cm D) 9 N/cm

2.4 Derivatives of Trigonometric Functions

1 Find Derivative of Trigonometric Function

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

Find $D_x y$.

1) $y = \frac{10}{x} + 5 \sec x$

A) $-\frac{10}{x^2} + 5 \sec x \tan x$

B) $-\frac{10}{x^2} + 5 \tan^2 x$

C) $\frac{10}{x^2} - 5 \sec x \tan x$

D) $-\frac{10}{x^2} - 5 \csc x$

2) $y = \frac{3}{\sin x} + \frac{1}{\cot x}$

A) $-3 \csc x \cot x + \sec^2 x$

B) $3 \csc x \cot x - \csc^2 x$

C) $3 \cos x - \csc^2 x$

D) $3 \csc x \cot x - \sec^2 x$

3) $y = x^5 \cos x - 5x \sin x - 5 \cos x$

A) $-x^5 \sin x + 5x^4 \cos x - 5x \cos x$

B) $x^5 \sin x - 5x^4 \cos x + 5x \cos x$

C) $-x^5 \sin x + 5x^4 \cos x - 5x \cos x - 10 \sin x$

D) $-5x^4 \sin x - 5 \cos x + 5 \sin x$

4) $y = \frac{\sin x}{4x} + \frac{4x}{\sin x}$

A) $\frac{x \cos x - \sin x}{4x^2} + \frac{4 \sin x - 4x \cos x}{\sin^2 x}$

B) $\frac{x \cos x + \sin x}{4x^2} + \frac{4 \sin x + 4x \cos x}{\sin^2 x}$

C) $\frac{\cos x}{4} + \frac{4}{\cos x}$

D) $\frac{\sin x - x \cos x}{16x^2} + \frac{4x \cos x - 4 \sin x}{\sin^2 x}$

5) $y = x^6 - \csc x + 4$

A) $6x^5 + \csc x \cot x$

B) $6x^5 - \csc x \cot x$

C) $6x^5 + \cot^2 x$

D) $x^5 - \cot^2 x + 4$

6) $y = \frac{7 + \sec x}{7 - \sec x}$

A) $\frac{14 \sin x}{(7 \cos x - 1)^2}$

B) $-\frac{14 \sin x}{(7 \cos x - 1)^2}$

C) $-\frac{2 \sec^2 x \tan x}{(7 - \sec x)^2}$

D) $\frac{14 \tan^2 x}{(7 - \sec x)^2}$

7) $y = \frac{\sec x + \csc x}{\csc x}$

A) $\sec^2 x$

B) $\sec^2 x + 1$

C) $\sec x \tan x$

D) $-\csc x \cot x$

2 Solve Apps: Tangent Lines

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

Solve the problem.

1) Find the tangent to $y = \cos x$ at $x = \frac{\pi}{2}$.

A) $y = -x + \frac{\pi}{2}$ B) $y = x + \frac{\pi}{2}$ C) $y = -x - \frac{\pi}{2}$ D) $y = 1$

2) Find the tangent to $y = \cot x$ at $x = \frac{\pi}{4}$.

A) $y = -2x + \frac{\pi}{2} + 1$ B) $y = -2x + \frac{\pi}{2}$ C) $y = 2x - \frac{\pi}{2} + 1$ D) $y = 2x + 1$

3) Find the tangent to $y = 2 - \sin x$ at $x = \pi$.

A) $y = x - \pi + 2$ B) $y = x - 2$ C) $y = -x + \pi - 2$ D) $y = -x + 2$

4) Does the graph of the function $y = \tan x - x$ have any horizontal tangents in the interval $0 \le x \le 2\pi$? If so, where?

A) Yes, at $x = 0$, $x = \pi$, $x = 2\pi$ B) Yes, at $x = \pi$

C) Yes, at $x = \frac{\pi}{2}$, $x = \frac{3\pi}{2}$ D) No

5) Does the graph of the function $y = 6x + 12 \sin x$ have any horizontal tangents in the interval $0 \le x \le 2\pi$? If so, where?

A) Yes, at $x = \frac{2\pi}{3}$, $x = \frac{4\pi}{3}$ B) Yes, at $x = \frac{2\pi}{3}$

C) Yes, at $x = \frac{\pi}{3}$, $x = \frac{2\pi}{3}$ D) No

6) Does the graph of the function $y = 6x + 3 \sin x$ have any horizontal tangents in the interval $0 \le x \le 2\pi$? If so, where?

A) No B) Yes, at $x = \frac{2\pi}{3}$, $x = \frac{4\pi}{3}$

C) Yes, at $x = \frac{\pi}{3}$, $x = \frac{2\pi}{3}$ D) Yes, at $x = \frac{2\pi}{3}$

7) Find all points on the curve $y = \sin x$, $0 \le x \le 2\pi$, where the tangent line is parallel to the line $y = \frac{1}{2}x$.

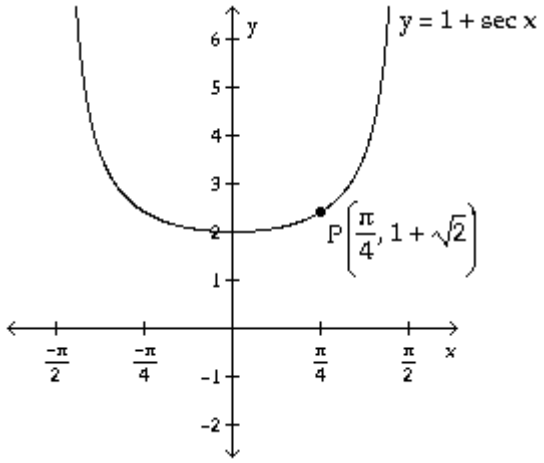
A) $\left(\frac{\pi}{3}, \frac{\sqrt{3}}{2}\right), \left(\frac{5\pi}{3}, -\frac{\sqrt{3}}{2}\right)$ B) $\left(\frac{\pi}{3}, \frac{\sqrt{3}}{2}\right), \left(\frac{2\pi}{3}, \frac{\sqrt{3}}{2}\right)$

C) $\left(\frac{\pi}{6}, \frac{1}{2}\right), \left(\frac{11\pi}{6}, -\frac{1}{2}\right)$ D) $\left(\frac{\pi}{3}, \frac{1}{2}\right), \left(\frac{2\pi}{3}, \frac{1}{2}\right)$

8) Find all points on the curve $y = \cos x$, $0 \le x \le 2\pi$, where the tangent line is parallel to the line $y = -x$.

A) $\left(\frac{\pi}{2}, 0\right)$ B) $\left(\frac{3\pi}{2}, 0\right)$ C) $(\pi, -1)$ D) $(2\pi, 1)$

9) Find an equation for the tangent to the curve at P.



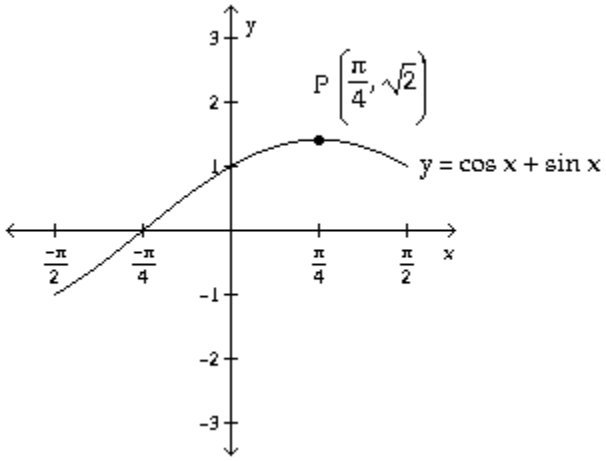
A) $y = \sqrt{2}x - \frac{\pi\sqrt{2}}{4} + 1 + \sqrt{2}$

B) $y = \sqrt{2}x + 1 + \sqrt{2}$

C) $y = -\sqrt{2}x + \frac{\pi\sqrt{2}}{4} - 1 - \sqrt{2}$

D) $y = -\sqrt{2}x - 1 - \sqrt{2}$

10) Find an equation for the horizontal tangent to the curve at P.



A) $y = \sqrt{2}$

B) $y = 0$

C) $y = \frac{3}{2}$

D) $y = 1$

3 Use Trigonometric Identity To Find Derivative

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

Solve the problem.

1) Use the trigonometric identity $\tan 2x = \frac{2\tan x}{1 - \tan^2 x}$ to find $D_x \tan 2x$.

A) $2\sec^2 x(1 + \tan^2 x)$

B) $2\sec^2 x(1 - \tan^2 x)$

C) $2\tan^2 x + \tan^3 x$

D) $2\sec^2 x \tan^2 x$

2.5 The Chain Rule

1 Find Derivative Using Chain Rule I

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

Find $D_x y$.

1) $y = \sin\left(\frac{3\pi x}{2}\right) - \cos\left(\frac{3\pi x}{2}\right)$

A) $\frac{3\pi}{2}\cos\left(\frac{3\pi x}{2}\right) + \frac{3\pi}{2}\sin\left(\frac{3\pi x}{2}\right)$

B) $\cos\left(\frac{3\pi x}{2}\right) + \sin\left(\frac{3\pi x}{2}\right)$

C) $\frac{3\pi}{2}\cos\left(\frac{3\pi x}{2}\right) - \frac{3\pi}{2}\sin\left(\frac{3\pi x}{2}\right)$

D) $-\frac{3\pi}{2}\cos\left(\frac{3\pi x}{2}\right) - \frac{3\pi}{2}\sin\left(\frac{3\pi x}{2}\right)$

2) $y = \frac{1}{6}(7x + 9)^3 + \left(1 - \frac{1}{x^3}\right)^{-1}$

A) $\frac{7}{2}(7x + 9)^2 - \frac{3}{x^4}\left(1 - \frac{1}{x^3}\right)^{-2}$

B) $\frac{1}{2}(7x + 9)^2 - \left(1 - \frac{1}{x^3}\right)^{-2}$

C) $\frac{1}{2}(7x)^2 - \left(\frac{3}{x^4}\right)^{-2}$

D) $\frac{7}{6}(7x + 9)^2 + \frac{3}{x^4}\left(1 - \frac{1}{x^3}\right)^{-2}$

3) $y = (\sec x + \tan x)^{-3}$

A) $\frac{-3 \sec x}{(\sec x + \tan x)^3}$

B) $-3(\sec x + \tan x)^{-4}$

C) $-3(\sec x \tan x + \sec^2 x)^{-4}$

D) $-3(\sec x + \tan x)^{-4}(\tan^2 x + \sec x \tan x)$

4) $y = \cos^7(\pi x - 20)$

A) $-7\pi \cos^6(\pi x - 20)\sin(\pi x - 20)$

B) $7\cos^6(\pi x - 20)$

C) $-7\cos^6(\pi x - 20)\sin(\pi x - 20)$

D) $-7\pi \sin^6(\pi x - 20)$

5) $y = \left(\frac{\cos x}{1 + \sin x}\right)^6$

A) $\frac{-6\cos^5 x}{(1 + \sin x)^6}$

B) $6\left(\frac{\cos x}{1 + \sin x}\right)^5$

C) $\left(-\frac{4 \sin x}{\cos x}\right)\left(\frac{\cos x}{1 + \sin x}\right)^5$

D) $\left(\frac{\sin x}{\cos x}\right)^5$

6) $y = (4x^2 + 5)^5$

A) $40x(4x^2 + 5)^4$

B) $40(4x^2 + 5)^4$

C) $5(4x^2 + 5)^4$

D) $(40x + 5)(4x^2 + 5)^4$

7) $y = (4x^5 - 4x^4 + 7)^{300}$

A) $300(4x^5 - 4x^4 + 7)^{299}(20x^4 - 16x^3)$

B) $300(4x^5 - 4x^4 + 7)^{299}$

C) $300(20x^4 - 16x^3)^{299}$

D) $300(4x^5 - 4x^4 + 7)^{299}(5x^4 - 4x^3)$

8) $y = \frac{1}{6}(9x + 9)^3$

A) $\frac{9}{2}(9x + 9)^2$ B) $\frac{1}{2}(9x + 9)^2$ C) $\frac{9}{2}x(9x + 9)^2$ D) $\frac{3}{2}(9x + 9)^2$

9) $y = \frac{1}{(7x - 8)^5}$

A) $-\frac{35}{(7x - 8)^6}$ B) $-\frac{5}{(7x - 8)^4}$ C) $-\frac{5}{(7x - 8)^6}$ D) $-\frac{35}{(7x - 8)^4}$

10) $y = (1 + \sin 12t)^{-3}$

A) $-36(1 + \sin 12t)^{-4} \cos 12t$ B) $-3(1 + \sin 12t)^{-4}$

C) $-3(1 + \sin 12t)^{-4} \cos 12t$ D) $-36(\cos 12t)^{-4}$

2 Find Derivative Using Chain Rule II

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

Find $D_x y$.

1) $y = 3x(4x + 3)^3$

A) $3(4x + 3)^2(16x + 3)$ B) $3(4x + 3)^2$ C) $3(16x + 3)^2$ D) $3(4x + 3)^3(7x + 3)$

2) $y = \left(\frac{2x + 4}{x - 4}\right)^4$

A) $\left(\frac{2x + 4}{x - 4}\right)^3 \cdot \frac{-48}{(x - 4)^2}$ B) $\left(\frac{2x + 4}{x - 4}\right)^3$ C) $\left(\frac{-48}{(x - 4)^2}\right)^3$ D) $\left(\frac{2x + 4}{x - 4}\right)^3 \cdot \frac{12}{(x - 4)^2}$

3) $y = \sqrt[3]{\frac{5z + 6}{-9z + 3}}$

A) $\frac{1}{3}\left(\frac{5z + 6}{-9z + 3}\right)^{-2/3}\left(\frac{69}{(-9z + 3)^2}\right)$ B) $\frac{1}{3}\left(\frac{5z + 6}{-9z + 3}\right)^{-2/3}$

C) $\frac{1}{3}\left(\frac{69}{(-9z + 3)^2}\right)^{-2/3}$ D) $-\frac{5}{27}\left(\frac{5z + 6}{-9z + 3}\right)^{-2/3}$

3 Evaluate Derivative at a Point Using Chain Rule

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

Evaluate the indicated derivative.

1) $f'(2)$ if $f(x) = (3 - x^3)^{-1}$

A) $\frac{12}{25}$ B) $-\frac{1}{25}$ C) $-\frac{12}{5}$ D) $-\frac{12}{25}$

2) $f'(5)$ if $f(x) = \left(\frac{x + 4}{x - 2}\right)^3$

A) -18 B) 18 C) 27 D) -27

3) f'(1/2) if f(x) = cos(πx) sin(πx)

A) $-\pi$ B) π C) 0 D) –1

4) f'(1) if f(x) = cos($\pi x^2 + 6$)

A) –1.76 B) 0 C) $\frac{\sqrt{2}}{2}$ D) –1

4 Apply Chain Rule More Than Once to Find Derivative

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

Apply the Chain Rule more than once to find the indicated derivative.

1) $D_t\left[\sin\left(\frac{7\pi t}{2}\right) - \cos\left(\frac{7\pi t}{2}\right)\right]$

A) $\frac{7\pi}{2}\cos\left(\frac{7\pi t}{2}\right) + \frac{7\pi}{2}\sin\left(\frac{7\pi t}{2}\right)$

B) $\cos\left(\frac{7\pi t}{2}\right) + \sin\left(\frac{7\pi t}{2}\right)$

C) $\frac{7\pi}{2}\cos\left(\frac{7\pi t}{2}\right) - \frac{7\pi}{2}\sin\left(\frac{7\pi t}{2}\right)$

D) $-\frac{7\pi}{2}\cos\left(\frac{7\pi t}{2}\right) - \frac{7\pi}{2}\sin\left(\frac{7\pi t}{2}\right)$

2) $D_\theta\left[(\sec\theta + \tan\theta)^{-6}\right]$

A) $\frac{-6\sec\theta}{(\sec\theta + \tan\theta)^6}$

B) $-6(\sec\theta + \tan\theta)^{-7}$

C) $-6(\sec\theta\tan\theta + \sec^2\theta)^{-7}$

D) $-6(\sec\theta + \tan\theta)^{-7}(\tan^2\theta + \sec\theta\tan\theta)$

3) $D_t\left[\cos^3(\pi t - 20)\right]$

A) $-3\pi\cos^2(\pi t - 20)\sin(\pi t - 20)$

B) $3\cos^2(\pi t - 20)$

C) $-3\cos^2(\pi t - 20)\sin(\pi t - 20)$

D) $-3\pi\sin^2(\pi t - 20)$

4) $D_t\left[\cos\left(\sqrt{6t + 11}\right)\right]$

A) $-\frac{3}{\sqrt{6t + 11}}\sin\left(\sqrt{6t + 11}\right)$

B) $-\sin\left(\sqrt{6t + 11}\right)$

C) $-\frac{1}{2\sqrt{6t + 11}}\sin\left(\sqrt{6t + 11}\right)$

D) $-\sin\left(\frac{3}{\sqrt{6t + 11}}\right)$

5) $D_x\left[\left(\frac{\cos x}{1 + \sin x}\right)^3\right]$

A) $\frac{-3\cos^2 x}{(1 + \sin x)^3}$

B) $3\left(\frac{\cos x}{1 + \sin x}\right)^2$

C) $\left(-\frac{4\sin x}{\cos x}\right)\left(\frac{\cos x}{1 + \sin x}\right)^2$

D) $-3\left(\frac{\sin x}{\cos x}\right)^2$

6) $D_t\left[(1 + \sin 10t)^{-6}\right]$

A) $-60(1 + \sin 10t)^{-7}\cos 10t$

B) $-6(1 + \sin 10t)^{-7}$

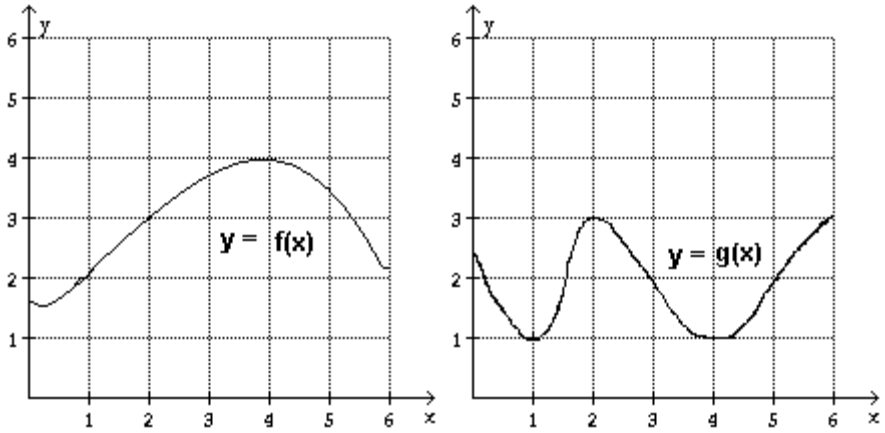
C) $-6(1 + \sin 10t)^{-7}\cos 10t$

D) $-60(\cos 10t)^{-7}$

5 Estimate Derivative Given Graphs of Two Functions

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

Use the figures below to approximate the indicated expressions.



1) (f + g)'(2)

A) 1 B) 2 C) 0 D) 6

2) (f – g)'(1)

A) 1 B) –1 C) 0 D) 3

3) (fg)'(2)

A) 3 B) 1 C) 0 D) 9

4) (f/g)'(5)

A) –1.4 B) 3.5 C) –1 D) 2

5) (f ∘ g)'(3)

A) –1 B) 3 C) 0 D) 1

6) (g ∘ f)'(1)

A) 0 B) 2 C) 1 D) 6

6 Express Derivative in Terms of F(x)

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

Express the indicated derivative in terms of the function F(x). Assume that F is differentiable.

1) $D_x(F(5x))$

A) 5F'(5x) B) F'(5x) C) 4F'(5x) D) 5F'(x)

2) $D_x((F(z))^{-2})$

A) $-2(F(z))^{-3}F'(z)$ B) $-2(F(z))^{-2}F'(z)$ C) $-2(F(z))^{-1}F'(z)$ D) $(F(z))^{-3}F'(z)$

3) $\frac{d}{dx}F(\sin x)$

A) $\cos x\, F'(\sin x)$ B) $-\cos x\, F'(\sin x)$ C) $\sin x\, F'(\cos x)$ D) $-\sin x\, F'(\cos x)$

7 Find Derivative Given Numerical Values

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

Suppose that the functions f and g and their derivatives with respect to x have the following values at the given values of x. Find the derivative with respect to x of the given combination at the given value of x.

1)

x	f(x)	g(x)	f'(x)	g'(x)
3	1	4	8	3
4	−3	3	2	−4

f(g(x)), x = 4

A) −32 B) −8 C) 8 D) 24

2)

x	f(x)	g(x)	f'(x)	g'(x)
3	1	16	6	5
4	−3	3	2	−4

$\sqrt{g(x)}$, x = 3

A) $\frac{5}{8}$ B) $\frac{1}{8}$ C) $\frac{1}{2\sqrt{5}}$ D) $-\frac{1}{2\sqrt{5}}$

3)

x	f(x)	g(x)	f'(x)	g'(x)
3	1	4	8	3
4	3	3	5	−4

$1/f^2(x)$, x = 4

A) $-\frac{10}{27}$ B) $-\frac{2}{27}$ C) $\frac{10}{27}$ D) $-\frac{2}{125}$

4)

x	f(x)	g(x)	f'(x)	g'(x)
3	1	16	8	5
4	−3	3	2	−5

$\sqrt{f(x) + g(x)}$, x = 3

A) $\frac{13}{2\sqrt{17}}$ B) $\frac{1}{2\sqrt{17}}$ C) $-\frac{1}{2\sqrt{17}}$ D) $\frac{13}{\sqrt{17}}$

5)

x	f(x)	g(x)	f'(x)	g'(x)
3	1	4	6	7
4	3	3	5	–5

$f^2(x) \cdot g(x)$, $x = 3$

A) 55 B) 15 C) 84 D) 31

6)

x	f(x)	g(x)	f'(x)	g'(x)
3	1	4	8	7
4	–3	3	5	–6

$g(x + f(x))$, $x = 3$

A) –54 B) –6 C) –48 D) 27

7)

x	f(x)	g(x)	f'(x)	g'(x)
3	1	9	6	5
4	3	3	5	–5

$1/g^2(x)$, $x = 4$

A) $\frac{10}{27}$ B) $-\frac{10}{27}$ C) $-\frac{2}{27}$ D) $\frac{2}{125}$

8 Find Equation of Tangent Line

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

Find an equation for the line tangent to the given curve at the indicated point.

1) $y = x^2 - 4$ at (4, 12)

A) $y = 8x - 20$ B) $y = 4x - 20$ C) $y = 8x - 36$ D) $y = 8x - 40$

2) $y = x^2 + 2$ at (3, 11)

A) $y = 6x - 7$ B) $y = 3x - 7$ C) $y = 6x - 16$ D) $y = 6x - 14$

3) $y = x^2 - x$ at (2, 2)

A) $y = 3x - 4$ B) $y = 3x - 6$ C) $y = 3x + 4$ D) $y = 3x + 6$

4) $y = x^3 - 9x - 4$ at (3, –4)

A) $y = 18x - 58$ B) $y = 18x - 4$ C) $y = 14x - 58$ D) $y = -4$

9 Solve Apps: Chain Rule

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

Solve the problem.

1) The position of a particle moving along a coordinate line is $s = \sqrt{6 + 10t}$, with s in meters and t in seconds. Find the particle's velocity at t = 1 sec.

A) $\frac{5}{4}$ m/sec B) $\frac{5}{2}$ m/sec C) $\frac{1}{8}$ m/sec D) $-\frac{1}{4}$ m/sec

2) The position of a particle moving along a coordinate line is $s = \sqrt{3 + 6t}$ with s in meters and t in seconds. Find the particle's acceleration at t = 1 sec.

A) $-\frac{1}{3}$ m/sec^2 B) $\frac{1}{3}$ m/sec^2 C) $-\frac{1}{18}$ m/sec^2 D) 1 m/sec^2

3) Suppose that the velocity of a falling body is $v = ks^2$ (k a constant) at the instant the body has fallen s meters from its starting point. Find the body's acceleration as a function of s.

A) $a = 2ks$ B) $a = 2k^2s^3$ C) $a = 2ks^2$ D) $a = 2ks^3$

4) Suppose that the velocity of a falling body is $v = \frac{k}{s}$ (k a constant) at the instant the body has fallen s meters from its starting point. Find the body's acceleration as a function of s.

A) $a = -\frac{k}{s^2}$ B) $a = -\frac{k^2}{s^3}$ C) $a = \frac{k^2}{s^3}$ D) $a = -\frac{1}{s^2}$

5) The position(in feet) of an object oscillating up and down at the end of a spring is given by $s = A \sin\left(\sqrt{\frac{k}{m}}t\right)$ at time t (in seconds). The value of A is the amplitude of the motion, k is a measure of the stiffness of the spring, and m is the mass of the object. Find the object's velocity at time t.

A) $v = A\sqrt{\frac{k}{m}} \cos\left(\sqrt{\frac{k}{m}}t\right)$ ft/sec B) $v = A \cos\left(\sqrt{\frac{k}{m}}t\right)$ ft/sec

C) $v = -A\sqrt{\frac{k}{m}} \cos\left(\sqrt{\frac{k}{m}}t\right)$ ft/sec D) $v = A\sqrt{\frac{m}{k}} \cos\left(\sqrt{\frac{k}{m}}t\right)$ ft/sec

6) The position (in centimeters) of an object oscillating up and down at the end of a spring is given by $s = A \sin\left(\sqrt{\frac{k}{m}}t\right)$ at time t (in seconds). The value of A is the amplitude of the motion, k is a measure of the stiffness of the spring, and m is the mass of the object. How fast is the object moving when it is moving fastest?

A) $A\sqrt{\frac{k}{m}}$ cm/sec B) A cm/sec C) $A\sqrt{\frac{m}{k}}$ cm/sec D) $\sqrt{\frac{k}{m}}$ cm/sec

7) The position (in centimeters) of an object oscillating up and down at the end of a spring is given by $s = A \sin\left(\sqrt{\frac{k}{m}}t\right)$ at time t (in seconds). The value of A is the amplitude of the motion, k is a measure of the stiffness of the spring, and m is the mass of the object. Find the object's acceleration at time t.

A) $a = -\frac{Ak}{m}\sin\left(\sqrt{\frac{k}{m}}t\right)$ cm/sec^2

B) $a = \frac{Ak}{m}\cos\left(\sqrt{\frac{k}{m}}t\right)$ cm/sec^2

C) $a = -A\sqrt{\frac{k}{m}}\sin\left(\sqrt{\frac{k}{m}}t\right)$ cm/sec^2

D) $a = -A\sin\left(\sqrt{\frac{k}{m}}t\right)$ cm/sec^2

8) The position (in centimeters) of an object oscillating up and down at the end of a spring is given by $s = A \sin\left(\sqrt{\frac{k}{m}}t\right)$ at time t (in seconds). The value of A is the amplitude of the motion, k is a measure of the stiffness of the spring, and m is the mass of the object. How fast is the object accelerating when it is accelerating the fastest?

A) $\frac{Ak}{m}$ cm/sec^2

B) $A\sqrt{\frac{k}{m}}$ cm/sec^2

C) A cm/sec^2

D) A^2 cm/sec^2

10 Know Concepts: Chain Rule

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

Solve the problem.

1) Consider the function L satisfying $L'(x) = \frac{1}{x}$. Find the derivative $D_x(L(x^8))$.

A) $\frac{8}{x}$

B) $\frac{8}{x^7}$

C) $\frac{8}{x^8}$

D) 8

2) Consider the function L satisfying $L'(x) = \frac{1}{x}$. Find the derivative $D_x(L(\sin^8 x))$.

A) 8 cot x

B) –8 tan x

C) 8 csc x

D) –8 sec x

3) Let f(0) = 0 and f'(0) = 6. Find the derivative of f(f(f(x))) at x = 0.

A) 216

B) 0

C) 6

D) 36

2.6 Higher–Order Derivatives

1 Find Higher–Order Derivative

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

Find the indicated derivative of the function.

1) $\frac{d^3y}{dx^3}$ for $y = 3x^3 + 6x^2 - 4x$

A) 18

B) 9

C) 18x + 9

D) 9x +18

2) $\frac{d^3y}{dx^3}$ for $y = (x + 1)^{-1}$

A) $-6(x + 1)^{-4}$

B) $6(x + 1)^{-4}$

C) $-6(x + 1)^{-3}$

D) $6(x + 1)^{-3}$

3) $\frac{d^3y}{dx^3}$ for $y = \frac{x}{x+1}$

A) $\frac{6}{(x+1)^4}$ B) $-\frac{6}{(x+1)^4}$ C) $\frac{6}{(x+1)^3}$ D) $-\frac{6}{(x+1)^3}$

4) $\frac{d^3y}{dx^3}$ for $y = \sqrt{x^2+1}$

A) $-\frac{3x}{(x^2+1)^{5/2}}$ B) $\frac{3x}{(x^2+1)^{5/2}}$ C) $-\frac{5x}{(x^2+1)^{3/2}}$ D) $\frac{5x}{(x^2+1)^{3/2}}$

5) $\frac{d^3y}{dx^3}$ for $y = (7-6x)^4$

A) 31,104x – 36,288 B) –144x + 168 C) –31,104x + 36,288 D) 5184x – 6048

6) $\frac{d^3y}{dx^3}$ for $y = x(2x-5)^3$

A) 192x – 360 B) 48x – 90 C) 96x – 180 D) 64x – 120

7) $\frac{d^2y}{dx^2}$ for $y = 4 \sin x$

A) –4 sin x B) 4 sin x C) 16 sin x D) 4 cos x

8) $\frac{d^4y}{dx^4}$ for $y = 9 \sin x$

A) 9 sin x B) –9 sin x C) 9 cos x D) –9 cos x

9) $\frac{d^2y}{dx^2}$ for $y = -4 \cos x$

A) 4 cos x B) –4 cos x C) 4 sin x D) –4 sin x

10) $\frac{d^4y}{dx^4}$ for $y = -4 \cos x$

A) –4 cos x B) 4 cos x C) –4 sin x D) 4 sin x

11) $\frac{d^2y}{dx^2}$ for $y = 7x \sin x$

A) 14 cos x – 7x sin x B) –7x sin x C) –14 cos x + 7x sin x D) 7 cos x – 14x sin x

12) $\frac{d^3y}{dx^3}$ for $y = 3x \sin x$

A) –3x cos x – 9 sin x B) 3x cos x + 9 sin x C) 6 cos x – 3x sin x D) –3x cos x + 9 sin x

2 Evaluate Second Derivative

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

Evaluate the second derivative of the function for the given value of x.

1) $f(x) = x^4 + 4x^3 - 2x + 9;\ x = -5$

A) 180 B) 184 C) 175 D) –179

2) $f(x) = \frac{3x - 4}{4x - 3};\ x = 1$

A) –56 B) 7 C) 32 D) 44

3) $f(x) = \frac{x^2 + 2}{3x^2 - 1};\ x = 0$

A) –14 B) 0 C) 1 D) –10

4) $f(x) = (x^2 - 3x + 2)(2x - 6);\ x = 0$

A) –24 B) 22 C) –12 D) 0

5) $f(x) = 4x^{2/3} + \frac{2}{x};\ x = 8$

A) $-\frac{55}{1152}$ B) $\frac{253}{96}$ C) $-\frac{55}{576}$ D) $-\frac{31}{1152}$

6) $f(x) = \frac{1}{x + 4};\ x = 5$

A) $\frac{2}{729}$ B) $-\frac{2}{729}$ C) $\frac{1}{81}$ D) $-\frac{1}{81}$

7) $f(x) = 9x^3 + 4x^2 + 4x + 5;\ x = 3$

A) 170 B) 271 C) 89 D) 105

8) $f(x) = 4(1 + 3x)^5;\ x = \frac{1}{3}$

A) 5760 B) 640 C) 288 D) 1440

3 Calculate Acceleration

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

s is the distance (in feet) traveled in time t (in seconds) by a particle. Find the acceleration at the given time.

1) $s = \frac{1}{t + 5};\ t = 2$ s

A) $\frac{2}{343}$ ft/s^2 B) $-\frac{2}{343}$ ft/s^2 C) $\frac{1}{49}$ ft/s^2 D) $-\frac{1}{49}$ ft/s^2

2) $s = 8t^3 + 9t^2 + 8t + 8;\ t = 3$ s

A) 162 ft/s^2 B) 278 ft/s^2 C) 90 ft/s^2 D) 126 ft/s^2

3) $s = 2t^3 + 6t^2 + 9t + 6;\ t = 1$ s

A) 24 ft/s^2 B) 27 ft/s^2 C) 12 ft/s^2 D) 18 ft/s^2

4) $s = 6t^3 - 8t^2 - 9t + 6;\ t = 3$ s

A) 92 ft/s^2 B) 105 ft/s^2 C) 81 ft/s^2 D) 6 ft/s^2

5) $s = 0.1(1 + 3t)^4;\ t = 0.3$ s

A) 39.0 ft/s^2 B) 4.3 ft/s^2 C) 3.3 ft/s^2 D) 15.6 ft/s^2

4 Solve Apps: Motion

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

Solve the problem.

1) Find the acceleration at time t = 9 s if the position (in cm) of a particle moving along a line is $s(t) = 6t^3 - 7t^2 - 9t + 2$ at time t.

A) 310 cm/s^2 B) 310 cm/s C) 1323 cm/s^2 D) 1323 cm/s

2) A projectile is fired vertically upward. Its distance s (in m) above the ground is given by $s = 287t - 4.9t^2$, where t is the time (in s). Find the acceleration of the projectile.

A) –9.8 m/s^2 B) –4.9 m/s^2 C) 9.8 m/s^2 D) <a – 9.8> m/s^2

3) The deflection y (in m) of a 6–m beam as a function of the distance x (in m) from one end is $y = 0.0001(x^5 - 36x^2)$. Find the value of d^2y/dx^2 (the rate of change at which the slope of the beam changes) where x = 3.2 m.

A) 0.058 B) 0.042 C) 0.21 D) 0.20

4) The force F (in N) acting on an object is given by $F = 13\ dv/dt + 2v + 4$, where v is the velocity (in m/s) and t is the time (in s). If the displacement is given by $s = 25t^{0.4}$, find F for t = 3.3 s.

A) 2.22 N B) 61.9 N C) 33.0 N D) 16.9 N

5 Know Concepts: Higher–Order Derivatives

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

Solve the problem.

1) Without doing any calculating find the derivative.

$D_x^{15}(53x^{14} - 65x^{13} + 27x - 15)$

A) 0 B) 742 C) 1 D) 53

2) Without doing any calculating find the derivative.

$D_x^7(x^2 + -8)^3$

A) 0 B) 2 C) 6 D) –16

3) If $f(x) = x^3 - 10.5x^2 + 36x + 4$, find the value of f'' at each zero of f', that is, at each point c where $f'(c) = 0$.

A) $f''(3) = -3$; $f''(4) = 3$

B) $f''(3) = 21$; $f''(4) = 21$

C) $f''(3) = -1$; $f''(4) = 1$

D) $f''(3) = <-12$; $f''(4) = -9$

4) Suppose that $f(t) = at^2 + bt + c$ and $f(1) = 15$, $f'(1) = 8$, and $f''(1) = 4$. Find a, b, and c.

A) $a = 2$; $b = 4$; $c = 9$ B) $a = 0$; $b = 8$; $c = 9$ C) $a = 4$; $b = 2$; $c = 7$ D) $a = 4$; $b = 2$; $c = 9$

2.7 Implicit Differentiation

1 Find Derivative Using Implicit Differentiation

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

Assuming that the equation defines a differential function of x, find $D_x y$ by implicit differentiation.

1) $2xy - y^2 = 1$

A) $\frac{y}{y - x}$ B) $\frac{y}{x - y}$ C) $\frac{x}{y - x}$ D) $\frac{x}{x - y}$

2) $x^3 + 3x^2y + y^3 = 8$

A) $-\frac{x^2 + 2xy}{x^2 + y^2}$ B) $\frac{x^2 + 2xy}{x^2 + y^2}$ C) $-\frac{x^2 + 3xy}{x^2 + y^2}$ D) $\frac{x^2 + 3xy}{x^2 + y^2}$

3) $\frac{x + y}{x - y} = x^2 + y^2$

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

4) $y\sqrt{x + 1} = 4$

A) $-\frac{y}{2(x + 1)}$ B) $\frac{y}{2(x + 1)}$ C) $-\frac{2y}{x + 1}$ D) $\frac{2y}{x + 1}$

5) $xy + x = 2$

A) $-\frac{1 + y}{x}$ B) $\frac{1 + y}{x}$ C) $-\frac{1 + x}{y}$ D) $\frac{1 + x}{y}$

6) $xy + x + y = x^2y^2$

A) $\frac{2xy^2 - y - 1}{-2x^2y + x + 1}$ B) $\frac{2xy^2 - y}{2x^2y + x}$ C) $\frac{2xy^2 + y + 1}{-2x^2y - x - 1}$ D) $\frac{2xy^2 + y}{2x^2y - x}$

7) $x^6 = \cot y$

A) $-\frac{6x^5}{\csc^2 y}$ B) $\frac{6x^5}{\csc^2 y}$ C) $-\frac{6x^5}{\csc y \cot y}$ D) $\frac{\csc^2 y}{6x^5}$

8) $\cos xy + x^3 = y^3$

A) $\frac{3x^2 - y \sin xy}{3y^2 + x \sin xy}$ B) $\frac{3x^2 + y \sin xy}{3y^2 - x \sin xy}$ C) $\frac{3x^2 - x \sin xy}{3y^2}$ D) $\frac{3x^2 + x \sin xy}{3y^2}$

9) $y \cos\left(\frac{1}{y}\right) = 3x + 3y$

A) $\frac{3y}{\sin\left(\frac{1}{y}\right) + y\cos\left(\frac{1}{y}\right) - 3y}$

B) $\frac{3}{\sin\left(\frac{1}{y}\right) + y\cos\left(\frac{1}{y}\right) - 3}$

C) $\frac{3y^2}{\sin\left(\frac{1}{y}\right) - 3y^2}$

D) $\frac{3 - y\sin\left(\frac{1}{y}\right)}{\cos\left(\frac{1}{y}\right) - 3}$

10) $x = \sec(5y)$

A) $\frac{1}{5}\cos(5y)\cot(5y)$ B) $\cos(5y)\cot(5y)$ C) $\frac{1}{5}\sec(5y)\tan(5y)$ D) $5\sec(5y)\tan(5y)$

2 Find Equation of Tangent Line

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

Find an equation for the line tangent to the given curve at the indicated point.

1) $x^2 + y^2 - 2x + 4y = 8$ at $(4, 0)$

A) $y = -\frac{3}{2}(x - 4)$ B) $x = 4$ C) $y = \frac{1}{2}(x - 4)$ D) $y = 0$

2) $y^4 + x^3 = y^2 + 11x$ at $(0, 1)$

A) $y = \frac{11}{2}x + 1$ B) $y = \frac{11}{4}x + 1$ C) $y = -\frac{11}{6}x$ D) $y = -\frac{11}{4}x - 1$

3) $-2x^2 + y + \sin(xy) = -2$ at $(1, 0)$

A) $y = 2x + -2$ B) $y = -2x + -2$ C) $y = 4x + -2$ D) $y = 0$

3 Find Derivative Containing Rational Power

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

Find $\frac{dy}{dx}$.

1) $y = x^{7/5}$

A) $\frac{7}{5}x^{2/5}$ B) $\frac{7}{5}x^{6/5}$ C) $x^{2/5}$ D) $\frac{7}{5}x^{-2/5}$

2) $y = \sqrt[8]{7x}$

A) $\frac{7}{8(7x)^{7/8}}$ B) $\frac{1}{8(7x)^{7/8}}$ C) $-\frac{7}{8(7x)^{9/8}}$ D) $\frac{1}{(7x)^{7/8}}$

3) $y = 14\sqrt{x + 5}$

A) $\frac{7}{\sqrt{x + 5}}$ B) $-\frac{7}{\sqrt{x + 5}}$ C) $\frac{1}{2\sqrt{x + 5}}$ D) $-\frac{7}{(x + 5)^{3/2}}$

4) $y = \sqrt[8]{x^5}$

A) $\frac{5}{8}x^{-3/8}$ B) $\frac{8}{5}x^{-3/8}$ C) $\frac{5}{8}x^{3/8}$ D) $\frac{8}{5}x^{3/8}$

5) $y = \sqrt[7]{x^{-3}}$

A) $-\frac{3}{7}x^{-10/7}$ B) $-\frac{7}{3}x^{-10/7}$ C) $\frac{3}{7}x^{10/7}$ D) $-\frac{3}{7}x^{10/7}$

6) $y = x(x^6 + 4)^{1/3}$

A) $\frac{3x^6 + 4}{(x^6 + 4)^{2/3}}$ B) $\frac{2x^5}{(x^6 + 4)^{2/3}}$ C) $\frac{3x^6 + x + 12}{3(x^6 + 4)^{2/3}}$ D) $\frac{3x^6}{(x^6 + 4)^{1/3}}$

7) $y = \sqrt{9 + \sin(10x)}$

A) $\frac{5\cos(10x)}{\sqrt{9 + \sin(10x)}}$ B) $\frac{\cos(10x)}{2\sqrt{9 + \sin(10x)}}$ C) $\frac{1}{2\sqrt{9 + \sin(10x)}}$ D) $\frac{\cos(10x)}{(9 + \sin(10x))^{3/2}}$

8) $y = \cos\left[(10x + 7)^{-1/2}\right]$

A) $\frac{5\sin\left[(10x + 7)^{-1/2}\right]}{(10x + 7)^{3/2}}$ B) $-\sin\left[(10x + 7)^{-1/2}\right]$

C) $\frac{-\sin\left[(10x + 7)^{-1/2}\right]}{2(10x + 7)^{3/2}}$ D) $-\sin\left[\frac{-5}{(10x + 7)^{3/2}}\right]$

9) $y = (\sin x)^{-1/5}$

A) $-\frac{\cos x}{5(\sin x)^{6/5}}$ B) $-\frac{1}{5(\sin x)^{6/5}}$ C) $\frac{\cos x}{(\sin x)^{6/5}}$ D) $\frac{1}{5(\cos x)^{6/5}}$

10) $y = \sqrt{\sqrt{x} + 6}$

A) $\frac{1}{4\sqrt{x}(\sqrt{\sqrt{x} + 6})}$ B) $\frac{1}{2\sqrt{\sqrt{x} + 6}}$ C) $\frac{1}{4\sqrt{\sqrt{x} + 6}}$ D) $\frac{1}{4\sqrt{x + 6}}$

4 Find Second Derivative Using Implicit Differentiation

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

Use implicit differentiation to find y".

1) $xy - x + y = 3$

A) $\frac{2y - 2}{(x + 1)^2}$ B) $\frac{2y + 2}{(x + 1)^2}$ C) $\frac{1 - y}{(x + 1)}$ D) $\frac{y + 1}{(x + 1)^2}$

2) $2y - x + xy = 3$

A) $\frac{2y - 2}{(x + 2)^2}$ B) $\frac{2y + 2}{(x + 2)^2}$ C) $\frac{2y - 2}{x + 2}$ D) $\frac{y + 1}{(x + 2)^2}$

3) $y^2 - xy + x^2 = 3$

A) $\frac{3x^2 - 3xy + 3y^2}{(x - 2y)^3}$ B) $\frac{(2x + y)^2}{(x - 2y)^3}$ C) $\frac{24}{(x + 2y)^3}$ D) $\frac{(2x + y)^2}{(x + 2y)^3}$

4) $y^2 - x^2 = 6$

A) $\frac{y^2 - x^2}{y^3}$ B) $\frac{y^2 + x^2}{y^3}$ C) $\frac{y^2 - x^2}{y^2}$ D) $\frac{y - x^2}{y^2}$

5) $x^2 - y^3 = 7$

A) $\frac{6y^3 - 8x^2}{9y^5}$ B) $\frac{6y^3 - 8x^2}{9y^6}$ C) $\frac{5y^3 - 8x^2}{9y^5}$ D) $\frac{6y^3 - 8x^2}{9y^3}$

5 Know Concepts: Implricit Differentiation

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

Solve the problem.

1) Find all points on the curve $x^2y + xy^2 = -1024$ where the tangent line is vertical, that is, where $\frac{dx}{dy} = 0$.

A) (16, –8) B) (0, –8) C) (16, 0) D) (–16, 8)

2.8 Related Rates

1 Solve Apps: Related Rates I

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

Solve the problem. Round your answer, if appropriate.

1) As the zoom lens in a camera moves in and out, the size of the rectangular image changes. Assume that the current image is 7 cm × 6 cm. Find the rate at which the area of the image is changing (dA/df) if the length of the image is changing at 0.7 cm/s and the width of the image is changing at 0.4 cm/s.

A) 7.0 cm^2/sec B) 7.3 cm^2/sec C) 14.0 cm^2/sec D) 14.6 cm^2/sec

2) One airplane is approaching an airport from the north at 201 km/hr. A second airplane approaches from the east at 242 km/hr. Find the rate at which the distance between the planes changes when the southbound plane is 28 km away from the airport and the westbound plane is 24 km from the airport.

A) –310 km/hr B) –465 km/hr C) –155 km/hr D) –620 km/hr

3) The volume of a sphere is increasing at a rate of 3 cm^3/sec. Find the rate of change of its surface area when its volume is $\frac{32\pi}{3}$ cm^3. (Do not round your answer.)

A) 3 cm^2/sec B) 6π cm^2/sec C) 2 cm^2/sec D) $\frac{8}{3}$ cm^2/sec

4) The volume of a rectangular box with a square base remains constant at 600 cm^3 as the area of the base increases at a rate of 15 cm^2/sec. Find the rate at which the height of the box is decreasing when each side of the base is 16 cm long. (Do not round your answer.)

A) $\frac{1125}{8192}$ cm/sec B) $\frac{1125}{512}$ cm/sec C) $\frac{75}{32}$ cm/sec D) $\frac{15}{256}$ cm/sec

5) The radius of a right circular cylinder is increasing at the rate of 10 in./sec, while the height is decreasing at the rate of 7 in./sec. At what rate is the volume of the cylinder changing when the radius is 8 in. and the height is 5 in.?

A) 352π $in.^3$/sec B) -44 $in.^3$/sec C) -48 $in.^3$/sec D) -48π $in.^3$/sec

6) A metal cube dissolves in acid such that an edge of the cube decreases by 0.56 mm/min. How fast is the volume of the cube changing when the edge is 6.7 mm?

A) -75 mm^3/min B) -168 mm^3/min C) -240 mm^3/min D) -25 mm^3/min

7) A ladder is slipping down a vertical wall. If the ladder is 20 ft long and the top of it is slipping at the constant rate of 4 ft/s, how fast is the bottom of the ladder moving along the ground when the bottom is 16 ft from the wall?

A) 3.0 ft/s B) 0.8 ft/s C) 0.25 ft/s D) 5.0 ft/s

8) A storage tank used to hold sand is leaking. The sand forms a conical pile whose height is twice the radius of the base. The radius of the pile increases at the rate of 3 inches per minute. Find the rate of change of volume when the radius is 7 inches.

A) 294π $in.^3$/min B) 147π $in.^3$/min C) 42π $in.^3$/min D) 336π $in.^3$/min

9) A man flies a kite at a height of 120 m. The wind carries the kite horizontally away from him at a rate of 10 m/sec. How fast is the distance between the man and the kite changing when the kite is 130 m away from him?

A) 7.3 m/sec B) 10 m/sec C) 120.4 m/sec D) 4.5 m/sec

10) A spherical balloon is inflated with helium at a rate of 110π ft^3/min. How fast is the balloon's radius increasing when the radius is 5 ft?

A) 1.10 ft/min B) 2.75 ft/min C) 3.30 ft/min D) 0.22 ft/min

2 Solve Apps: Related Rates II

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

Solve the problem. Round your answer, if appropriate.

1) Water is falling on a surface, wetting a circular area that is expanding at a rate of 6 mm^2/s. How fast is the radius of the wetted area expanding when the radius is 128 mm? (Round your answer to four decimal places.)

A) 0.0075 mm/s B) 134.0412 mm/s C) 0.0149 mm/s D) 0.0469 mm/s

2) Water is being drained from a container which has the shape of an inverted right circular cone. The container has a radius of 3.00 inches at the top and a height of 6.00 inches. At the instant when the water in the container is 3.00 inches deep, the surface level is falling at a rate of 2 in./sec. Find the rate at which water is being drained from the container.

A) 14.1 $in.^3/s$ B) 13.5 $in.^3/s$ C) 22.0 $in.^3 s$ D) 23.6 $in.^3/s$

3) A man 6 ft tall walks at a rate of 7 ft/sec away from a lamppost that is 13 ft high. At what rate is the length of his shadow changing when he is 70 ft away from the lamppost? (Do not round your answer)

A) 6 ft/sec B) $\frac{42}{19}$ ft/sec C) $\frac{21}{19}$ ft/sec D) $\frac{245}{3}$ ft/sec

3 Solve Apps: Related Rates III

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

Solve the problem. Round your answer, if appropriate.

1) A piece of land is shaped like a right triangle. Two people start at the right angle of the triangle at the same time, and walk at the same speed along different legs of the triangle. If the area formed by the positions of the two people and their starting point (the right angle) is changing at 2 m^2/s, then how fast are the people moving when they are 4 m from the right angle? (Round your answer to two decimal places.)

A) 0.50 m/s B) 8.00 m/s C) 1.00 m/s D) 0.25 m/s

2) Water is discharged from a pipeline at a velocity v (in ft/sec) given by $v = 1856p^{(1/2)}$, where p is the pressure (in psi). If the water pressure is changing at a rate of 0.413 psi/sec, find the acceleration (dv/dt) of the water when p = 30.0 psi.

A) 70.0 ft/sec^2 B) 169 ft/sec^2 C) 2100 ft/sec^2 D) 50.8 ft/sec^2

3) Boyle's law states that if the temperature of a gas remains constant, then $PV = c$, where P = pressure, V = volume, and c is a constant. Given a quantity of gas at constant temperature, if V is decreasing at a rate of 14 $in.^3/sec$, at what rate is P increasing when P = 60 $lb/in.^2$ and V = 20 $in.^3$? (Do not round your answer.)

A) 42 $lb/in.^2$ per sec B) $\frac{14}{3}$ $lb/in.^2$ per sec C) $\frac{600}{7}$ $lb/in.^2$ per sec D) 9 $lb/in.^2$ per sec

2.9 Differentials and Approximations

1 Find Differential

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

Find dy.

1) $y = 2x^2 + 2x + 9$

A) (4x + 2) dx B) 4x + 4 dx C) 4x dx D) 4x + 9 dx

2) $y = 3\sqrt{x} + \frac{4}{x}$

A) $\left(\frac{3}{2\sqrt{x}} - \frac{4}{x^2}\right) dx$ B) $\left(\frac{3}{2\sqrt{x}} + \frac{4}{x^2}\right) dx$ C) $\left(\frac{3\sqrt{x}}{2} - \frac{4}{x^2}\right) dx$ D) $\left(\frac{3\sqrt{x}}{2} + \frac{4}{x^2}\right) dx$

3) $y = x\sqrt{5x + 8}$

A) $\frac{15x + 16}{2\sqrt{5x + 8}}\,dx$ B) $\frac{15x + 16}{\sqrt{5x + 8}}\,dx$ C) $\frac{15x - 16}{2\sqrt{5x + 8}}\,dx$ D) $\frac{15x - 16}{\sqrt{5x + 8}}\,dx$

4) $y = \frac{x}{\sqrt{9x + 8}}$

A) $\frac{9x + 16}{2(9x + 8)^{3/2}}\,dx$ B) $\frac{9x - 16}{2(9x + 8)^{3/2}}\,dx$ C) $\frac{9x + 16}{2\sqrt{9x + 8}}\,dx$ D) $\frac{9x - 16}{2\sqrt{9x + 8}}\,dx$

5) $4y^{1/2} - 3xy + x = 0$

A) $\left(\frac{3y - 1}{2y^{-1/2} - 3x}\right)dx$ B) $\left(\frac{-1}{2y^{-1/2} - 3x}\right)dx$ C) $\left(\frac{3y - 1}{2y^{-1/2} + 3x}\right)dx$ D) $\left(\frac{3y - 1}{4y - 3x}\right)dx$

6) $2x^2y - 4x^{1/2} - y = 0$

A) $\left(\frac{2x^{-1/2} - 4xy}{2x^2 - 1}\right)dx$ B) $\left(\frac{2x^{-1/2} - 4xy}{2x^2 + 1}\right)dx$ C) $\left(\frac{2x^{-1/2} + 4xy}{2x^2 - 1}\right)dx$ D) $\left(\frac{2x^{-1/2} + 4xy}{2x^2 + 1}\right)dx$

7) $y = \cos(5\sqrt{x})$

A) $\left(\frac{-5\sin(5\sqrt{x})}{2\sqrt{x}}\right)dx$ B) $\left(\frac{5\sin(5\sqrt{x})}{2\sqrt{x}}\right)dx$

C) $\left(\frac{-5\sqrt{x}\sin(5\sqrt{x})}{2}\right)dx$ D) $\left(\frac{5\sqrt{x}\sin(5\sqrt{x})}{2}\right)dx$

8) $y = \sin(2x^2)$

A) $4x\cos(2x^2)\,dx$ B) $-4x\cos(2x^2)\,dx$ C) $4\cos(2x^2)\,dx$ D) $-4\cos(2x^2)\,dx$

9) $y = 3\cot\left(\frac{1}{3}x^3\right)$

A) $-3x^2\csc^2\left(\frac{1}{3}x^3\right)dx$ B) $-3x^3\csc^2\left(\frac{1}{3}x^3\right)dx$ C) $3x^2\csc^2\left(\frac{1}{3}x^3\right)dx$ D) $-3x^2\csc\left(\frac{1}{3}x^3\right)dx$

10) $y = \csc(3x^2 - 1)$

A) $-6x\csc(3x^2 - 1)\cot(3x^2 - 1)\,dx$ B) $6x\csc(3x^2 - 1)\cot(3x^2 - 1)dx$

C) $-3x^2\csc(3x^2 - 1)\cot(3x^2 - 1)\,dx$ D) $-6x\csc(6x)\cot(6x)\,dx$

2 Find Value of Differential

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

Find $\triangle y$ for the given values of x_1 and x_2.

1) $y = x^3 + 2x;\ x = 2, \Delta x = 0.01$

A) 0.14 B) 0.014 C) 0.007 D) 0.07

2) $y = \frac{1}{x};\ x = 10, \Delta x = -0.003$

A) 0.00003 B) 0.0003 C) 0.003 D) 0.03

3) $y = \frac{x^2}{\sqrt{x^2 + 21}}$; $x = 10$, $\Delta x = 0.1$

A) $\frac{142}{1331}$ B) $\frac{144}{1331}$ C) $\frac{146}{1331}$ D) $\frac{148}{1331}$

4) $y = x^3 - 4x^2 + 2x + 1$; $x = 8$, $\Delta x = -0.3$

A) −39 B) −37 C) 39 D) 37

5) $y = 2x + 3$; $x = 18$, $\Delta x = 0.5$

A) 1 B) 0.1 C) 5 D) 0.5

6) $y = 5x^2 - 2x + 3$; $x = 2$, $\Delta x = -\frac{1}{6}$

A) −3 B) 3 C) −6 D) 6

7) $y = 2x^5 - 3x^2 + x - 1$; $x = -1$, $\Delta x = \frac{1}{3}$

A) $\frac{17}{3}$ B) $\frac{19}{3}$ C) $\frac{22}{3}$ D) $\frac{25}{3}$

8) $y = \frac{4}{x^4} + 3\sqrt{x}$; $x = 4$, $\Delta x = 0.5$

A) $\frac{47}{128}$ B) $\frac{45}{128}$ C) 0.47 D) 0.45

9) $y = \frac{1}{4x^3} + 3\sqrt{x^2 + 3}$; $x = 1$, $\Delta x = 0.2$

A) 0.15 B) 0.5 C) 0.02 D) 0.05

10) $y = \frac{3x - 7}{x - 1}$; $x = 2$, $\Delta x = 0.1$

A) 0.4 B) 4 C) 0.6 D) 6

3 Use Differential to Approximate Value

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

Use differentials to calculate the given number.

1) $\sqrt[3]{1.006}$
Give your answer as a decimal.

A) 1.002 B) 1.006 C) 1.02 D) 2.002

2) $\sqrt{64.25}$
Give your answer as a decimal. Round to 5 decimal places if necessary.

A) 8.01563 B) 9.00000 C) 10.00000 D) 7.00000

3) $\sqrt{28}$
Give your answer as a decimal. Round to 4 decimal places if necessary.

A) 5.3000 B) 8.0000 C) 5.6000 D) 4.7000

4) $\sqrt{16.3}$
Give your answer as a decimal. Round to 4 decimal places if necessary.

A) 4.0375 B) 4.3000 C) 4.0750 D) 3.9625

4 Solve Apps: Differentials

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

Solve the problem.

1) A surveyor is standing 35 ft from the base of a building. She measures the angle of elevation to the top of the building to be 65°. How accurately must the angle be measured for the percentage error in estimating the height of the building to be less than 5%?

A) To within −0.02° B) To within −0.02% C) To within −0.005° D) To within −0.47°

2) About how accurately must the interior diameter of a 8−m high cylindrical storage tank be measured to calculate the tank's volume within 0.5% of its true value?

A) To within 0.25% B) To within 0.5%

C) To within 0.25 meters D) To within 0.5 meters

3) A manufacturer contracts to mint coins for the federal government. How much variation dr in the radius of the coins can be tolerated if the coins are to weigh within 1/10 of their ideal weight? Assume that the thickness does not vary.

A) Variation of 5.0000% or less B) Variation of 0.0500% or less

C) Variation of 5.0000 cm or less D) Variation of 10.0000% or less

4) The radius of a ball is claimed to be 4.5 inches, with a possible error of 0.05 inch. Use differentials to approximate the maximum possible error in calculating the volume of the sphere and the surface area of the sphere.

A) 4.05π in.^{3}; 1.8π in.^{2} B) 1.8π in.^{3}; 4.05π in.^{2}

C) 8.1π in.^{3}; 3.6π in.^{2} D) 0.9π in.^{3}; 18π in.^{2}

5) A cube 7 inches on an edge is given a protective coating 0.1 inches thick. About how much coating should a production manager order for 1000 cubes?

A) About 29,400 in.^{3} B) About 34,300 in.^{3} C) About 14,700 in.^{2} D) About 4900 in.^{2}

6) The concentration of a certain drug in the bloodstream x hr after being administered is approximately $C(x) = \frac{4x}{14 + x^2}$. Use the differential to approximate the change in concentration as x changes from 1 to 1.11.

A) 0.03 B) 0.16 C) 0.29 D) 0.25

7) $A = \pi r^2$, where r is the radius, in centimeters. By approximately how much does the area of a circle decrease when the radius is decreased from 2.0 cm to 1.8 cm? (Use 3.14 for π.)

A) 2.5 cm^2 B) 1.3 cm^2 C) 2.7 cm^2 D) 2.3 cm^2

8) $V = \frac{4}{3}\pi r^3$, where r is the radius, in centimeters. By approximately how much does the volume of a sphere increase when the radius is increased from 3.0 cm to 3.2 cm? (Use 3.14 for π.)

A) 22.6 cm^3 B) 1.5 cm^3 C) 22.8 cm^3 D) 22.4 cm^3

9) The diameter of a tree was 11 in. During the following year, the circumference increased 2 in. About how much did the tree's diameter increase? (Leave your answer in terms of π.)

A) $\frac{2}{\pi}$ in. B) $\frac{11}{\pi}$ in. C) $\frac{13}{\pi}$ in. D) $\frac{\pi}{2}$ in.

10) Estimate the volume of material in a cylindrical shell with height 28 in., radius 7 in., and shell thickness 0.6 in. (Use 3.14 for π.)

A) 738.5 $in.^3$ B) 1230.9 $in.^3$ C) 369.3 $in.^3$ D) 748.5 $in.^3$

11) About how accurately must the interior diameter of a cylindrical storage tank that is 14 m high be measured in order to calculate the tank's volume within 0.5% of its true value?

A) Within 0.25% B) Within 0.5% C) Within 0.25 meters D) Within 0.5 meters

12) A manufacturer contracts to mint coins for the federal government. How much variation dr in the radius of the coins can be tolerated if the coins are to weigh within 1/10 of their ideal weight? Assume that the thickness does not vary.

A) 5.0% B) 0.050% C) 0.10% D) 10%

13) The radius of a ball is claimed to be 4.5 inches, with a possible error of 0.05 inch. Use differentials to approximate the maximum possible error in calculating the volume of the sphere and the surface area of the sphere.

A) 4.05π $in.^3$; 1.8π $in.^2$ B) 1.8π $in.^3$; 4.05π $in.^2$

C) 8.1π $in.^3$; 3.6π $in.^2$ D) 0.9π $in.^3$; 18π $in.^2$

14) The elasticity ε of a particular thermoplastic can be modeled approximately by the relation $\varepsilon = \frac{2.5x10^5}{T^{2.3}}$, where T is the Kelvin temperature. If the thermometer used to measure T is accurate to 1%, and if the measured temperature is 480 K, how should the elasticity be reported?

A) $\varepsilon = 0.170 \pm 0.004$ B) $\varepsilon = 0.170 \pm 0.002$ C) $\varepsilon = \pm 0.004$ D) $\varepsilon = 0.170$

5 Find Linear Approximation

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

Find the linearization L(x) of f(x) at x = a.

1) $f(x) = 2x^2 - 5x - 1$, $a = 2$

A) $L(x) = 3x - 9$ B) $L(x) = 13x - 9$ C) $L(x) = 3x + 7$ D) $L(x) = 13x + 7$

2) $f(x) = \sqrt{2x + 81}$, $a = 0$

A) $L(x) = \frac{1}{9}x + 9$ B) $L(x) = \frac{2}{9}x + 9$ C) $L(x) = \frac{1}{9}x - 9$ D) $L(x) = \frac{2}{9}x - 9$

3) $f(x) = \frac{1}{7x + 4}$, $a = 0$

A) $L(x) = -\frac{7}{16}x + \frac{1}{4}$ B) $L(x) = -\frac{7}{16}x + \frac{1}{16}$ C) $L(x) = \frac{7}{16}x + \frac{1}{4}$ D) $L(x) = \frac{7}{16}x + \frac{1}{16}$

4) $f(x) = \frac{x}{6x + 9}$, $a = 0$

A) $L(x) = \frac{1}{9}x$ B) $L(x) = -\frac{1}{9}x$ C) $L(x) = \frac{1}{81}x$ D) $L(x) = -\frac{1}{81}x$

5) $f(x) = x + \frac{1}{x}$, $a = 2$

A) $L(x) = \frac{3}{4}x + 1$ B) $L(x) = \frac{3}{4}x + \frac{2}{3}$ C) $L(x) = \frac{5}{4}x + \frac{2}{3}$ D) $L(x) = \frac{5}{4}x + 1$

6) $f(x) = \sqrt[3]{x}$, $a = 27$

A) $L(x) = \frac{1}{27}x + 2$ B) $L(x) = \frac{1}{27}x + 1$ C) $L(x) = \frac{1}{9}x + 1$ D) $L(x) = \frac{1}{9}x + 6$

7) $f(x) = \tan x$, $a = \pi$

A) $L(x) = x - \pi$ B) $L(x) = x + \pi$ C) $L(x) = x - 3\pi$ D) $L(x) = 3x - \pi$

8) $f(x) = \cos x$, $a = 0$

A) $L(x) = 1$ B) $L(x) = -1$ C) $L(x) = 3x + 1$ D) $L(x) = 0$

6 *Know Concepts: Differentials

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

Solve the problem.

1) Suppose f is a function satisfying $f(-4) = -6$ and $f'(-3.99) = \frac{1}{10}$. Use this information to approximate $f(-3.99)$.

A) -5.999 B) 0.001 C) -5.99 D) -5.9

2) Find the linear approximation to $f(x) = -8x + -4$ at $a = -7$. What is the relationship between the linearization $L(x)$ and $f(x)$?

A) $L(x) = -8x + -4 = f(x)$

Ch. 2 The Derivative
Answer Key

2.1 Two Problems with One Theme

1 Estimate Slope of Tangent Line at a Point

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A

2 Find Slope of Tangent by Finding Limit of Slopes of Secant Lines

1) A
2) A
3) A

3 Find Slope of Tangent Line at a Point

1) A
2) A
3) A
4) A
5) A

4 Find Equation of Tangent Line at a Point

1) A
2) A
3) A
4) A
5) A
6) A
7) A

5 Calculate Instantaneous Velocity

1) A
2) A
3) A
4) A
5) A
6) A
7) A

6 Find Expression for Instantaneous Acceleration

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A

7 Tech: Find Slope of Tangent Line

1) A
2) A
3) A
4) A

2.2 The Derivative

1 Evaluate Derivative at a Point

1) A
2) A
3) A
4) A
5) A
6) A
7) A

2 Find Derivative I

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A

3 Find Derivative II

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A
11) A

4 Use Definition of Derivative To Find Function

1) A
2) A
3) A
4) A

5 Graph Derivative Given Graph of Function

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A

6 Find Delta y

1) A
2) A
3) A
4) A
5) A

7 Estimate Derivative at a Point

1) A

2) A
3) A
4) A
5) A
6) A
7) A
8) A

8 *Know Concepts: The Derivative

1) $[5, \infty)$
2) The function $y = 2x^2$ increases (as x increases) over the interval $0 < x < \infty$. Its derivative $y' = 4x$ is positive for $x > 0$. The function increases (as x increases) wherever its derivative is positive.
3) The function $y = \frac{x^5}{5}$ decreases (as x increases) over no intervals of x–values. Its derivative $y' = x^4$ is negative for no values of x. The function decreases (as x increases) wherever its derivative is negative.
4) The curve $y = \sqrt{x}$ never has a negative slope. The derivative of the curve is $y' = \frac{1}{2\sqrt{x}}$, which is never negative. A curve only has a negative slope where its derivative is negative. Since the derivative of $y = \sqrt{x}$ is never negative, the curve never has a negative slope.
5) The curve $y = (x + 3)^3$ has a horizontal tangent at $x = -3$. The derivative of the curve is $y' = 3(x + 3)^2$, which equals zero at $x = -3$. A curve has a horizontal tangent wherever its derivative equals zero.
6) The curve has no tangent whose slope is -2. The derivative of the curve, $y' = 3x^2 + 4$, is always positive and thus never equals -2.
7) Yes, a tangent line to a graph can intersect the graph at more than one point. For example, the graph $y = x^3 - 2x^2$ has a horizontal tangent at $x = 0$. It intersects the graph at both (0, 0) and (2, 0).
8) $g'(4) = 10$
9) $g'(4) = -5$
10) There is no difference at all. At $x = a$, the slope of the tangent $= \lim_{x \to a} \frac{f(x) - f(a)}{x - a} = f'(x)$.

2.3 Rules for Finding Derivatives

1 Find Derivative Using Power/Sum/Difference Rules

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A

2 Find Derivative of Product

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A

3 Find Derivative of Quotient

1) A

2) A
3) A
4) A
5) A
6) A
7) A
8) A

4 Find Derivative Given Numerical Values

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A

5 Find Equation of Tangent Line at a Point

1) A
2) A
3) A
4) A

6 Find Points at Which Tangent Line Has Given Slope

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A

7 Solve Apps: Derivative Rules

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A

2.4 Derivatives of Trigonometric Functions

1 Find Derivative of Trigonometric Function

1) A
2) A
3) A
4) A
5) A
6) A
7) A

2 Solve Apps: Tangent Lines

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A

3 Use Trigonometric Identity To Find Derivative

1) A

2.5 The Chain Rule

1 Find Derivative Using Chain Rule I

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A

2 Find Derivative Using Chain Rule II

1) A
2) A
3) A

3 Evaluate Derivative at a Point Using Chain Rule

1) A
2) A
3) A
4) A

4 Apply Chain Rule More Than Once to Find Derivative

1) A
2) A
3) A
4) A
5) A
6) A

5 Estimate Derivative Given Graphs of Two Functions

1) A
2) A
3) A
4) A
5) A
6) A

6 Express Derivative in Terms of F(x)

1) A
2) A
3) A

7 Find Derivative Given Numerical Values

1) A

2) A
3) A
4) A
5) A
6) A
7) A

8 Find Equation of Tangent Line

1) A
2) A
3) A
4) A

9 Solve Apps: Chain Rule

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A

10 Know Concepts: Chain Rule

1) A
2) A
3) A

2.6 Higher–Order Derivatives

1 Find Higher–Order Derivative

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A
11) A
12) A

2 Evaluate Second Derivative

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A

3 Calculate Acceleration

1) A
2) A
3) A
4) A
5) A

4 Solve Apps: Motion

1) A
2) A
3) A
4) A

5 Know Concepts: Higher–Order Derivatives

1) A
2) A
3) A
4) A

2.7 Implicit Differentiation

1 Find Derivative Using Implicit Differentiation

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A

2 Find Equation of Tangent Line

1) A
2) A
3) A

3 Find Derivative Containing Rational Power

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A

4 Find Second Derivative Using Implicit Differentiation

1) A
2) A
3) A
4) A
5) A

5 Know Concepts: Implricit Differentiation

1) A

2.8 Related Rates

1 Solve Apps: Related Rates I

1) A
2) A
3) A
4) A
5) A
6) A
7) A

8) A
9) A
10) A

2 Solve Apps: Related Rates II

1) A
2) A
3) A

3 Solve Apps: Related Rates III

1) A
2) A
3) A

2.9 Differentials and Approximations

1 Find Differential

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A

2 Find Value of Differential

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A

3 Use Differential to Approximate Value

1) A
2) A
3) A
4) A

4 Solve Apps: Differentials

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A
9) A
10) A
11) A
12) A
13) A
14) A

5 Find Linear Approximation

1) A
2) A
3) A
4) A
5) A
6) A
7) A
8) A

6 *Know Concepts: Differentials

1) A
2) A