8.1 Definition of a Limit

Answers

1. $\lim_{x \to a^-} 4x^3 + 3x^2 - 4x - 1$
2. $\lim_{z \to a^-} g(z)$
3. $\lim_{y \to b^-} g(y)$
4. $\lim_{z \to -1^+} h(z)$
5. $\lim_{y \to a^-} h(y)$
6. $\lim_{z \to a} h(z)$
7. -0.35355
8. -1
9. 1.8508
10. -0.02066
11. The limit does not exist
12. -2
13. -0.05
14. the limit does not exist
15. -0.05774
16. 1.5574
17. For each element > 0 there exists a difference > 0,

    such that if $0 < |y - 2| <$ difference, then $|tan\ y - L| <$ element
18. The answer for each element > 0 there exists a difference > 0,

    such that if $0 < |x - 1| <$ difference, then $|f(x) - N| <$ element
19. The answer for each element > 0 there exists a difference > 0,

    such that $if\ 0 < |x - (-x)| <$ difference, then $| - x^3 + 3x^2 + 2x + 4 - L| <$ element

8.2 One Sided Limits

Answers

1. 5
2. -3
3. -8, 2
4. 2
5. -2.5, 5
6. Substituting $x = 2$ into $-x - 4$, we get an answer of -6.
7. From the left we are looking at 1. Substituting $x = -3$ into 1, we get 1.
8. Substituting $x = 0$ into $-x + 4$, we get an answer of 4.
9. From the right we are looking at -5. Substituting $x = -1$ into -5, we get -5.
10. Substituting $x = 1$ into $4x + 3$, we get an answer of 7.
11. From the left we are looking at $x + 1$. Substituting $x = 3$ into $x + 1$, we get 4.
12. Substituting $x = 0$ into $x - 4$, we get an answer of -4.
13. From the right we are looking at $4x + 4$. Substituting $x = 2$ into $4x + 4$, we get 12.
14. Substituting $x = 2$ into $4x + 1$, we get an answer of 9.
15. From the left we are looking at $4x + 1$. Substituting $x = -2$ into $4x + 1$, we get -7.
16. From the left we are looking at $-3x$. Substituting $x = 3$ into $-3x$, we get -9.
17. Substituting $x = -5$ into $-3x + 2$, we get an answer of 17.
18. From the left we are looking at $3x - 3$. Substituting $x = 2$ into $3x - 3$, we get 3.

8.3 Infinite Limits

Answers

1. $-\infty$
2. $+\infty$
3. $-\infty$
4. 1
5. $-\infty$
6. $\frac{11}{9}$
7. 13
8. $-\frac{2}{17}$
9. 15
10. $-\infty$
11. ∞
12. $-\infty$
13. 0
14. $-\infty$
15. $-\infty$

8.4 Polynomial Function Limits

Answers

1. -12
2. 2
3. 4
4. -2
5. 4
6. 3
7. 0
8. -94
9. -7
10. -44
11. $\sqrt{2}$
12. 10
13. 10
14. $-\sqrt{3i}$
15. -3
16. -2354
17. $\sqrt{26}$

8.5 Rational Function Limits

Answers

1. -6
2. the limit does not exist
3. 0.17284
4. -3
5. 2.75
6. -0.04
7. the limit does not exist
8. 0
9. 0.05159
10. 17
11. -18
12. 0.01561
13. 0.25
14. the limit does not exist
15. 1.5
16. 2
17. 3

8.6 Applications of One-Sided Limits

Answers

1. Yes
2. No
3. No
4. Yes
5. Yes
6. 0
7. 9
8. -6
9. 3
10. 9
11. limit does not exist
12. -8
13. -3
14. -3
15. -7
16. 9
17. limit does not exist
18. 4
19. -2
20. $+\infty$
21. Use a graph, see it here: https://www.desmos.com/drive/calculator/esekwoanq8

8.7 Tangents to a Curve

Answers

1. The secant line
2. Tangent
3. The distance between the two points used to find the tangent line
4. "h" – the distance between the points
5. The limit of the function $\frac{f(x+h)-f(x)}{h}$ as $h \to 0$ describes the slope of the tangent.
6. $y = x - 2$
7. $y = -5x + 8$
8. $y = -3x + 7$
9. $y = 3x - 8$
10. $y = 5x + 22$
11. $y = -20x + 16$
12. $y = -2x$
13. $y = 19x - 5$
14. $y = 8x + 3$
15. $y = 10x$
16. $y = -19x - 7$
17. $x = y$
18. $y = -2x + 3$
19. $y = 3$
20. $y = 36x + 19$

8.8 Instantaneous Rates of Change

Answers

1. $\frac{2376}{44} = \frac{54}{1}$
2. $\frac{646}{19} = \frac{34}{1}$
3. $\frac{10208}{44} = \frac{232}{1}$
4. $\frac{5341}{49} = 109$
5. $\frac{9720}{24} = 405$
6. 210
7. 55
8. 80
9. 105
10. 140
11. $f'(x) = 12x,\ y = 36x - 54$
12. $f'(x) = \frac{1}{2\sqrt{(x+2)}},\ y = \frac{1}{\sqrt{(10)}}\left(\frac{1}{2}x + 6\right)$
13. $f'(x) = 9x^2, y = 9x + 4$
14. $f'(x) = \frac{-1}{(x+2)^2},\ y = -x$
15. $f'(x) = 2ax, y = 2abx - b(b(ab + 1)$
16. $f'(x) = \frac{1}{3x^{\frac{2}{3}}} : y = \frac{1}{3}x + \frac{2}{3}$
17. $f'(0) = 0, f(x) = 4 + 3x$
18. 10

19. $f'(x)$ is the instantaneous rate of change of J with respect to x, that is, change in the production cost with respect to the number of jars produced. So the rate of change in the production cost with respect to the number of jars produced is $9999\frac{dollars}{jar}$. So we get the instantaneous rate of change in the production cost with respect to the number of jars produced is $9999\frac{dollars}{jar}$

20. $f'(x)$ is the instantaneous rate of change of T with respect to x, that is, change in the temperature of the pie with respect to the number of minutes that have passed. So the rate of change in the temperature of the pie with respect to the number of minutes that have passed is 102 degrees/minute. So we get the instantaneous rate of change in the temperature of the pie with respect to the number of minutes that have passed is $102\frac{degrees}{minute}$.

21. $f'(x)$ is the instantaneous rate of change of V with respect to x, that is, change in the quantity of the virus with respect to the number of hours that have passed. So we get $\frac{virus}{hour}$.

22. $f'(x)$ is the instantaneous rate of change of N with respect to x, that is, change in the number of cold cases in the US with respect to the date in November.

23. Change in households affected by hurricanes is: $2483 - 76 = 2407$.
Change in days is $34 - 5 = 29$
$2407/29 = 83$ households affected per day on average.

24. $135\frac{degrees}{minute}$.

25. So the change in degrees is $6107 - 80 = 6027$
And the change in minutes is $54 - 5 = 49$
So the answer is $123\frac{degrees}{minute}$

8.9 Constant Derivatives and the Power Rule

Answers

1. $n^2 = nx^{n-1}$
2. $y' = 35x^6$
3. $y' = -3$
4. $f'(x)\frac{1}{3}$
5. $y' = 4x^3 - 6x^2 - \frac{5}{2\sqrt{(x)}}$
6. $y' = 20x\ (5x^2 - 3)$
7. -29.4784
8. $0\ for\ all\ x$
9. 0
10. 0
11. -0.37
12. $g'(x) = -3x^{-4}$ for all x
13. $u'(x) = .96x^{-0.49}$ for all x
14. $k'(x) = -0.49x^{-1.49}$ for all x
15. $s'(x) = -5\pi^3\ x^{-5\pi^3-1}$ for all x

8.10 Derivative pf Sums and Differences

Answers

1. $y' = \frac{3}{2}x^2 - 2x$
2. $y' = 3\sqrt{2}\,x^2 - \sqrt{2}x + 2$
3. $y' = 2x + 1$
4. $y' = -\frac{3}{x^4} - \frac{7}{x^8}$
5. $y' = \frac{1}{2\sqrt{x}} - \frac{1}{2x^{\frac{3}{2}}}$
6. $f(x) = 18x - 24$
7. $-9.3x^9 + (-\frac{5}{12}\pi^3\, x^{-\frac{17}{12}})$ for all x
8. $8x + 4$
9. $50x - 30$
10. $(-x + 2)(e^x)$
11. $y' = (x^3 - 3x^2 + x)\cdot(6x^2 + 28x^3) + (3x^2 - 6x + 1)\cdot(2x^3 + 7x^4)$
12. $y' = 9x^2 + 6x + \frac{7}{x^2} + \frac{14}{x^3}$
13. $27x^2 + 12x - 15$
14. $3\cos x - (3x)\sin x + 3\sin x$
15. $3 = r(-2)$
16. $g'(x) = 45$
17. $-4\sin x - (4x)\cos x + 3\cos x$
18. 282
19. $a(1)$
20. $d'(x) = -3$

8.11 Quotient Rule and Higher Derivatives

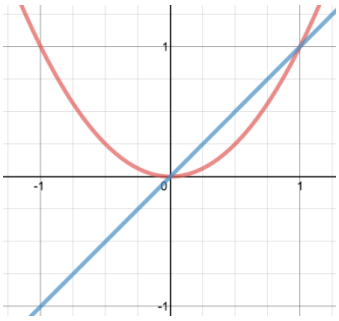
Answers

1. $q(0) = 14$
2. $b'(x) = -\frac{1}{32}$
3. $(3xe^x + e^x)(9x^2 + 24x + 16)$
4. $\frac{x\cos x - 4\cos x - \sin x}{x^2 - 8x + 16}$
5. $\frac{\sin x - x\cos x}{\sin^2 x}$
6. $-24x + 6$
7. 2
8. $3x^4e^x + 24x^3e^x + 36x^2e^x$
9. $2x^5\sin x - 20x^4\cos x - 40x^3\sin x$
10. $3x^5e^x + 30x^4e^x + 60x^3e^x$
11. $y' = \frac{-3}{2\sqrt{x}}\left(\sqrt{x} + 3\right)^2$
12. $y' = \frac{-4x^2 - 2x - 36}{(x^2 - 9)^2}$
13. $\frac{dF}{dr} = -2G\frac{mM}{r^3}$
14. $\frac{(\psi_0 + 3\psi^2)}{(3 - \psi_0)}$
15. -120

8.12 Area Under the Curve

Answers

1. $\frac{8}{3}$
2. 4
3. -4
4. 0
5. 18
6. $= F(5) - F(4) = 3(5) - 3(4) = 15 - 12 = 3$
7. $= F(5) - F(1) = \left(\frac{3}{2}5^2 + 5\right) - \left[\frac{3}{2}(1)^2 + (1)\right] = \frac{85}{2} - \frac{5}{2} = 40$
8. $= F(4) - F(3) = ln(4) - ln(3) = 0.2877$
9. $= F(6) - F(5) = [(6)^2 + 4(6)] - [(5)^2 + 4(5)] = 60 - 45 = 15$
10. $= \frac{11645}{12} - \frac{110}{3} = \frac{3735}{4}$
11. $= F(7) - F(3) = [ln(7)] - [ln(3)] = 0.8473$
12. $= F(6) - F(5) = [(6)3 + (6)2] - [(5)3 + (5)2] = 252 - 150 = 102$
13. $= F(6) - F(2) = [4(6)] - [4(2)] = 24 - 8 = 16$
14. $= \frac{475}{3} - \frac{23}{3} = \frac{452}{3}$
15.



Area is $\frac{1}{6}$

8.13 Fundamental Theorem of Calculus

Answers

1. $\frac{45}{2}$
2. $\frac{1}{5}$
3. $-\frac{3}{2}$
4. $-\frac{9}{2}$
5. 18
6. $F(0) - F(-1) = [-3(0)] - [-3(-1)] = 0 - 3 = -3$
7. $F(3) - F(-1) = [(3)] - [(-1)] = 3 - -1 = 4$
8. $F(\frac{p}{2}) - F(-p) = [-4sin\left(\frac{p}{2}\right)] - [-4sin(-p)] = -4 - 0 = -4$
9. $F(2) - F(0) = [-2] - [0] = -2$
10. $F(7) - F(2) = [ln(7)] - [ln(2)] = 1.2528$
11. $F(0) - F(-2) = [\frac{1}{2}(0)^2 + 5(0)] - [\frac{1}{2}(-2)^2 + 5(-2)] = 0 - -8 = 8$
12. $F(\frac{3p}{2}) - F(-p) = [-6cos\left(\frac{3p}{2}\right)] - [-6cos(-p)] = 0 - 6 = -6$
13. $F(7) - F(6) = [ln(7)] - [ln(6)] = 0.1542$
14. a) ¼

    b) 0
15. $\frac{4\pi}{3}R^3$