Use the **limit definition** of the derivative to find the equation of the tangent line to the graph of the function at the given point.

(1) $f(x) = 6 + x - 3x^2$ at $x = 2$

(2) $f(x) = 7x^2 - 6x + 3$ at $x = -1$

(3) $f(x) = -2x^2 + 3x + 2$ at $x = 3$

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

(5) $f(x) = 4x^2 + 5x - 7$ at $x = -3$

(6) $f(x) = 3x^2 + 8x - 6$ *at* $x = 1$

(7) $f(x) = 4 - 2x - x^2$ *at* $x = 1$

(8) $f(x) = 2x^2 + 4x + 1$ *at* $x = -2$

(9) $f(x) = -4x^2 + 5x + 6$ *at* $x = -1$

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

(11) $f(x) = 6x^2 - 9x + 5$ *at* $x = 3$

(12) $f(x) = 5x^2 - 3x + 6$ *at* $x = -3$

(13) $f(x) = \dfrac{4}{x+1}$ *at* $x = 3$

(14) $f(x) = 6\sqrt{x+2}$ *at* $x = 2$

(15) $f(x) = \dfrac{2}{x^2 - 3}$ at $x = -2$

(16) $f(x) = \sqrt{x^3 - 4}$ at $x = 2$

Find the slope of the tangent line to the graph of the given function at the given point.

(17) $f(x) = 7x^2 - 2\sqrt{x} + \dfrac{16}{x} - 12$ at $x = 4$

(18) $g(x) = 6x^3 - 4\sqrt[3]{x} - \dfrac{3}{x^2} + 3$ *at* $x = -1$

(19) $g(x) = \dfrac{4}{\sqrt[3]{x}} - 12x^2 - 6\sqrt{x} + 7$ *at* $x = 1$

(20) $g(x) = 18x^4 + 6\sqrt[4]{x^3} - \dfrac{5}{x^2} + 10$ *at* $x = 1$

(21) $g(x) = 6x - \dfrac{15}{x^4} + 4x^2 + 13$ *at* $x = 2$

(22) $g(x) = 7x + \dfrac{12}{x^3} - 16x^2 + 25$ *at* $x = -1$

(23) $f(x) = \left(x^2 + 1\right)\left(1 - x^3\right)$ *at* $x = 2$

(24) $f(x) = \left(3x^2 + x + 2\right)(1 + 3x)$ *at* $x = -1$

(25) $f(x) = \left(x^2 - 2x\right)\left(5 - x + 2x^2\right)$ *at* $x = 3$

(26) $f(x) = \left(5 + x - x^2\right)\left(2x^2 - 3x + 1\right)$ *at* $x = 1$

(27) $f(x) = (2x + \sqrt{x})\left(10\sqrt{x} - 3x^2\right)$ *at* $x = 1$

(28) $f(x) = (3x - 2\sqrt{x})\left(x^3 - x\right)$ *at* $x = 4$

(29) $g(x) = \dfrac{6}{\left(2 + x - x^2\right)^3}$ *at* $x = 1$

(30) $g(x) = \sqrt[3]{\left(4 - 4x - x^2\right)^4}$ *at* $x = 2$

(31) $g(x) = \dfrac{9}{\sqrt{2x^2 - 4x + 3}}$ *at* $x = -1$

(32) $g(x) = \left(x^4 - 2x^2 - 9\right)^4$ *at* $x = 2$

(33) $g(x) = \sqrt[5]{x^3 - 3x + 3}$ *at* $x = -2$

(34) $g(x) = 5x^3 - 4\sqrt{x} + \dfrac{2}{\sqrt{x}} - 8$ *at* $x = 1$

(35) $g(x) = 8x^4 - 6\sqrt[3]{x^2} - \dfrac{4}{x^3} + 9$ *at* $x = -1$

(36) $g(x) = \dfrac{2}{\sqrt[3]{x^5}} + 8x^{1/2} - 2x^4 + 5$ *at* $x = 1$

(37) $g(x) = \dfrac{4}{\sqrt{x^3}} - 12\sqrt[3]{x^4} + 32x^2 - 25$ *at* $x = 1$

(38) $g(x) = 3x^2 - \dfrac{5}{x^2} + 5x - 20$ *at* $x = 2$

(39) $g(x) = 12x - \dfrac{8}{x^4} + 10x^3 - 18$ *at* $x = -2$

(40) $f(x) = \left(x^2 + x\right)\left(2 - x^2\right)$ *at* $x = -2$

(41) $f(x) = \left(4x^2 + 3x + 1\right)(2 + 5x)$ *at* $x = 1$

(42) $f(x) = \left(x - x^3\right)\left(1 + x - x^2\right)$ *at* $x = -1$

(43) $f(x) = \left(2 + 3x + x^2\right)\left(4x^2 - 2x + 3\right)$ *at* $x = -1$

(44) $f(x) = (4x + 2\sqrt{x})\left(6\sqrt{x} - 4x^2\right)$ *at* $x = 4$

(45) $f(x) = (4x - 6\sqrt{x})\left(5x - x^3\right)$ *at* $x = 1$

(46) $g(x) = \dfrac{4}{\left(3 + 2x + x^2\right)^2}$ *at* $x = 1$

(47) $g(x) = \sqrt[5]{(x^3 - 4x + 1)^3}$ *at* $x = 2$

(48) $g(x) = \dfrac{12}{\sqrt{9 - 2x - x^2}}$ *at* $x = -2$

(49) $g(x) = \left(8 + 5x + 4x^3\right)^5$ *at* $x = -1$

(50) $g(x) = \sqrt[3]{2x^2 - 6x + 1}$ *at* $x = 3$

Find the equation of the tangent line to the graph of the function at the given point.

(51) $f(x) = \dfrac{2x}{x+3}$ *at* $x = -2$

(52) $f(x) = \dfrac{1 - 3x}{x - 1}$ *at* $x = 2$

(53) $f(x) = \dfrac{2 + \sqrt{x}}{2 - \sqrt{x}}$ *at* $x = 1$

(54) $f(x) = \dfrac{4\sqrt{x}}{x - 3}$ *at* $x = 9$

(55) $f(x) = \dfrac{2x + 3}{4 + \sqrt{x}}$ *at* $x = 1$

(56) $f(x) = \dfrac{3x}{x - 4}$ *at* $x = 5$

(57) $f(x) = \dfrac{2 - 5x}{x - 3}$ *at* $x = 2$

(58) $f(x) = \dfrac{\sqrt{x} + 1}{3 - \sqrt{x}}$ *at* $x = 4$

(59) $f(x) = \dfrac{3\sqrt{x}}{2 - x}$ *at* $x = 1$

(60) $f(x) = \dfrac{5x - 1}{2\sqrt{x} - 3}$ *at* $x = 4$

(61) $f(x) = \dfrac{x^2}{x - 2}$ *at* $x = 3$

(62) $f(x) = \left(x^3 - 2x^2 + 3x - 1\right)^{3/2}$ *at* $x = 1$

(63) $f(x) = \left(4x - x^2\right)\left(x^3 + 4\right)$ *at* $x = 1$

(64) $f(x) = \dfrac{24}{\sqrt{x}} + \dfrac{16}{x^2} + 3x$ *at* $x = 4$

(65) Given $f(x) = x^3 + 6x^2 - 15x + 4$, find the x-value(s) such that the tangent line to the curve of $f(x)$ is horizontal.

(66) Find the point(s) on the curve of $f(x) = 2x^3 + 15x^2 - 140x + 10$ such that the slope of the tangent line is 4.

(67) Given $f(x) = \dfrac{x^2}{x + 4}$, find the point(s) such that the tangent line to the curve of $f(x)$ is horizontal.

(68) Given $f(x) = \dfrac{\sqrt{x}}{x^2 + 3}$, find the point(s) such that the tangent line to the curve of $f(x)$ is horizontal.

(69) If $f(1) = 5$, $f'(1) = -2$ and $g(x) = x^3 \cdot f(x)$, then find $g'(1)$

(70) If $h(2) = 4$, $h'(2) = -3$ and $f(x) = \dfrac{2\,h(x)}{x^2}$, then find $f'(2)$

(71) If $g(-1) = -4$, $g'(1) = 7$ and $f(x) = g\left(x^2\right)$, then find $f'(-1)$

(72) Let the revenue R obtained from selling x units of an item be given by $R(x) = 3x(2 + x^2) + 600$. Find the marginal revenue when production is 35 units. Interpret the result.

(73) Let the average cost of production for an item be $\overline{C}(x) = -2x^2 + 4 + \dfrac{100}{x}$. Find the marginal cost when production is 50 units. Interpret the result.

(74) Let the demand for an item be $p(x) = 3x + 5x^2$, and the average cost of production be $\overline{C}(x) = 5 + 4x$. Find the marginal profit when production is 20 units. Interpret the result.

(75) Let the demand for an item be $p(x) = 4x + 10x^2$. Find the marginal revenue when production is 35 units. Interpret the result.

(76) Let the average cost of production for an item be $\overline{C}(x) = 5(4 - 3x) + \dfrac{75}{x}$. Find the marginal cost when production is 12 units. Interpret the result.

(77) Let the price function for an item be $p = 8x - 4 + \dfrac{80}{x}$. Find the marginal revenue when production is 15 units. Interpret the result.

(78) Let the revenue R (in dollars) obtained from selling x units of an item be given by $R(x) = 4x(3 + x^2) + 800$. Find the marginal revenue when production is 40 units. Interpret the result.

(79) Let the average cost of production for an item be $\overline{C}(x) = -3x + 6 + \dfrac{220}{x}$. Find the marginal cost when production is 15 units. Interpret the result.

(80) Let the demand for an time be $p(x) = 2x + 7x^2$, and the average cost of production be $\overline{C}(x) = 4 + 3x$. Find the marginal profit when production is 25 units. Interpret the result.

(81) Let the demand for an item be $p(x) = 6x + 4x^2$. Find the marginal revenue when production is 20 units. Interpret the result.

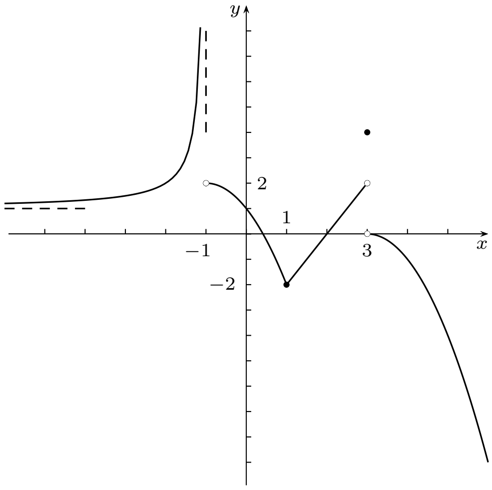
(82) Let the average cost of production for an item be $\overline{C}(x) = 6(3 - 7x) + \dfrac{150}{x}$. Find the marginal cost when production is 22 units. Interpret the result.

(83) Let the price function for an item be $p = 12x - 8 + \dfrac{90}{x}$. Find the marginal revenue when production is 9 units. Interpret the result.

(84) Let the revenue R in dollars obtained from selling x units of an item be given by $R(x) = 4x^2 + 5x + 100$. Find the marginal demand when production is 50 units. Interpret the result.

(85) Let the cost C in dollars for producing x units of an item be given by $C(x) = 0.1x^3 + 50x + 200$. Find the marginal average cost when production is 20 units. Interpret the result.

(86) Given the graph of $f(x)$,



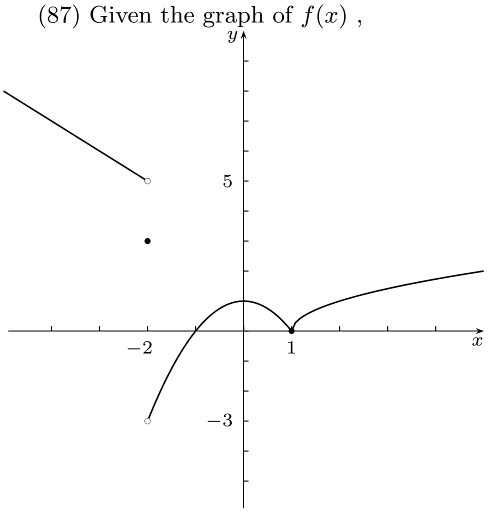
(a) Give the interval(s) where the slope of the tangent line to the curve of $f(x)$ is negative.

(b) Locate the x-value(s) where $f(x)$ is continuous but <u>not</u> differentiable.

(c) Give the interval(s) where $f(x)$ is continuous.

(d) Find the values of $f(-1)$; $f(0)$; $f(1)$; $f(3)$

(87) Given the graph of $f(x)$,



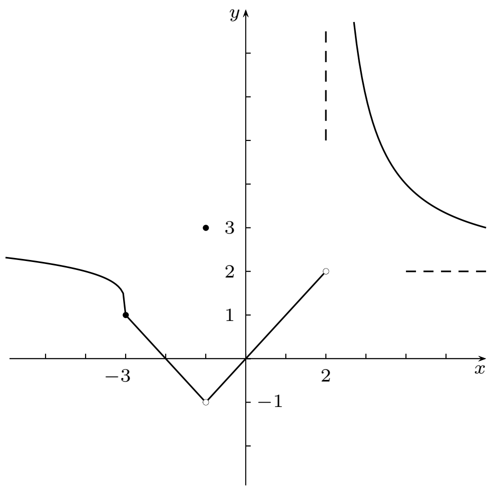
(a) Give the interval(s) where the slope of the tangent line to the curve of $f(x)$ is positive.

(b) Locate the x-value(s) where $f(x)$ is continuous but <u>not</u> differentiable.

(c) Give the interval(s) where $f(x)$ is continuous.

(d) Find the values of $f(-2)$; $f(0)$; $f(1)$; $f(-1)$

(88) Given the graph of $f(x)$,



(a) Give the interval(s) where the slope of the tangent line to the curve of $f(x)$ is negative.

(b) Locate the x-value(s) where $f(x)$ is continuous but <u>not</u> differentiable.

(c) Give the interval(s) where $f(x)$ is continuous.

(d) Find the values of $f(-3)$; $f(-2)$; $f(-1)$; $f(2)$

ANSWERS

(1) $y = -11x + 18$ (2) $y = -20x - 4$ (3) $y = -9x + 20$ (4) $y = -21x - 16$ (5) $y = -19x - 43$
(6) $y = 14x - 9$ (7) $y = -4x + 5$ (8) $y = -4x - 7$ (9) $y = 13x + 10$ (10) $y = 5x - 10$ (11) $y = 27x - 49$
(12) $y = -33x - 39$ (13) $y = \frac{-1}{4}x + \frac{7}{4}$ (14) $y = \frac{3}{2}x + 9$ (15) $y = 8x + 18$ (16) $y = 3x - 4$
(17) $\frac{109}{2}$ (18) $\frac{32}{3}$ (19) $\frac{-85}{3}$ (20) $\frac{173}{2}$ (21) $\frac{191}{8}$ (22) 3 (23) -88 (24) 22 (25) 113 (26) 5
(27) $\frac{29}{2}$ (28) 526 (29) $\frac{9}{8}$ (30) $\frac{64}{3}$ (31) $\frac{4}{3}$ (32) -96 (33) $\frac{9}{5}$ (34) 12 (35) -16 (36) $\frac{-22}{3}$
(37) 42 (38) $\frac{73}{4}$ (39) 131 (40) 14 (41) 117 (42) 2 (43) 9 (44) -844 (45) 0 (46) $\frac{-4}{27}$
(47) $\frac{24}{5}$ (48) $\frac{-4}{9}$ (49) 85 (50) 2 (51) $y = 6x + 8$ (52) $y = 2x - 9$ (53) $y = 2x + 1$ (54) $y = \frac{-2}{9}x + 4$
(55) $y = \frac{3}{10}x + \frac{7}{10}$ (56) $y = -12x + 75$ (57) $y = 13x - 18$ (58) $y = x - 1$ (59) $y = \frac{9}{2}x - \frac{3}{2}$
(60) $y = \frac{-9}{2}x + 37$ (61) $y = -3x + 18$ (62) $y = 3x - 2$ (63) $y = 19x - 4$ (64) $y = x + 21$
(65) $x = -5$ and $x = 1$ (66) $(3, -221)$ and $(-8, 1066)$ (67) $(0, 0)$ and $(-8, -16)$ (68) $\left(1, \frac{1}{4}\right)$
(69) 13 (70) $\frac{-7}{2}$ (71) -14 (72) 11031 (Don't forget to interpret)
(73) -14996 (Don't forget to interpret) (74) 5955 (Don't forget to interpret)
(75) 37030 (Don't forget to interpret) (76) -340 (Don't forget to interpret)
(77) 236 (Don't forget to interpret) (78) 19212 (Don't forget to interpret)
(79) -84 (Don't forget to interpret) (80) 13071 (Don't forget to interpret)
(81) 5040 (Don't forget to interpret) (82) -1830 (Don't forget to interpret)
(83) 208 (Don't forget to interpret) (84) 3.96 (Don't forget to interpret)
(85) 3.50 (Don't forget to interpret) (86a) $]-1, 1[\cup]3, +\infty[$ (86b) $x = 1$ (86c) $\mathbb{R}\backslash\{-1, 3\}$
(86d) DNE, 1, -2, 4 (87a) $]-2, 0[\cup]1, +\infty[$ (87b) $x = 1$ (87c) $\mathbb{R}\backslash\{-2\}$ (87d) 3, 1, 0, 0
(88a) $]-\infty, -3[\cup]-3, -1[\cup]2, +\infty[$ (88b) $x = -3$ (88c) $\mathbb{R}\backslash\{-1, 2\}$ (88d) 1, 0, 3, DNE