

Discontinuities, Tangent Lines, and Miscellaneous Limits

Determine if each function is continuous. If the function is not continuous, find the x -axis location of and classify each discontinuity.

$$1) f(x) = \begin{cases} -2x - 2, & x < -3 \\ 2x + 6, & x \geq -3 \end{cases}$$

- A) Removable discontinuity at: $x = 2$
Infinite discontinuity at: $x = 3$
- B) Removable discontinuity at: $x = -1$
Infinite discontinuity at: $x = 1$
- C) Continuous
- D) Jump discontinuity at: $x = -3$

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

- A) Continuous
- B) Infinite discontinuities at: $x = 0, x = 3$
- C) Removable discontinuity at: $x = 1$
Infinite discontinuity at: $x = 3$
- D) Removable discontinuity at: $x = 0$

$$3) f(x) = \begin{cases} -x^2 - 4x - 1, & x \neq -1 \\ 4, & x = -1 \end{cases}$$

- A) Infinite discontinuities at: $x = -2, x = 1$
- B) Removable discontinuity at: $x = 2$
- C) Continuous
- D) Removable discontinuity at: $x = -1$

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

- A) Jump discontinuity at: $x = -3$
- B) Removable discontinuity at: $x = 3$
Infinite discontinuity at: $x = -3$
- C) Removable discontinuity at: $x = -1$
- D) Continuous

For each problem, find the equation of the line tangent to the function at the given point. Your answer should be in slope-intercept form.

$$5) f(x) = -\frac{x^2}{2} + 4 \text{ at } \left(-3, -\frac{1}{2}\right)$$

- A) $y = 3x + \frac{17}{2}$
- B) $y = -x + \frac{9}{2}$
- C) $y = 4x + 12$
- D) $y = 2x + 6$

$$6) y = -\frac{x^2}{4x - 8} \text{ at } \left(3, -\frac{9}{4}\right)$$

- A) $y = -\frac{5}{36}x - \frac{1}{18}$
- B) $y = \frac{3}{4}x - \frac{9}{2}$
- C) $y = 0$
- D) $y = -2$

7) $f(x) = \frac{1}{x-2}$ at $\left(-1, -\frac{1}{3}\right)$

A) $y = -\frac{1}{4}x + \frac{3}{2}$

B) $y = -\frac{1}{16}x - \frac{3}{8}$

C) $y = -x$

D) $y = -\frac{1}{9}x - \frac{4}{9}$

8) $f(x) = x^3 - 2x^2 - 4$ at $(3, 5)$

A) $y = -x - 4$

B) $y = 64x + 156$

C) $y = -4$

D) $y = 15x - 40$

Evaluate each limit.

9) $\lim_{x \rightarrow -1} \frac{x^2 + x}{x + 1}$

A) 8 B) -11

C) 2 D) -1

10) $\lim_{x \rightarrow 1} \frac{x - 1}{\sqrt{x + 3} - 2}$

A) 4 B) -2

C) 13 D) 1

11) $\lim_{x \rightarrow -2} f(x), f(x) = \begin{cases} -x + 2, & x \neq -2 \\ 2, & x = -2 \end{cases}$

A) 2 B) -4

C) 4 D) 0

12) $\lim_{x \rightarrow 0} \frac{1 - \cos(3x)}{2x}$

A) -7 B) 0

C) 6 D) 7

13) $\lim_{x \rightarrow 3} \frac{-5x + 15}{|-x + 3|}$

A) 0 B) -1

C) -4 D) Does not exist.

14) $\lim_{x \rightarrow -3^+} \frac{5|x + 3|}{x + 3}$

A) 13 B) 5

C) 4 D) 10

15) $\lim_{x \rightarrow -1} \frac{|x + 1|}{x + 1}$

A) -4 B) Does not exist.

C) -2 D) 1

16) $\lim_{x \rightarrow 0^-} -\frac{|-x|}{x}$

A) 10 B) 1

C) -1 D) -6