

1. For the function f whose graph is shown, find $\lim_{x \rightarrow -9^+} f(x)$.

- a) -9
- b) 1
- c) $-\infty$
- d) 0
- e) ∞

2. Determine $\lim_{x \rightarrow 0} \frac{x-1}{x^2(x+7)}$.

- a) $-\infty$
- b) ∞
- c) $\frac{1}{7}$
- d) $-\frac{1}{7}$
- e) 0

3. If $7x \leq f(x) \leq x^3 + 6$ for all x , find $\lim_{x \rightarrow 2} f(x)$.

- a) 2
- b) 14
- c) The limit does not exist.
- d) 7
- e) 6

4. If $F(x) = \frac{x^2 - 16}{|x - 4|}$, find $\lim_{x \rightarrow 4^+} F(x)$.

- a) 4
- b) -8
- c) 8
- d) -4
- e) 16

5. For what value of the constant c is the function f continuous on $(-\infty, \infty)$ where

$$f(x) = \begin{cases} cx + 117, & x \leq 6 \\ cx^2 - 3, & x > 6 \end{cases} \quad ?$$

- a) 4
- b) 117
- c) -3
- d) 6
- e) 0

6. Which of the following represents the slope of the tangent line to the curve $y = 2x^3$ at the point $(3, 54)$?

- a) $\lim_{h \rightarrow 0} \frac{2(x-3)^3 - 54h}{h}$
- b) $\lim_{h \rightarrow 0} \frac{2x^3 - h}{h}$
- c) $\lim_{h \rightarrow 0} \frac{2(3+h)^3 - 3}{h}$
- d) $\lim_{h \rightarrow 0} \frac{2(3-h)^3 + x^3}{h}$
- e) $\lim_{h \rightarrow 0} \frac{2(3+h)^3 - 54}{h}$

7. The following limit represents the derivative of some function f at some number a . State such an f and a .

$$\lim_{t \rightarrow 0} \frac{\sin(\frac{\pi}{2} + t) - 1}{t}$$

- a) $f(x) = \cos(x), a = \frac{\pi}{2}$
- b) $f(x) = \cos(x + \frac{\pi}{2}), a = 0$
- c) $f(x) = \sin(x + \frac{\pi}{2}), a = \frac{\pi}{2}$
- d) $f(x) = \sin(x), a = \frac{\pi}{2}$
- e) $f(x) = \sin(x), a = 1$

8. If $h(-5) = 2$ and $h'(-5) = 4$, find $\frac{d}{dx} \left(\frac{h(x)}{x} \right)$ at $x = -5$.

- a) $-\frac{15}{13}$
- b) $-\frac{22}{25}$
- c) $\frac{3}{4}$
- d) $\frac{31}{19}$
- e) $-\frac{10}{11}$

9. If a ball is thrown vertically upward with a velocity of 216 ft/s, then its height after t seconds is $s(t) = 216t - 18t^2$. What is the maximum height reached by the ball?

- a) 36 ft
- b) 6 ft
- c) 648 ft
- d) 216 ft
- e) 18 ft

10. Differentiate $y = \frac{\sin x}{1 + \cos x}$.

- a) $\frac{dy}{dx} = \frac{\cos x - 1}{(1 + \cos x)^2}$
- b) $\frac{dy}{dx} = \frac{\cos x + 1}{(1 + \cos x)^2}$
- c) $\frac{dy}{dx} = \frac{\cos x + 2}{(1 - \cos x)^2}$
- d) $\frac{dy}{dx} = \frac{\cos x - 1}{(1 - \cos x)^2}$
- e) $\frac{dy}{dx} = \frac{\cos x - 2}{(1 - \cos x)^2}$

11. Find an equation of the tangent line to the curve $y = x^8 \cos x$ at the point $(\pi, -\pi^8)$.

- a) $y = -15\pi^7 x + 9\pi^8$
- b) $y = -8\pi^7 x + 7\pi^8$
- c) $y = -16\pi^7 x + 2\pi^8$
- d) $y = -7\pi^7 x + 11\pi^8$
- e) $y = -8\pi^7 x + 10\pi^8$

12. Find y' by implicit differentiation where $xy + 4x + 4x^2 = 3$.

- a) $y' = 3$
- b) $y' = -4 - y - 8x$
- c) $y' = \frac{-4 - y - 8x}{x}$
- d) $y' = \frac{4 - y + 8x}{x}$
- e) $y' = \frac{4 + y + 8x}{x}$

13. Find the second derivative of the function $y = \frac{x}{5 - x}$.

- a) $-\frac{5}{(5 - x)^3}$
- b) $-\frac{10}{(5 - x)^3}$
- c) $\frac{5}{(5 - x)^2}$
- d) $\frac{10}{(5 - x)^3}$
- e) $-\frac{1}{(5 - x)^2}$

14. If $f(x) = |x - 5|$, find $f'(x)$.

- a) $f'(x) = \begin{cases} 1 & \text{if } x < 5 \\ -1 & \text{if } x > 5 \end{cases}$
- b) $f'(x) = 1, x \neq 5$
- c) $f'(x) = \begin{cases} 1 & \text{if } x < 5 \\ 0 & \text{if } x = 5 \\ -1 & \text{if } x > 5 \end{cases}$
- d) $f'(x) = \begin{cases} -1 & \text{if } x < 5 \\ 1 & \text{if } x > 5 \end{cases}$
- e) $f'(x) = -1, x \neq 5$

15. Find an equation of the tangent line to the curve $y = 5 \sin x - 4 \sin^2 x$ at the point $(0, 0)$.

- a) $y = 5x$
- b) $y = -5x$
- c) $y = 13x$
- d) $y = 8x$
- e) $y = -8x$

16. (7 pts) Determine the points of removable discontinuity, jump discontinuity and infinite discontinuity for the following graph.

- a) jump discontinuities:
- b) removable discontinuities:
- c) infinite discontinuities:

17. (4 pts) Match the graph of each function on the left with the graph of its derivative to the right.

18. (7 pts) Find the slope of the tangent line to the curve $9(x^2 + y^2)^2 = 75(x^2 - y^2)$ at the point $(2, 1)$.

19. (7 pts) Find a formula for $f^{(n)}(x)$ where $f(x) = (5 + x)^{-1}$.