Use the properties of limits to help decide whether the limit exists. If the limit exists, find its value.

1) \( \lim_{{x \to 2}} \frac{x^2 + 8x - 20}{x^2 - 4} \)

Find all points where the function is discontinuous.

2) 

Give an appropriate answer.

3) Find the instantaneous rate of change for the function \( f(x) = 5x^2 + x \) at \( x = -4 \).

The graphs of a function \( f(x) \) and its derivative \( f'(x) \) are shown below. Decide which is the graph of \( f(x) \) and which is the graph of \( f'(x) \).

4) 

Find the derivative of the given function.

5) \((x^2 + 3)^3\)

Find the derivative.

6) \( f(x) = 20x^{1/2} - \frac{1}{2}x^{20} \), find \( f'(x) \)

Find all values of \( x \) (if any) where the tangent line to the graph of the function is horizontal.

7) \( y = x^3 - 12x + 2 \)

Find the derivative.

8) \( y = (2x - 1)^3(x + 7)^{-3} \)

9) \( f(x) = (x^3 - 8)^{2/3} \)

10) \( y = 4e^{x^2} \)

Find the derivative of the function.

11) \( y = \ln (7 + x^2) \)

Find the open interval(s) where the function is changing as requested.

12) Increasing; \( f(x) = \frac{1}{x^2 + 1} \)

13) Decreasing; \( f(x) = x^3 - 4x \)

Find the values of any relative extrema.

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

Find the largest open intervals where the function is concave upward.

15) \( f(x) = 4x^3 - 45x^2 + 150x \)

Decide if the given value of \( x \) is a critical number for \( f \), and if so, decide whether the point for \( x \) on \( f \) is a relative minimum, relative maximum, or neither.

16) \( f(x) = x^5; \quad x = 0 \)

Find \( f'(x) \) for the function.

17) \( f(x) = 5e^{-x^2} \)

Find the locations of all absolute extrema if they exist.

18) \( f(x) = -3x^4 + 16x^3 - 18x^2 + 10 \)

Find the location of the indicated absolute extremum within the specified domain.

19) Minimum of \( f(x) = (x^2 + 4)^{2/3}; \quad [-2, 2] \)

Solve the problem.

20) An architect needs to design a rectangular room with an area of 87 ft\(^2\). What dimensions should he use in order to minimize the perimeter?
Find dy/dx by implicit differentiation.
21) \( xy + x = 2 \)

Evaluate dy/dt for the function at the point.
22) \( xy^2 = 4; \ dx/dt = -5, \ x = 4, \ y = 1 \)

Solve the problem.
23) One airplane is approaching an airport from the north at 157 km/hr. A second airplane approaches from the east at 285 km/hr. Find the rate at which the distance between the planes changes when the southbound plane is 36 km away from the airport and the westbound plane is 25 km from the airport.

Find the integral.
24) \( \int x^{11} \, dx \)
25) \( \int (5x^2 - 8x) \, dx \)
26) \( \int \left( \frac{5}{x^2} - \frac{4}{\sqrt{x}} \right) \, dx \)
27) \( \int 8e^{4y} \, dy \)
28) \( \int \frac{x}{(7x^2 + 3)^{5/3}} \, dx \)
29) \( \int \frac{x^2 + 16x}{(x + 8)^2} \, dx \)
30) \( \int (1 - 6x)e^{3x - 9x^2} \, dx \)
31) \( \int \frac{3e^{\sqrt{z}}}{8\sqrt{z}} \, dz \)

Evaluate the definite integral.
32) \( \int_0^1 \frac{1}{4}x^2 \, dx \)

33) \( \int_0^1 \frac{5x^4}{(1 + x^5)^6} \, dx \)
34) \( \int_2^3 \frac{dt}{1 + t} \)

Find the area between the curves.
35) \( y = 2x - x^2; \ y = 2x - 4 \)

Find the integral.
36) \( \int e^{2x} x^2 \, dx \)

Find \( f_x(x, y) \).
37) \( f(x, y) = \ln xy \)

Find the partial derivative.
38) Let \( z = f(x, y) = x^3 - 5x^2y - 5xy^3 \). Find \( \frac{\partial z}{\partial x} \).

Find all points where the function has any relative extrema or saddle points and identify the type of relative extremum.
39) \( f(x, y) = x^3 - 12xy + 8y^3 \)
1) 3
2) None
3) -39
4) \( f(x) \) is the dashed line; \( f'(x) \) is the solid line.
5) \( 6x^5 + 36x^3 + \frac{54x}{5} \)
6) \( 10x^{-1/2} - \frac{19}{10}x^9 \)
7) \( 2, -2 \)
8) \( \frac{dy}{dx} = 45(2x - 1)^2(x + 7)^{-4} \)
9) \( f(x) = \frac{2x^2}{\sqrt{x^3 - 8}} \)
10) \( 8xe^{x^2} \)
11) \( \frac{2x}{x^2 + 7} \)
12) \( (-\infty, 0) \)
13) \( \left( -\frac{2\sqrt{3}}{3}, \frac{2\sqrt{3}}{3} \right) \)
14) No relative extrema.
15) \( \left( \frac{15}{4}, \infty \right) \)
16) Critical number but not an extreme point
17) \( 20x^2 e^{-x^2} - 10e^{-x^2} \)
18) Absolute maximum at \( x = 3; \) no absolute minimum
19) \( x = 0 \)
20) 9.33 ft \( \times \) 9.33 ft
21) \( -\frac{1 + y}{x} \)
22) \( \frac{5}{8} \)
23) 426 km/hr
24) \( \frac{x^{12}}{12} + C \)
25) \( \frac{5}{3}x^3 - 4x^2 + C \)
26) \( -\frac{5}{x} - 8\sqrt{x} + C \)
27) \( 2e^{4x} + C \)
28) \( \frac{-1}{56(7x^2 + 3)^4} + C \)
29) \( x + \frac{64}{x + 8} + C \)
30) \( \frac{1}{3}e^{3x} - 9x^2 + C \)
31) \( \frac{3}{4}e^{\sqrt{x}} + C \)
32) \( \frac{1}{12} \)
33) \( \frac{31}{160} \)
34) \( \ln \frac{4}{3} \)
35) \( \frac{32}{3} \)
36) \( \frac{1}{2}x^2e^{2x} - \) \( \frac{1}{2}xe^{2x} + \) \( \frac{1}{4}e^{2x} + C \)
37) \( \frac{y}{x} \)
38) \( 3x^2 - 10xy - 5y^3 \)
39) Relative minimum at (2,1) and saddle point at (0, 0)