1. For what values is the function discontinuous?

Discontinuities:_____________________________

2. Evaluate each limit using the graph above.

\[
\lim_{{x \to -3}} f(x) = \ldots \quad \lim_{{x \to 1^{-}}} f(x) = \ldots
\]

\[
\lim_{{x \to -4}} f(x) = \ldots \quad \lim_{{x \to 1^{+}}} f(x) = \ldots
\]

\[
\lim_{{x \to -1}} f(x) = \ldots \quad \lim_{{x \to 0}} f(x) = \ldots
\]

\[
\lim_{{x \to 1}} f(x) = \ldots \quad \lim_{{x \to a}} f(x) = \ldots
\]

3. Show by example that \( \lim_{{x \to a}} [f(x) - g(x)] \) may exist even though \( \lim_{{x \to a}} f(x) \) and \( \lim_{{x \to a}} g(x) \) do not exist. (Give specific functions for \( f \) and \( g \) and a value for \( a \).)
Evaluate the following limits.

4. \( \lim_{x \to 5} \frac{x - 5}{x^2 + 2x - 35} \)

Answer: _____________

5. \( \lim_{x \to 0} \frac{1}{x^4} \)

Answer: _____________

6. \( \lim_{x \to 2} \frac{1}{x - 2} \)

Answer: _____________

7. \( \lim_{x \to 2} \frac{1}{x - 2} \)

Answer: _____________

8. \( \lim_{t \to 1} e^{2t-2} = \)

Answer: _____________

9. \( \lim_{t \to 0} \frac{1}{3+t} - \frac{1}{3} = \)

Answer: _____________
10. \( \lim_{t \to 0} \frac{|t|}{t} = \)

Answer: _______________

11. \( \lim_{t \to 0} \frac{|t|}{t} = \)

Answer: _______________

12. \( \lim_{x \to 0} \frac{\sqrt{x + 4} - 2}{x} = \)

Answer: _______________

13. Find the discontinuities of the function \( f(x) = \begin{cases} 3 & \text{if } x < -1 \\ x^2 + 2 & \text{if } -1 \leq x \leq 3 \\ 4 & \text{if } 3 < x \end{cases} \)

Discontinuities: _______________

14. With what linear function \( y = ax + b \) would you need to replace the middle function \( (x^2 + 2) \) in order to make the function continuous?

Answer: ________________
15. Find the equation for the line tangent to the function \( f(x) = \frac{1}{x} \) at the point \((2, 0.5)\). Show how you calculate the slope and give your answer in slope-intercept form.

Equation: ______________________

16. The position of a falling object at time \( t \) is given by \( f(t) = 4.9t^2 \).
   a. Give the average velocity from \( t=0 \) to \( t=2 \).

   Average velocity: ______________

   b. Find the instantaneous velocity when \( t=2 \).

   Instantaneous velocity: ______________

For problems 17-23 find the requested derivative by any appropriate method.

17. \( F(x) = 3x^4 + 4x^3 + 6x^2 + 12x + 52 \). Find \( F'(x) \).

   Answer: ______________________

18. \( y = (x^3 - 2x) \sqrt{x} \). Find \( y' \).

   Answer: ______________________

19. Let \( f(x) = x^{12} - 12x^2 + 9x + 42 \). Find \( f''(x) \).

   Answer: ______________________
20. \( f(x) = \frac{1 + 2x + 3x^2 + 4x^3 + 5x^4}{x^4} \). Find \( f'(x) \).

Answer: _______________

21. Let \( g(x) = \frac{1}{x-3} \). Find \( g'(4) \).

Answer: _______________

22. \( h(x) = \frac{x^2 + 3x + 1}{x^2 - 10} \). Find \( h'(x) \), simplifying as appropriate.

Answer: _______________

23. \( y = 6e^x + \frac{e^x + 15}{e^x} \). Find \( y' \).

Answer: _______________
For 24 and 25, calculate the derivative of the given function directly from the definition, showing all steps.

24. \( f(x) = x^2 + 12x \)

24. \( f(x) = \sqrt{x + 3} \)