

Limit Laws

Let $\lim_{x \rightarrow a} f(x) = L$ and $\lim_{x \rightarrow a} g(x) = M$.

1. **Constant Law:** $\lim_{x \rightarrow a} c = c$

2. **Identity Law:** $\lim_{x \rightarrow a} x = a$

3. **Sum Law:** $\lim_{x \rightarrow a} [f(x) + g(x)] = L + M$

4. **Difference Law:** $\lim_{x \rightarrow a} [f(x) - g(x)] = L - M$

5. **Constant Multiple Law:** $\lim_{x \rightarrow a} [cf(x)] = cL$

6. **Product Law:** $\lim_{x \rightarrow a} [f(x)g(x)] = LM$

7. **Quotient Law:** $\lim_{x \rightarrow a} \frac{f(x)}{g(x)} = \frac{L}{M}$, when $M \neq 0$

8. **Power Law:** $\lim_{x \rightarrow a} [f(x)]^n = L^n$

9. **Root Law:** $\lim_{x \rightarrow a} \sqrt[n]{f(x)} = \sqrt[n]{L}$

10. **Polynomial Law:**

If $p(x)$ is a polynomial, then $\lim_{x \rightarrow a} p(x) = p(a)$.

11. **Rational Function Law:**

If $r(x) = \frac{p(x)}{q(x)}$, where $p(x)$ and $q(x)$ are polynomials and $q(a) \neq 0$, then

$$\lim_{x \rightarrow a} r(x) = r(a) = \frac{p(a)}{q(a)}.$$

12. **Squeeze Theorem:**

If $g(x) \leq f(x) \leq h(x)$ for all x sufficiently close to a , and $\lim_{x \rightarrow a} g(x) = \lim_{x \rightarrow a} h(x) = L$,

then $\boxed{\lim_{x \rightarrow a} f(x) = L}$.

1. Compute $\lim_{x \rightarrow 2} (3x^2 - 5x + 4)$.
2. Compute $\lim_{x \rightarrow -1} (x^3 + 2x^2 - 4x + 7)$.
3. Compute $\lim_{x \rightarrow 3} \frac{x^2 - 9}{x - 3}$.
4. Compute $\lim_{x \rightarrow -2} \frac{x^2 - 4}{x + 2}$.
5. Compute $\lim_{x \rightarrow 1} \frac{x^3 - 1}{x - 1}$.
6. Compute $\lim_{x \rightarrow 4} \frac{x^2 - 16}{x - 4}$.
7. Compute $\lim_{x \rightarrow 2} \frac{x^2 + x - 6}{x - 2}$.
8. Compute $\lim_{x \rightarrow -3} \frac{x^2 + 5x + 6}{x + 3}$.
9. Compute $\lim_{x \rightarrow 0} \frac{\sqrt{x+9} - 3}{x}$.
10. Compute $\lim_{x \rightarrow 5} \frac{\sqrt{x+4} - 3}{x - 5}$.
11. Compute $\lim_{x \rightarrow 1} \frac{x - 1}{x^2 - 1}$.
12. Compute $\lim_{x \rightarrow -2} \frac{x + 2}{x^2 + 3x + 2}$.
13. Compute $\lim_{x \rightarrow 2} \frac{x^2 - 4}{x^2 - x - 2}$.
14. Compute $\lim_{x \rightarrow 1} \frac{x^2 - 1}{x^2 + x - 2}$.
15. Compute $\lim_{x \rightarrow 0} \frac{\sqrt{1+x} - \sqrt{1-x}}{x}$.
16. Compute $\lim_{x \rightarrow 3} (x^2 - 4x + 7)$.
17. Compute $\lim_{x \rightarrow -2} (2x^3 + x^2 - 5)$.
18. Compute $\lim_{x \rightarrow 0} \frac{\sqrt{x+16} - 4}{x}$.
19. Compute $\lim_{x \rightarrow 2} \frac{1}{(x-2)^2}$.
20. Compute $\lim_{x \rightarrow 3} \frac{1}{x-3}$.
21. Compute $\lim_{x \rightarrow -1^+} \frac{2}{x+1}$.
22. Compute $\lim_{x \rightarrow 4} \frac{3x+1}{(x-4)^2}$.
23. Compute $\lim_{x \rightarrow 0} \frac{5}{x^2}$.
24. Compute $\lim_{x \rightarrow 2} \frac{x+1}{x-2}$.
25. Let $f(x) = \begin{cases} x+2, & x < 1, \\ 3x-1, & x \geq 1. \end{cases}$
Compute $\lim_{x \rightarrow 1} f(x)$.
26. Let $f(x) = \begin{cases} x^2, & x < 2, \\ x+2, & x \geq 2. \end{cases}$
Compute $\lim_{x \rightarrow 2} f(x)$.
27. Let $f(x) = \begin{cases} 2x+1, & x < 0, \\ x^2+1, & x \geq 0. \end{cases}$
Compute $\lim_{x \rightarrow 0} f(x)$.
28. Let $f(x) = \begin{cases} x+3, & x < 2, \\ 7-x, & x \geq 2. \end{cases}$
Compute $\lim_{x \rightarrow 2} f(x)$.
29. Let $f(x) = \begin{cases} x^2+1, & x < 3, \\ 2x-2, & x \geq 3. \end{cases}$
Compute $\lim_{x \rightarrow 3} f(x)$.
30. Let $f(x) = \begin{cases} 4-x, & x < 1, \\ x+2, & x \geq 1. \end{cases}$
Compute $\lim_{x \rightarrow 1} f(x)$.

31. Compute $\lim_{x \rightarrow 0} \frac{\sin x}{x}$.

32. Compute $\lim_{x \rightarrow 0} \frac{\tan x}{x}$.

33. Compute $\lim_{x \rightarrow 0} \frac{1 - \cos x}{x^2}$.

34. Compute $\lim_{x \rightarrow 0} x \sin \left(\frac{1}{x} \right)$.

35. Compute $\lim_{x \rightarrow 0} x^2 \cos \left(\frac{1}{x} \right)$.

36. Compute $\lim_{x \rightarrow 0} \frac{\sin(3x)}{x}$.

37. Compute $\lim_{x \rightarrow 0} \frac{1 - \cos(2x)}{x^2}$.

38. Compute $\lim_{x \rightarrow 0} x^2 \sin \left(\frac{5}{x} \right)$.