

# 1 General Limit Laws

Suppose  $\lim_{x \rightarrow a} f(x)$  and  $\lim_{x \rightarrow a} g(x)$  both exist, and let  $c$  be any constant.

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

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

3. Constant Multiplier Law: 
$$\lim_{x \rightarrow a} [cf(x)] = c \lim_{x \rightarrow a} f(x)$$

4. Product Law: 
$$\lim_{x \rightarrow a} [f(x)g(x)] = \left( \lim_{x \rightarrow a} f(x) \right) \left( \lim_{x \rightarrow a} g(x) \right)$$

5. Quotient Law: 
$$\lim_{x \rightarrow a} \left[ \frac{f(x)}{g(x)} \right] = \frac{\lim_{x \rightarrow a} f(x)}{\lim_{x \rightarrow a} g(x)} \text{ provided } \lim_{x \rightarrow a} g(x) \neq 0 .$$

6. Power Law: 
$$\lim_{x \rightarrow a} [f(x)]^n = \left[ \lim_{x \rightarrow a} f(x) \right]^n \text{ where } n \text{ is a positive integer.}$$

7. Root Law: 
$$\lim_{x \rightarrow a} \sqrt[n]{f(x)} = \sqrt[n]{\lim_{x \rightarrow a} f(x)} \text{ where } n \text{ is a positive integer, and where } \lim_{x \rightarrow a} f(x) > 0 \text{ if } n \text{ is even.}$$

# 2 Particular Limit Results

1. Constants: 
$$\lim_{x \rightarrow a} c = c$$

2. Limit of  $f(x) = x$ : 
$$\lim_{x \rightarrow a} x = a$$

3. Polynomials: If  $f(x)$  is a polynomial (for eg.  $f(x) = 5x^3 - \pi x^2 - 1/2$ ) then  $\lim_{x \rightarrow a} f(x) = f(a)$  .

4. Sine & Cosine: 
$$\lim_{x \rightarrow a} \sin(x) = \sin(a), \quad \lim_{x \rightarrow a} \cos(x) = \cos(a) .$$

5. Rational Functions: If  $f(x)$  and  $g(x)$  are polynomials and  $g(a) \neq 0$  then  $\lim_{x \rightarrow a} \frac{f(x)}{g(x)} = \frac{f(a)}{g(a)}$  .

6. Squeeze Theorem: If  $f(x) \leq g(x) \leq h(x)$  for  $x$  near  $a$  and  $\lim_{x \rightarrow a} f(x) = \lim_{x \rightarrow a} h(x) = L$ , then  $\lim_{x \rightarrow a} g(x) = L$  .

7. Important Trig Limit: 
$$\lim_{x \rightarrow 0} \frac{\sin(x)}{x} = 1$$