

Basic Forms from Calculus I

1. Definition of a Limit:

$$\lim_{x \rightarrow a} f(x) = L \Leftrightarrow \forall \varepsilon > 0, \exists \delta \text{ such that } 0 < |x - a| < \delta \Rightarrow |f(x) - L| < \varepsilon$$

2. $\lim_{x \rightarrow a} k = k$

3. $\lim_{x \rightarrow a} x = a$

4. $\lim_{x \rightarrow a} x^n = a^n$

5. $\lim_{x \rightarrow a} [kf(x)] = k \lim_{x \rightarrow a} [f(x)]$

6. $\lim_{x \rightarrow a} [f(x) \pm g(x)] = \lim_{x \rightarrow a} [f(x)] \pm \lim_{x \rightarrow a} [g(x)]$

7. $\lim_{x \rightarrow a} [f(x) \cdot g(x)] = \lim_{x \rightarrow a} [f(x)] \cdot \lim_{x \rightarrow a} [g(x)]$

8. $\lim_{x \rightarrow a} [f(x)^n] = \left[\lim_{x \rightarrow a} [f(x)] \right]^n$

9. $\lim_{x \rightarrow a} \left[\frac{f(x)}{g(x)} \right] = \frac{\lim_{x \rightarrow a} [f(x)]}{\lim_{x \rightarrow a} [g(x)]} \quad \lim_{x \rightarrow a} [g(x)] \neq 0$

10. $\lim_{x \rightarrow a} f(g(x)) = f\left(\lim_{x \rightarrow a} g(x)\right)$

11. $\lim_{x \rightarrow 0} \frac{\sin(x)}{x} = 1$

12. $\lim_{x \rightarrow 0} \frac{1 - \cos(x)}{x} = 0$

13. Definition of Continuity:

$f(x)$ is continuous at $x = a$ if and only if:

A. $f(a)$ is defined

B. $\lim_{x \rightarrow a} f(x)$ exists

C. $\lim_{x \rightarrow a} f(x) = f(a)$

14. Definition of the Derivative:

$$\frac{d}{dx} [f(x)] = \lim_{\Delta x \rightarrow 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

15. $\frac{d}{dx} [k] = 0$

16. $\frac{d}{dx} [x^n] = n x^{n-1}$

17. $\frac{d}{dx} [k u] = k u'$

18. $\frac{d}{dx} [u \pm v] = u' \pm v'$

19. $\frac{d}{dx} [u v] = u v' + v u'$

20. $\frac{d}{dx} \left[\frac{u}{v} \right] = \frac{v u' - u v'}{v^2}$

21. $\frac{d}{dx} [f(u)] = f'(u) \cdot u'$

22. $\frac{d}{dx} [e^u] = e^u u'$

23. $\frac{d}{dx} [\ln(u)] = \frac{1}{u} u'$

24. $\frac{d}{dx} [\sin(u)] = \cos(u) u'$

25. $\frac{d}{dx} [\csc(u)] = -\csc(u) \cot(u) u'$

$$26. \frac{d}{dx} [\cos(u)] = -\sin(u)u'$$

$$27. \frac{d}{dx} [\sec(u)] = \sec(u) \tan(u)u'$$

$$28. \frac{d}{dx} [\tan(u)] = \sec^2(u)u'$$

$$29. \frac{d}{dx} [\cot(u)] = -\csc^2(u)u'$$

$$30. \frac{d}{dx} [\sin^{-1}(u)] = \frac{u'}{\sqrt{1-u^2}}$$

$$31. \frac{d}{dx} [\tan^{-1}(u)] = \frac{u'}{1+u^2}$$

$$32. \frac{d}{dx} [\sec^{-1}(u)] = \frac{u'}{|u|\sqrt{u^2-1}}$$

$$33. \int k \, du = ku + c$$

$$34. \int u^n \, du = \frac{u^{n+1}}{n+1} + c \quad n \neq -1$$

$$35. \int k f(u) \, du = k \int f(u) \, du$$

$$36. \int [f(u) \pm g(u)] \, du = \int f(u) \, du \pm \int g(u) \, du$$

$$37. \int e^u \, du = e^u + c$$

$$38. \int \frac{1}{u} \, du = \ln|u| + c$$

$$39. \int u^{-1} \, du = \ln|u| + c$$

$$40. \int \sin(u) \, du = -\cos(u) + c$$

$$41. \int \csc(u) \cot(u) \, du = -\csc(u) + c$$

$$42. \int \cos(u) \, du = \sin(u) + c$$

$$43. \int \sec(u) \tan(u) \, du = \sec(u) + c$$

$$44. \int \tan(u) \, du = \ln|\sec(u)| + c$$

$$45. \int \cot(u) \, du = \ln|\sin(u)| + c$$

$$46. \int \sec^2(u) \, du = \tan(u) + c$$

$$47. \int \csc^2(u) \, du = -\cot(u) + c$$

$$48. \int \sec(u) \, du = \ln|\sec(u) + \tan(u)| + c$$

$$49. \int f(au + b) \, du = \frac{1}{a} F(au + b) + c$$

$$50. \int \frac{du}{\sqrt{a^2 - u^2}} = \sin^{-1}\left(\frac{u}{a}\right) + c$$

$$51. \int \frac{1}{a^2 + u^2} \, du = \frac{1}{a} \tan^{-1}\left(\frac{u}{a}\right) + C$$

$$52. \int \frac{du}{u\sqrt{u^2 - a^2}} = \frac{1}{a} \sec^{-1}\left(\frac{|u|}{a}\right) + c$$