□ Class 11 Mathematics – Chapter: Limits and Derivatives

---

1. Introduction

- Limits and derivatives form the foundation of calculus.
- They describe how a function behaves near a point and how it changes.

---

2. Limits

- The limit of a function f(x)f(x)f(x) as xxx approaches aaa is the value f(x)f(x)f(x) gets closer to as xxx gets closer to aaa.
-

Notation:

$\lim_{x \to a} f(x) = L$

- Limits may exist or not; they describe function behavior near points.

---

3. Properties of Limits

- Linearity:

$\lim_{x \to a} [cf(x)] = c \lim_{x \to a} f(x)$

- Sum/Difference:

$\lim_{x \to a} [f(x) \pm g(x)] = \lim_{x \to a} f(x) \pm \lim_{x \to a} g(x)$

- Product:

limx→a[f(x)⋅g(x)]=limx→af(x)⋅limx→ag(x)\lim_{x \to a} [f(x) \cdot g(x)] = \lim_{x \to a} f(x) \cdot \lim_{x \to a} g(x)x→alim[f(x)⋅g(x)]=x→alimf(x)⋅x→alimg(x)

- Quotient:

  limx→af(x)g(x)=limx→af(x)limx→ag(x)if limx→ag(x)≠0\lim_{x \to a} \frac{f(x)}{g(x)} = \frac{\lim_{x \to a} f(x)}{\lim_{x \to a} g(x)} \quad \text{if } \lim_{x \to a} g(x) \neq 0x→alimg(x)f(x)=limx→ag(x)limx→af(x)if x→alimg(x)=0

---

4. Common Limits

- limx→0sinxx=1\lim_{x \to 0} \frac{\sin x}{x} = 1limx→0xsinx=1

- limx→01−cosxx=0\lim_{x \to 0} \frac{1 - \cos x}{x} = 0limx→0x1−cosx=0

---

5. Derivatives

- The derivative of a function f(x)f(x)f(x) at x=ax = ax=a measures the rate of change or slope of the function at that point.
- Definition:

  f′(a)=limh→0f(a+h)−f(a)hf'(a) = \lim_{h \to 0} \frac{f(a+h) - f(a)}{h}f′(a)=h→0limhf(a+h)−f(a)

---

6. Basic Derivative Formulas

- ddxc=0\frac{d}{dx} c = 0dxdc=0 (constant)
- ddxxn=nxn−1\frac{d}{dx} x^n = n x^{n-1}dxdxn=nxn−1
- ddxsinx=cosx\frac{d}{dx} \sin x = \cos xdxdsinx=cosx

- $\frac{d}{dx} \cos x = -\sin x$
- $\frac{d}{dx} e^x = e^x$

---

7. Applications of Derivatives

- Finding slope of curve
- Tangents and normals
- Increasing/decreasing functions
- Maxima and minima

8. Exam Tips

- Understand the limit concept clearly.
- Memorize basic derivatives.
- Practice using definition and formulas.
- Solve problems on tangent lines and rates.