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# NCERT Class 11 Mathematics Solutions: Chapter 13 –Limits and Derivatives Miscellaneous Exercise 13.2 Part 1

## Limit Formulas

$$\lim_{x \rightarrow a} [f(x) + g(x)] = \lim_{x \rightarrow a} f(x) + \lim_{x \rightarrow a} g(x)$$

$$\lim_{x \rightarrow a} [f(x) - g(x)] = \lim_{x \rightarrow a} f(x) - \lim_{x \rightarrow a} g(x)$$

$$\lim_{x \rightarrow a} p * f(x) = p \lim_{x \rightarrow a} f(x) \quad p \text{ is constant}$$

$$\lim_{x \rightarrow a} [f(x) * g(x)] = \lim_{x \rightarrow a} f(x) * \lim_{x \rightarrow a} g(x)$$

$$\lim_{x \rightarrow a} [f(x) \div g(x)] = \lim_{x \rightarrow a} f(x) \div \lim_{x \rightarrow a} g(x)$$

$$\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a} = na^{n-1}$$

$$\lim_{x \rightarrow 0} e^x = 1$$

$$\lim_{x \rightarrow 0} \frac{e^x - 1}{x} = \log_e e = 1$$

$$\lim_{x \rightarrow 0} \frac{a^x - 1}{x} = \log_e a$$

$$\lim_{x \rightarrow 0} \frac{\log(1+x)}{x} = 1$$

$$\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$$

$$\lim_{x \rightarrow 0} \cos x = 1$$

$$\lim_{x \rightarrow 0} \frac{\tan x}{x} = 1$$

$$\lim_{x \rightarrow 0} (1+x)^{1/x} = e$$

$$\lim_{x \rightarrow \infty} (1 + 1/x)^x = e$$

Limit Formulas

Evaluate the following limits, if exists.

1.  $\lim_{x \rightarrow 0} \frac{e^{4x} - 1}{x}$

Answer:

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$$\begin{aligned} & \lim_{x \rightarrow 0} \frac{e^{4x} - 1}{x} \\ &= \lim_{x \rightarrow 0} \frac{e^{4x} - 1}{4x} \times 4 \\ &= \lim_{y \rightarrow 0} \frac{e^y - 1}{y} \times 4 \text{ [Where } y = 4x\text{]} \\ &= 1 \times 4 \text{ [Using } \lim_{y \rightarrow 0} \frac{e^y - 1}{y} = 1\text{]} \\ &= 4 \end{aligned}$$

2.  $\lim_{x \rightarrow 0} \frac{e^{2+x} - e^2}{x}$

Answer:

$$\begin{aligned} & \lim_{x \rightarrow 0} \frac{e^{2+x} - e^2}{x} \\ &= \lim_{x \rightarrow 0} \frac{e^2(e^x - 1)}{x} \\ &= e^2 \times 1 \text{ [Using } \lim_{x \rightarrow 0} \frac{(e^x - 1)}{x} = 1\text{]} \\ &= e^2 \end{aligned}$$

3.  $\lim_{x \rightarrow 5} \frac{e^x - e^5}{x - 5}$

Answer:

$$\begin{aligned} & \lim_{x \rightarrow 5} \frac{e^x - e^5}{x - 5} \\ & \text{Put } x = 5 + h, \text{ then as } x \rightarrow 5 \rightarrow 0 \\ & \lim_{x \rightarrow 5} \frac{e^x - e^5}{x - 5} \\ &= \lim_{x \rightarrow 5} \frac{e^{5+h} - e^5}{h} \\ &= \lim_{h \rightarrow 0} \frac{e^5(e^h - 1)}{h} \\ &= e^5 \times 1 \text{ [Using } \lim_{h \rightarrow 0} \frac{e^h - 1}{h} = 1\text{]} \\ &= e^5 \end{aligned}$$

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$$4. \lim_{x \rightarrow 0} \frac{e^{\sin x} - 1}{x}$$

Answer:

$$\lim_{x \rightarrow 0} \frac{e^{\sin x} - 1}{x}$$

$$= \lim_{x \rightarrow 0} \frac{e^{\sin x} - 1}{x} \times \frac{\sin x}{\sin x}$$

$$= \lim_{x \rightarrow 0} \frac{e^{\sin x} - 1}{\sin x} \times \frac{\sin x}{x}$$

$$= \lim_{y \rightarrow 0} \frac{e^y - 1}{y} \times \lim_{x \rightarrow 0} \frac{\sin x}{x} \quad [\text{where } y = \sin x]$$

$$= 1 \times 1 \quad [\text{Using } \lim_{y \rightarrow 0} \frac{e^y - 1}{y} \text{ and } \lim_{x \rightarrow 0} \frac{\sin x}{x} = 1]$$

$$= 1$$