

**Q 1.** Evaluate  $\lim_{x \rightarrow 0} \frac{2 \sec 3x - 2}{9x^2}$

[Identity Based Trig Limit]

**Solution**

$$\begin{aligned}
 \lim_{x \rightarrow 0} \frac{2 \sec 3x - 2}{9x^2} &= \lim_{x \rightarrow 0} \frac{\left(\frac{2}{\cos 3x} - 2\right)}{9x^2} \\
 &= \lim_{x \rightarrow 0} \frac{\left(\frac{2 - 2 \cos 3x}{\cos 3x}\right)}{9x^2} \\
 &= \lim_{x \rightarrow 0} \frac{2(1 - \cos 3x)}{\cos 3x (9x^2)} \times \frac{1 + \cos 3x}{1 + \cos 3x} \\
 &= \lim_{x \rightarrow 0} \frac{2(1 - \cos^2 3x)}{\cos 3x (9x^2)} \times \frac{1}{1 + \cos 3x} \\
 &= \lim_{x \rightarrow 0} \frac{2(\sin^2 3x)}{(3x)^2} \times \frac{1}{\cos 3x(1 + \cos 3x)} \\
 &= 2 \lim_{3x \rightarrow 0} \frac{(\sin^2 3x)}{(3x)^2} \times \lim_{3x \rightarrow 0} \frac{1}{\cos 3x(1 + \cos 3x)} \\
 &= 2(1) \times \frac{1}{1(1+1)} \\
 &= 1
 \end{aligned}$$

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**Hints:**

As  $x \rightarrow 0$ ,  $3x \rightarrow 0$   
 $\cos 0 = 1$

$$\lim_{3x \rightarrow 0} \frac{(\sin^2 3x)}{(3x)^2} = 1^2 = 1$$

**Answer**