

Derivatives Recall (1) $\frac{d}{dx}(x^n) = nx^{n-1}$

2) $\frac{d}{dx}(\sin x) = \cos x$ 3) $\frac{d}{dx}(\cos x) = -\sin x$

4) $\frac{d}{dx}(\tan x) = \sec^2 x$ 5) $\frac{d}{dx}(\cot x) = -\operatorname{cosec}^2 x$

6) $\frac{d}{dx}(\sec x) = \sec x \tan x$ 7) $\frac{d}{dx}(\operatorname{cosec} x) = -\operatorname{cosec} x \cot x$

Product rule

$$\frac{d}{dx}(uv) = uv' + vu'$$

Quotient rule

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{vu' - uv'}{v^2}$$

Differentiate the following

1) $y = x^3 + 5x^2 - 6x + 8$

2) $y = 3\sin x + \cos x - \tan x$

3) $y = \sin(x+1)$

4) $y = \tan(x-1)$

5) $y = x^2 \cot x$

6) $y = x \sin x + 7x^3$

7) $y = \frac{1-x}{x^2+7}$

8) $y = \frac{x^2 \cos x}{x^2+5}$

9) $y = \frac{1+\tan x}{1-\tan x}$

10) $y = \frac{2x+3}{3x+2}$

11) $y = \frac{\sec x - 1}{\sec x + 1}$

12) $y = \frac{\sin x + \cos x}{\sin x - \cos x}$

13) $y = \frac{x \tan x}{\sec x + \tan x}$

14) $y = \frac{\cos x}{\sin x + 7x^2}$

15) $y = \frac{1}{1+\sin x}$

16) $y = \frac{7}{1+x^2} - \frac{x}{1-x^2}$

17) $y = \frac{3x+4}{5x-7} + \frac{5 \tan x}{1+x}$

18) $y = \frac{x^3 \sin x}{1-x}$

19) $y = \frac{x^2 + 5x - 6}{4x^2 - x + 3}$

LIMITS

RECALL

- 1) $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a} = n a^{n-1}; a > 0$
 2) $\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$ 3) $\lim_{x \rightarrow 0} \frac{\tan x}{x} = 1$ 4) $\lim_{x \rightarrow 0} \frac{e^x - 1}{x} = 1$
 5) $\lim_{x \rightarrow 0} \frac{\log(1+x)}{x} = 1$

Evaluate the following limits

- ① $\lim_{x \rightarrow 3} \frac{x^4 - 81}{x - 3}$ ② $\lim_{x \rightarrow 2} \frac{x^5 - 32}{x^3 - 8}$ ⑬ $\lim_{x \rightarrow 0} \left(\frac{\sin 5x}{\tan 3x} \right)$
 ③ $\lim_{x \rightarrow 3} \frac{x^2 - 4x + 3}{x^2 - 2x - 3}$ ⑭ $\lim_{x \rightarrow 0} \left(\frac{1 - \cos 4x}{1 - \cos 5x} \right)$
 ④ $\lim_{x \rightarrow 0} \frac{\sqrt{1+x} - 1}{x}$ ⑮ $\lim_{x \rightarrow 0} \left(\frac{\sin 2x + \sin 6x}{\sin 5x - \sin 3x} \right)$
 ⑤ $\lim_{x \rightarrow 0} \frac{\sqrt{1+3x} - \sqrt{1-3x}}{x}$ ⑯ $\lim_{x \rightarrow 0} \left(\frac{\operatorname{cosec} x - \cot x}{x} \right)$
 ⑥ $\lim_{x \rightarrow 1} \frac{(2x-3)(\sqrt{x}-1)}{2x^2+x-3}$ ⑰ $\lim_{x \rightarrow \pi/2} (\sec x - \tan x)$
 ⑦ $\lim_{x \rightarrow 0} \frac{e^{4x} - 1}{x}$ ⑱ $\lim_{x \rightarrow \pi/6} \left(\frac{\tan x - \sin x}{\sin^3 x} \right)$
 ⑧ $\lim_{x \rightarrow 0} \frac{(1+x)^6 - 1}{(1+x)^5 - 1}$ ⑲ $\lim_{x \rightarrow \pi/6} \left(\frac{\sqrt{3} \sin x - \cos x}{x - \pi/6} \right)$
 ⑨ $\lim_{x \rightarrow 4} \frac{x^2 - 7x + 12}{x^2 - 3x - 4}$ ⑳ $\lim_{x \rightarrow 0} \left(\frac{\sqrt{1+2x} - \sqrt{1-2x}}{\sin x} \right)$
 ⑩ $\lim_{x \rightarrow 5} \frac{x^3 - 125}{x^2 - 7x + 10}$ ㉑ $\lim_{x \rightarrow 0} \left(\frac{e^{\tan x} - 1}{x} \right)$
 ⑪ $\lim_{x \rightarrow 3} \frac{x^2 - x - 6}{x^3 - 3x^2 + x - 3}$ ㉒ $\lim_{x \rightarrow \pi/4} \left(\frac{\operatorname{cosec}^2 x - 2}{\cot x - 1} \right)$