

1. Compute $\frac{d}{dx}(x^2 \sin(2x))$
2. Compute $\frac{d}{dx} \frac{x^2+1}{x^2+x-4}$
3. Compute $\frac{d}{dx}(\tan(x+3))^3$
4. Compute $\frac{d}{dx} \sqrt[5]{(x^3+2)^2}$
5. Compute $\frac{d}{dx} \frac{\sin x}{1+\sec x}$
6. Compute $\frac{d}{dx} \frac{\csc^2 x + 3}{\pi}$
7. Use the definition of derivative to compute $\frac{d}{dx} \sqrt{2x+3}$
8. Use the definition of derivative to compute $\frac{d}{dx} \frac{2x+3}{x-1}$
9. Derive the formula for the derivative of $\sec x$. You may use the formula for the derivative of $\sin x$ and $\cos x$.
10. Compute the limit and use the definition of limit to prove it is what you say:
 $\lim_{x \rightarrow 4} (3x^2 + 2x + 1)$
11. Compute the limit and use the definition of limit to prove it is what you say:
 $\lim_{x \rightarrow -1} \frac{2x+3}{x-1}$
12. Compute the limit and use the definition of limit to prove it is what you say:
 $\lim_{t \rightarrow 5} (3t^3 - 2t^2 + 4)$
13. Prove: $\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$.
14. Prove: $\lim_{x \rightarrow 0} \frac{1 - \cos x}{x} = 0$. (You may use Problem 12.)
15. Derive the formula for the derivative of $\sin x$. (You may use Problems 12 and 13.)
16. Derive the formula for the derivative of $\cos x$ (You may use Problems 12 and 13.)
17. Use the fact that $\frac{d}{dx} x^n = nx^{n-1}$ for any positive integer n to show that $\frac{d}{dx} x^n = nx^{n-1}$ for any negative integer n .
18. Find an equation of the tangent line to $y = \sin^3 x \cos x$ at the point where $x = \frac{\pi}{4}$.
19. Find an equation of the tangent line to $y = x \sin x$ at the point where $x = \frac{\pi}{3}$.
20. Find an equation of the tangent line to $y = \sqrt{3x-2}$ at the point where $x = 6$.
21. Find equations for all the lines that pass through the point $(2, 10)$ and are tangent to the graph of $y = x^2 + 2x + 3$. (Note that the point is not on the graph.)
22. Find equations for all the lines that pass through the point $(1, 50/9)$ and are tangent to the graph of $y = \frac{10}{x}$. (Note that the point is not on the graph.)
23. Compute $\lim_{x \rightarrow 0} \frac{\sin x + x}{x}$.
24. Compute $\lim_{x \rightarrow 0} \frac{\tan x}{x}$.
25. Compute $\lim_{\theta \rightarrow 0} \frac{1 - \cos^2 \theta}{\theta^2}$.
26. Compute $\lim_{t \rightarrow 0} t \csc t$.
27. Compute $\lim_{t \rightarrow 0} \frac{\sin(2t)}{3t}$.

28. Prove $\lim_{x \rightarrow 3} \sqrt{x^2 + 7} = 4$

29. Prove $\lim_{x \rightarrow 2} \frac{5x^2 + 2x - 2}{x^2 - x - 4} = -11$

30. Let

$$f(x) = \begin{cases} \frac{\sin x}{x} & : x < 0 \\ \frac{\tan x}{x} & : 0 < x \\ 0 & : x = 0 \end{cases}$$

Is f continuous at $x = 0$? If so show why. If not, determine if 0 is a removable discontinuity.

31. Give an example of a function that is continuous at $x = 1$, but it is not differentiable there.32. Prove that if $f'(a)$ exists, then $f(x)$ is continuous at $x = a$.33. State why $\lim_{x \rightarrow 0} (3x + 2) \neq 3$.34. State why $\lim_{x \rightarrow 0} \frac{x+1}{x^2}$ does not exist.35. State why $\lim_{x \rightarrow 4} \frac{x-4}{|x-4|}$ does not exist.36. State the definition of $\lim_{x \rightarrow a} f(x) = l$ and state the negation of the definition.

37. Prove the product formula for derivatives.

38. Prove the quotient formula for derivatives.

39. Compute $\lim_{x \rightarrow 3^+} f(x)$ and $\lim_{x \rightarrow 3^-} f(x)$. Does $\lim_{x \rightarrow 3} f(x)$ exist? If so state how you know, if not state why.

$$f(x) = \begin{cases} \sin x & : x \leq 0 \\ x & : 0 < x \leq 3 \\ x^2 - 4 & : x > 3 \end{cases}$$

40. Compute $\lim_{x \rightarrow 0^+} f(x)$ and $\lim_{x \rightarrow 0^-} f(x)$. Does $\lim_{x \rightarrow 0} f(x)$ exist? If so state how you know, if not state why.

$$f(x) = \begin{cases} \sin x & : x \leq 0 \\ x & : 0 < x \leq 3 \\ x^2 - 4 & : x > 3 \end{cases}$$

41. Is there a number c that makes the function f continuous, where f is defined below? If so, find c .

$$f(x) = \begin{cases} x^2 + 3 & : x \leq 1 \\ -2x^2 + c & : x > 1 \end{cases}$$

42. Prove that if $\lim_{x \rightarrow a} f(x) = l$ and $\lim_{x \rightarrow a} g(x) = k$, then $\lim_{x \rightarrow a} (f(x) + g(x)) = l + k$.43. Prove that if $\lim_{x \rightarrow a} f(x) = l$ and c is a constant, then $\lim_{x \rightarrow a} (cf(x)) = cl$.44. Prove that $\frac{d}{dx} x^{\frac{1}{n}} = \frac{1}{n} x^{\frac{1}{n}-1}$ for all natural numbers n .45. Prove that $\frac{d}{dx} x^{\frac{a}{b}} = \frac{a}{b} x^{\frac{a}{b}-1}$ for all integers a and $b \neq 0$. (You can use the previous problem.)