

Study with the Prof: Derivative Rules

Problem Set 1: Basic Derivatives

Do each problem on your own set of paper. Write out the problem as if you were doing it for an exam. Show all of your steps so that you can compare to the videos if you need to.

Using either the formula associated with the definition of the derivative or the alternative formula, find the derivatives of the following functions. You should **not** use the derivative rules here, the point is to practice using the formula (and memorizing it if needed).

1. $f(x) = 3x - 1$

2. $g(x) = x^2 + 5$

3. $h(x) = x^3$

Using the derivative rules, find the derivative of the following functions:

4. $f(x) = 4x^5 - 3x^4 + 2x^3 + 8x^2 - 3x + 9$

14. $y = \frac{\cos x}{\cot x}$

5. $g(x) = \frac{5}{x} + \frac{6}{x^2}$

15. $f(x) = \sin 6x - e^{7x}$

6. $y = x^{\frac{5}{4}} - 3x^{\frac{1}{3}} + 5\sqrt{x} + x^{3\pi}$

16. $g(x) = \frac{\sin 5x}{\tan 2x}$

7. $g(x) = 5x e^x$

17. $h(x) = \sin^{-1} x$

8. $y = \sin x - \tan x + \csc x$

18. $y = \tan^{-1} 3x$

9. $g(x) = e^x \csc x$

19. $f(x) = \log_3 x - 2^x$

10. $y = \frac{4x^2 - 3x}{\sin x}$

20. $g(x) = \log_5 4x + \ln 5x$

11. $f(x) = \tan x \cos x$

21. $y = e^{\sin x}$

12. $y = (4x + 1)(3x^2 + 2)$

22. $y = \csc^{-1} 5x$

13. $y = \frac{\tan x}{e^x + 4x^2}$

23. $y = 2^{e^{3x}}$

24. For each function, find the equation of the tangent line at the given point.

a. $f(x) = 3x^2 - 2$ at $(1, 1)$

b. $g(x) = \sin 3x$ at $(0, 0)$

c. $y = 2^x$ at $(2, 4)$

Answers

- | | |
|---|---|
| 1) $f'(x) = 3$ | 13) $y' = \frac{\sec^2 x}{e^x + 4x^2} - \frac{(e^x + 8x) \tan x}{(e^x + 4x^2)^2}$ |
| 2) $g'(x) = 2x$ | 14) $y' = \frac{\cos x \csc^2 x}{\cot^2 x} - \frac{\sin x}{\cot x}$ |
| 3) $h'(x) = 3x^2$ | 15) $f'(x) = 6 \cos 6x - 7e^{7x}$ |
| 4) $f'(x) = 20x^4 - 12x^3 + 6x^2 + 16x - 3$ | 16) $g'(x) = \frac{5 \cos 5x}{\tan 2x} - \frac{2 \sec^2 2x \sin 5x}{\tan^2 2x}$ |
| 5) $g'(x) = -5x^{-2} - 12x^{-3}$ | 17) $h'(x) = \frac{1}{\sqrt{1-x^2}}$ |
| 6) $y' = \frac{5}{4}x^{\frac{1}{4}} - x^{-\frac{2}{3}} + \frac{5}{2}x^{-\frac{1}{2}} + 3\pi x^{3\pi-1}$ | 18) $y' = \frac{3}{9x^2+1}$ |
| 7) $g'(x) = 5e^x + 5xe^x$ | 19) $f'(x) = \frac{1}{x \ln 3} - 2^x \ln 2$ |
| 8) $y' = \cos x - \sec^2 x - \csc x \cot x$ | 20) $g'(x) = \frac{1}{x \ln 5} + \frac{1}{x}$ |
| 9) $g'(x) = e^x \csc x - e^x \csc x \cot x$ | 21) $y' = \cos x e^{\sin x}$ |
| 10) $y' = \frac{((8x-3) \sin x - (4x^2-3x) \cos x)}{\sin^2 x}$ | 22) $y' = -\frac{1}{ x \sqrt{25x^2-1}}$ |
| 11) $f'(x) = \cos x \sec^2 x - \sin x \tan x$ | 23) $y' = 3 \ln 2 * 2^{e^{3x}} e^{3x}$ |
| 12) $y' = 36x^2 + 6x + 8$ | 24) a) $y = 6x - 5$ b) $y = 3x$ c) $y = 4 \ln 2x + 4 - 8 \ln 2$ |

In case you need more review, here are other videos to watch (by problem). These videos will give you a much deeper review and/or more examples.

Questions 1, 2, 3 Definition formula versus alternative formula <https://youtu.be/S1U5RpgCUos>, alternative formula examples <https://youtu.be/vt9nQQdXkEc>, definition version of the formula <https://youtu.be/BMIkWYo3C7w>

Questions 4, 5, 6 Basic derivative rules lesson <https://youtu.be/-gfcRvqT3po>, examples of basic derivatives <https://youtu.be/9CVMFU5G2Fk>

Question 7 Basic derivative rules lesson <https://youtu.be/-gfcRvqT3po>, examples of product rule <https://youtu.be/IZy9UPWMQwE>

Question 8, 9, 10, 11 Basic derivative rules lesson (product rule, quotient rule) <https://youtu.be/-gfcRvqT3po>, examples of product rule and quotient rule <https://youtu.be/IZy9UPWMQwE>; examples of trig derivatives <https://youtu.be/zsTWUdSeBXA>

Question 12 Basic derivative rules lesson (product rule, quotient rule) <https://youtu.be/-gfcRvqT3po>

Question 13, 14 Basic derivative rules lesson (product rule, quotient rule) <https://youtu.be/-gfcRvqT3po>, examples of quotient rule <https://youtu.be/IZy9UPWMQwE>; examples of trig derivatives <https://youtu.be/zsTWUdSeBXA>

Question 15, 16 Chain rule lesson <https://youtu.be/FsxMB-5SDzk>, chain rule examples with trig functions https://youtu.be/W1dan_IdHVO

Question 17, 18 Chain rule lesson <https://youtu.be/FsxMB-5SDzk>, inverse trig function derivatives lesson <https://youtu.be/vLe18VKxlqI>, inverse trig function derivatives examples <https://youtu.be/nFhdOwlbeWM>

Question 19, 20 Derivatives of general exponentials and logarithms lesson https://youtu.be/CbAuJ1R5_0k; examples of derivatives of general exponentials and logarithms https://youtu.be/zXk_LOxap0w

Question 21 Chain rule lesson <https://youtu.be/FsxMB-5SDzk>, chain rule examples with trig functions https://youtu.be/W1dan_IdHVO

Question 22 Chain rule lesson <https://youtu.be/FsxMB-5SDzk>, inverse trig function derivatives lesson <https://youtu.be/vLe18VKxlqI>, inverse trig function derivatives examples <https://youtu.be/nFhdOwlbeWM>

Question 23 Chain rule lesson <https://youtu.be/FsxMB-5SDzk>, examples of chain rule <https://youtu.be/GqtWUdtQ-uo>

Question 24 How to write the equation of a tangent line <https://youtu.be/gW04qcAzWno>