

Formal Definition of Derivative

4: Use the formal definition of a derivative to find $f'(x)$.

1. $f(x) = 3x^2 + 1$

$$f'(x) = 6x$$

2. $f(x) = \frac{1}{x-2}$

$$f'(x) = \frac{-2}{(x-2)^2}$$

3. $f(x) = \sqrt{x+5}$

$$f'(x) = \frac{1}{2\sqrt{x+5}}$$

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

$$f'(x) = 3x^2 - 2$$

Find the equation of the tangent line to the graph of $y=g(x)$ at $x=3$ if $g(3)=-2$ and $g'(3)=6$.

$$y + 2 = 6(x - 3)$$

Find the equation of the tangent line to the graph of $y=g(x)$ at $x=-2$ if $g(-2)=5$ and $g'(-2)=-3$.

$$y - 5 = -3(x + 2)$$

7-8 Find an equation of the tangent line to the curve at the given point.

7. $y = 2x - x^2$, (3, -3)

$$y + 3 = -4(x - 3)$$

8. $y = \sqrt{x}$, (9, 3)

$$y - 3 = \frac{1}{6}(x - 9)$$

9. If an equation of the tangent line to the curve $y = f(x)$ at the point where $a = 2$ is $y = 5x + 8$, find $f(2)$ and $f'(2)$.

$$f(2) = 18 \quad f'(2) = 5$$

10. If the tangent line to $y = f(x)$ at $(-2, 8)$ passes through the point $(0, 2)$, find $f(-2)$ and $f'(-2)$.

$$f(-2) = 8 \quad f'(-2) = -3$$

11-19 Each limit represents some derivative of some function f . State such an f and what derivative is asked for in each case.

11. $\lim_{h \rightarrow 0} \frac{\frac{1}{x+h-3} - \frac{1}{x-3}}{h}$
 $f(x) = \frac{1}{x-3}$

12. $\lim_{t \rightarrow 2} \frac{t^3 - 2t - 4}{t - 2}$
 $f(t) = t^3 - 2t$
 want $f'(t) \Big|_{t=2}$

13. $\lim_{h \rightarrow 0} \frac{((x+h)^2 + 2(x+h) - 7) - (x^2 + 2x - 7)}{h}$
 $f(x) = x^2 + 2x - 7$

14. $\lim_{h \rightarrow 0} \frac{\ln(x+h+4) - \ln(x+4)}{h}$
 $f(x) = \ln(x+4)$

15. $\lim_{h \rightarrow 0} \frac{\sin\left(\frac{\pi}{2} + h\right) - 1}{h}$
 $f(x) = \sin x$
 want $f'(x) \Big|_{x=\pi/2}$

16. $\lim_{h \rightarrow 0} \frac{2(2+h)^5 - 64}{h}$ want $f'(x)$
 $f(x) = 2x^5$

17. $\lim_{x \rightarrow \frac{2\pi}{3}} \frac{\cos x + \frac{1}{2}}{x - \frac{2\pi}{3}}$
 $f(x) = \cos x$
 want $f'(x) \Big|_{x=\frac{2\pi}{3}}$

18. $\lim_{h \rightarrow 0} \frac{\sqrt[3]{27+h} - 3}{h}$
 $f(x) = \sqrt[3]{x}$
 want $f'(x) \Big|_{x=27}$

19. $\lim_{x \rightarrow 3} \frac{e^x - e^3}{x - 3}$
 $f(x) = e^x$
 want $f'(x) \Big|_{x=3}$