

differentiable at 0, this function is differentiable everywhere and there is a formula for its derivative.

- We can use a formula to find the derivative of $y = \ln x$, and the relationship $\log_b x = \frac{\ln x}{\ln b}$ allows us to extend our differentiation formulas to include logarithms with arbitrary bases.
- Logarithmic differentiation allows us to differentiate functions of the form $y = g(x)^{f(x)}$ or very complex functions by taking the natural logarithm of both sides and exploiting the properties of logarithms before differentiating.

CHAPTER 3 REVIEW EXERCISES

True or False? Justify the answer with a proof or a counterexample.

367. Every function has a derivative.
368. A continuous function has a continuous derivative.
369. A continuous function has a derivative.
370. If a function is differentiable, it is continuous.

Use the limit definition of the derivative to exactly evaluate the derivative.

371. $f(x) = \sqrt{x+4}$

372. $f(x) = \frac{3}{x}$

Find the derivatives of the following functions.

373. $f(x) = 3x^3 - \frac{4}{x^2}$

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

375. $f(x) = e^{\sin x}$

376. $f(x) = \ln(x+2)$

377. $f(x) = x^2 \cos x + x \tan(x)$

378. $f(x) = \sqrt{3x^2 + 2}$

379. $f(x) = \frac{x}{4} \sin^{-1}(x)$

380. $x^2 y = (y+2) + xy \sin(x)$

Find the following derivatives of various orders.

381. First derivative of $y = x \ln(x) \cos x$

382. Third derivative of $y = (3x+2)^2$

383. Second derivative of $y = 4^x + x^2 \sin(x)$

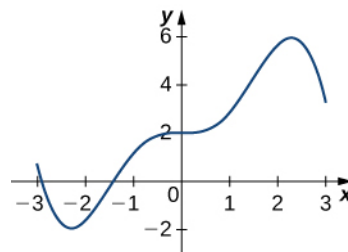
Find the equation of the tangent line to the following equations at the specified point.

384. $y = \cos^{-1}(x) + x$ at $x = 0$

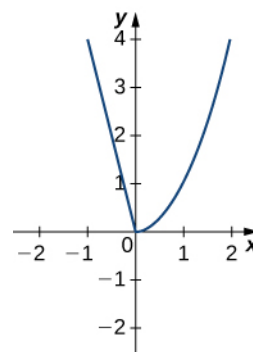
385. $y = x + e^x - \frac{1}{x}$ at $x = 1$

Draw the derivative for the following graphs.

386.



387.



The following questions concern the water level in Ocean City, New Jersey, in January, which can be approximated by $w(t) = 1.9 + 2.9 \cos\left(\frac{\pi}{6}t\right)$, where t is measured in hours after midnight, and the height is measured in feet.

388. Find and graph the derivative. What is the physical meaning?