

I. Definitions/Concepts.

1. (3.2) Differentiate $y = \frac{x-a}{\sqrt{x}-\sqrt{a}}$ with respect to x , using any method you like.
2. (3.3) Use the Quotient Rule to find $\frac{d}{dx} \left(\frac{1}{x^n} \right)$. In this problem, n is a positive integer.
3. **ChAlLeNgE or Extra Credit** (3.4) Using the trig identity

$$\sin 2x = 2 \sin x \cos x$$

find $\frac{d}{dx} (\sin 2x)$.

4. **ChAlLeNgE** (3.4) Use the trig identity

$$\cos^2 x + \sin^2 x = 1$$

to prove that

$$\lim_{x \rightarrow 0} \frac{\cos x - 1}{x} = 0.$$

5. (3.5) Suppose a company produces x items at a cost $C(x)$.
 - (a) Write a formula for the **average cost**.
 - (b) Write a formula for the **marginal cost**.
 - (c) Suppose $\Delta x = 1$ item. In words, what is $\frac{\Delta C}{\Delta x}$?
6. (3.6) Suppose $f(x)$ and $g(x)$ are differentiable at all values of x . Then

$$f(g(x^2)) =$$

II. Questions/Problems.

1. (3.2) $f(x) = 2x^3 - 3x^2 - 12x + 4$
 - (a) Find all points on the graph of f at which the tangent line is horizontal.
 - (b) Find all points on the graph of f at which the tangent line has slope 60.
2. (3.2) Let $F = f + g$ and $G = 3f - g$, where the graphs of f and g are shown in Figure 1. Find the following derivatives:
 - (a) $F'(1)$
 - (b) $G'(1)$
 - (c) $F'(5)$
 - (d) $G'(5)$
3. (3.3) Let $f(t) = 100e^{-0.05t}$.
 - (a) Find the values of t for which the slope of the curve $y = f(t)$ is -5 .

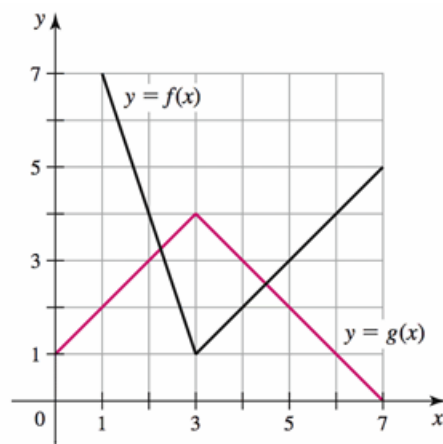


Figure 1: (Briggs, W. and Cochran, L. *Calculus: Early ranscendentals*)

- (b) Does the graph of f have a horizontal tangent line?
4. (3.4) For what values of x does $f(x) = x - \cos x$ have a horizontal tangent line?
5. (3.5) Suppose a stone is thrown vertically upward from the edge of a cliff on mars (where the acceleration of gravity is only about 12 ft/s^2) with an initial velocity of 64 ft/s from a height of 192 ft above the ground. The height s of the stone above the ground after t seconds is given by
- $$s = -6t^2 + 64t + 192.$$
- (a) Determine the velocity v of the stone after t seconds.
- (b) When does the stone reach its highest point?
- (c) What is the height of the stone at the highest point?
- (d) When does the stone strike the ground?
- (e) With what velocity does the stone strike the ground?
6. (3.7) For each function ($g(x)$), find the value of $g'(3)$ using the data given below.

$$\begin{array}{llll} f(1) = 6 & f(3) = 2 & f(6) = 5 & f(9) = -3 \\ f'(1) = -2 & f'(3) = 4 & f'(6) = -1 & f'(9) = 1 \end{array}$$

- (a) $g(x) = f(3) + 10f(2x)$
- (b) $g(x) = \frac{f(x^2)}{x}$
- (c) $g(x) = (f(x))^3$
- (d) $g(x) = f(\sqrt{2} \sin \frac{\pi}{4} x)$

III. Computations/Algebra.

1. (3.2) $f(x) = 3x^2 + 5e^x$
Find $f'(x)$, $f''(x)$, and $f^{(3)}(x)$.

2. (3.2) Find the derivative of $h(x) = (x^2 + 1)^2$.
3. (3.2) Find the derivative of $h(x) = \sqrt{x}(\sqrt{x} - 1)$.
4. (3.2) Find the derivative of the following functions:

- (a) $y = x^5$
(b) $f(v) = v^{100}$
(c) $8x$
(d) $g(w) = 2w^3 + 3w + e^w$

5. (3.3) Find the derivative of the following functions:

- (a) $h(x) = \frac{(x-1)(2x^2-1)}{x^3-1}$
(b) $h(x) = \frac{x+1}{x^2e^x}$

6. (3.4) Evaluate the following limits:

- (a) $\lim_{x \rightarrow 0} \frac{\sin 3x}{x}$
(b) $\lim_{x \rightarrow 0} \frac{\tan 5x}{x}$
(c) $\lim_{x \rightarrow -3} \frac{\sin(x+3)}{x^2+8x+15}$

7. (3.4) Find y' for each of the following functions:

- (a) $y = \sin x + \cos x$
(b) $y = 5x^2 + \cos x$
(c) $y = \frac{(x^2-1)\sin x}{\sin x + 1}$

8. (3.6) $y = x \cos x^2$

Find $\frac{d^2y}{dx^2}$.

9. (3.6) Find the derivative of $f(x) = (\cos x + 2 \sin x)^8$.
10. (3.6) Find the derivative of $f(x) = \sin^5(\cos 3x)$.

11. (3.7) Find $\frac{dy}{dx}$.

- (a) $\sin(xy) = x + y$
(b) $e^{xy} = 2y$
(c) $(xy+1)^3 = x - y^2 + 8$

12. (3.7) For each function find $\frac{d^2y}{dx^2}$.

- (a) $x^4 + y^4 = 64$
(b) $e^{2y} + x = y$