3.3 EXERCISES

For the following exercises, find $f'(x)$ for each function.

106. $f(x) = x^7 + 10$

107. $f(x) = 5x^3 - x + 1$

108. $f(x) = 4x^2 - 7x$

109. $f(x) = 8x^4 + 9x^2 - 1$

110. $f(x) = x^4 + \frac{2}{x}$

111. $f(x) = 3x\left(18x^4 + \frac{13}{x+1}\right)$

112. $f(x) = (x+2)\left(2x^2 - 3\right)$

113. $f(x) = x^2\left(\frac{2}{x^2} + \frac{5}{x^3}\right)$

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

115. $f(x) = \frac{4x^3 - 2x + 1}{x^2}$

116. $f(x) = \frac{x^2 + 4}{x^2 - 4}$

117. $f(x) = \frac{x + 9}{x^2 - 7x + 1}$

For the following exercises, find the equation of the tangent line $T(x)$ to the graph of the given function at the indicated point. Use a graphing calculator to graph the function and the tangent line.

118. **[T]** $y = 3x^2 + 4x + 1$ at $(0, 1)$

119. **[T]** $y = 2\sqrt{x} + 1$ at $(4, 5)$

120. **[T]** $y = \frac{2x}{x-1}$ at $(-1, 1)$

121. **[T]** $y = \frac{2}{x} - \frac{3}{x^2}$ at $(1, -1)$

For the following exercises, assume that $f(x)$ and $g(x)$ are both differentiable functions for all x. Find the derivative of each of the functions $h(x)$.

122. $h(x) = 4f(x) + \frac{g(x)}{7}$

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

124. $h(x) = \frac{f(x)g(x)}{2}$

125. $h(x) = \frac{3f(x)}{g(x) + 2}$

For the following exercises, assume that $f(x)$ and $g(x)$ are both differentiable functions with values as given in the following table. Use the following table to calculate the following derivatives.

x	1	2	3	4
$f(x)$	3	5	−2	0
$g(x)$	2	3	−4	6
$f'(x)$	−1	7	8	−3
$g'(x)$	4	1	2	9

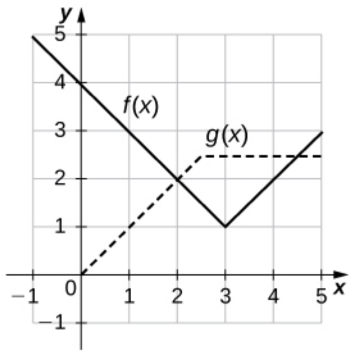
126. Find $h'(1)$ if $h(x) = xf(x) + 4g(x)$.

127. Find $h'(2)$ if $h(x) = \frac{f(x)}{g(x)}$.

128. Find $h'(3)$ if $h(x) = 2x + f(x)g(x)$.

129. Find $h'(4)$ if $h(x) = \frac{1}{x} + \frac{g(x)}{f(x)}$.

For the following exercises, use the following figure to find the indicated derivatives, if they exist.



130. Let $h(x) = f(x) + g(x)$. Find

a. $h'(1)$,

b. $h'(3)$, and

c. $h'(4)$.

131. Let $h(x) = f(x)g(x)$. Find

a. $h'(1)$,

b. $h'(3)$, and

c. $h'(4)$.

132. Let $h(x) = \frac{f(x)}{g(x)}$. Find

a. $h'(1)$,

b. $h'(3)$, and

c. $h'(4)$.

For the following exercises,

a. evaluate $f'(a)$, and

b. graph the function $f(x)$ and the tangent line at $x = a$.

133. **[T]** $f(x) = 2x^3 + 3x - x^2, a = 2$

134. **[T]** $f(x) = \frac{1}{x} - x^2, a = 1$

135. **[T]** $f(x) = x^2 - x^{12} + 3x + 2, a = 0$

136. **[T]** $f(x) = \frac{1}{x} - x^{2/3}, a = -1$

137. Find the equation of the tangent line to the graph of $f(x) = 2x^3 + 4x^2 - 5x - 3$ at $x = -1$.

138. Find the equation of the tangent line to the graph of $f(x) = x^2 + \frac{4}{x} - 10$ at $x = 8$.

139. Find the equation of the tangent line to the graph of $f(x) = (3x - x^2)(3 - x - x^2)$ at $x = 1$.

140. Find the point on the graph of $f(x) = x^3$ such that the tangent line at that point has an x intercept of 6.

141. Find the equation of the line passing through the point $P(3, 3)$ and tangent to the graph of $f(x) = \frac{6}{x - 1}$.

142. Determine all points on the graph of $f(x) = x^3 + x^2 - x - 1$ for which

a. the tangent line is horizontal

b. the tangent line has a slope of -1.

143. Find a quadratic polynomial such that $f(1) = 5, f'(1) = 3$ and $f''(1) = -6$.

144. A car driving along a freeway with traffic has traveled $s(t) = t^3 - 6t^2 + 9t$ meters in t seconds.

a. Determine the time in seconds when the velocity of the car is 0.

b. Determine the acceleration of the car when the velocity is 0.

145. **[T]** A herring swimming along a straight line has traveled $s(t) = \frac{t^2}{t^2 + 2}$ feet in t seconds. Determine the velocity of the herring when it has traveled 3 seconds.

146. The population in millions of arctic flounder in the Atlantic Ocean is modeled by the function $P(t) = \frac{8t + 3}{0.2t^2 + 1}$, where t is measured in years.

a. Determine the initial flounder population.

b. Determine $P'(10)$ and briefly interpret the result.

147. **[T]** The concentration of antibiotic in the bloodstream t hours after being injected is given by the function $C(t) = \frac{2t^2 + t}{t^3 + 50}$, where C is measured in milligrams per liter of blood.

a. Find the rate of change of $C(t)$.

b. Determine the rate of change for $t = 8, 12, 24$, and 36.

c. Briefly describe what seems to be occurring as the number of hours increases.

148. A book publisher has a cost function given by $C(x) = \frac{x^3 + 2x + 3}{x^2}$, where x is the number of copies of a book in thousands and C is the cost, per book, measured in dollars. Evaluate $C'(2)$ and explain its meaning.

149. **[T]** According to Newton's law of universal gravitation, the force F between two bodies of constant mass m_1 and m_2 is given by the formula $F = \frac{Gm_1 m_2}{d^2}$, where G is the gravitational constant and d is the distance between the bodies.

a. Suppose that $G, m_1,$ and m_2 are constants. Find the rate of change of force F with respect to distance d.
b. Find the rate of change of force F with gravitational constant $G = 6.67 \times 10^{-11}$ Nm^2/kg^2, on two bodies 10 meters apart, each with a mass of 1000 kilograms.