Section 2.3 (page 126)

1. $2(2x^3 - 6x^2 + 3x - 6)$ **3.** $(1 - 5t^2)/(2\sqrt{t})$

5. $x^2(3\cos x - x\sin x)$ **7.** $(1 - x^2)/(x^2 + 1)^2$

9. $(1 - 5x^3)/[2\sqrt{x}(x^3 + 1)^2]$ **11.** $(x\cos x - 2\sin x)/x^3$

13. $f'(x) = (x^3 + 4x)(6x + 2) + (3x^2 + 2x - 5)(3x^2 + 4)$

$= 15x^4 + 8x^3 + 21x^2 + 16x - 20$

$f'(0) = -20$

15. $f'(x) = \dfrac{x^2 - 6x + 4}{(x - 3)^2}$

$f'(1) = -\dfrac{1}{4}$

17. $f'(x) = \cos x - x\sin x$

$f'\left(\dfrac{\pi}{4}\right) = \dfrac{\sqrt{2}}{8}(4 - \pi)$

	Function	*Rewrite*	*Differentiate*	*Simplify*
19.	$y = \dfrac{x^2 + 3x}{7}$	$y = \dfrac{1}{7}x^2 + \dfrac{3}{7}x$	$y' = \dfrac{2}{7}x + \dfrac{3}{7}$	$y' = \dfrac{2x + 3}{7}$
21.	$y = \dfrac{6}{7x^2}$	$y = \dfrac{6}{7}x^{-2}$	$y' = -\dfrac{12}{7}x^{-3}$	$y' = -\dfrac{12}{7x^3}$
23.	$y = \dfrac{4x^{3/2}}{x}$	$y = 4x^{1/2}$, $x > 0$	$y' = 2x^{-1/2}$	$y' = \dfrac{2}{\sqrt{x}}$, $x > 0$

25. $\dfrac{(x^2 - 1)(-3 - 2x) - (4 - 3x - x^2)(2x)}{(x^2 - 1)^2} = \dfrac{3}{(x + 1)^2},\ x \neq 1$

27. $1 - 12/(x + 3)^2 = (x^2 + 6x - 3)/(x + 3)^2$

29. $\dfrac{3}{2}x^{-1/2} + \dfrac{1}{2}x^{-3/2} = (3x + 1)/2x^{3/2}$

31. $6s^2(s^3 - 2)$ **33.** $-(2x^2 - 2x + 3)/[x^2(x - 3)^2]$

35. $(6x^2 + 5)(x - 3)(x + 2) + (2x^3 + 5x)(1)(x + 2)$
$+ (2x^3 + 5x)(x - 3)(1)$
$= 10x^4 - 8x^3 - 21x^2 - 10x - 30$

37. $\dfrac{(x^2 - c^2)(2x) - (x^2 + c^2)(2x)}{(x^2 - c^2)^2} = -\dfrac{4xc^2}{(x^2 - c^2)^2}$

39. $t(t\cos t + 2\sin t)$ **41.** $-(t\sin t + \cos t)/t^2$

43. $-1 + \sec^2 x = \tan^2 x$ **45.** $\dfrac{1}{4t^{3/4}} - 6\csc t\cot t$

47. $\dfrac{-6\cos^2 x + 6\sin x - 6\sin^2 x}{4\cos^2 x} = \dfrac{3}{2}(-1 + \tan x\sec x - \tan^2 x)$
$= \dfrac{3}{2}\sec x(\tan x - \sec x)$

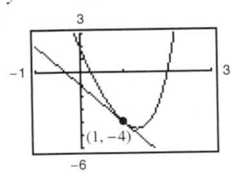
49. $\csc x\cot x - \cos x = \cos x\cot^2 x$ **51.** $x(x\sec^2 x + 2\tan x)$

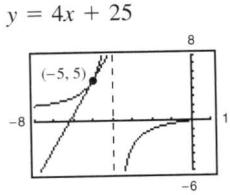
53. $2x\cos x + 2\sin x - x^2\sin x + 2x\cos x$
$= 4x\cos x + (2 - x^2)\sin x$

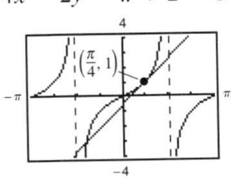
55. $\left(\dfrac{x+1}{x+2}\right)(2) + (2x - 5)\left[\dfrac{(x+2)(1) - (x+1)(1)}{(x+2)^2}\right]$
$= \dfrac{2x^2 + 8x - 1}{(x+2)^2}$

57. $\dfrac{1 - \sin\theta + \theta\cos\theta}{(1 - \sin\theta)^2}$ **59.** $y' = \dfrac{-2\csc x\cot x}{(1 - \csc x)^2}$, $-4\sqrt{3}$

61. $h'(t) = \sec t(t\tan t - 1)/t^2$, $1/\pi^2$

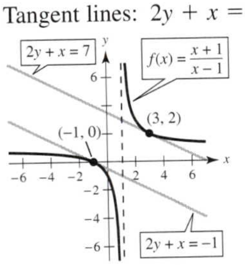
63. (a) $y = -3x - 1$
(b)


65. (a) $y = 4x + 25$
(b)


67. (a) $4x - 2y - \pi + 2 = 0$
(b)


69. $2y + x - 4 = 0$

71. $25y - 12x + 16 = 0$ **73.** $(1, 1)$ **75.** $(0, 0)$, $(2, 4)$

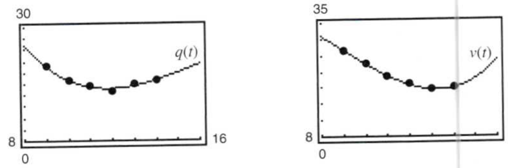
77. Tangent lines: $2y + x = 7$; $2y + x = -1$


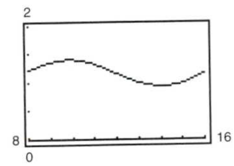
79. $f(x) + 2 = g(x)$ **81.** (a) $p'(1) = 1$ (b) $q'(4) = -1/3$

83. $(18t + 5)/(2\sqrt{t})$ cm²/sec

85. (a) −\$38.13 thousand/100 components
(b) −\$10.37 thousand/100 components
(c) −\$3.80 thousand/100 components
The cost decreases with increasing order size.

87. 31.55 bacteria/h **89.** Proof

91. (a) $q(t) = -0.0546t^3 + 2.529t^2 - 36.89t + 186.6$
$v(t) = 0.0796t^3 - 2.162t^2 + 15.32t + 5.9$
(b)


(c) $A = \dfrac{0.0796t^3 - 2.162t^2 + 15.32t + 5.9}{-0.0546t^3 + 2.529t^2 - 36.89t + 186.6}$


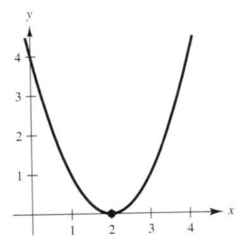
A represents the average value (in billions of dollars) per one million personal computers.

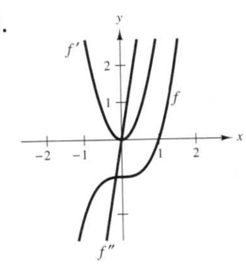
(d) $A'(t)$ represents the rate of change of the average value per one million personal computers for the given year.

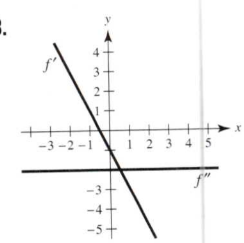
93. $12x^2 + 12x - 6$ **95.** $3/\sqrt{x}$ **97.** $2/(x - 1)^3$

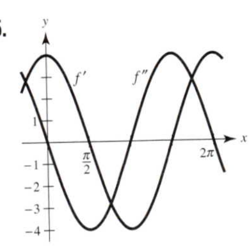
99. $2\cos x - x\sin x$ **101.** $2x$ **103.** $1/\sqrt{x}$

105. 0 **107.** −10

109. Answers will vary. For example: $f(x) = (x - 2)^2$


111.


113.


115.


117. $v(3) = 27$ m/sec
$a(3) = -6$ m/sec²
The speed of the object is decreasing.

119.

t	0	1	2	3	4
$s(t)$	0	57.75	99	123.75	132
$v(t)$	66	49.5	33	16.5	0
$a(t)$	−16.5	−16.5	−16.5	−16.5	−16.5

The average velocity on [0, 1] is 57.75, on [1, 2] is 41.25, on [2, 3] is 24.75, and on [3, 4] is 8.25.

121. $f^{(n)}(x) = n(n-1)(n-2)\cdots(2)(1) = n!$

123. (a) $f''(x) = g(x)h''(x) + 2g'(x)h'(x) + g''(x)h(x)$

$f'''(x) = g(x)h'''(x) + 3g'(x)h''(x) + 3g''(x)h'(x) + g'''(x)h(x)$

$f^{(4)}(x) = g(x)h^{(4)}(x) + 4g'(x)h'''(x) + 6g''(x)h''(x) + 4g'''(x)h'(x) + g^{(4)}(x)h(x)$

(b) $f^{(n)}(x) = g(x)h^{(n)}(x) + \dfrac{n!}{1!(n-1)!}g'(x)h^{(n-1)}(x) + \dfrac{n!}{2!(n-2)!}g''(x)h^{(n-2)}(x) + \cdots + \dfrac{n!}{(n-1)!1!}g^{(n-1)}(x)h'(x) + g^{(n)}(x)h(x)$

125. $n = 1$: $f'(x) = x\cos x + \sin x$

$n = 2$: $f'(x) = x^2\cos x + 2x\sin x$

$n = 3$: $f'(x) = x^3\cos x + 3x^2\sin x$

$n = 4$: $f'(x) = x^4\cos x + 4x^3\sin x$

General rule: $f'(x) = x^n\cos x + nx^{(n-1)}\sin x$

127. $y' = -1/x^2$, $y'' = 2/x^3$,

$x^3y'' + 2x^2y' = x^3(2/x^3) + 2x^2(-1/x^2) = 2 - 2 = 0$

129. $y' = 2\cos x$, $y'' = -2\sin x$,

$y'' + y = -2\sin x + 2\sin x + 3 = 3$

131. False. $dy/dx = f(x)g'(x) + g(x)f'(x)$ **133.** True

135. True **137.** $f(x) = 3x^2 - 2x - 1$

139. $f'(x) = 2|x|$; $f''(0)$ does not exist. **141.** Proof