

## Section 3.1-3.3 Homework

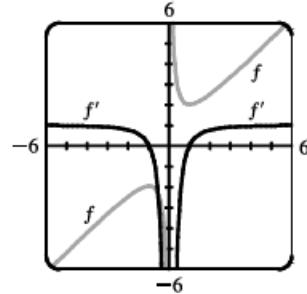
14.  $R(x) = \frac{\sqrt{10}}{x^7} = \sqrt{10}x^{-7} \Rightarrow R'(x) = -7\sqrt{10}x^{-8} = -\frac{7\sqrt{10}}{x^8}$

16.  $y = \sqrt{x}(x-1) = x^{3/2} - x^{1/2} \Rightarrow y' = \frac{3}{2}x^{1/2} - \frac{1}{2}x^{-1/2} = \frac{1}{2}x^{-1/2}(3x-1)$  [factor out  $\frac{1}{2}x^{-1/2}$ ]  
or  $y' = \frac{3x-1}{2\sqrt{x}}$ .

18.  $g(u) = \sqrt{2}u + \sqrt{3u} = \sqrt{2}u + \sqrt{3}\sqrt{u} \Rightarrow g'(u) = \sqrt{2}(1) + \sqrt{3}\left(\frac{1}{2}u^{-1/2}\right) = \sqrt{2} + \sqrt{3}/(2\sqrt{u})$

32.  $f(x) = x + 1/x = x + x^{-1} \Rightarrow f'(x) = 1 - x^{-2} = 1 - 1/x^2$ .

Notice that  $f'(x) = 0$  when  $f$  has a horizontal tangent,  $f'$  is positive when  $f$  is increasing, and  $f'$  is negative when  $f$  is decreasing.

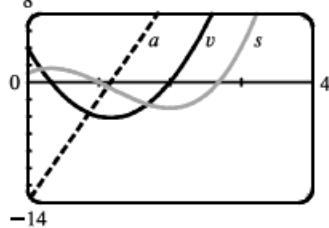


38.  $G(r) = \sqrt{r} + \sqrt[3]{r} \Rightarrow G'(r) = \frac{1}{2}r^{-1/2} + \frac{1}{3}r^{-2/3} \Rightarrow G''(r) = -\frac{1}{4}r^{-3/2} - \frac{2}{9}r^{-5/3}$

42. (a)  $s = 2t^3 - 7t^2 + 4t + 1 \Rightarrow v(t) = s'(t) = 6t^2 - 14t + 4 \Rightarrow a(t) = v'(t) = 12t - 14$

(b)  $a(1) = 12 - 14 = -2 \text{ m/s}^2$

(c)



43.  $f(x) = 1 + 2e^x - 3x \Rightarrow f'(x) = 2e^x - 3$ .  $f'(x) > 0 \Rightarrow 2e^x - 3 > 0 \Rightarrow 2e^x > 3 \Rightarrow e^x > 1.5 \Rightarrow x > \ln 1.5 \approx 0.41$ .  $f$  is increasing when  $f'$  is positive; that is, on  $(\ln 1.5, \infty)$ .

45. The curve  $y = 2x^3 + 3x^2 - 12x + 1$  has a horizontal tangent when  $y' = 6x^2 + 6x - 12 = 0 \Leftrightarrow 6(x^2 + x - 2) = 0 \Leftrightarrow 6(x+2)(x-1) = 0 \Leftrightarrow x = -2 \text{ or } x = 1$ . The points on the curve are  $(-2, 21)$  and  $(1, -6)$ .

47.  $y = 6x^3 + 5x - 3 \Rightarrow m = y' = 18x^2 + 5$ , but  $x^2 \geq 0$  for all  $x$ , so  $m \geq 5$  for all  $x$ .

36. (a)  $P(x) = F(x)G(x)$ , so  $P'(2) = F(2)G'(2) + G(2)F'(2) = 3 \cdot \frac{2}{4} + 2 \cdot 0 = \frac{3}{2}$ .

(b)  $Q(x) = F(x)/G(x)$ , so  $Q'(7) = \frac{G(7)F'(7) - F(7)G'(7)}{[G(7)]^2} = \frac{1 \cdot \frac{1}{4} - 5 \cdot \left(-\frac{2}{3}\right)}{1^2} = \frac{1}{4} + \frac{10}{3} = \frac{43}{12}$

42.  $f$  is concave downward when  $f''$  is negative.  $f(x) = x^2e^x \Rightarrow f'(x) = x^2e^x + e^x(2x) \Rightarrow f''(x) = x^2e^x + e^x(2x) + e^x(2) + (2x)e^x = e^x(x^2 + 2x + 2 + 2x) = e^x(x^2 + 4x + 2)$ . Note that  $e^x > 0$  for all  $x$  and  $f''(x) = 0 \Leftrightarrow x = -2 \pm \sqrt{2}$ .  $f''(x) < 0$  when  $x \in (-2 - \sqrt{2}, -2 + \sqrt{2})$ .

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2. (a)  $x(t) = \frac{t}{1+t^2} \Rightarrow v(t) = x'(t) = \frac{(1+t^2)(1)-t(2t)}{(1+t^2)^2} = \frac{1-t^2}{(1+t^2)^2}$

(b) Right:  $v(t) > 0 \Rightarrow 1-t^2 > 0 \Rightarrow t^2 < 1 \Rightarrow |t| < 1 \Rightarrow 0 \leq t < 1$

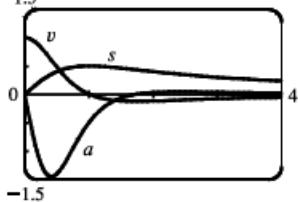
Left:  $v(t) < 0 \Rightarrow 1-t^2 < 0 \Rightarrow t > 1$

(c)  $|x(1) - x(0)| + |x(4) - x(1)| = \left|\frac{1}{2} - 0\right| + \left|\frac{4}{17} - \frac{1}{2}\right| = \frac{1}{2} + \frac{9}{34} = \frac{13}{17}$

(d)  $x(t) = \frac{t}{1+t^2} \Rightarrow v(t) = x'(t) = \frac{(1+t^2)(1)-t(2t)}{(1+t^2)^2} = \frac{1-t^2}{(1+t^2)^2}, a(t) = v'(t) = \frac{2t(t^2-3)}{(1+t^2)^3}$

$a(t) = 0 \Rightarrow 2t(t^2-3) = 0 \Rightarrow t = 0 \text{ or } \sqrt{3}$

(e)



(f)  $v$  and  $a$  have the same sign and the particle is speeding up when

$1 < t < \sqrt{3}$ . The particle is slowing down and  $v$  and  $a$  have opposite signs

when  $0 < t < 1$  and when  $t > \sqrt{3}$ .