18. $f(x) = \dfrac{x^2 - 3x + 1}{x^2} = 1 - \dfrac{3}{x} + \dfrac{1}{x^2} = 1 - 3x^{-1} + x^{-2} \quad \Rightarrow$

$f'(x) = 0 - 3(-1)x^{-2} + (-2)x^{-3} = 3x^{-2} - 2x^{-3}$ or $\dfrac{3}{x^2} - \dfrac{2}{x^3}$ or $\dfrac{3x-2}{x^3}$

19. $y = \dfrac{x^2 + 4x + 3}{\sqrt{x}} = x^{3/2} + 4x^{1/2} + 3x^{-1/2} \quad \Rightarrow$

$y' = \frac{3}{2}x^{1/2} + 4\left(\frac{1}{2}\right)x^{-1/2} + 3\left(-\frac{1}{2}\right)x^{-3/2} = \frac{3}{2}\sqrt{x} + \dfrac{2}{\sqrt{x}} - \dfrac{3}{2x\sqrt{x}}$ [note that $x^{3/2} = x^{2/2} \cdot x^{1/2} = x\sqrt{x}$]

The last expression can be written as $\dfrac{3x^2}{2x\sqrt{x}} + \dfrac{4x}{2x\sqrt{x}} - \dfrac{3}{2x\sqrt{x}} = \dfrac{3x^2 + 4x - 3}{2x\sqrt{x}}$.

23. $u = \sqrt[5]{t} + 4\sqrt{t^5} = t^{1/5} + 4t^{5/2} \quad \Rightarrow \quad u' = \frac{1}{5}t^{-4/5} + 4\left(\frac{5}{2}t^{3/2}\right) = \frac{1}{5}t^{-4/5} + 10t^{3/2}$ or $1/\left(5\sqrt[5]{t^4}\right) + 10\sqrt{t^3}$

24. $v = \left(\sqrt{x} + \dfrac{1}{\sqrt[3]{x}}\right)^2 = \left(\sqrt{x}\right)^2 + 2\sqrt{x} \cdot \dfrac{1}{\sqrt[3]{x}} + \left(\dfrac{1}{\sqrt[3]{x}}\right)^2 = x + 2x^{1/2-1/3} + 1/x^{2/3} = x + 2x^{1/6} + x^{-2/3} \quad \Rightarrow$

$v' = 1 + 2\left(\frac{1}{6}x^{-5/6}\right) - \frac{2}{3}x^{-5/3} = 1 + \frac{1}{3}x^{-5/6} - \frac{2}{3}x^{-5/3}$ or $1 + \dfrac{1}{3\sqrt[6]{x^5}} - \dfrac{2}{3\sqrt[3]{x^5}}$

45. (a) $s = t^3 - 3t \quad \Rightarrow \quad v(t) = s'(t) = 3t^2 - 3 \quad \Rightarrow \quad a(t) = v'(t) = 6t$

(b) $a(2) = 6(2) = 12\ \text{m/s}^2$

(c) $v(t) = 3t^2 - 3 = 0$ when $t^2 = 1$, that is, $t = 1$ and $a(1) = 6\ \text{m/s}^2$.

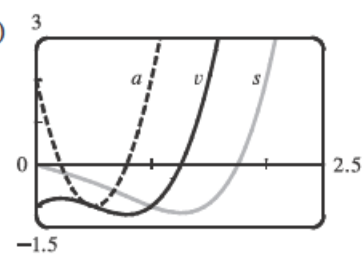
46. (a) $s = t^4 - 2t^3 + t^2 - t \quad \Rightarrow$

$v(t) = s'(t) = 4t^3 - 6t^2 + 2t - 1 \quad \Rightarrow$

$a(t) = v'(t) = 12t^2 - 12t + 2$

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

(c)



48. $f(x) = x^3 - 4x^2 + 5x \quad \Rightarrow \quad f'(x) = 3x^2 - 8x + 5 \quad \Rightarrow \quad f''(x) = 6x - 8$.

$f''(x) > 0 \quad \Rightarrow \quad 6x - 8 > 0 \quad \Rightarrow \quad x > \frac{4}{3}$. f is concave upward when $f''(x) > 0$; that is, on $\left(\frac{4}{3}, \infty\right)$.

5. By the Quotient Rule, $y = \dfrac{e^x}{x^2} \quad \Rightarrow \quad y' = \dfrac{x^2 \frac{d}{dx}(e^x) - e^x \frac{d}{dx}(x^2)}{(x^2)^2} = \dfrac{x^2(e^x) - e^x(2x)}{x^4} = \dfrac{xe^x(x-2)}{x^4} = \dfrac{e^x(x-2)}{x^3}$.

6. By the Quotient Rule, $y = \dfrac{e^x}{1+x} \quad \Rightarrow \quad y' = \dfrac{(1+x)e^x - e^x(1)}{(1+x)^2} = \dfrac{e^x + xe^x - e^x}{(x+1)^2} = \dfrac{xe^x}{(x+1)^2}$.

15. $y = (r^2 - 2r)e^r \quad \overset{\text{PR}}{\Rightarrow} \quad y' = (r^2 - 2r)(e^r) + e^r(2r - 2) = e^r(r^2 - 2r + 2r - 2) = e^r(r^2 - 2)$

16. $y = \dfrac{1}{s + ke^s} \overset{\text{QR}}{\Rightarrow} y' = \dfrac{(s + ke^s)(0) - (1)(1 + ke^s)}{(s + ke^s)^2} = -\dfrac{1 + ke^s}{(s + ke^s)^2}$

23. $f(x) = \dfrac{x}{x + c/x} \Rightarrow f'(x) = \dfrac{(x + c/x)(1) - x(1 - c/x^2)}{\left(x + \dfrac{c}{x}\right)^2} = \dfrac{x + c/x - x + c/x}{\left(\dfrac{x^2 + c}{x}\right)^2} = \dfrac{2c/x}{\dfrac{(x^2 + c)^2}{x^2}} \cdot \dfrac{x^2}{x^2} = \dfrac{2cx}{(x^2 + c)^2}$

24. $f(x) = \dfrac{ax + b}{cx + d} \Rightarrow f'(x) = \dfrac{(cx + d)(a) - (ax + b)(c)}{(cx + d)^2} = \dfrac{acx + ad - acx - bc}{(cx + d)^2} = \dfrac{ad - bc}{(cx + d)^2}$

8. $F(x) = (4x - x^2)^{100} \Rightarrow F'(x) = 100(4x - x^2)^{99} \cdot \dfrac{d}{dx}(4x - x^2) = 100(4x - x^2)^{99}(4 - 2x)$

[or $200x^{99}(x - 2)(x - 4)^{99}$]

9. $F(x) = \sqrt{1 - 2x} = (1 - 2x)^{1/2} \Rightarrow F'(x) = \frac{1}{2}(1 - 2x)^{-1/2}(-2) = -\dfrac{1}{\sqrt{1 - 2x}}$

19. $y = (2x - 5)^4(8x^2 - 5)^{-3} \Rightarrow$

$y' = 4(2x - 5)^3(2)(8x^2 - 5)^{-3} + (2x - 5)^4(-3)(8x^2 - 5)^{-4}(16x)$

$= 8(2x - 5)^3(8x^2 - 5)^{-3} - 48x(2x - 5)^4(8x^2 - 5)^{-4}$

[This simplifies to $8(2x - 5)^3(8x^2 - 5)^{-4}(-4x^2 + 30x - 5)$.]

20. $h(t) = (t^4 - 1)^3(t^3 + 1)^4 \Rightarrow$

$h'(t) = (t^4 - 1)^3 \cdot 4(t^3 + 1)^3(3t^2) + (t^3 + 1)^4 \cdot 3(t^4 - 1)^2(4t^3)$

$= 12t^2(t^4 - 1)^2(t^3 + 1)^3\left[(t^4 - 1) + t(t^3 + 1)\right] = 12t^2(t^4 - 1)^2(t^3 + 1)^3(2t^4 + t - 1)$

22. Using Formula 5 and the Chain Rule, $y = 10^{1 - x^2} \Rightarrow y' = 10^{1 - x^2}(\ln 10) \cdot \dfrac{d}{dx}\left(1 - x^2\right) = -2x(\ln 10)10^{1 - x^2}$.

23. $y = \left(\dfrac{x^2 + 1}{x^2 - 1}\right)^3 \Rightarrow$

$y' = 3\left(\dfrac{x^2 + 1}{x^2 - 1}\right)^2 \cdot \dfrac{d}{dx}\left(\dfrac{x^2 + 1}{x^2 - 1}\right) = 3\left(\dfrac{x^2 + 1}{x^2 - 1}\right)^2 \cdot \dfrac{(x^2 - 1)(2x) - (x^2 + 1)(2x)}{(x^2 - 1)^2}$

$= 3\left(\dfrac{x^2 + 1}{x^2 - 1}\right)^2 \cdot \dfrac{2x[x^2 - 1 - (x^2 + 1)]}{(x^2 - 1)^2} = 3\left(\dfrac{x^2 + 1}{x^2 - 1}\right)^2 \cdot \dfrac{2x(-2)}{(x^2 - 1)^2} = \dfrac{-12x(x^2 + 1)^2}{(x^2 - 1)^4}$

31. Using Formula 5 and the Chain Rule, $y = 2^{\sin \pi x} \Rightarrow$

$y' = 2^{\sin \pi x}(\ln 2) \cdot \dfrac{d}{dx}(\sin \pi x) = 2^{\sin \pi x}(\ln 2) \cdot \cos \pi x \cdot \pi = 2^{\sin \pi x}(\pi \ln 2) \cos \pi x$

32. $y = \sin(\sin(\sin x)) \Rightarrow y' = \cos(\sin(\sin x)) \dfrac{d}{dx}(\sin(\sin x)) = \cos(\sin(\sin x)) \cos(\sin x) \cos x$

40. $y = e^{e^x} \quad \Rightarrow \quad y' = e^{e^x} \cdot (e^x)' = e^{e^x} \cdot e^x \quad \Rightarrow$

$y'' = e^{e^x} \cdot (e^x)' + e^x \cdot \left(e^{e^x}\right)' = e^{e^x} \cdot e^x + e^x \cdot e^{e^x} \cdot e^x = e^{e^x} \cdot e^x(1 + e^x) \quad \text{or} \quad e^{e^x + x}(1 + e^x)$