3. $f(x) = 2^{40}$ is a constant function, so its derivative is 0, that is, $f'(x) = 0$.

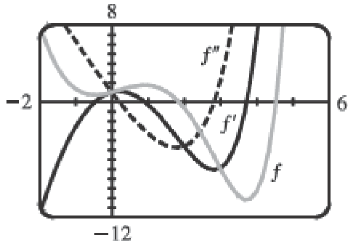
6. $F(x) = \frac{3}{4}x^8 \quad \Rightarrow \quad F'(x) = \frac{3}{4}(8x^7) = 6x^7$

26. $k(r) = e^r + r^e \quad \Rightarrow \quad k'(r) = e^r + er^{e-1}$

34. $y = x^4 + 2x^2 - x \quad \Rightarrow \quad y' = 4x^3 + 4x - 1$. At $(1, 2)$, $y' = 7$ and an equation of the tangent line is $y - 2 = 7(x - 1)$ or $y = 7x - 5$.

46. $f(x) = e^x - x^3 \quad \Rightarrow \quad f'(x) = e^x - 3x^2 \quad \Rightarrow \quad f''(x) = e^x - 6x$

Note that $f'(x) = 0$ when f has a horizontal tangent and that $f''(x) = 0$ when f' has a horizontal tangent.



62. (a) $f(x) = x^n \quad \Rightarrow \quad f'(x) = nx^{n-1} \quad \Rightarrow \quad f''(x) = n\,(n-1)\,x^{n-2} \quad \Rightarrow \quad \cdots \quad \Rightarrow$

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

(b) $f(x) = x^{-1} \quad \Rightarrow \quad f'(x) = (-1)x^{-2} \quad \Rightarrow \quad f''(x) = (-1)(-2)x^{-3} \quad \Rightarrow \quad \cdots \quad \Rightarrow$

$f^{(n)}(x) = (-1)(-2)(-3)\cdots(-n)x^{-(n+1)} = (-1)^n n! x^{-(n+1)}$ or $\dfrac{(-1)^n\, n!}{x^{n+1}}$

66. $y = ax^2 + bx + c \quad \Rightarrow \quad y'(x) = 2ax + b$. The parabola has slope 4 at $x = 1$ and slope -8 at $x = -1$, so $y'(1) = 4 \quad \Rightarrow$ $2a + b = 4$ **(1)** and $y'(-1) = -8 \quad \Rightarrow \quad -2a + b = -8$ **(2)**. Adding **(1)** and **(2)** gives us $2b = -4 \quad \Leftrightarrow \quad b = -2$. From **(1)**, $2a - 2 = 4 \quad \Leftrightarrow \quad a = 3$. Thus, the equation of the parabola is $y = 3x^2 - 2x + c$. Since it passes through the point $(2, 15)$, we have $15 = 3(2)^2 - 2(2) + c \quad \Rightarrow \quad c = 7$, so the equation is $y = 3x^2 - 2x + 7$.

24. $f(x) = \dfrac{1 - xe^x}{x + e^x} \quad \overset{\text{QR}}{\Rightarrow} \quad f'(x) = \dfrac{(x + e^x)(-xe^x)' - (1 - xe^x)(1 + e^x)}{(x + e^x)^2}$

$$\overset{\text{PR}}{\Rightarrow} \quad f'(x) = \frac{(x + e^x)[-(xe^x + e^x \cdot 1)] - (1 + e^x - xe^x - xe^{2x})}{(x + e^x)^2}$$

$$= \frac{-x^2e^x - xe^x - xe^{2x} - e^{2x} - 1 - e^x + xe^x + xe^{2x}}{(x + e^x)^2} = \frac{-x^2e^x - e^{2x} - e^x - 1}{(x + e^x)^2}$$

28. $f(x) = x^{5/2}e^x \quad \Rightarrow \quad f'(x) = x^{5/2}e^x + e^x \cdot \frac{5}{2}x^{3/2} = \left(x^{5/2} + \frac{5}{2}x^{3/2}\right)e^x \quad \left[\text{or } \frac{1}{2}x^{3/2}e^x(2x + 5)\right] \quad \Rightarrow$

$f''(x) = \left(x^{5/2} + \frac{5}{2}x^{3/2}\right)e^x + e^x\left(\frac{5}{2}x^{3/2} + \frac{15}{4}x^{1/2}\right) = \left(x^{5/2} + 5x^{3/2} + \frac{15}{4}x^{1/2}\right)e^x \quad \left[\text{or } \frac{1}{4}x^{1/2}e^x(4x^2 + 20x + 15)\right]$

44. We are given that $f(2) = -3$, $g(2) = 4$, $f'(2) = -2$, and $g'(2) = 7$.

(a) $h(x) = 5f(x) - 4g(x) \quad \Rightarrow \quad h'(x) = 5f'(x) - 4g'(x)$, so

$$h'(2) = 5f'(2) - 4g'(2) = 5(-2) - 4(7) = -10 - 28 = -38.$$

(b) $h(x) = f(x)g(x) \quad \Rightarrow \quad h'(x) = f(x)g'(x) + g(x)f'(x)$, so

$$h'(2) = f(2)g'(2) + g(2)f'(2) = (-3)(7) + (4)(-2) = -21 - 8 = -29.$$

(c) $h(x) = \dfrac{f(x)}{g(x)} \quad \Rightarrow \quad h'(x) = \dfrac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$, so

$$h'(2) = \frac{g(2)f'(2) - f(2)g'(2)}{[g(2)]^2} = \frac{4(-2) - (-3)(7)}{4^2} = \frac{-8 + 21}{16} = \frac{13}{16}.$$

(d) $h(x) = \dfrac{g(x)}{1 + f(x)} \quad \Rightarrow \quad h'(x) = \dfrac{[1 + f(x)]\, g'(x) - g(x)f'(x)}{[1 + f(x)]^2}$, so

$$h'(2) = \frac{[1 + f(2)]\, g'(2) - g(2)\, f'(2)}{[1 + f(x)]^2} = \frac{[1 + (-3)](7) - 4(-2)}{[1 + (-3)]^2} = \frac{-14 + 8}{(-2)^2} = \frac{-6}{4} = -\frac{3}{2}.$$