1. $f(x) = 186.5$ is a constant function, so its derivative is 0, that is, $f'(x) = 0$.

2. $f(x) = \sqrt{30}$ is a constant function, so its derivative is 0, that is, $f'(x) = 0$.

3. $f(t) = 2 - \frac{2}{3}t \quad \Rightarrow \quad f'(t) = 0 - \frac{2}{3} = -\frac{2}{3}$

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

5. $f(x) = x^3 - 4x + 6 \quad \Rightarrow \quad f'(x) = 3x^2 - 4(1) + 0 = 3x^2 - 4$

6. $h(x) = (x-2)(2x+3) = 2x^2 - x - 6 \quad \Rightarrow \quad h'(x) = 2(2x) - 1 - 0 = 4x - 1$

7. $f(t) = \frac{1}{4}(t^4 + 8) \quad \Rightarrow \quad f'(t) = \frac{1}{4}(t^4+8)' = \frac{1}{4}(4t^{4-1} + 0) = t^3$

8. $f(t) = \frac{1}{2}t^6 - 3t^4 + t \quad \Rightarrow \quad f'(t) = \frac{1}{2}(6t^5) - 3(4t^3) + 1 = 3t^5 - 12t^3 + 1$

9. $V(r) = \frac{4}{3}\pi r^3 \quad \Rightarrow \quad V'(r) = \frac{4}{3}\pi(3r^2) = 4\pi r^2$

10. $R(t) = 5t^{-3/5} \quad \Rightarrow \quad R'(t) = 5\left[-\frac{3}{5}t^{(-3/5)-1}\right] = -3t^{-8/5}$

11. $Y(t) = 6t^{-9} \quad \Rightarrow \quad Y'(t) = 6(-9)t^{-10} = -54t^{-10}$

12. $R(x) = \dfrac{\sqrt{10}}{x^7} = \sqrt{10}\,x^{-7} \quad \Rightarrow \quad R'(x) = -7\sqrt{10}\,x^{-8} = -\dfrac{7\sqrt{10}}{x^8}$

13. $F(x) = (\frac{1}{2}x)^5 = \left(\frac{1}{2}\right)^5 x^5 = \frac{1}{32}x^5 \quad \Rightarrow \quad F'(x) = \frac{1}{32}(5x^4) = \frac{5}{32}x^4$

14. $f(t) = \sqrt{t} - \dfrac{1}{\sqrt{t}} = t^{1/2} - t^{-1/2} \quad \Rightarrow \quad f'(t) = \frac{1}{2}t^{-1/2} - \left(-\frac{1}{2}t^{-3/2}\right) = \dfrac{1}{2\sqrt{t}} + \dfrac{1}{2t\sqrt{t}} \quad \left[\text{or } \dfrac{t+1}{2t\sqrt{t}}\right]$

15. $A(s) = -\dfrac{12}{s^5} = -12s^{-5} \quad \Rightarrow \quad A'(s) = -12(-5s^{-6}) = 60s^{-6}$ or $60/s^6$

16. $B(y) = cy^{-6} \quad \Rightarrow \quad B'(y) = c(-6y^{-7}) = -6cy^{-7}$

17. $y = 4\pi^2 \quad \Rightarrow \quad y' = 0$ since $4\pi^2$ is a constant.

23. $V(x) = (2x^3+3)(x^4-2x) \quad \overset{\text{PR}}{\Rightarrow}$

$$V'(x) = (2x^3+3)(4x^3-2) + (x^4-2x)(6x^2) = (8x^6 + 8x^3 - 6) + (6x^6 - 12x^3) = 14x^6 - 4x^3 - 6$$

27. $g(x) = \dfrac{3x-1}{2x+1} \quad \overset{\text{QR}}{\Rightarrow} \quad g'(x) = \dfrac{(2x+1)(3)-(3x-1)(2)}{(2x+1)^2} = \dfrac{6x+3-6x+2}{(2x+1)^2} = \dfrac{5}{(2x+1)^2}$

28. $f(t)=\dfrac{2t}{4+t^2} \overset{\text{QR}}{\Rightarrow} f'(t)=\dfrac{(4+t^2)(2)-(2t)(2t)}{(4+t^2)^2}=\dfrac{8+2t^2-4t^2}{(4+t^2)^2}=\dfrac{8-2t^2}{(4+t^2)^2}$

29. $y=\dfrac{x^3}{1-x^2} \overset{\text{QR}}{\Rightarrow} y'=\dfrac{(1-x^2)(3x^2)-x^3(-2x)}{(1-x^2)^2}=\dfrac{x^2(3-3x^2+2x^2)}{(1-x^2)^2}=\dfrac{x^2(3-x^2)}{(1-x^2)^2}$

30. $y=\dfrac{x+1}{x^3+x-2} \overset{\text{QR}}{\Rightarrow}$

$$y'=\frac{(x^3+x-2)(1)-(x+1)(3x^2+1)}{(x^3+x-2)^2}=\frac{x^3+x-2-3x^3-3x^2-x-1}{(x^3+x-2)^2}=\frac{-2x^3-3x^2-3}{(x^3+x-2)^2}$$

or $-\dfrac{2x^3+3x^2+3}{(x-1)^2(x^2+x+2)^2}$

31. $y=\dfrac{v^3-2v\sqrt{v}}{v}=v^2-2\sqrt{v}=v^2-2v^{1/2} \Rightarrow y'=2v-2\left(\frac{1}{2}\right)v^{-1/2}=2v-v^{-1/2}$.

We can change the form of the answer as follows: $2v-v^{-1/2}=2v-\dfrac{1}{\sqrt{v}}=\dfrac{2v\sqrt{v}-1}{\sqrt{v}}=\dfrac{2v^{3/2}-1}{\sqrt{v}}$

32. $y=\dfrac{t}{(t-1)^2}=\dfrac{t}{t^2-2t+1} \overset{\text{QR}}{\Rightarrow}$

$$y'=\frac{(t^2-2t+1)(1)-t(2t-2)}{[(t-1)^2]^2}=\frac{(t-1)^2-2t(t-1)}{(t-1)^4}=\frac{(t-1)[(t-1)-2t]}{(t-1)^4}=\frac{-t-1}{(t-1)^3}$$

33. $y=\dfrac{t^2+2}{t^4-3t^2+1} \overset{\text{QR}}{\Rightarrow}$

$$y'=\frac{(t^4-3t^2+1)(2t)-(t^2+2)(4t^3-6t)}{(t^4-3t^2+1)^2}=\frac{2t[(t^4-3t^2+1)-(t^2+2)(2t^2-3)]}{(t^4-3t^2+1)^2}$$

$$=\frac{2t(t^4-3t^2+1-2t^4-4t^2+3t^2+6)}{(t^4-3t^2+1)^2}=\frac{2t(-t^4-4t^2+7)}{(t^4-3t^2+1)^2}$$

34. $g(t)=\dfrac{t-\sqrt{t}}{t^{1/3}}=\dfrac{t}{t^{1/3}}-\dfrac{t^{1/2}}{t^{1/3}}=t^{2/3}-t^{1/6} \Rightarrow g'(t)=\frac{2}{3}t^{-1/3}-\frac{1}{6}t^{-5/6}$

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

(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 $a(1)=6\text{ m/s}^2$.

63. We are given that $f(5) = 1$, $f'(5) = 6$, $g(5) = -3$, and $g'(5) = 2$.

(a) $(fg)'(5) = f(5)g'(5) + g(5)f'(5) = (1)(2) + (-3)(6) = 2 - 18 = -16$

(b) $\left(\dfrac{f}{g}\right)'(5) = \dfrac{g(5)f'(5) - f(5)g'(5)}{[g(5)]^2} = \dfrac{(-3)(6) - (1)(2)}{(-3)^2} = -\dfrac{20}{9}$

(c) $\left(\dfrac{g}{f}\right)'(5) = \dfrac{f(5)g'(5) - g(5)f'(5)}{[f(5)]^2} = \dfrac{(1)(2) - (-3)(6)}{(1)^2} = 20$

65. $f(x) = \sqrt{x}\,g(x) \quad\Rightarrow\quad f'(x) = \sqrt{x}\,g'(x) + g(x)\cdot\frac{1}{2}x^{-1/2}$, so $f'(4) = \sqrt{4}\,g'(4) + g(4)\cdot\dfrac{1}{2\sqrt{4}} = 2\cdot 7 + 8\cdot\dfrac{1}{4} = 16$.

70. (a) $y = x^2 f(x) \quad\Rightarrow\quad y' = x^2 f'(x) + f(x)(2x)$

(b) $y = \dfrac{f(x)}{x^2} \quad\Rightarrow\quad y' = \dfrac{x^2 f'(x) - f(x)(2x)}{(x^2)^2} = \dfrac{xf'(x) - 2f(x)}{x^3}$

(c) $y = \dfrac{x^2}{f(x)} \quad\Rightarrow\quad y' = \dfrac{f(x)(2x) - x^2 f'(x)}{[f(x)]^2}$

(d) $y = \dfrac{1 + xf(x)}{\sqrt{x}} \quad\Rightarrow$

$$y' = \frac{\sqrt{x}\,[xf'(x) + f(x)] - [1 + xf(x)]\dfrac{1}{2\sqrt{x}}}{(\sqrt{x})^2}$$

$$= \frac{x^{3/2} f'(x) + x^{1/2} f(x) - \frac{1}{2}x^{-1/2} - \frac{1}{2}x^{1/2} f(x)}{x}\cdot\frac{2x^{1/2}}{2x^{1/2}} = \frac{xf(x) + 2x^2 f'(x) - 1}{2x^{3/2}}$$

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