(1-31 odds, omit 25, 83-91 odds)

2.3A pp. 124-127 ~~(1-37 odds, 83-97 odds)~~

1. $g(x) = (x^2+1)(x^2-2x)$

$g'(x) = (x^2+1)(2x-2)+(x^2-2x)(2x)$

$g'(x) = 2x^3-2x^2+2x-2+2x^3-4x^2$

$\boxed{g'(x) = 4x^3-6x^2+2x-2}$

3. $h(t) = \sqrt[3]{t}\,(t^2-4) = t^{1/3}(t^2-4)$

distribute, use power rule

$h(t) = t^{7/3} - 4t^{1/3}$

$h'(t) = \frac{7}{3}t^{4/3} - \frac{4}{3}t^{-2/3}$

$h'(t) = \frac{7t^{4/3}\cdot t^{2/3}}{3\cdot t^{2/3}} - \frac{4}{3t^{2/3}}$

$\boxed{h'(t) = \frac{7t^2-4}{3t^{2/3}}}$

or

$h(t) = t^{1/3}(t^2-4)$

$h'(t) = t^{1/3}\cdot 2t + (t^2-4)\cdot\frac{1}{3}t^{-2/3}$ (distribute, use product rule)

$h'(t) = 2t^{4/3} + \frac{1}{3}t^{4/3} - \frac{4}{3}t^{-2/3}$

$h'(t) = \frac{7}{3}t^{4/3} - \frac{4}{3}t^{-2/3}$

5. $f(x) = x^3\cos x$

$\boxed{f'(x) = -x^3\sin x + 3x^2\cos x}$

7. $f(x) = \frac{x}{x^2+1}$

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

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

$\boxed{f'(x) = \frac{1-x^2}{(x^2+1)^2}}$

9. $h(x) = \frac{\sqrt[3]{x}}{x^3+1}$

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

$h'(x) = \frac{\frac{1}{3}x^{7/3} + \frac{1}{3}x^{-2/3} - 3x^{7/3}}{(x^3+1)^2} = \frac{\frac{1}{3}x^{-2/3} - \frac{8}{3}x^{7/3}}{(x^3+1)^2}$

$h'(x) = \frac{\frac{1}{3x^{2/3}} - \frac{8x^{7/3}}{3}}{(x^3+1)^2} = \frac{\frac{1-8x^3}{3x^{2/3}}}{(x^3+1)^2}$

$\boxed{h'(x) = \frac{1-8x^3}{3x^{2/3}(x^3+1)^2}}$

11. $g(x) = \frac{\sin x}{x^2}$

$g'(x) = \frac{x^2\cos x - \sin x(2x)}{x^4}$

$\boxed{g'(x) = \frac{x\cos x - 2\sin x}{x^3}}$

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

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

$f'(x) = 4x^4 + 3x^3 - 12x^2 - 9x + 6x^4 - 6x^2 + 9x^3 - 9x + 15x^2 - 15$

$\boxed{f'(x) = 10x^4 + 12x^3 - 3x^2 - 18x - 15}$

$f'(0) = 10(0)^4 + 12(0)^3 - 3(0)^2 - 18(0) - 15$

$\boxed{f'(0) = -15}$

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

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

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

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

$f'(1) = \dfrac{1^2 - 6 \cdot 1 + 4}{(1-3)^2}$

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

17. $f(x) = x \cos x$

$f'(x) = -x \sin x + \cos x$

$f'(\pi/4) = -\pi/4 \sin \pi/4 + \cos \pi/4$

$f'(\pi/4) = -\dfrac{\pi}{4} \cdot \dfrac{\sqrt{2}}{2} + \dfrac{\sqrt{2}}{2}$

$\boxed{f'(\pi/4) = -\dfrac{\pi\sqrt{2}}{8} + \dfrac{\sqrt{2}}{2}}$

19. $y = \dfrac{x^2 + 2x}{3} = \dfrac{1}{3}x^2 + \dfrac{2}{3}x$

$\boxed{y' = \dfrac{2}{3}x + \dfrac{2}{3}}$

21. $y = \dfrac{7}{3x^3} = \dfrac{7}{3}x^{-3}$

$y' = -7x^{-4}$

$\boxed{y' = \dfrac{-7}{x^4}}$

23. $y = \dfrac{4x^{3/2}}{x} = 4x^{1/2}$

$y' = 2x^{-1/2}$

$\boxed{y' = \dfrac{2}{\sqrt{x}}}$

25. $f(x) = \dfrac{3 - 2x - x^2}{x^2 - 1}$

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

$f'(x) = \dfrac{-2x^3 - 2x^2 + 2x + 2 - 6x + 4x^2 + 2x^3}{(x^2-1)^2}$

$f'(x) = \dfrac{2x^2 - 4x + 2}{(x^2-1)^2} = \dfrac{2(x^2 - 2x + 1)}{(x^2-1)^2}$

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

$\boxed{f'(x) = \dfrac{2}{(x+1)^2}}$

27. $f(x) = x\left(1 - \frac{4}{x+3}\right)$

simplify first →

$f(x) = x\left(\frac{x+3}{x+3} - \frac{4}{x+3}\right)$

$f(x) = x\left(\frac{x-1}{x+3}\right) = \frac{x^2-x}{x+3}$

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

$f'(x) = \frac{2x^2+6x-x-3-x^2+x}{(x+3)^2}$

$\boxed{f'(x) = \frac{x^2+6x-3}{(x+3)^2}}$

Product rule first ↓

$f(x) = x\left(1 - \frac{4}{x+3}\right) = x\left(1 + \frac{-4}{x+3}\right)$

$f'(x) = x\left(\frac{(x+3)(0) - -4(1)}{(x+3)^2}\right) + \left(1 + \frac{-4}{x+3}\right)(1)$

$f'(x) = \frac{4x}{(x+3)^2} + 1 + \frac{-4}{x+3}$

$f'(x) = \frac{4x}{(x+3)^2} + \frac{(x+3)^2}{(x+3)^2} + \frac{-4(x+3)}{(x+3)^2}$

$f'(x) = \frac{4x + x^2+6x+9 - 4x - 12}{(x+3)^2}$

$\boxed{f'(x) = \frac{x^2+6x-3}{(x+3)^2}}$ =

29. $f(x) = \frac{2x+5}{\sqrt{x}} = \frac{2x+5}{x^{1/2}}$

$f'(x) = \frac{x^{1/2}(2) - (2x+5)(\frac{1}{2}x^{-1/2})}{x}$

$f'(x) = \frac{2x^{1/2} - x^{1/2} + \frac{5}{2}x^{-1/2}}{x}$

$f'(x) = \frac{x^{1/2} + \frac{5}{2x^{1/2}}}{x}$

$f'(x) = \frac{2x+5}{2x^{1/2}}$

$\boxed{f'(x) = \frac{2x+5}{2x^{3/2}}}$

OR

$f(x) = x^{-1/2}(2x+5)$

$f(x) = 2x^{1/2} + 5x^{-1/2}$

$f'(x) = x^{-1/2} + \frac{-5}{2}x^{-3/2}$

$f'(x) = \frac{1}{x^{1/2}} - \frac{5}{2x^{3/2}} = \frac{2x}{2x}\cdot\frac{1}{x^{1/2}} - \frac{5}{2x^{3/2}}$

$\boxed{f'(x) = \frac{2x-5}{2x^{3/2}}}$

31. $h(s) = (s^3-2)^2 = (s^3-2)(s^3-2)$

$h'(s) = (s^3-2)(3s^2) + (s^3-2)(3s^2)$

$h'(s) = 3s^5 - 6s^2 + 3s^5 - 6s^2$

$\boxed{h'(s) = 6s^5 - 12s^2}$

~~33~~. $f(x) = \frac{2 - \frac{1}{x}}{x-3} = \frac{2 - x^{-1}}{x-3}$

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

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

$f'(x) = \frac{\frac{2}{x} - \frac{3}{x^2} - 2}{(x-3)^2}$

$f'(x) = \frac{2x - 3 - 2x^2}{\frac{x^2}{(x-3)^2}}$

$\boxed{f'(x) = \frac{2x-3-2x^2}{x^2(x-3)^2}}$

35. $f(x) = (3x^3+4x)(x-5)(x+1)$

$f(x) = (3x^3+4x)(x^2+x-5x-5)$

$f(x) = (3x^3+4x)(x^2-4x-5)$

$f(x) = 3x^5-12x^4-15x^3+4x^3-16x^2-20x$

$f(x) = 3x^5-12x^4-11x^3-16x^2-20x$

$\boxed{f'(x) = 15x^4-48x^3-33x^2-32x-20}$

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

$f'(x) = \dfrac{(x^2-c^2)(2x)-(x^2+c^2)(2x)}{(x^2-c^2)^2}$

$f'(x) = \dfrac{2x^3-2c^2x-2x^3-2c^2x}{(x^2-c^2)^2}$

$\boxed{f'(x) = \dfrac{-4c^2x}{(x^2-c^2)^2}}$

83. $f(x) = 4x^{3/2}$

$f'(x) = 6x^{1/2}$

$f''(x) = 3x^{-1/2}$

$\boxed{f''(x) = \dfrac{3}{\sqrt{x}}}$

85. $f(x) = \dfrac{x}{x-1}$

$f'(x) = \dfrac{(x-1)(1)-x}{(x-1)^2} = \dfrac{-1}{(x-1)^2}$

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

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

$f''(x) = \dfrac{2x-2}{(x-1)^4} = \dfrac{2(x-1)}{(x-1)^4}$

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

87. $f(x) = 3\sin x$

$f'(x) = 3\cos x$

$\boxed{f''(x) = -3\sin x}$

89. $f'(x) = x^2$

$\boxed{f''(x) = 2x}$

91. $f'''(x) = 2\sqrt{x} = 2x^{1/2}$

$f^{(4)}(x) = x^{-1/2}$

$\boxed{f^{(4)}(x) = \dfrac{1}{\sqrt{x}}}$