

Week 4

1. a) $f(x) = \sqrt{1 + (2x-3)^2}$

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

b) $f(x) = \left(\frac{x}{\sqrt{x} - 1} \right)^5$

$$f'(x) = (\sqrt{x} - 1)^{-5} \times 5x^4 - \frac{5x^{9/2}}{2(\sqrt{x} - 1)^6}$$

$$f'(x) = \frac{5x^4}{(\sqrt{x} - 1)^5} - \frac{5x^{9/2}}{2(\sqrt{x} - 1)^6}$$

c) $f(x) = (3x + \sqrt{x})^{1/2}$

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

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2.

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

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

$$= \frac{1}{(x^2+1)} \times \left[3x^2(x^5+3) + (x^3-1) \times 5x^4 \right]$$

$$- \frac{2x(x^5+3)(x^3-1)}{(x^2+1)^2}$$

$$= \frac{1}{(x^2+1)} (3x^7+9x^2+5x^7-5x^4)$$

$$- \frac{2x(x^5+3)(x^3-1)}{(x^2+1)^2}$$

$$= \frac{(8x^7-5x^4+9x^2)}{(x^2+1)} - \frac{2x(x^5+3)(x^3-1)}{(x^2+1)^2}$$

$$(b) f(x) = \frac{(x-1)(x^2+x+1)}{(x^4-3x^3-5)}$$

$$f'(x) = \frac{(x^4-3x^3-5) \frac{d}{dx} (x-1)(x^2+x+1) - (x-1)(x^2+x+1) \frac{d}{dx} (x^4-3x^3-5)}{(x^4-3x^3-5)^2}$$

$$= \frac{(x^2+x+1) + (x-1)(2x+1)}{(x^4-3x^3-5)} - \frac{(x-1)(x^2+x+1)(4x^3-9x^2)}{(x^4-3x^3-5)^2}$$

$$= \frac{3x^2}{(x^4-3x^3-5)} - \frac{(x^3-1)(4x^3-9x^2)}{(x^4-3x^3-5)^2}$$

$$= \frac{3x^2}{(x^4-3x^3-5)} - \frac{(x^3-1)(4x^3-9x^2)}{(x^4-3x^3-5)^2}$$