

Differentiate.

$$1 \quad f(x) = 2^{40} \rightarrow f'(x) = 0$$

$$2 \quad f(t) = 2 - \frac{2}{3}t \rightarrow f'(t) = -\frac{2}{3}$$

$$3 \quad f(x) = x^3 - 4x + 6 \rightarrow f'(x) = 3x^2 - 4$$

$$4 \quad g(x) = x^2(1-2x) \rightarrow g'(x) = 2x(1-2x) + x^2(-2)$$

$$\text{OR } 2x(1-2x) - 2x^2$$

$$\text{OR } 2x - 4x^2 - 2x^2 = -6x^2 + 2x$$

$$\text{OR } g(x) = x^2 - 2x^3 = -2x^3 + x^2 \rightarrow g'(x) = -6x^2 + 2x$$

either way

$$5 \quad g(t) = 2t^{-3/4} \rightarrow g'(t) = \left(-\frac{3}{4}\right)(2)t^{-7/4}$$

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

$$6 \quad A(s) = -\frac{12}{s^5} = -12s^{-5} \rightarrow A'(s) = 60s^{-6}$$

$$7 \quad S(p) = \sqrt{p} - p \rightarrow S'(p) = \frac{1}{2}p^{-1/2} - 1 \quad \text{OR } \frac{1}{2\sqrt{p}} - 1$$

$$8 \quad R(a) = (3a+1)^2 = 9a^2 + 6a + 1 \rightarrow R'(a) = 18a + 6$$

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9 $y = \frac{x^2 + 4x + 3}{\sqrt{x}} = \frac{x^2 + 4x + 3}{x^{1/2}} = x^{3/2} + 4x^{1/2} + 3x^{-1/2}$

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

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

$$= \frac{2x^{3/2} + 4x^{1/2} - \frac{1}{2}x^{3/2} - 2x^{1/2} - \frac{3}{2}x^{-1/2}}{x}$$

quick & slick

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

On a test, you'd never want to expand the answer on the left, and it'd probably be less work to just apply the quotient rule, without simplifying at the start (method on the right) or the end (method on the left).

$$= \frac{3}{2}x^{1/2} + 2x^{-1/2} - \frac{3}{2}x^{-3/2}$$

lengthy but same finish.

10 $H(x) = (x + x^{-1})^3 = x^3 + 3x^2x^{-1} + 3x \cdot x^{-2} + x^{-3}$

$$= x^3 + 3x + 3x^{-1} + x^{-3} \rightarrow$$

$$H'(x) = 3x^2 + 3 - 3x^{-2} - 3x^{-4}$$

g'2.5 method: $3(x + x^{-1})^2(1 - x^{-2})$ STOP

$$= 3(x^2 + 2xx^{-1} + x^{-2})(1 - x^{-2})$$

$$= 3[x^2 - 1 + 2 - 2x^{-2} + x^{-2} - x^{-4}]$$

$$= 3x^2 + 3 - 3x^{-2} - 3x^{-4}$$

① Product Rule

② Old-school

11 Find $\frac{d}{dx} [(1+2x^2)(x-x^2)]$ in 2 ways

(1) $f'(x) = 4x(x-x^2) + (1+2x^2)(1-2x)$

$$= 4x^2 - 4x^3 + 1 - 2x + 2x^2 - 4x^3$$

$$= 6x^2 - 8x^3 - 2x + 1$$

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

$$f'(x) = 1 - 2x + 6x^2 - 8x^3$$

Yes, they agree.

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#525-44 Differentiate

12 $v(x) = (2x^3 + 3)(x^4 - 2x)$

$$\begin{aligned} \Rightarrow v'(x) &= (6x^2)(x^4 - 2x) + (2x^3 + 3)(4x^3 - 2) \text{ STOP!} \\ &= 6x^6 - 12x^3 + 8x^6 - 4x^3 + 12x^3 - 6 \\ &= 14x^6 - 4x^3 - 6 \end{aligned}$$

13 $F(y) = \left(\frac{1}{y^2} - \frac{1}{y^4}\right)(y + 5y^3)$

~~$F(y) = \left(\frac{1}{y^2} - \frac{1}{y^4}\right)(y + 5y^3)$~~ $= (y^{-2} - y^{-4})(y + 5y^3)$

$$F'(y) = (-2y^{-3} + 4y^{-5})(y + 5y^3) + (y^{-2} - y^{-4})(1 + 15y^2)$$

STOP!

$$= -2y^{-2} - 10 + 4y^{-4} + 20y^{-2} + y^{-2} + 15 - y^{-4} - 15y^{-2}$$

$$= 4y^{-2} + 5 + 3y^{-4}$$

14 $g(x) = \frac{1+2x}{3-4x}$ $\Rightarrow g'(x) = \frac{2(3-4x) - (1+2x)(-4)}{(3-4x)^2}$

STOP!

$$= \frac{6 - 8x - 4 - 8x}{(3-4x)^2} = \frac{-16x + 2}{(3-4x)^2} = \frac{2(-8x + 1)}{(3-4x)^2}$$

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$$y = \frac{x^3}{1-x^2}$$

$$\rightarrow y' = \frac{3x^2(1-x^2) - (x^3)(-2x)}{(1-x^2)^2} \quad \text{STOP!}$$

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

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$$y = \frac{v^3 - 2v\sqrt{v}}{v} = \frac{v^3 - 2v^{3/2}}{v} = v^2 - 2v^{1/2}$$

$$\rightarrow y' = 2v - v^{-1/2}$$

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$$y = \frac{t^2 + 2}{t^4 - 3t^2 + 1} \quad \rightarrow$$

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

STOP!
Please!

$$= \frac{2t^5 - 6t^3 + 2t - 4t^5 - 6t^3 + 8t^3 - 12t}{(t^4 - 3t^2 + 1)^2}$$

$$= \frac{-2t^5 - 4t^3 - 10t}{(t^4 - 3t^2 + 1)^2} = \frac{-2t(t^4 + 2t + 5)}{(t^4 - 3t^2 + 1)^2}$$