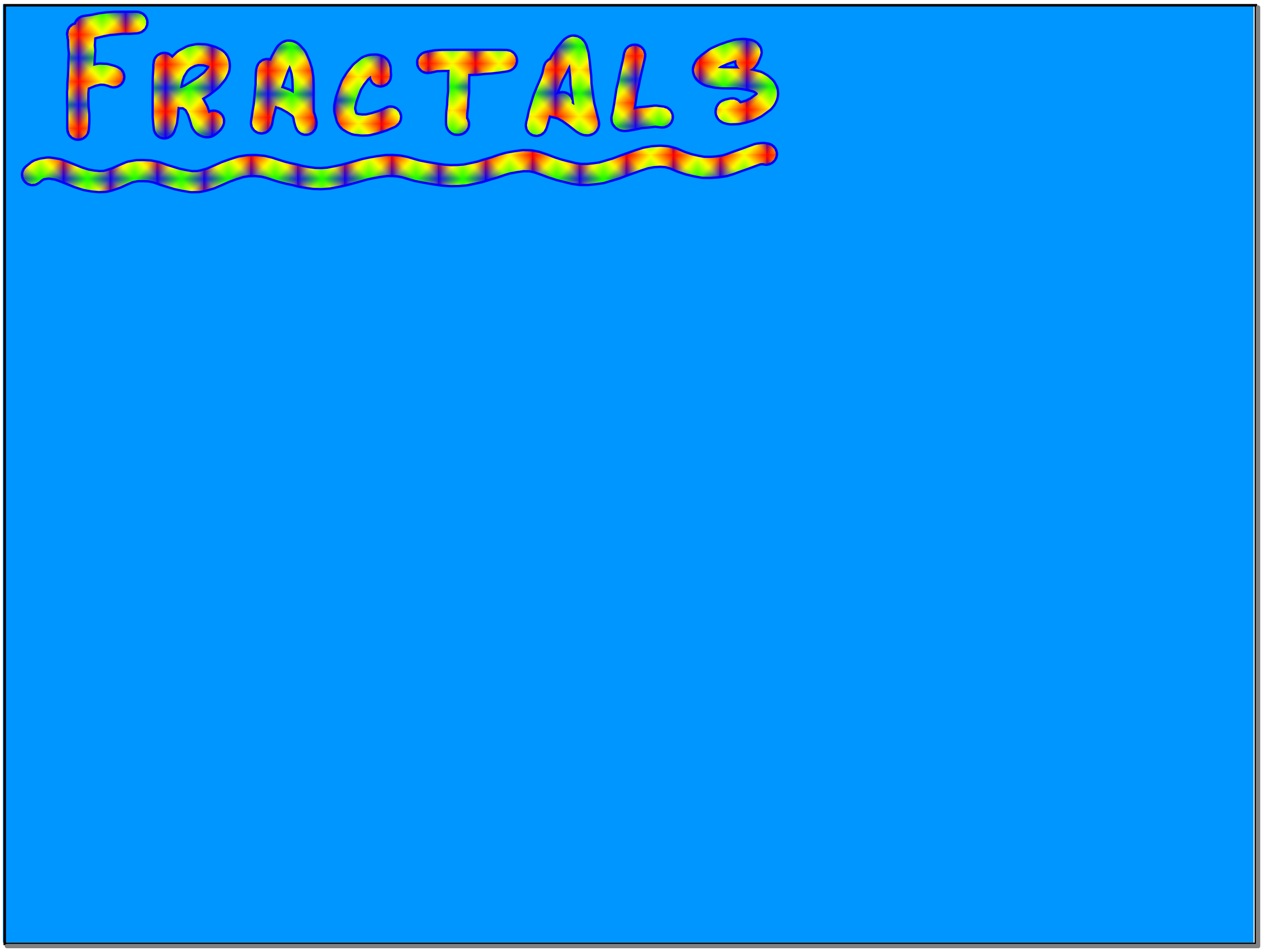
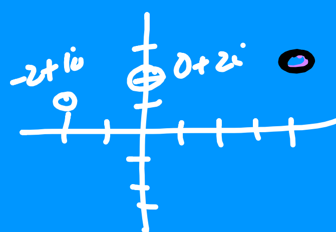
May 6, 2024



Mandelbrot Set--Choose coordinate for c-value. Always iterate beginning with 0. Change coordinate for c-value each time you want to color a different point.

$f(x) = x^2 + c$

$f($



Key Characterist

Self-Similar

$f(x) = x^2 + 4 + 2i$

$f(0) = 0^2 + 4 + 2i = 4 + 2i$

$f(4+2i) = (4+2i)^2 + 4 + 2i$

$= 16 + 16i \cancel{-4} \cancel{+4} + 2i$

$= 16 + 18i$

$f(16+18i) = (16+8i)^2 + 4 + 2i$

$= 256 + 256i - 64\cancel{i^2} + 4 + 2i$

$= 196 + 258i$

Orbit: $4+2i,\ 16+8i,\ 196+258i$

Calculator:

1) $x^2 + (1+i)$ | x = 0

2) $x^2 + (1+i)$ | x = Ans

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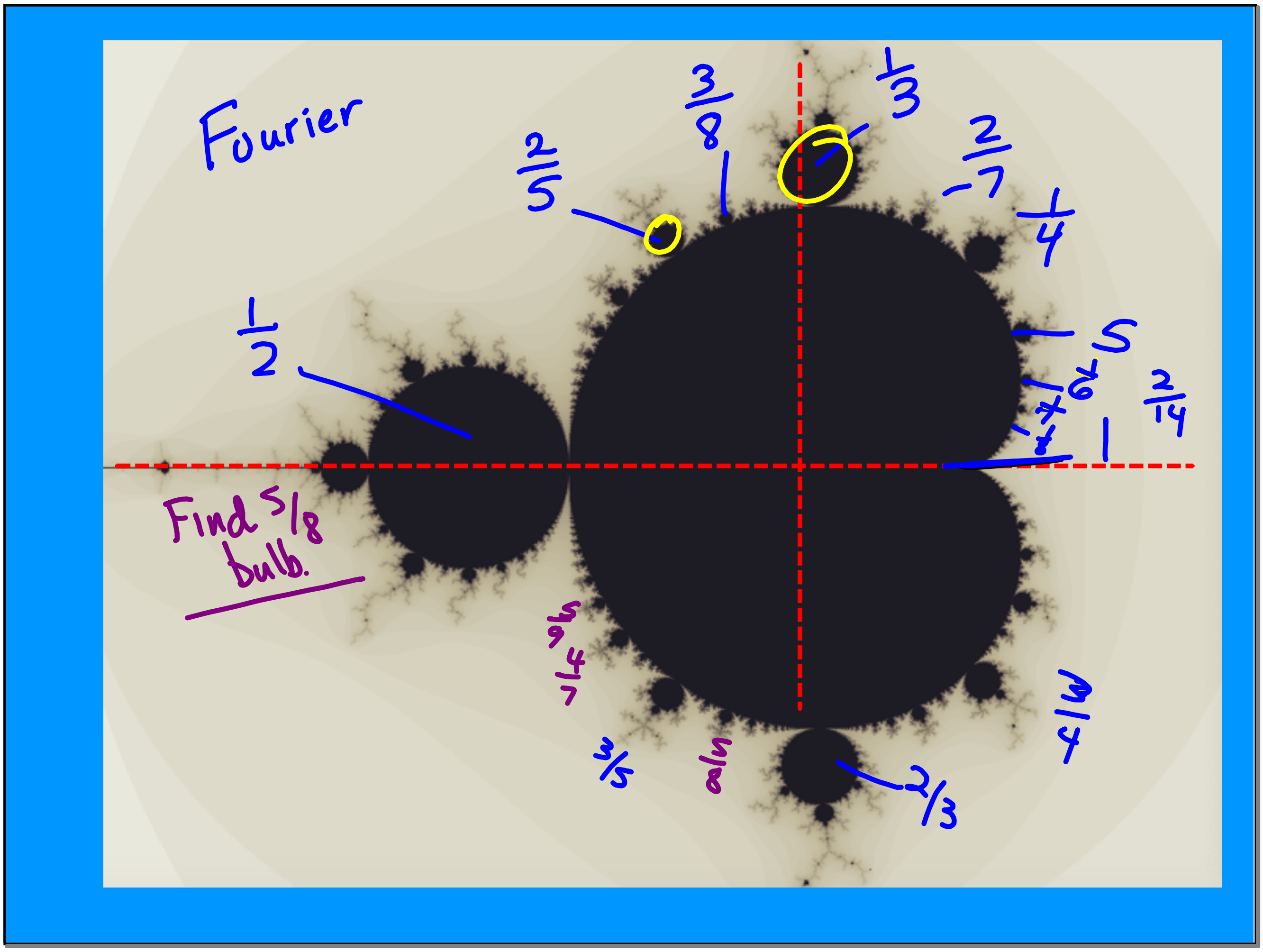

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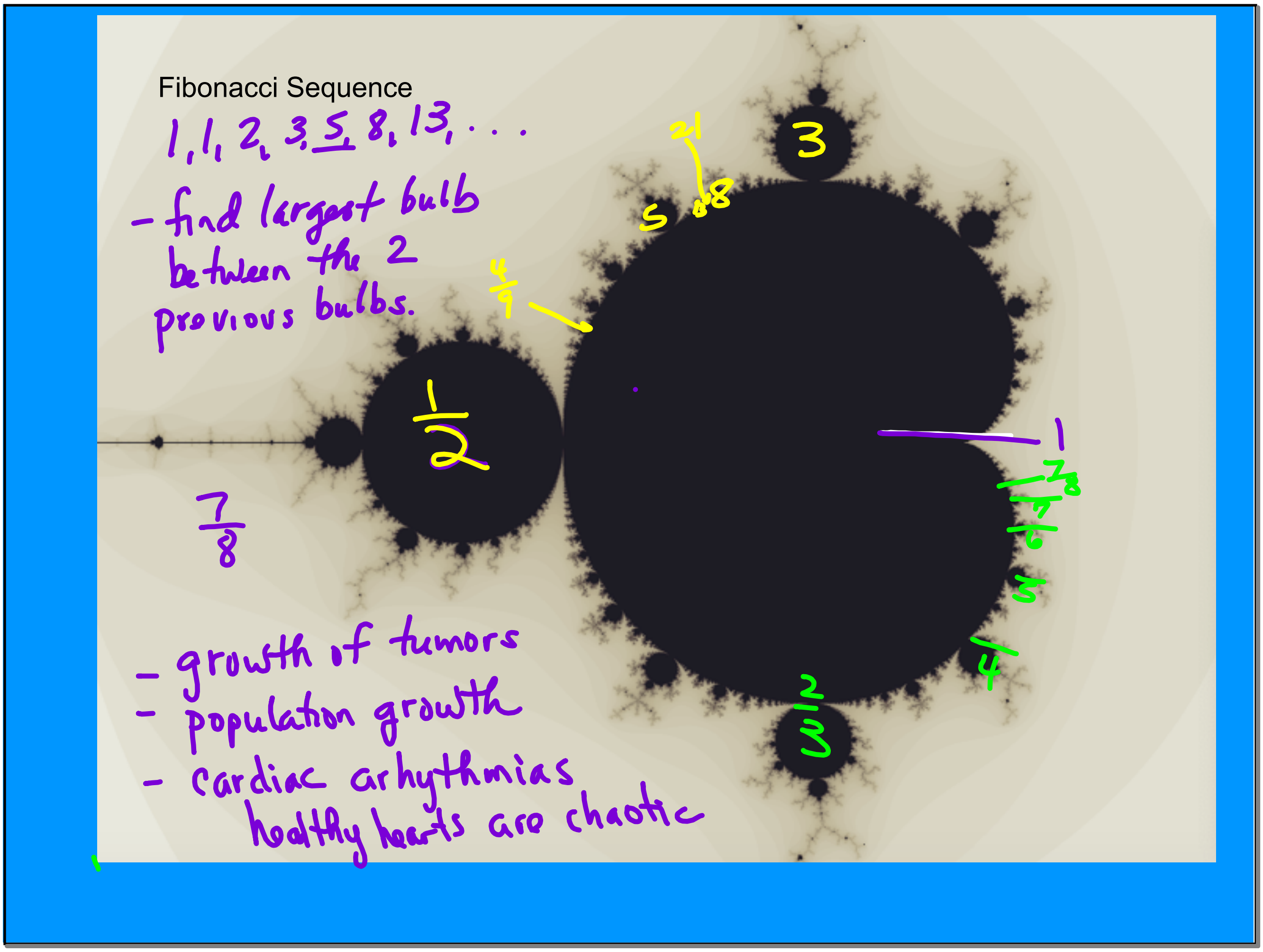
Fibonacci Sequence
1, 1, 2, 3, 5, 8, 13, . . .
- find largest bulb between the 2 previous bulbs.
3
5
8
21
1/2
7/8
1
4
- growth of tumors
- population growth
- cardiac arhythmias
healthy hearts are chaotic

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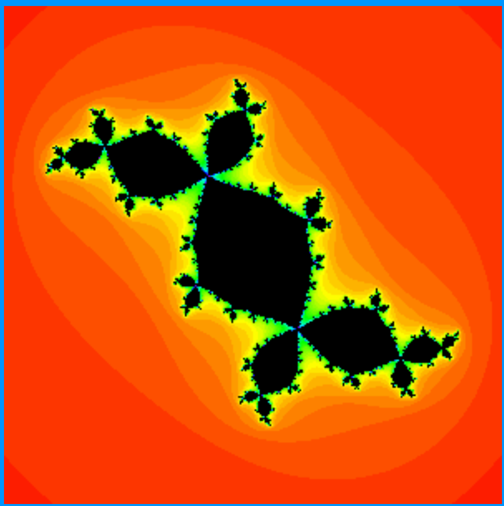
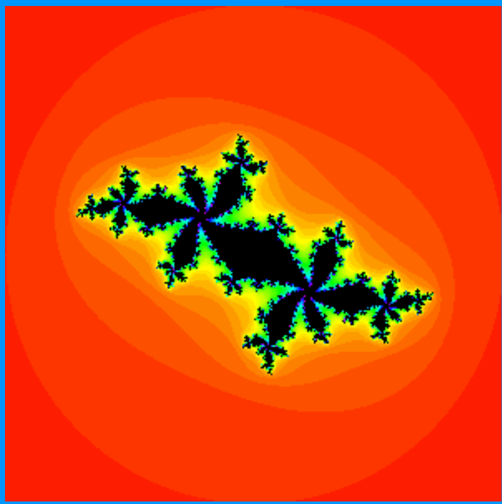
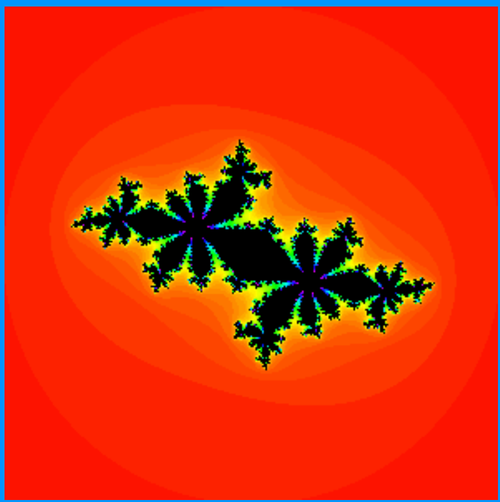
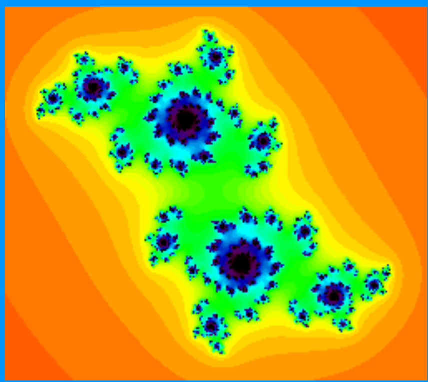
Julia Sets

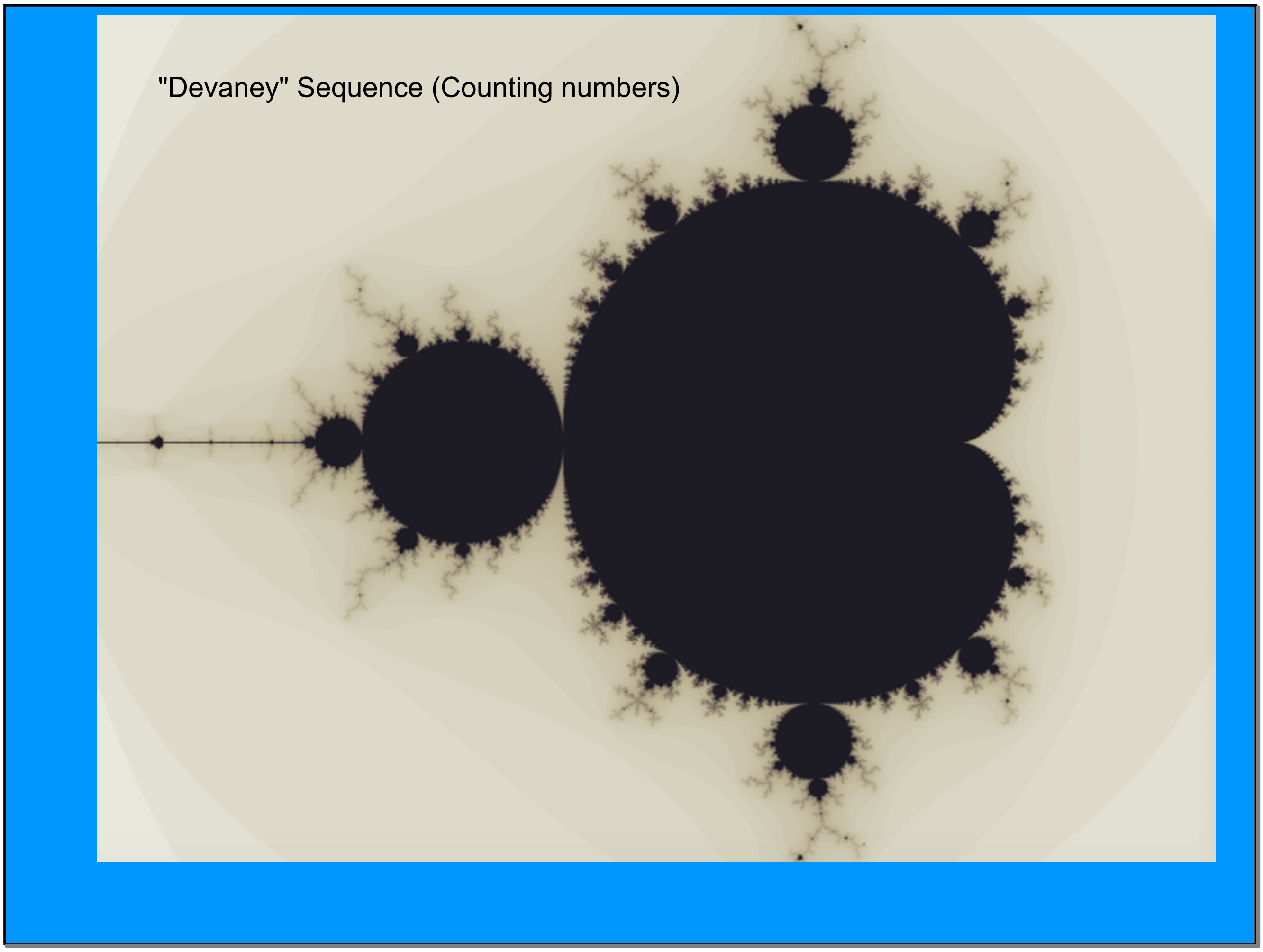
Mandelbrot | Julia










"Devaney" Sequence (Counting numbers)

MORE DERIVATIVES

$f(x) = 3x^7 \cdot 5x^4 = 15x^{11}$

$f'(x) = 165x^{10}$

$\cancel{f'(x) = 21x^6 \cdot 20x^3}$

$\cancel{= 420x^9}$

$f(x) = 3x^7 \cdot 5x^4$

$f'(x) = 3x^7 \cdot 20x^3 + 5x^4 \cdot 21x^6$

$= 60x^{10} + 105x^{10}$

$= 165x^{10}$

PRODUCT RULE

$$\frac{d}{dx} f \cdot g = f \cdot g' + g \cdot f'$$

1st · d'2nd + 2nd · d'1st

$$f(x) = (7x^5 + 3x^8 - 2)\left(8x - \frac{7}{\sqrt[5]{x^2}} + 9\right)$$

$-7x^{-2/5}$

1st d'2nd 2nd d'1st

$$f'(x) = (7x^5 + 3x^8 - 2)\left(8 + \frac{14}{5}x^{-7/5}\right) + \left(8x - 7x^{-2/5} + 9\right)\left(35x^4 + 24x^7\right)$$

QUOTIENT RULE

$$\frac{d}{dx}\frac{f}{g} = \frac{g \cdot f' - f \cdot g'}{g^2}$$

$$= \frac{\text{low} \cdot d'\text{high} - \text{high} \cdot d'\text{low}}{\text{low}^2}$$

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

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

$$f(x) = \frac{x^4 - 7x^3 + 8}{2x^5 - 17x^2}$$

$$f'(x) = \frac{(2x^5 - 17x^2) \cdot (4x^3 - 21x^2) - (x^4 - 7x^3 + 8)(10x^4 - 34x)}{(2x^5 - 17x^2)^2}$$

CHAIN RULE

$$\frac{d}{dx} f[g(h(x))] = f'[g(h(x))] \cdot g'(h(x)) \cdot h'(x)$$

x^8

$\cancel{f(x) = \sin^4(\cos(3x^2-7)^5)}$

$$f(x) = (x^2-7x+3)^8$$

$$f'(x) = 8(x^2-7x+3)^7 \cdot (2x-7)$$

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

$$= [(x^2+3-5(x^2+4)^9]^{1/2}$$

$$f'(x) = \frac{1}{2}[x^2+3-5(x^2+4)^9]^{-1/2} \cdot [2x-45(x^2+4)^8 \cdot 2x]$$

$$f(x) = \frac{(x^5-4x^8+7)(3x^2-5x^7)}{(x^6+8)^{100}}$$

$$f'(x) = \frac{\overbrace{(x^6+8)^{100}}^{\text{low}} \cdot \overbrace{\left[\overbrace{(x^5-4x^8+7)}^{\text{1st}}\overbrace{(6x-35x^6)}^{\text{d'2nd}} + \overbrace{(3x^2-5x^7)}^{\text{2nd}} \cdot \overbrace{(5x^4-32x^7)}^{\text{d'1st}}\right]}^{\text{d'high}} - \overbrace{(x^5-4x^8+7)(3x^2-5x^7)}^{\text{high}} \cdot \overbrace{100(x^6+8)^{99} \cdot (6x^5)}^{\text{d'low}}}{\left[(x^6+8)^{100}\right]^2}$$