$$f(x) = 2x^5 - x^4 - 2x^3 + 28x^2 - 56x - 160$$

We'll come back to this, since there's no miracle cure for 5th degree

$f(x) = x^5 - 5x^4 - x^3 + 28x^2 - 2x$

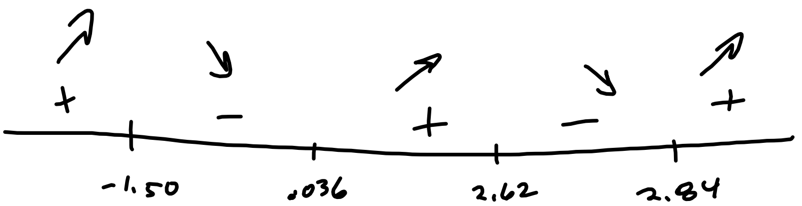
$f'(x) = 5x^4 - 20x^3 - 3x^2 + 56x - 2$

Rational zeros:

$\pm \frac{\text{factors of } 2}{\text{factors of } 5}$ $\qquad \pm 1, \pm \frac{1}{5}, \pm 2, \pm \frac{2}{5}$

$$\begin{array}{r|rrrrr} 1 & 5 & -20 & -3 & +56 & -2 \\ & & 5 & -15 & -18 & \text{Nope} \\ \hline & 5 & -15 & -18 & 38 & \end{array}$$

0.03579918077, 2.622735166, 2.841010876, -1.499545222



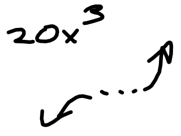
Inc: $(-\infty, -1.50) \cup (.04, 3.62) \cup (2.84, \infty)$

Dec: $(-1.50, .036) \cup (2.62, 2.84)$

$20x^3 - 60x^2 - 6x + 56 = 2(10x^3 - 30x^2 - 3x + 28)$

2.735481343 - (3.*10^(-10))*I, -0.8880731574 - (2.464101616*10^(-10))*I, 1.152591815 + (4.464101616*10^(-10))*I

Means 2.73, -.89, 1.15



C-up: $(-.89, 1.15) \cup (2.73, \infty)$

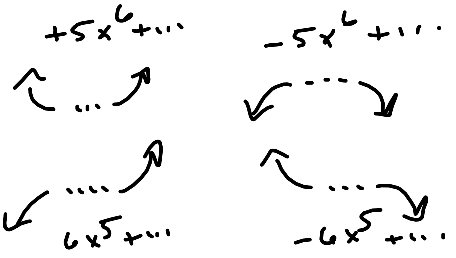
C-down $(-\infty, -.89) \cup (1.15, 2.73)$

Limits @ Infinity

"End Behavior"

Polynomials Degree 2n

" 2n+1



Proper Rational Function

Horizontal Asymptote (H.A.)

$$\frac{a_nx^n+\dots+a_0}{b_mx^m+\dots+b_0}$$

If $m > n$

$$\lim_{|x|\to\infty} f(x) = 0$$

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

IMPROPER "Tie"

H.A.

$$\frac{a_nx^n+\dots+a_0}{b_mx^n+\dots+b_0}$$

$$\lim_{|x|\to\infty} f(x) = \frac{a_n}{b_n}$$

$$\frac{5+7x^2-17x}{6x^2+5x+1} \xrightarrow{|x|\to\infty} \frac{7}{6}$$

Improper $n > m$ oblique asymptote

$$\frac{x^2-3x-28}{x-1} = x-2-\frac{30}{x-1}$$

$$\begin{array}{r|rrr} 1 & 1 & -3 & -28 \\ & & 1 & -2 \\ \hline & 1 & -2 & -30 \end{array}$$

$$\begin{array}{r l} & x-2 \quad r -30 \\ x-1 & \overline{)\,x^2-3x-28} \\ & -(x^2-x) \\ \hline & \quad -2x-28 \\ & \quad -(-2x+2) \\ \hline & \qquad -30 \end{array}$$

$$\xrightarrow{x\to\pm\infty} x-2$$

Oblique Asymptote $y=x-2$

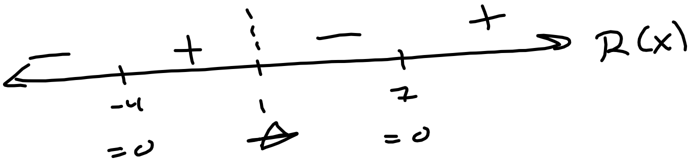
x

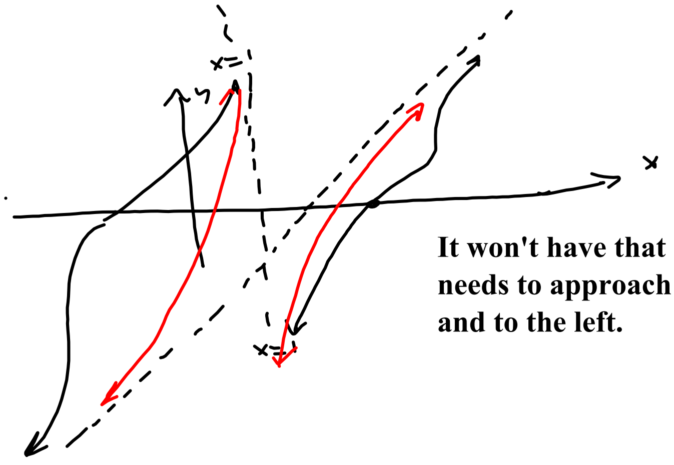
Let's graph $R(x) = \frac{x^3-3x-28}{x-1} = \frac{(x-7)(x+4)}{x-1}$

$\mathcal{D} = \mathbb{R} \setminus \{1\}$

$\boxed{x=1 \text{ is V.A.}}$

$R(x)=0 \Rightarrow x=-4, 7$



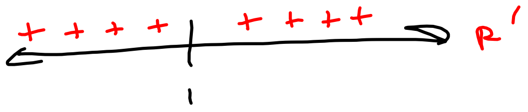


It won't have that much wiggle. But it needs to approach x - 2 off to the right and to the left.

$R(x) = \frac{x^3-3x-28}{x-1} \Rightarrow$

$R'(x)\ \frac{(2x-3)(x-1)-(x^2-3x-28)(1)}{(x-1)^2} = \frac{2x^2-2x-3x+3-x^2+3x+28}{(x-1)^2}$

$= \frac{x^2-2x+31}{(x-1)^2}$ SET $=0 \Rightarrow b^2-4ac = 2^2-4(1)(31) < 0 \longrightarrow$ No real zeros!



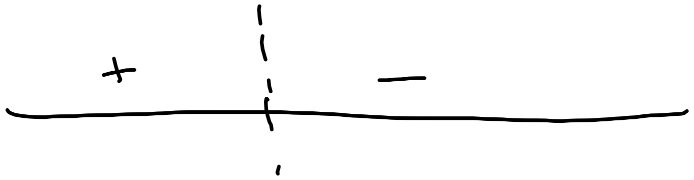
$$R''(x) = \frac{(2x-2)(x-1)^2 - (x^2-2x+31)(2(x-1))}{((x-1)^2)^2}$$

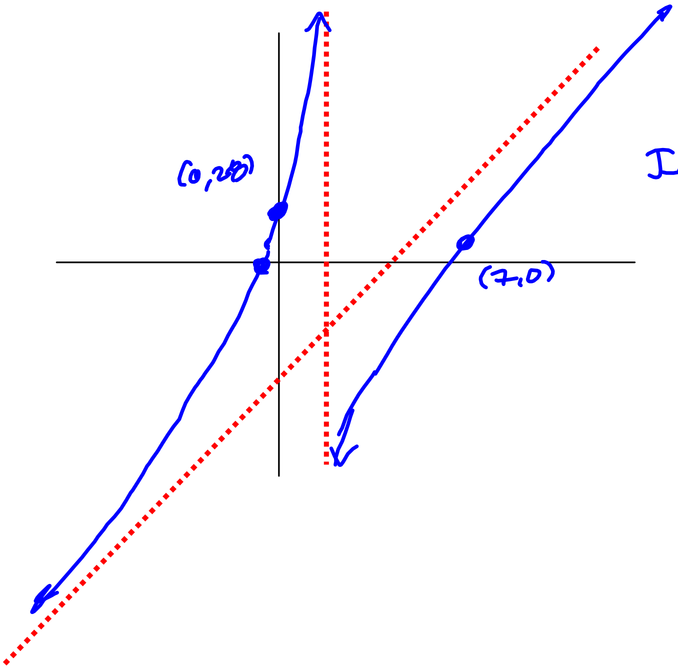
~~$2(x-1)(x-1)^2 = 2(x^3-3x^2+3x-1) = 2x^3-6x^2+6x-2$~~

~~$2(x-1)$~~ Cancel, idiot!

$$\frac{(x-1)\left[(2x-2)(x-1) - 2(x^2-2x+31)\right]}{(x-1)^4} = \frac{2x^2-4x+2-2x^2+4x-62}{(x-1)^3}$$

$$= \frac{-60}{(x-1)^3}$$



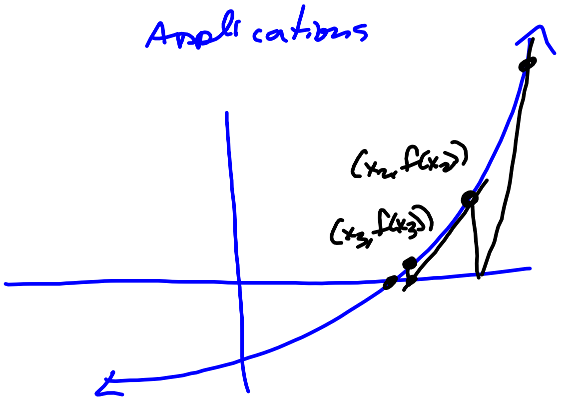


Jesse fixed my x=1 v.A. 4 me.

Next Time $2\sin(x) + \cos(2x) = f(x)$

Newton's Method

Applications



$x_0 =$ guess

$x_1 =$ where tan line $= 0$

$$f'(x_0)(x_1 - x_0) + f(x_0) = 0$$

$$x_1 - x_0 = -\frac{f(x_0)}{f'(x_0)}$$

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

$$\vdots$$

$$x_n = x_{n-1} - \frac{f(x_{n-1})}{f'(x_{n-1})}$$