Agenda

Homework/Quiz

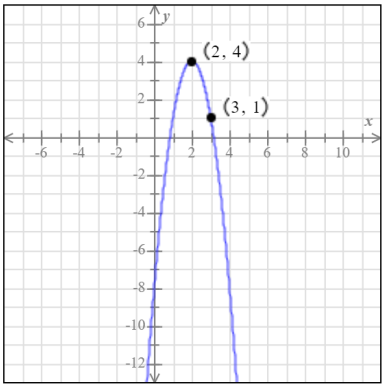
Lecture

Project

Homework

Writing the equation of a quadratic function given its graph

Find the equation of the quadratic function f whose graph is shown below.



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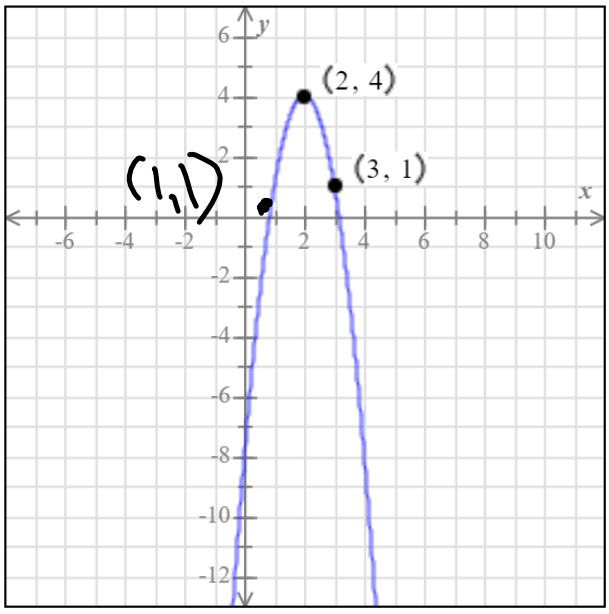
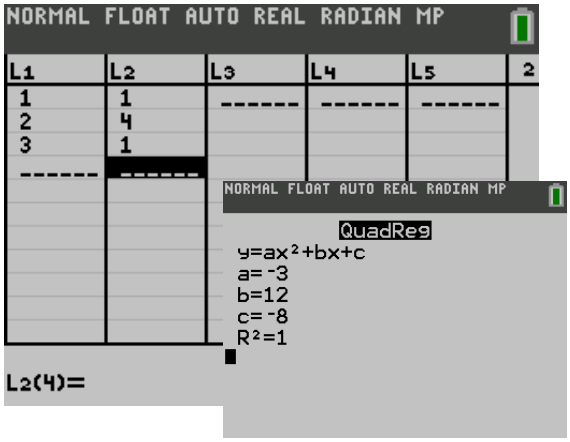
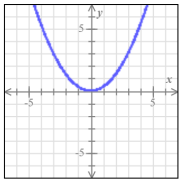




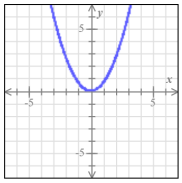
$y = -3x^2 + 12x - 8$

How the leading coefficient affects the shape of a parabola

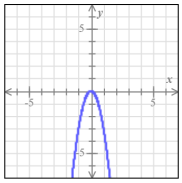
Look at the graphs and their equations below. Then fill in the information about the leading coefficients A, B, C, an



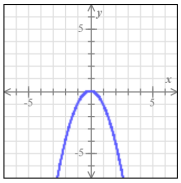
$y = Ax^2$



$y = Bx^2$



$y = Cx^2$



$y = Dx^2$

	A	***B***	***C***	***D***
(a) For each coefficient, choose whether it is positive or negative	Select One ▾	Select One ▾	Select One ▾	Select One ▾
(b) Choose the coefficient closest to 0	○	○	○	○
(c) Choose the coefficient with the greatest value	○	○	○	○

How the leading coefficient affects the shape of a parabola

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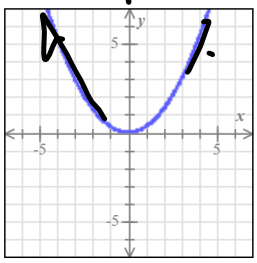

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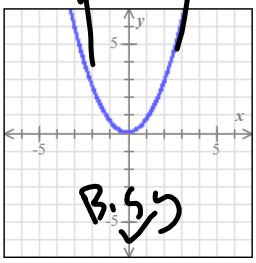

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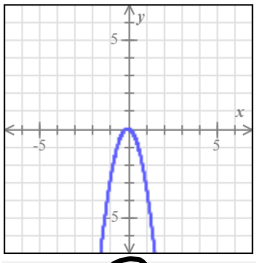

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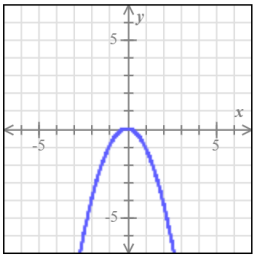

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	A	B	C	D
(a) For each coefficient, choose whether it is positive or negative	Select One	Select One	Select One	Select One
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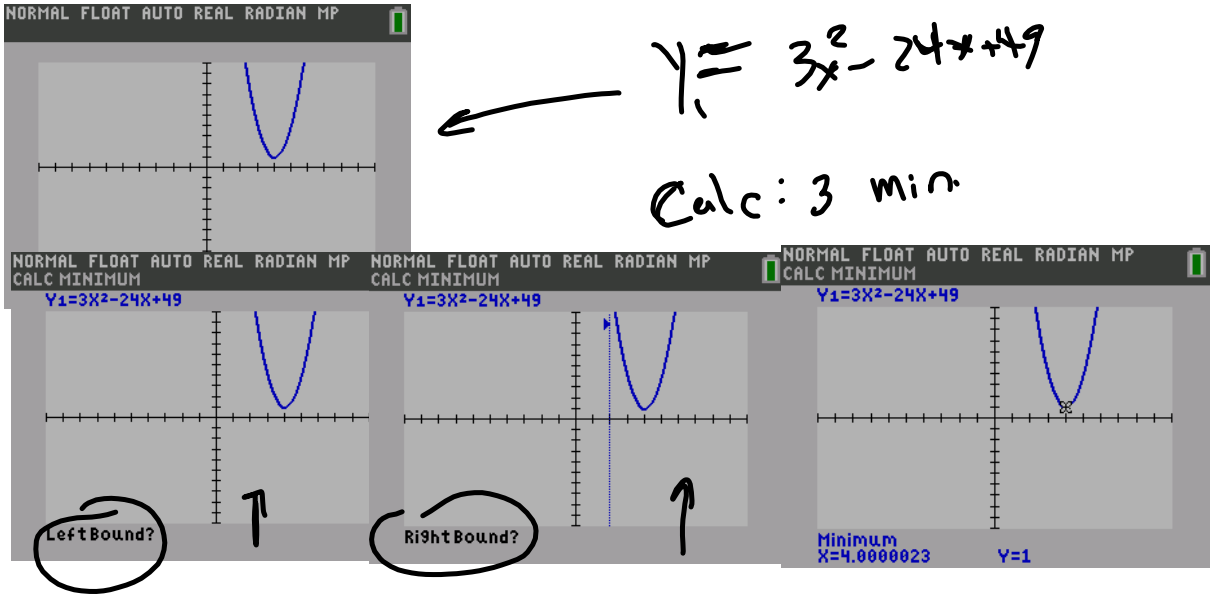
Finding the maximum or minimum of a quadratic function

Answer the questions below about the quadratic function.

$$f(x) = 3x^2 - 24x + 49$$

Does the function have a minimum or maximum value? ○ Minimum ○ Maximum
Where does the minimum or maximum value occur? $x =$ □
What is the function's minimum or maximum value? □



ALEKS Calculator easier(?)

Finding the maximum or minimum of a quadratic function

Answer the questions below about the quadratic function.

$$f(x) = 3x^2 - 24x + 49$$

Does the function have a minimum or maximum value?

(•) Minimum ( ) Maximum

Where does the minimum or maximum value occur?

$x =$ 4.0000...

What is the function's minimum or maximum value?

1.

Where / When → x

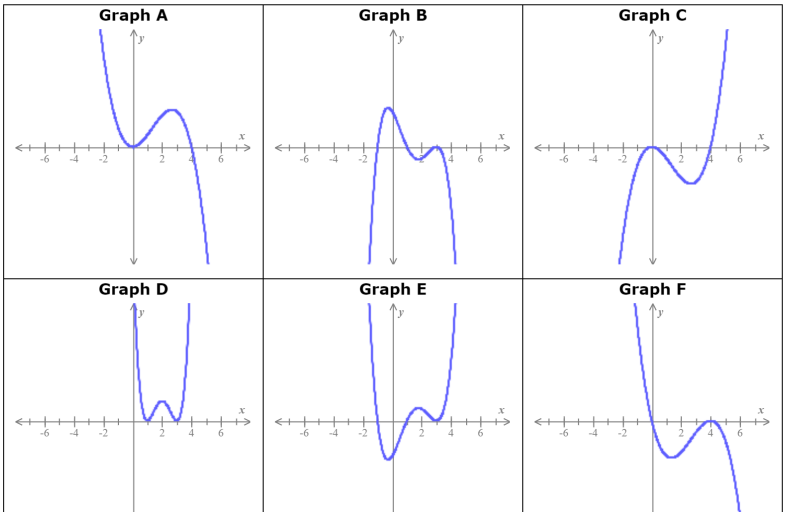
What → y

Matching graphs with polynomial functions

Consider the following polynomial functions.

$$g(x) = (x-3)^2\left(x^2-1\right)$$
$$h(x) = -x^3+4x^2$$

Choose the graph of each function from the choices below.



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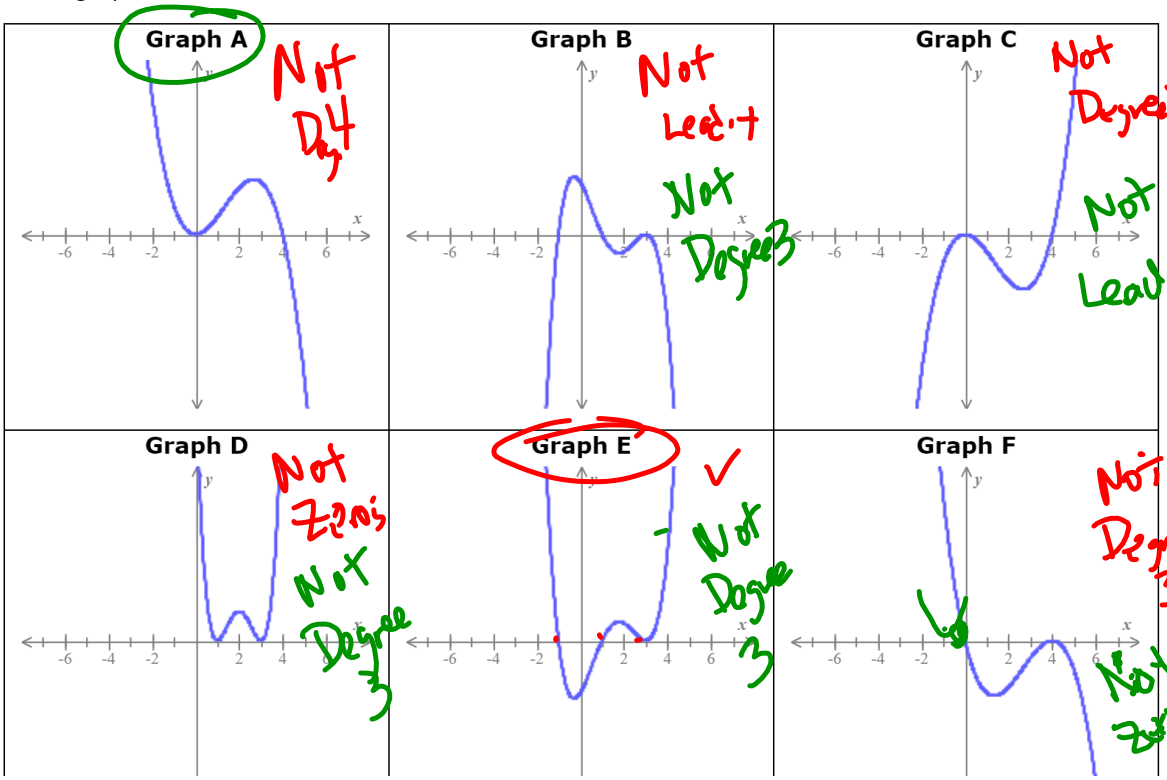


Lecture: Zeros & Inequalities

Math?

Precalc?

Function = Job

Data, Graphs, Equations

✓ $f(x) = ax + b$ Linear

✓ $f(x) = ax^2 + bx + c$ Quadratic

✓ $f(x) = ax^n + bx^{n-1} + \ldots$ Polynomial

→ $3x^3 + 5x + 7$

Degree: n Leadi: a

Faces: n or less

Zeros: n or less

Max/Turns: n-1 or less

3 or mo faces

Zeros

Fundamental Theorem of Algebra ★

Poly degree "n"

$$a(x-x_1)(x-x_2)(x-x_3)\cdots(x-x_n)$$

n factors

fully factored form

$$= (x-1)(x-2)(x+3)$$

zeros: 1, 2, -3

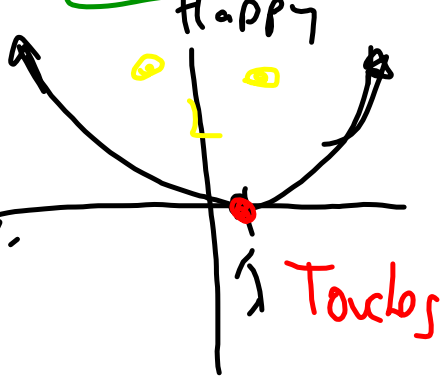
$$= x^3 + ax^2 + \cdots + 6$$

Ex $y = (x-1)(x-1) = x^2-2x+1$

zeros: 1, 1

~~Two~~ One zeros: multiplicity

repeated Two.



Imaginary (Unit i)

$\sqrt{-1} = i$

so $(i)^2 = -1$

Complex

$a + bi$

real imaginary

Ex $3 + 2i$

Ex $(3+2i)^2$

$(3+2i)(3+2i) = 9 + 6i + 6i + 4i^2$

$9 + 12i - 4$

$5 + 12i$

mode:

```
NORMAL FLOAT AUTO a+bi RADIAN MP
SCREEN VIEW
MATHPRINT CLASSIC
NORMAL SCI ENG
FLOAT 0 1 2 3 4 5 6 7 8 9
RADIAN DEGREE
FUNCTION PARAMETRIC POLAR SEQ
THICK DOT-THICK THIN DOT-THIN
SEQUENTIAL SIMUL
REAL a+bi re^(θi)
FULL HORIZONTAL GRAPH-TABLE
FRACTION TYPE: n/d Un/d
ANSWERS: AUTO DEC FRAC-APPROX
GO TO 2ND FORMAT GRAPH: NO YES
STAT DIAGNOSTICS: OFF ON
STAT WIZARDS: ON OFF
SET CLOCK 02/12/20 7:23PM
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NORMAL FLOAT AUTO a+bi RADIAN MP
(3+2i)^2
                          5+12i
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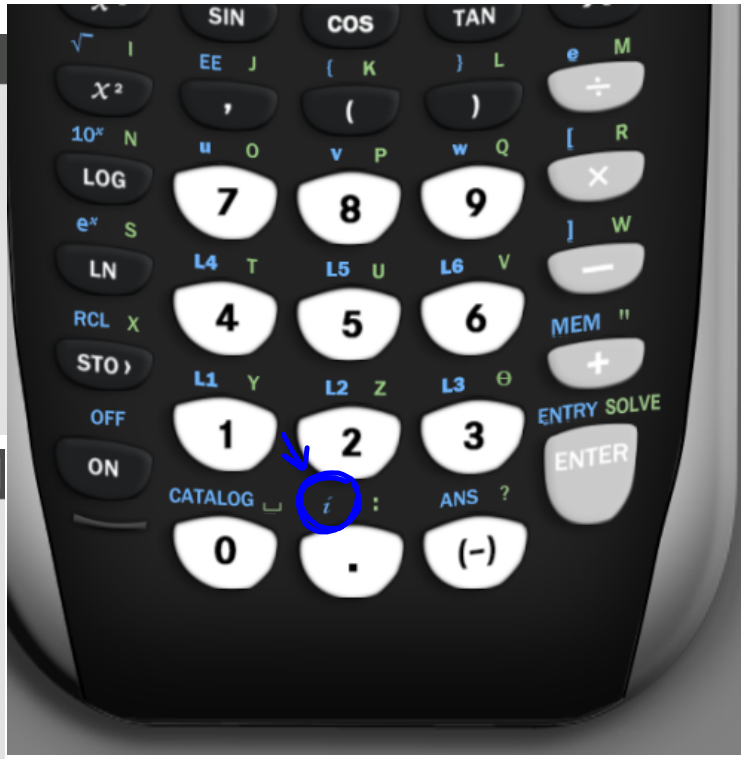


CONJUGATES (complex)

$(a+bi)(a-bi)$

FOIL

$a^2 - \cancel{abi} + \cancel{abi} - b^2 i^2$ $\quad i^2 = -1$

$a^2 + b^2$ real

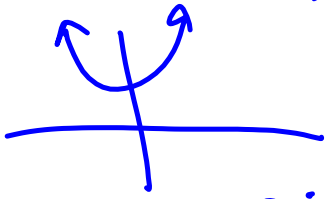
$y = (x^2 - 4) = (x+2)(x-2)$

Real Factors

zeros: 2, -2

$y = (x^2 + 4) = (x - 2i)(x + 2i)$

Complex Factors



zeros: $2i, -2i$

$= ax^2 + bx + c$

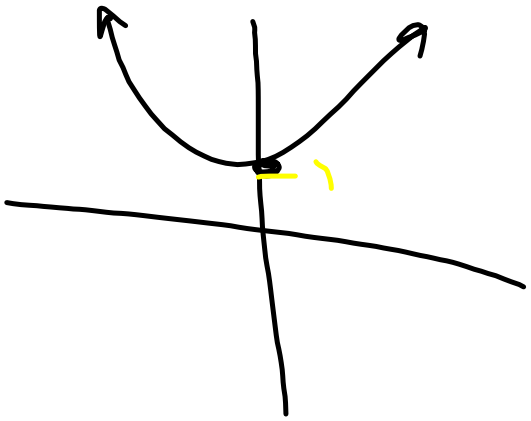
Ex: $(x - i)(x + i)$

Zeros: $\pm i$

$x^2 + xi - xi - i^2$

$x^2 - i^2$

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



$y = x^2 + 1$

$0 = x^2 + 0x + 1$

$x = \frac{\pm\sqrt{-4}}{2} = \frac{\pm 2i}{2}$

$= \pm i$

Find all real zeros of the function.

$$f(x) = -2x(x^2 - 9)(x - 7)$$

0, 3, -3, 7

PASS PASS PASS PASS

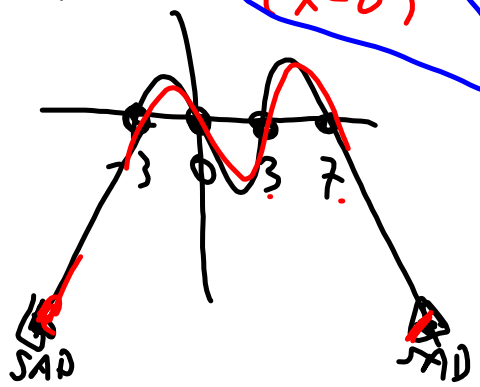
Degree: 4

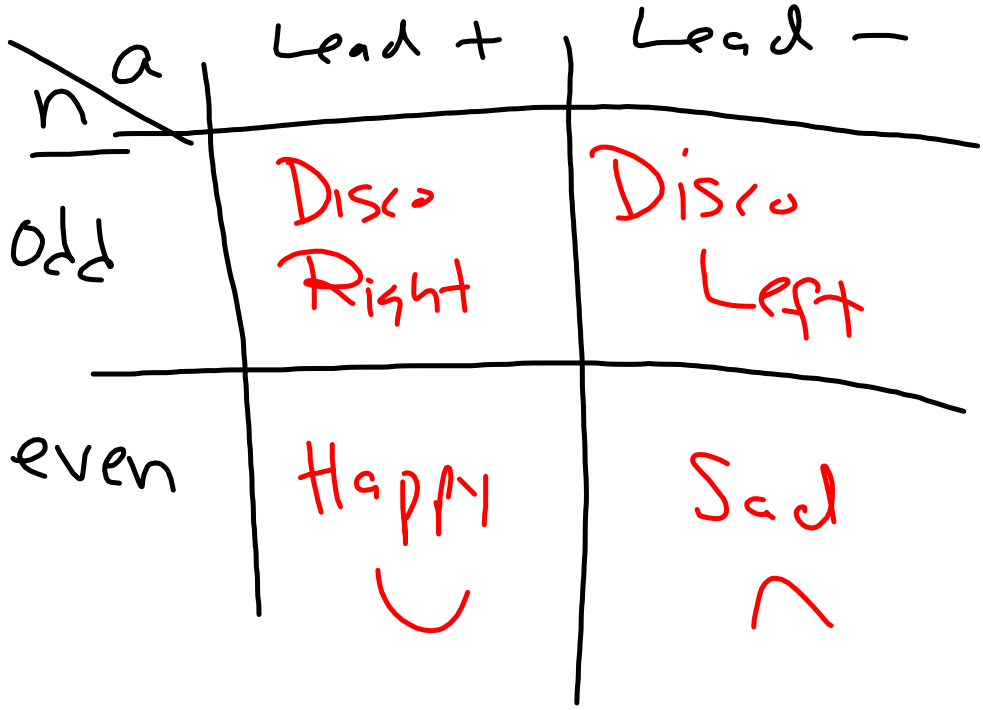
$-2x(x-3)(x+3)(x-7)$ END: SAD

Begin

(x-0)

Sad




a
n
Lead +
Lead −
odd
Disco
Right
Disco
Left
even
Happy
Sad

$(x-a)(x-b)$

Conjugates

$(A-B)(A+B)$

(A^2-B^2) ← diff of squares

Zeros

$\frac{(x-1+i)(x-1-i)}{((x-1)+i)((x-1)-i)}$ → $1+i$, $1-i$

$(x-1)^2 - i^2$

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

$A=1 \quad B=-2 \quad C=2$

$x = \frac{+2 \pm \sqrt{4-4(2)}}{2}$

$= \frac{2 \pm \sqrt{-4}}{2}$

$= \frac{2 \pm 2i}{2} = \frac{2}{2} \pm \frac{2i}{2} = 1 \pm i$

$$(x-(a+bi))(x-(a-bi))$$

$$(x-a-bi)(x-a+bi)$$

$$((x-a)-bi)((x-a)+bi)$$

$$(x-a)^2-b^2i^2$$

$$(x-a)^2+b^2$$

$n = 3$ cubic Poly

with zeros. Included

1, $1+i$, $1-i$

Factors $(x-1)(x-(1+i))(x-(1-i))$

$(x-1)(x-1-i)(x-1+i)$

$(x-1)\underbrace{((x-1)-i)((x-1)+i)}$

$(x-1)((x-1)^2 - i^2)$

$x^2 - 2x + 1 + 1$

$(x-1)(x^2-2x+2)$

$$\begin{array}{r} x-1 \\ \hline -x^2+2x-2 \\ x^3-2x^2\ \ 2x \\ \hline x^3-3x^2+4x-2 \end{array}$$

Finding x- and y-intercepts given a polynomial function

Find all x-intercepts and y-intercepts of the graph of the function.

$$f(x) = 3x^3 - 12x^2 - 15x$$

If there is more than one answer, separate them with commas.

Click on "None" if applicable

Finding x- and y-intercepts given a polynomial function

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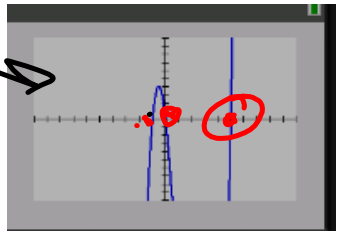


y-int 0,0

x int 0, 5, −1

Calc: zero

$3x(x^2 - 4x - 5)$

$3x(x-5)(x+1)$

Input interpretation:

factor $3x^3 - 12x^2 - 15x$

Result:

$3x(x+1)(x-5)$

Irreducible factorization:

$3(x-5)x(x+1)$

Plots:

Determining the end behavior of the graph of a polynomial function

Choose the end behavior of the graph of each polynomial function.

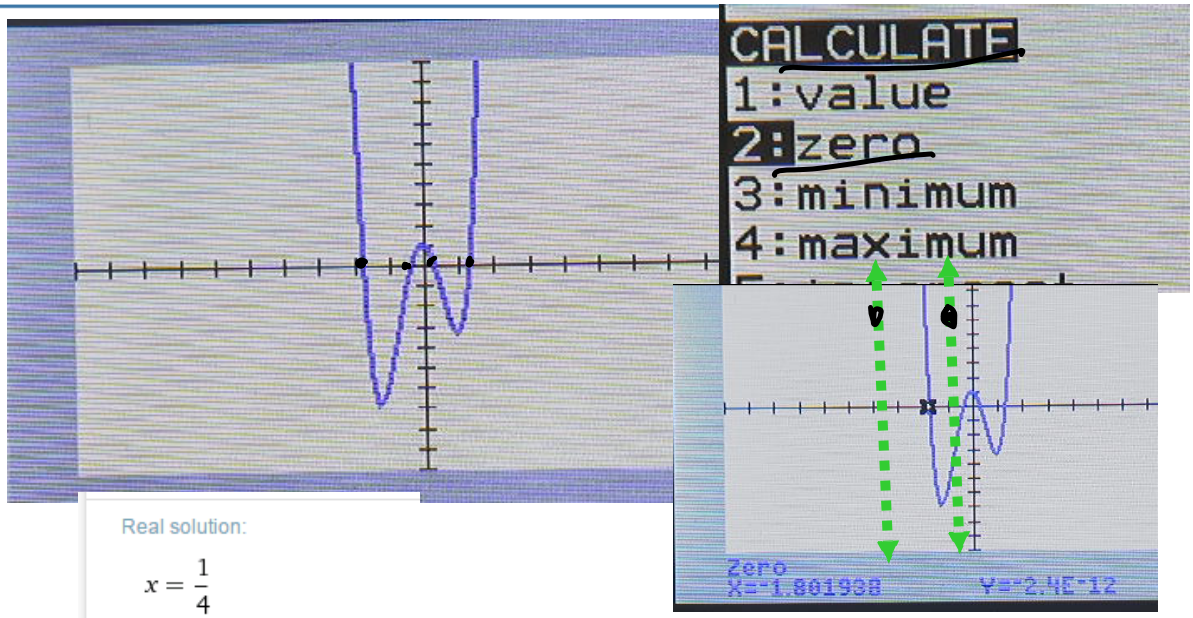
(a) $f(x) = -5x^6 - x^4 + 8x^3 - 3x$ degree:6(even) Lead: -5 (negative) sad	○ Falls to the left and rises to the right ○ Rises to the left and falls to the right ○ Rises to the left and rises to the right ○ Falls to the left and falls to the right
(b) $f(x) = x^3 - 3x^2 - 2x - 9$ disco right	○ Falls to the left and rises to the right ○ Rises to the left and falls to the right ○ Rises to the left and rises to the right ○ Falls to the left and falls to the right
(c) $f(x) = -5x(2x - 5)^2$ disco left degree:3 Lead: -20(negative)	○ Falls to the left and rises to the right ○ Rises to the left and falls to the right ○ Rises to the left and rises to the right ○ Falls to the left and falls to the right

(a) $f(x) = -5x^3 + 3x^2 + 5x + 2$ disco left	○ Falls to the left and rises to the right ○ Rises to the left and falls to the right ○ Rises to the left and rises to the right ○ Falls to the left and falls to the right
(b) $f(x) = 4x^5 + 3x^3 + 8x + 9$ disco right	○ Falls to the left and rises to the right ○ Rises to the left and falls to the right ○ Rises to the left and rises to the right ○ Falls to the left and falls to the right
(c) $f(x) = 2(x-2)^2(x+4)$ disco right 0 1 = 3	○ Falls to the left and rises to the right ○ Rises to the left and falls to the right ○ Rises to the left and rises to the right ○ Falls to the left and falls to the right

Use the ALEKS graphing calculator to find all the zeros of the poly

$$f(x) = 4x^4 + 3x^3 - 9x^2 - 2x + 1$$

Round to the nearest hundredth.
If there is more than one answer, separate them with commas.



Real solution:

$$x = \frac{1}{4}$$

Solution:

$$x = \frac{1}{4}$$

Complex solutions:

$x \approx -1.8019$

$x \approx -0.44504$

$x \approx 1.2470$

warning.. .25000002

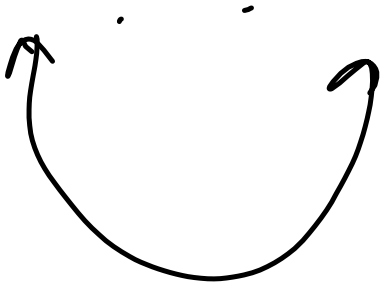
calculator crud

.24999999

$$.\overline{3} = \frac{1}{3}$$

$$.\overline{6} = \frac{2}{3}$$

$$.\overline{9} = \frac{3}{3} = 1$$



(a) The function f is increasing over which intervals? Choose all that apply. x values

☐ (-∞ , -8) ☑ (-8, -5) ☐ (-5, -1) ☑ (-1, 3) ☐ (-1, 5) ☑ (5, ∞)

(b) The function f has local maxima at which x-values? If there is more than one value, separate them with commas.

x= -5,3

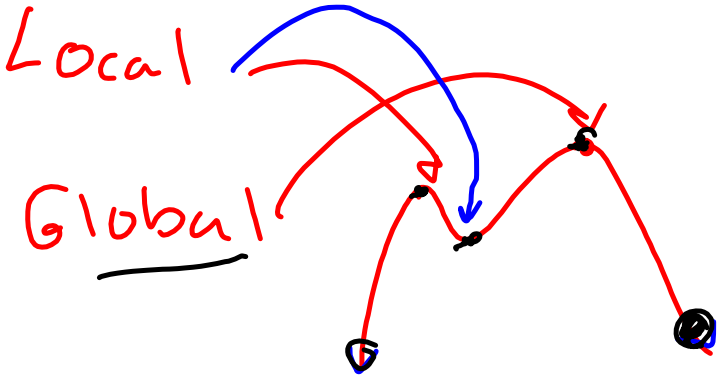
(c) What is the sign of the leading coefficient of f?

Select One positive....happy

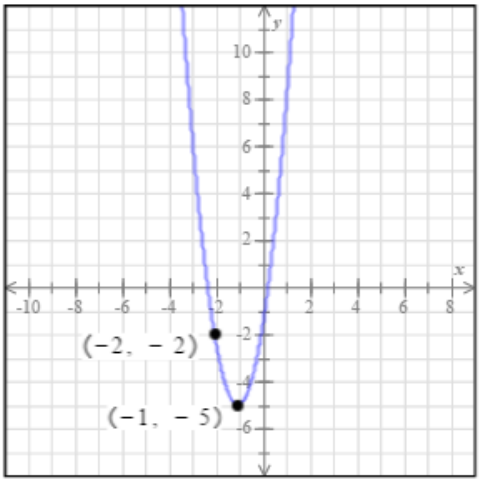
(d) Which of the following is a possibility for the degree of f? Choose all that apply.

☐ 4 ☐ 5 ☑ 6 ☐ 7 ☑ 8 ☐ 9

6 turns


Local
Global

Find the equation of the quadratic function f whose graph is shown bel

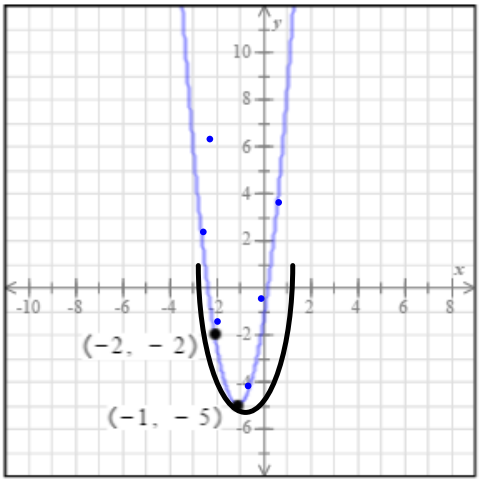


The graph of a quadratic function is a parabola.
Any quadratic function f whose graph has vertex (h, k) can be written i

$$f(x) = a(x-h)^2 + k, \quad \text{where } a \neq 0.$$

In the current problem, the vertex is $(-1, -5)$

Find the equation of the quadratic function f whose graph is shown bel



vertex (-1,-5)

move x^2 to left (x+1)^2

down by 5, (x+1)^2-5

y = a(x+1)^2-5

-2=a(-2+1)^2-5

-2=a-5 so a=3

The graph of a quadratic function is a parabola.
Any quadratic function f whose graph has vertex $(h,\ k)$ can be written i

$$f(x) = a(x-h)^2 + k\,, \quad \text{where } a \neq 0.$$

In the current problem, the vertex is $(-1,\ -5)$

Find a polynomial $f(x)$ of degree 3 with real coefficients and the following zeros.

3 , $2i$

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

Find a polynomial $f(x)$ of degree 3 with real coefficients and the following zeros.

3 , $2i$

Zeros = 3 by FTA

$3, 0+2i, 0-2i$

Zeros: $3, 2i, -2i$

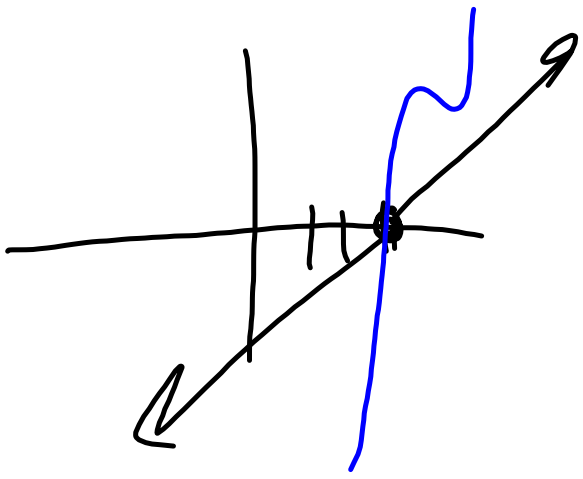
Factors: $(x-3)(x-2i)(x+2i)$

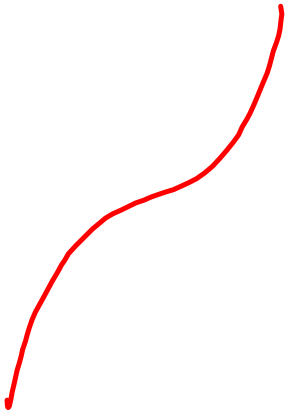
$x^2 - 2xi + 2xi - 4i^2$

$+4$

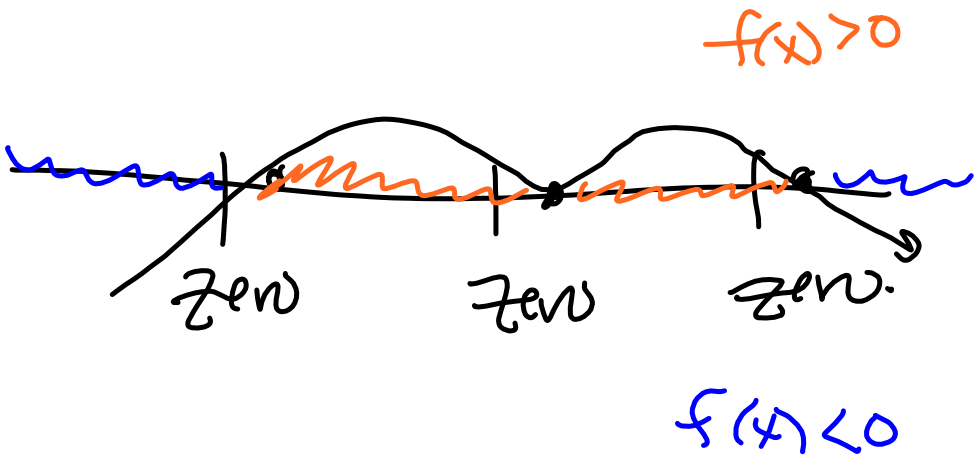
$(x-3)(x^2+4)$

$= x^3 - 3x^2 + 4x - 12$





Polynomial Inequalities

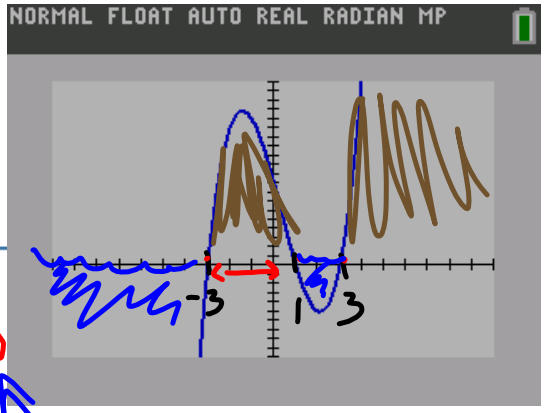


Solving a polynomial inequality

Solve the inequality.

$$x^3 - x^2 \geq 9x - 9$$

Write your answer as an interval or union of intervals.
If there is no real solution, click on "No solution".



$y = x^3 - x^2 - 9x + 9 \geq 0$

$x^2(x-1) - 9(x-1)$

$(x^2-9)(x-1)$

$(x-3)(x+3)(x-1)$

LAND

$[-3, 1] \cup [3, \infty)$

Solving a polynomial inequality

Solve the inequality.

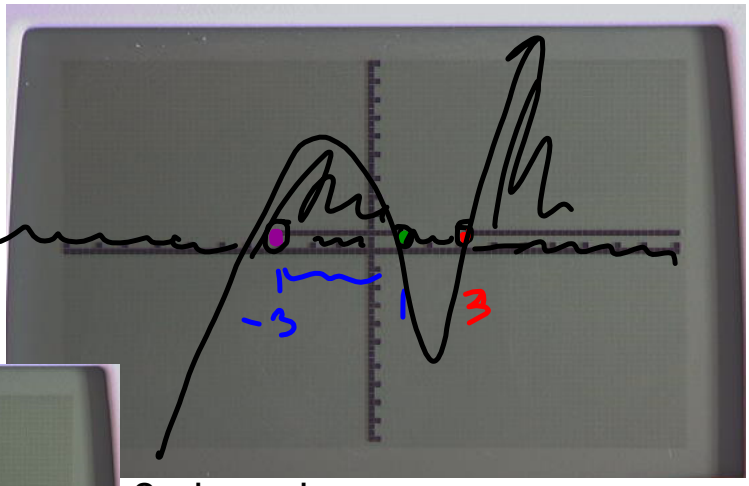
$x^3 - x^2 \geq 9x - 9$

$y = x^3 - x^2 - 9x + 9 \geq 0$

Write your answer as an interval or union of intervals.
If there is no real solution, click on "No solution".

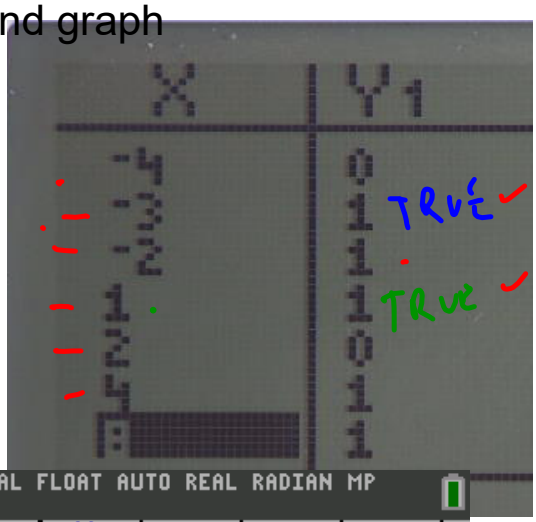
2nd math = test

y1=(x^3-x^2)≥(9x-9)

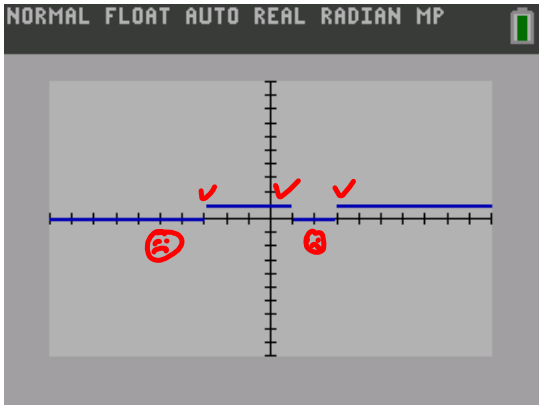


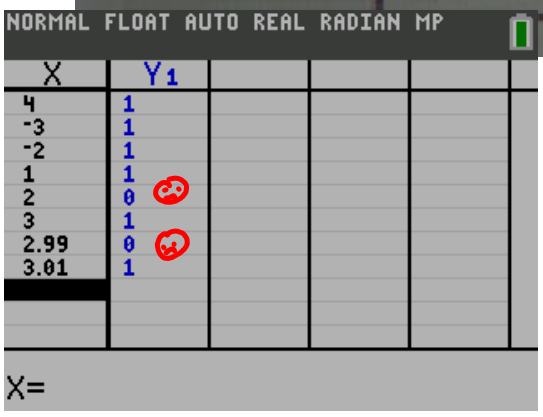
2nd window

2nd graph



$[-3, 1] \cup [3, \infty)$





Solving a polynomial inequality

Solve the inequality.

$$x^3 - x^2 \geq 9x - 9$$

Write your answer as an interval or union of intervals.
If there is no real solution, click on "No solution".

Degree

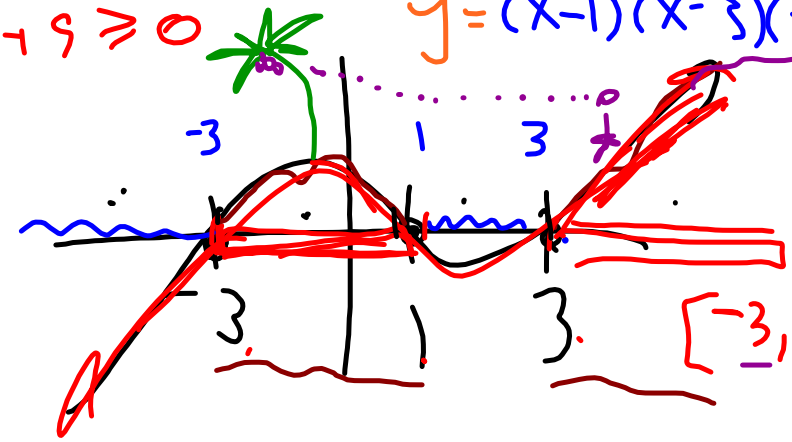
$y = x^3 - x^2 - 9x + 9 \geq 0$

$x^2(x-1) - 9(x-1)$

$(x-1)(x^2-9)$

$y = (x-1)(x-3)(x+3)$

$x^3 - x^2 - 9x + 9 \geq 0$



> 0

$[-3, 1] \cup [3, \infty)$

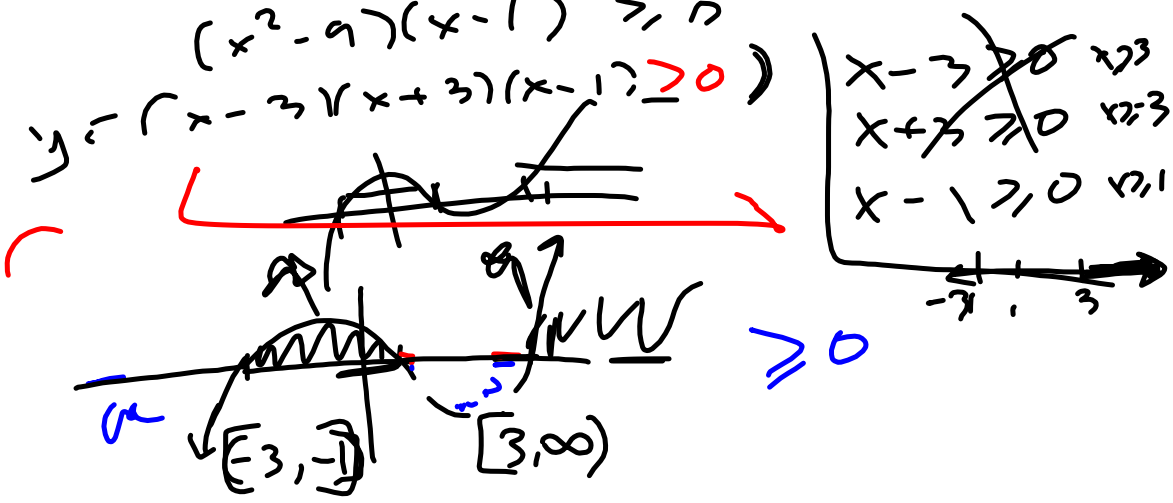
$$x^3 - 8x^2 \geq 9x - 9$$

$$x^3 - x^2 - 9x + 9 \geq 0$$

$$x^2(x-1) - 9(x-1) \geq 0$$

$$(x^2 - 9)(x-1) \geq 0$$

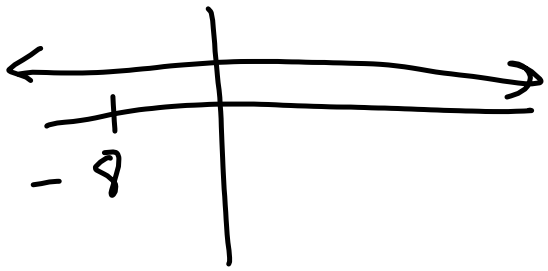
$$y = (x-3)(x+3)(x-1) \geq 0$$



9. Solve the inequality.

$$(-x-8)(x^2+5)(x+8)\leq 0$$

Write your answer as an interval or union of intervals.



$(-\infty, \infty)$

9. Solve the inequality.

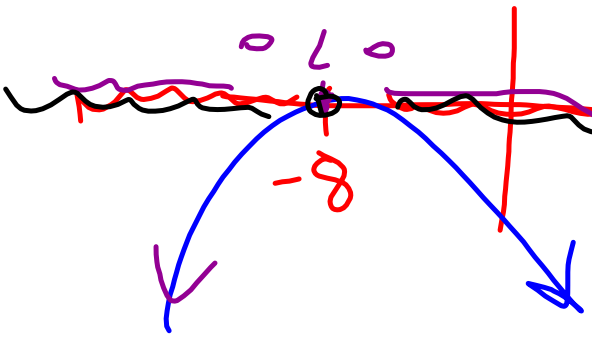
$$(-x-8)(x^2+5)(x+8)\leq 0$$

Write your answer as an interval or union of intervals.

Degree: 4

Lead −1 Sum

Zeros: −8, −8

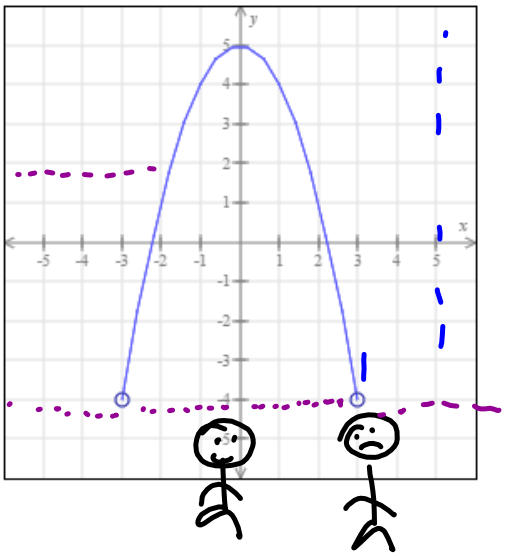


$\mathbb{R}$

$(-\infty, \infty)$ but $(-\infty, -8] \cup [-8, \infty)$

The entire graph of the function g is shown in the figure below.

Write the domain and range of g using interval notation.



Domain

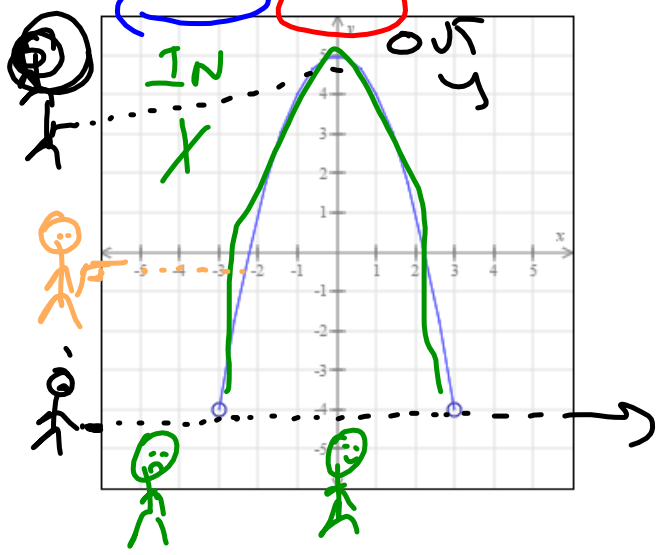
$(-3, 3)$

Range

$(-4, 5]$

The entire graph of the function g is shown in the figure below.

Write the domain and range of g using interval notation.



Domain

$(-3, 3)$

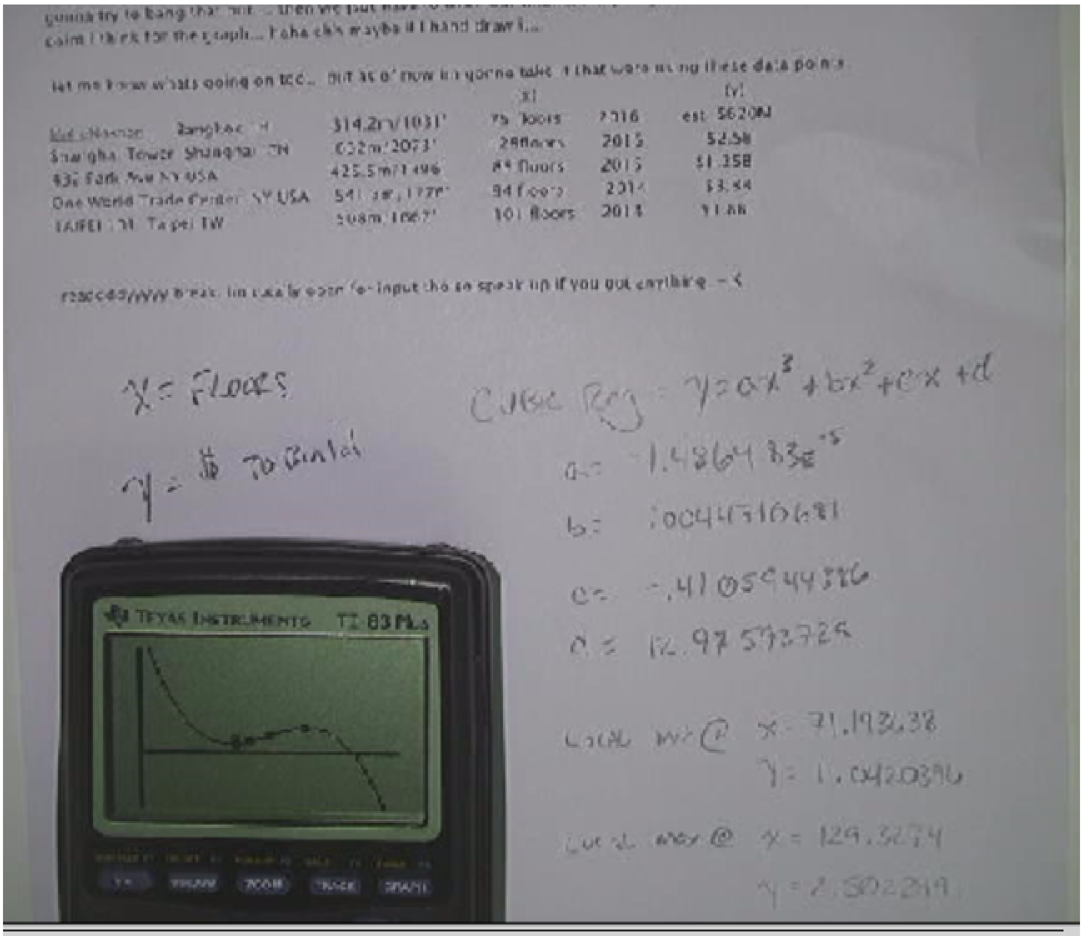
Range

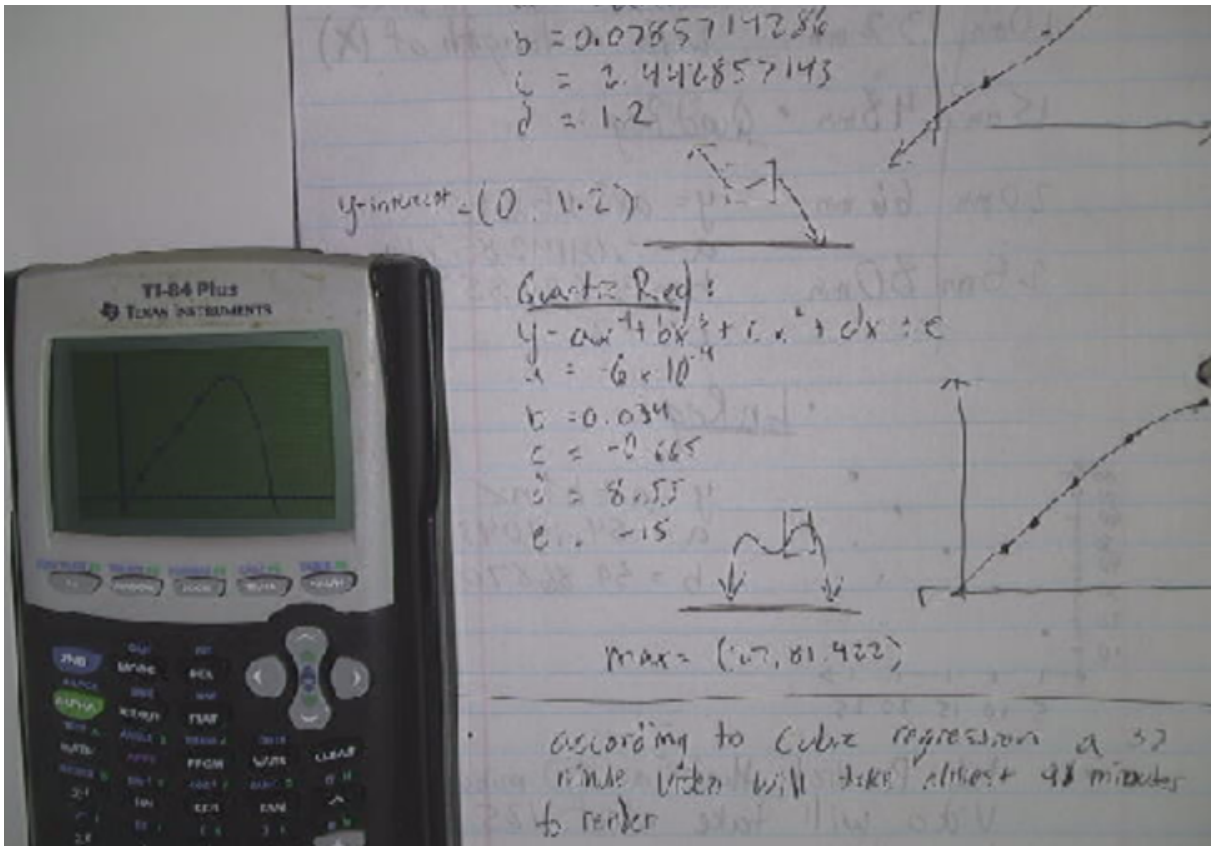
$(-4, 5]$

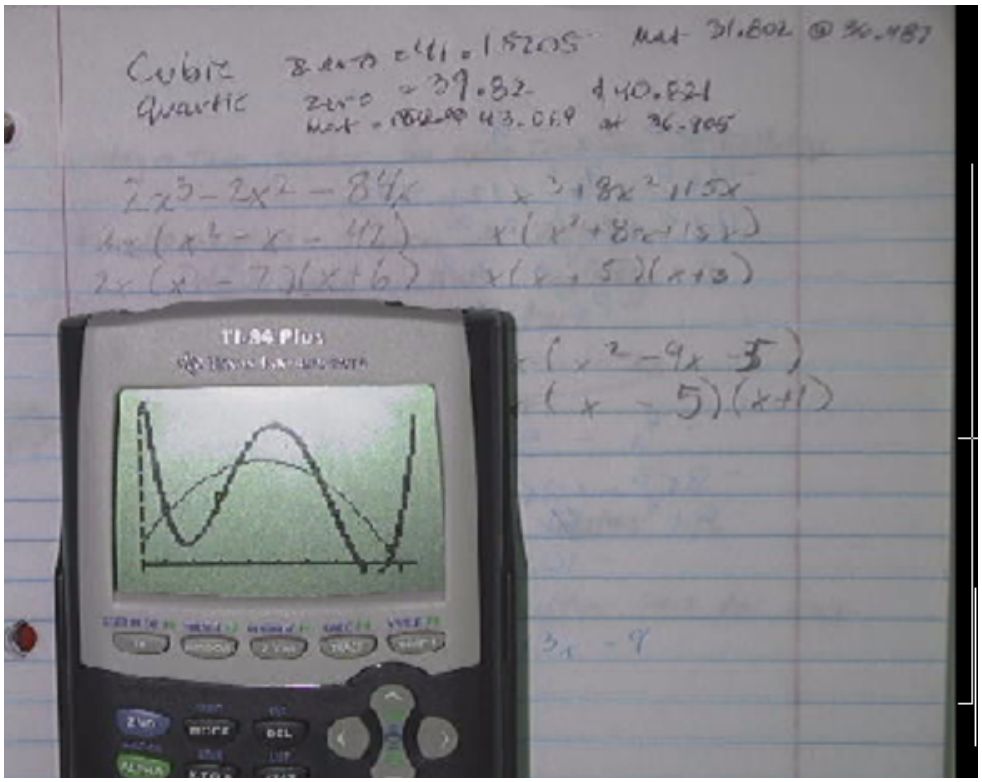
Project Work

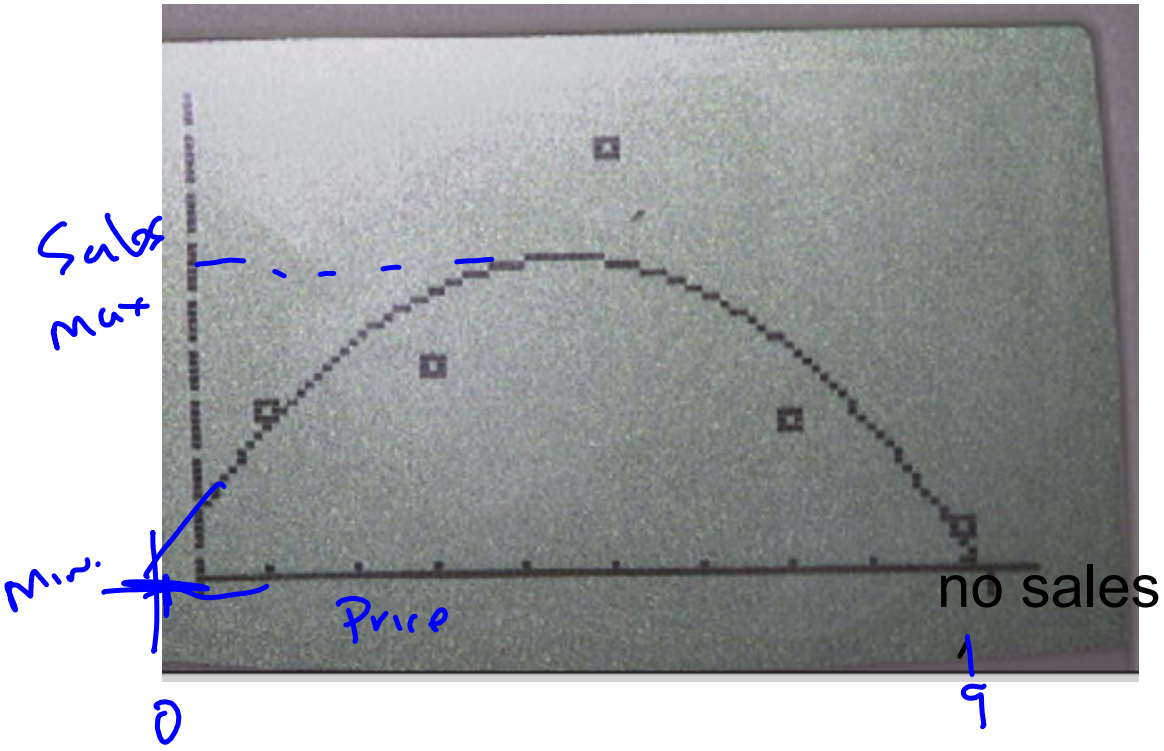
Realistic Domain: [0, 100]

Realistic Range [0, 50]


x = Floors
Cubic Reg: y = ax^3 + bx^2 + cx + d
a = 1.486483E-5
b = .00447106481
c = -.4105944886
d = 12.97573725
Local min @ x = 71.193638
y = 1.0420396
Local max @ x = 129.3274
y = 2.502219
TEXAS INSTRUMENTS TI-83 Plus
ZOOM
TRACE
GRAPH
Shanghai Tower Shanghai CN
One World Trade Center NY USA
TAIPEI 101 Taipei TW
314.2m/1031'
425.5m/1396
101 floors
2015
2014
est. $620M
$2.5B
$1.35B
$3.9B
$1.8B


TI-84 Plus
Texas Instruments
b = 0.078571 47286
c = 2.44685 7143
d = 1.2
y-intercept = (0, 1.2)
Quartic Reg:
y = ax^4 + bx^3 + cx^2 + dx + e
a = -6 x 10^-4
b = 0.034
c = -0.665
d = 8.55
e = -15
max = (17, 81.422)
according to Cubic regression a 32 minute video will take almost 98 minutes to render


Cubic
Quartic
TI-84 Plus


Sales
Max
Min.
Price
no sales
0
1
9

Find Max/min on Calculator