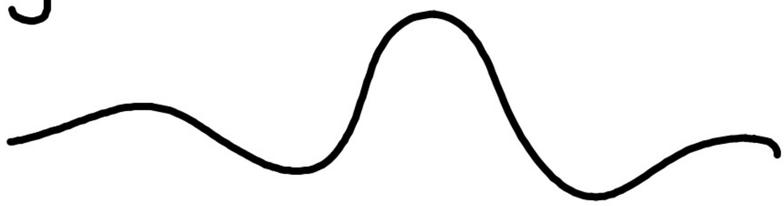
Algebra 2 5.4
Graph polynomial functions and locate their zeros
Find relative maxima and minima of polynomial functions
polynomial function
zero (of a function)
maximum (pl. maxima)
minimum (pl. minima)
* extrema
continuous (function)
location principle
turning points

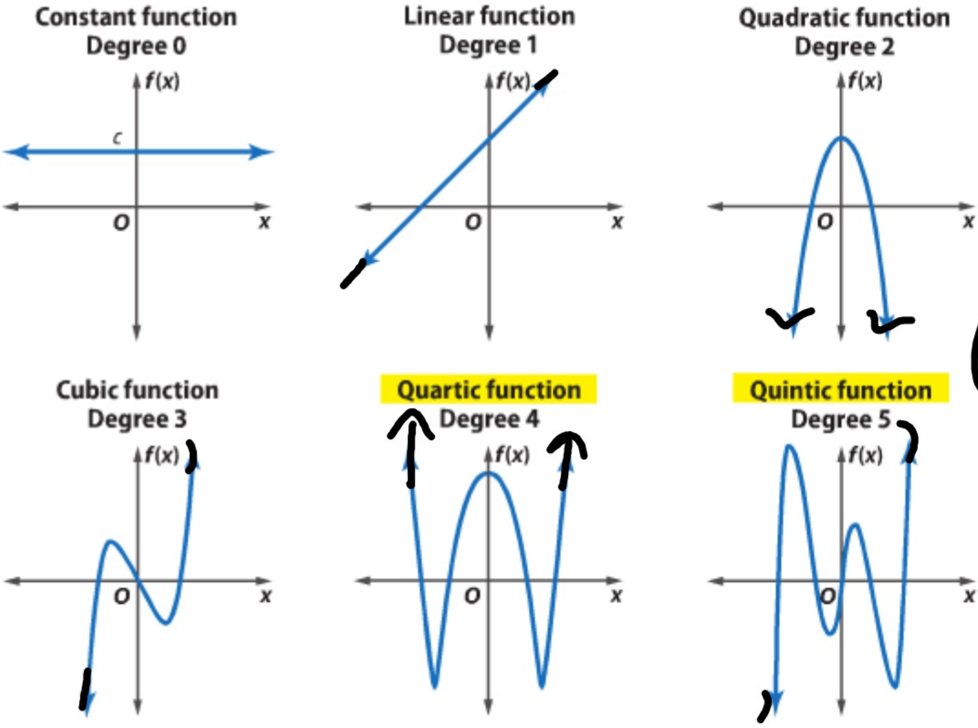
Kroon says

$f(x) =$

$y =$



2 Graphs of Polynomial Functions The general shapes of the graphs of several polynomial functions show the *maximum* number of times the graph of each function may intersect the x-axis. This is the same number as the degree of the polynomial.



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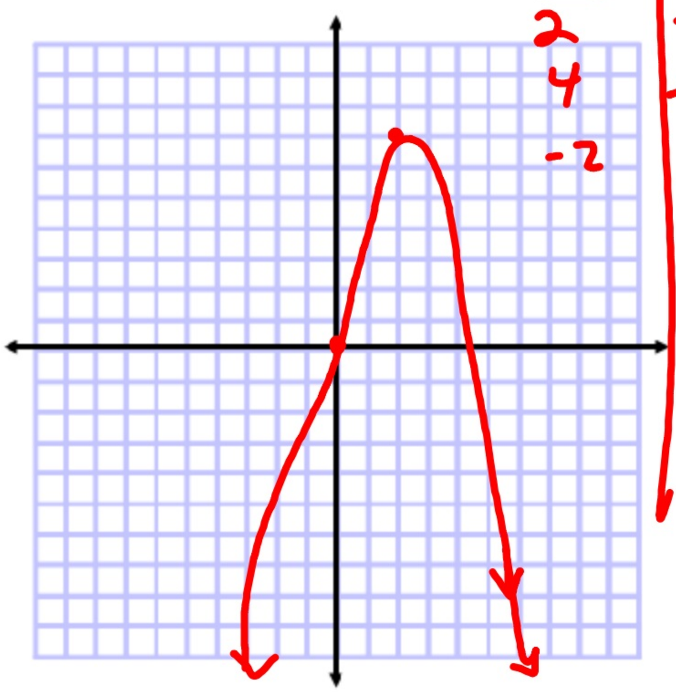
Example 1 Graph of a Polynomial Function

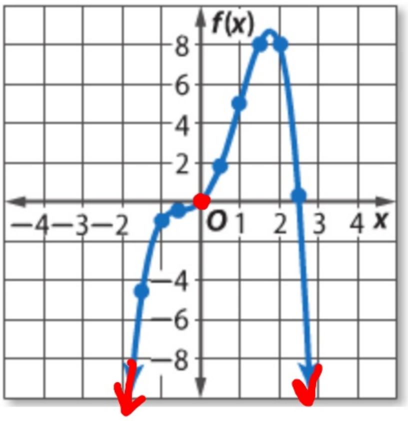
Graph $f(x) = -x^4 + x^3 + 3x^2 + 2x$ by making a table of values.



x	$-x^4+x^3+3x^2+2x$	
2	$-16+8+12+4$	8
4	$-256+64+48+8$	-136
-2	$-16+-8+12+-4$	-16

- parent graph
- turning points
- y-intercept
- end behavior
- table of values

Try $-10<x<10$ ish
(next)

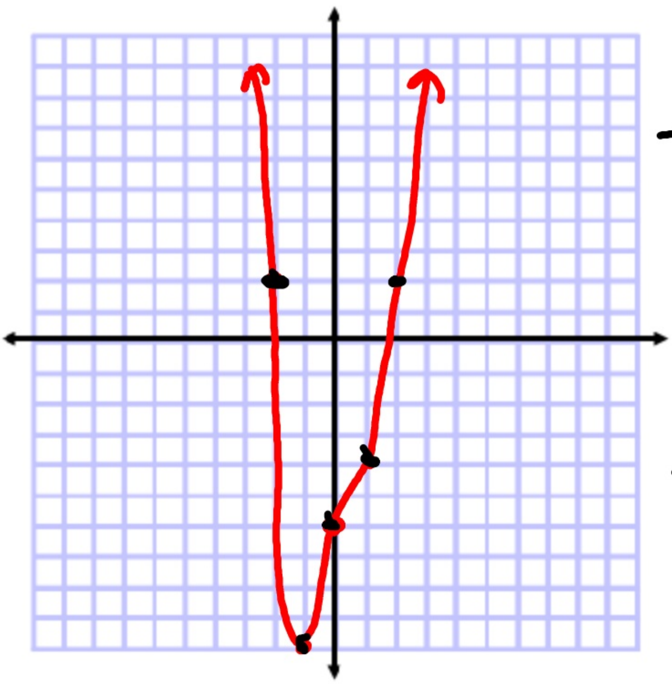


f(x)
8
6
4
2
−4
−3
−2
O
1
2
3
4
x
−4
−6
−8

Use technology (table) to find table of values (use ordered pairs to graph)

GuidedPractice

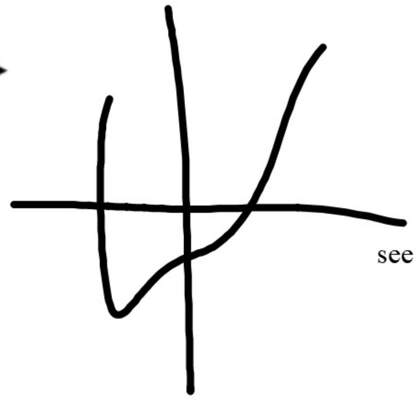
1. Graph $f(x) = x^4 - x^3 - 2x^2 + 4x - 6$ by making a table of values.



$-10 \Leftrightarrow 10$

Before using calculator consider the following:

- parent graph
- # of turning points
- y-intercept
- end behavior
- table of values



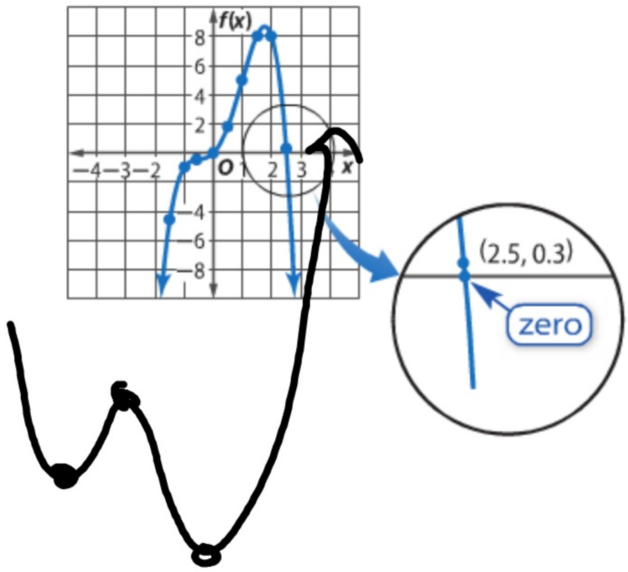
see next

Why bother to think about the parent graph first?

Use your gc to graph $\boxed{f(x) = 2x^4 - 20x^3 - 25x^2 + 8x + 3}$

How do you know that you are seeing everything?

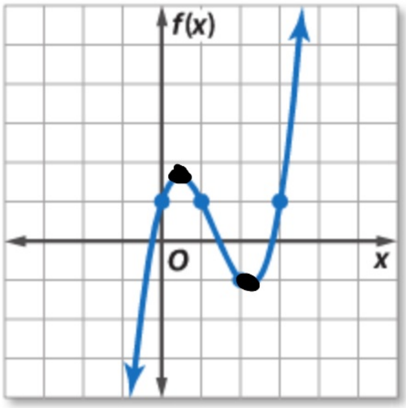
In Example 1, one of the zeros occurred at $x = 0$. Another zero occurred between $x = 2.5$ and $x = 3.0$. Because $f(x)$ is positive for $x = 2.5$ and negative for $x = 3.0$ and all polynomial functions are continuous, we know there is a zero between these two values. (zoom in...)



y

So, if the value of $f(x)$ *changes signs* from one value of x to the next, then there is a zero between those two x-values. This idea is called the **Location Principle**.

Where does y-coord change from positive to negative?



f(x)
O
x

Where do y-coords change from - to +? (table) Indicates a crossing point.

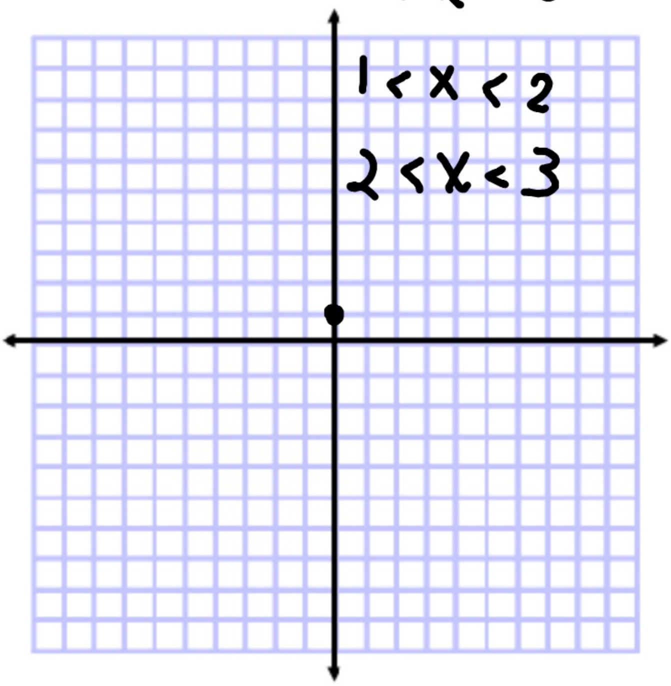
Example 2 Locate Zeros of a Function

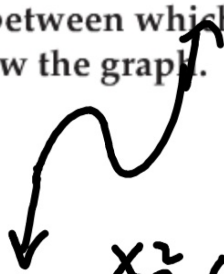
Determine consecutive integer values of x between which each real zero of $f(x) = x^3 - 4x^2 + 3x + 1$ is located. Then draw the graph.

$-1 < x < 0$

$1 < x < 2$

$2 < x < 3$





$x \approx 0$

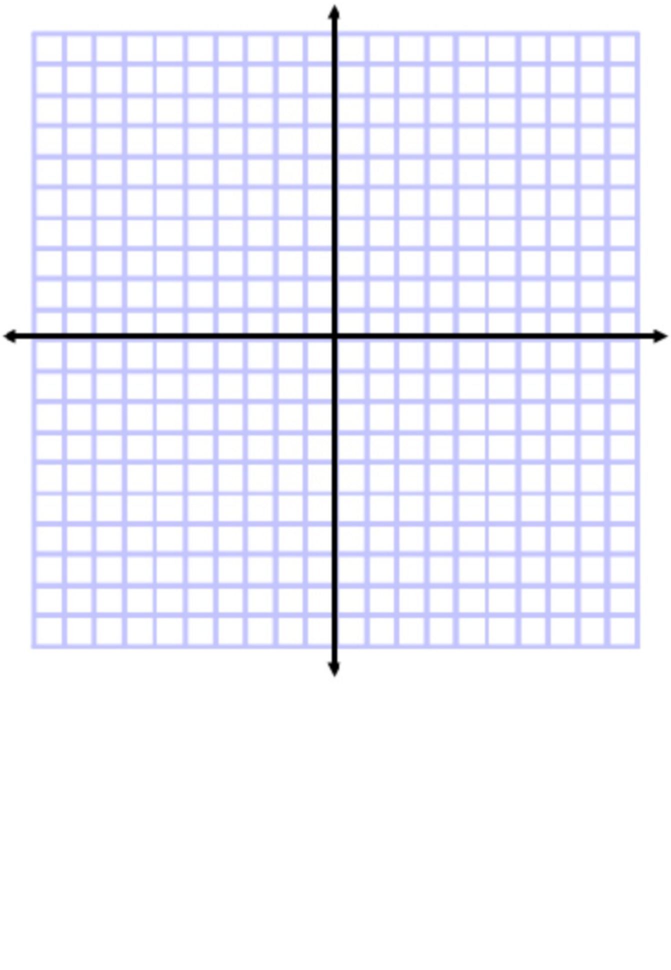
$1 - 2$

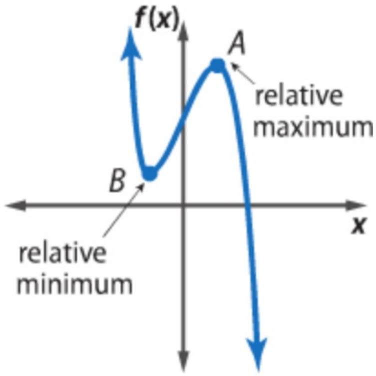
$x \approx 3$

parent graph
turning points
y-intercept
end behavior
table of values
(next)

GuidedPractice

2. Determine consecutive integer values of x between which each real zero of the function $f(x) = x^4 - 3x^3 - 2x^2 + x + 1$ is located. Then draw the graph.



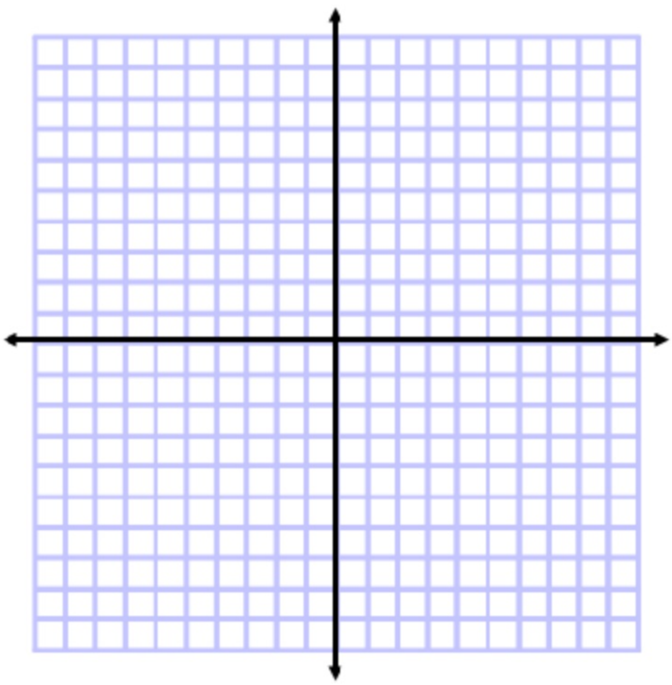


relative vs absolute

Turning points

Example 3 Maximum and Minimum Points

Graph $f(x) = x^3 - 4x^2 - 2x + 3$. Estimate the x-coordinates at which the relative maxima and relative minima occur.



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3. Graph $f(x) = 2x^3 + x^2 - 4x - 2$. Estimate the x-coordinates at which the relative maxima and relative minima occur.