

# Getting Started with Advanced Functions

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## Graphs of Polynomial Functions

Name \_\_\_\_\_

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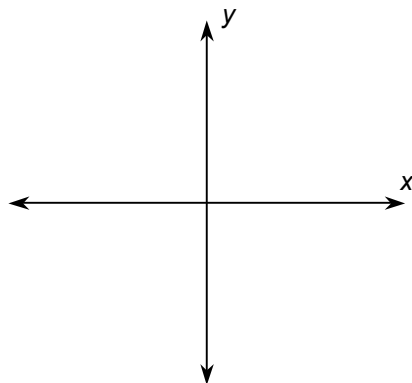
In this activity, you will explore:

- degree and leading coefficient of polynomials
- end behavior
- role of the degree and relation to zeros

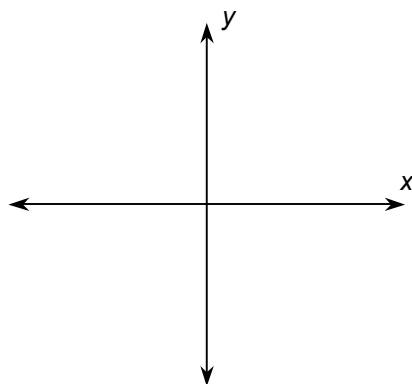
Use this document as a reference and to record your answers.

### Problem 1 – Making comparisons

- Graph the functions below.  
Sketch the shapes of the graphs to the right.
  - $f_1(x) = x^3 + x^2 + 1$
  - $f_2(x) = x^5 - 2x^4 - 15x^3 - 4x^2 + 20x$
- How are these graphs alike?



- Graph the functions below.  
Sketch the shapes of the graphs to the right.
  - $f_3(x) = -x^4 + 4x^3 + 7x^2 - 22x - 24$
  - $f_4(x) = x^2 - 5x - 24$
- How is the graph of **f3** different than the graphs of **f1** and **f2**?



- How is the graph of **f4** similar to the graph of **f3**?
- What characteristic(s) of a function might affect its end behavior?

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### Problem 2 – Cubic functions

- Graph the functions below  
Sketch the shapes of the graphs to the right.
  - $f_1(x) = x^3 + 2x^2 - x - 2$
  - $f_2(x) = -x^3 - 2x^2 + x + 2$
- Graph two more cubic functions—one in which the leading coefficient is positive and one in which it is negative. Sketch the shapes of the graphs to the right.

- $f_3(x) = \underline{\hspace{4cm}}$

- $f_4(x) = \underline{\hspace{4cm}}$

**Take a picture of this part and tweet it to @MrOrr\_geek**

- Make a conjecture about the sign of the leading coefficient of a cubic function and the graph of the function.

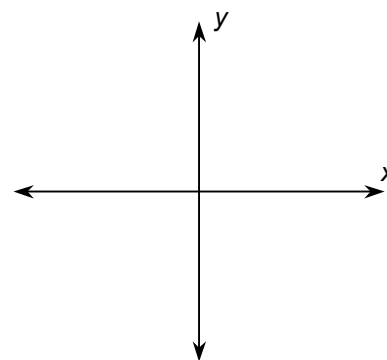
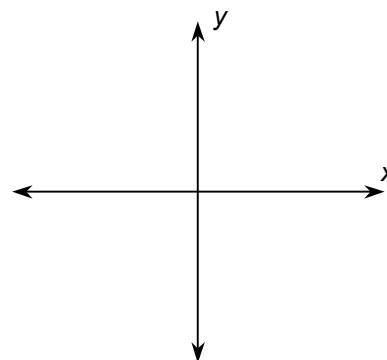
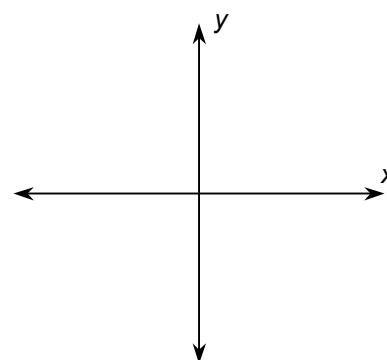
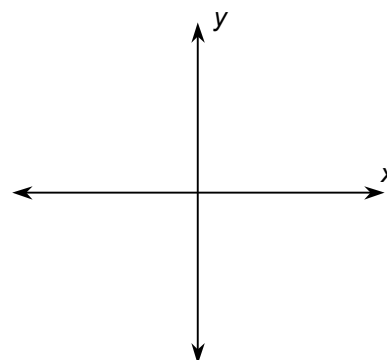
### Problem 3 – Quartic functions

- Graph the functions below  
Sketch the shapes of the graphs to the right.
  - $f_1(x) = x^4 + 3x^3 - 7x^2 - 15x + 18$
  - $f_2(x) = -x^4 - 3x^3 + 7x^2 + 15x - 18$
- Graph two more quartic functions—one in which the leading coefficient is positive and one in which it is negative. Sketch the shapes of the graphs to the right.

- $f_3(x) = \underline{\hspace{4cm}}$

- $f_4(x) = \underline{\hspace{4cm}}$

- Make a conjecture about the sign of the leading coefficient of a quartic function and the graph of the function.



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- Guess the end behavior of the graph of each function below.

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

$$y = -x^8$$

- Guess the end behavior of the graph of each function below.

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

$$y = -x^9$$

### Problem 4 – Summarize your findings

- Explain how to determine the end behavior of the graph of a polynomial function based on its degree and the sign of the leading coefficient.

*(Hint: There are four cases for you to consider.)*

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### Problem 5 – Finding Zeros Graphically

Graph each function and state the number of x-intercepts it has.

Function	Number of Zeros
$f(x) = x^3 - 3x^2 - x + 3$	
$f(x) = x^3 - 3x - 2$	
$f(x) = x^4 + 5x^3 + 3x^2 - 5x - 4$	
$f(x) = x^4 - x^3 - 7x^2 + x + 6$	
$f(x) = x^4 - 3x^3 - 6x^2 + 28x - 24$	
$f(x) = x^5 - 2.6x^4 - 1.11x^3 - 3.74x^2 - 0.73x + 0.3$	

1. Make a conjecture about the number of real zeros of a polynomial in relation to the degree of the polynomial.
2. A fourth degree polynomial has four zeros:  
*Sometimes Always Never.*
3. A polynomial can have more zeros than the highest degree of the function.  
*True False.*
4. What is the greatest number of zeros possible for the function  
 $f(x) = x^5 - 15x^3 + 10x^2 + 60x - 72$ ?