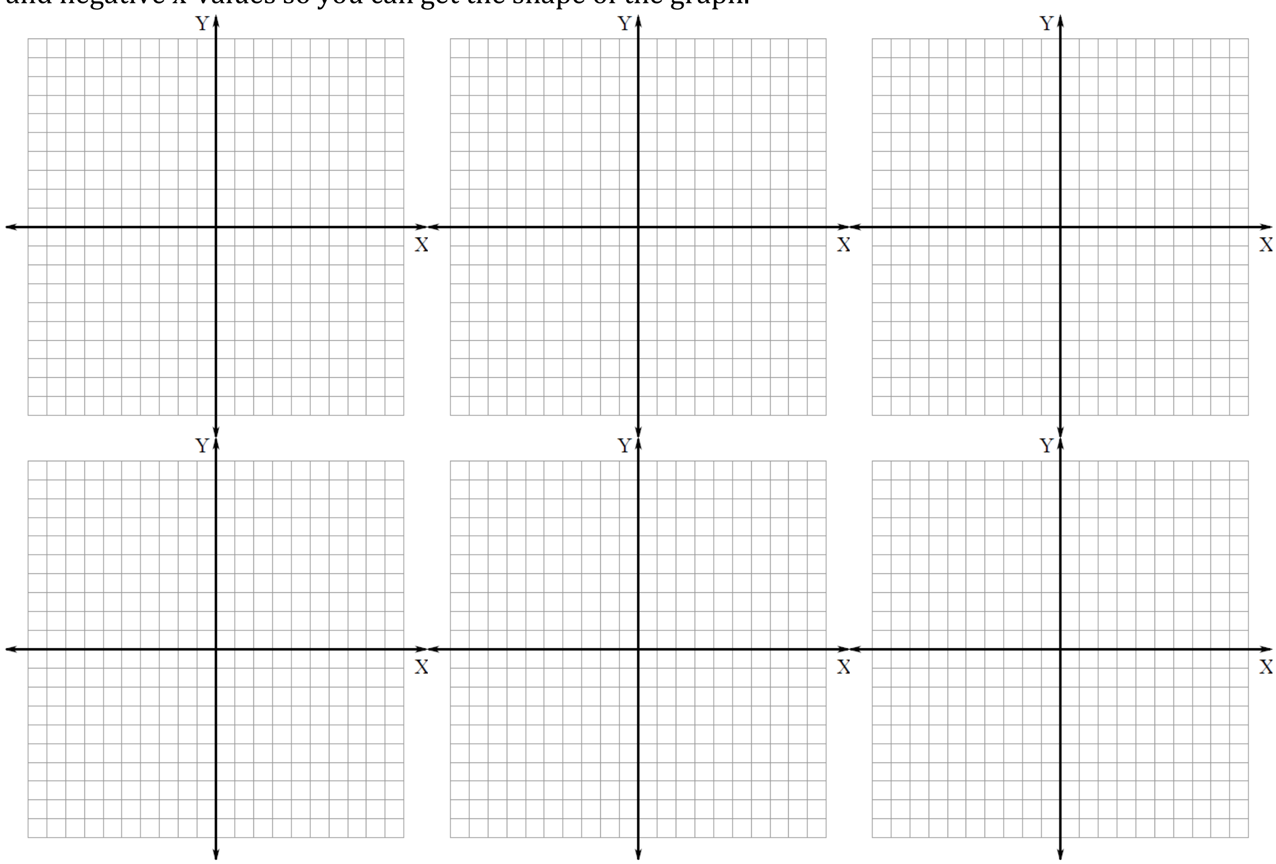
CCGPS Adv Alg – 201: Intro to Polynomial Functions Name: ___________________________

Unit 2 investigates the graphs of polynomial functions. You have studied polynomials before; linear, quadratic and cubic functions are examples of polynomial functions. These functions are combinations (addition and subtraction) of multiple terms, and each term is the product of a coefficient and variable. Written in mathematical language, a polynomial function looks like $f(x) = a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \ldots + a_{n-1}x^1 + a_nx^0$. A very important note is that the exponents must be **integers** and **non-negative** for the function to be considered polynomial.

Before we consider some characteristics of polynomial function graphs, we need to review (or relearn) a few important terms. One is the **degree** of the polynomial function. You can always tell what the degree is because it is equal to ____________________________________________. Another key vocabulary term will be **leading coefficient**. This is the coefficient of the variable with the greatest exponent. Identify the degree and leading coefficient of $f(x) = 4x^3 - 5x^2 + x - 8$

Degree: _______________ Leading Coefficient: _______________

To get an idea of what polynomial functions look like, graph the first through sixth degree polynomials with leading coefficient of 1. For each function, make a table with at least five points, using both positive and negative x-values so you can get the shape of the graph.




The graphs you made are the parent functions of each polynomial degree. You should have been familiar with the first three. The major point is that these are the fundamentals… the building blocks. As we add more terms to the functions, the characteristics of these graphs will change. Remember, when we discuss **characteristics** of a graph (or a function) in this class, we will focus on the following things:

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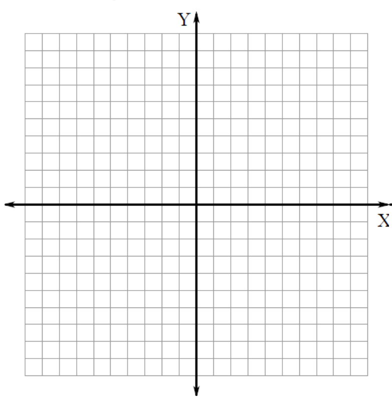
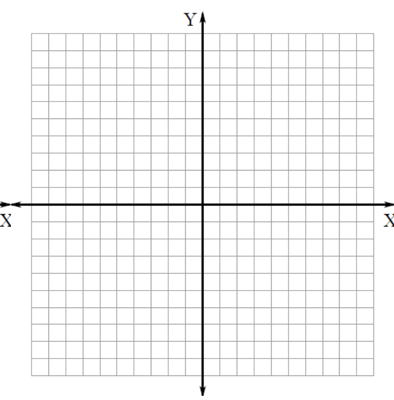
**Relative extrema:** relative maximum and relative minimum points. The term *relative* means these points are higher (or lower) than those immediately surrounding them.
**Absolute extrema:** the maximum or minimum value of the function
**Domain:** the set of possible values for the function's independent variable
**Range:** the set of all possible resulting values of a function's dependent variable
**Zeros:** the values of the independent variable which make the function equal zero.
**Multiplicity of roots:** the number of times a root occurs at a given point of a polynomial function
**Intervals of increase or decrease:** the range of values of the independent variable over which the function's value is increasing (or decreasing)
**End behavior:** the value of the function as *x* approaches negative infinity and positive infinity

One of the first things you learned to do with parent functions was how to translate, or "shift," them around the coordinate plane. Let's review this skill…
<u>Vertical Shifts</u> – You may remember shifting a graph vertically was accomplished by adding a constant to the end of the function. So you learned to recognize that $g(x) = x^2 + 8$ was the same graph as $f(x) = x^2$, but shifted up 8 units. Use your parent function tables/graphs above to try these:

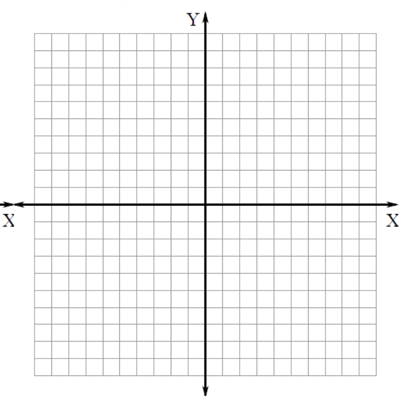
$f(x) = x^2 + 4$




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

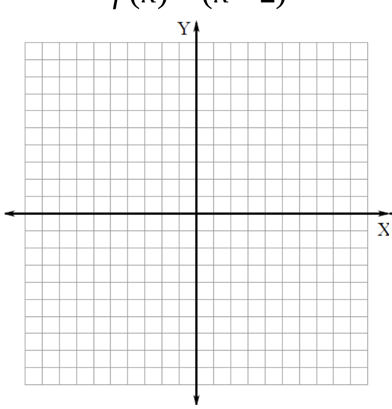



$f(x) = x^4 + 1$

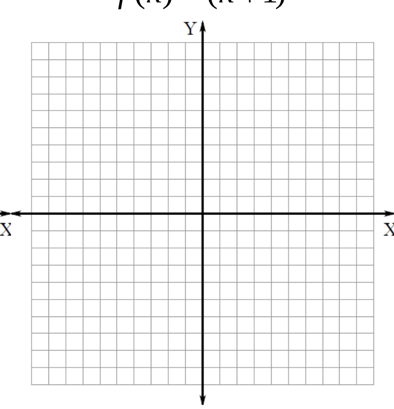



<u>Horizontal Shifts</u> – Horizontal shifts are slightly trickier, as you may recall, because they are counterintuitive. The shift is indicated by a number added or subtracted from *x*, and is actually in the opposite direction of the sign.

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




$f(x) = (x+1)^3$




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