# Power Functions

You are already familiar with linear and quadratic (polynomial) functions. In this lab you will explore features of higher degree polynomial functions.

1. Graph the following functions.
   $y = x$ $y = x^2$ $y = x^3$ $y = x^4$ $y = x^5$ $y = x^6$

   a. Note any similarities and differences between the various graphs.

   b. Predict (below, by sketching) the shape of $y = x^7$ and $y = x^8$. Verify your prediction by graphing.

   c. Write a rule to determine the shape of a power function based on its exponent.

2. Graph the following pairs of functions on the same set of axes.
   $y = x^2$ and $y = -x^2$ $y = x^3$ and $y = -x^3$ $y = x^4$ and $y = -x^4$.

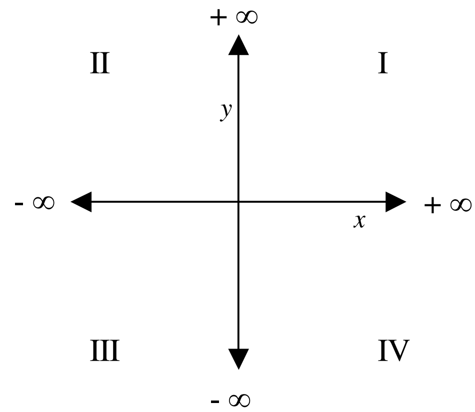
   a. Note similarities and differences in the pairs of graphs.

   b. Predict, by sketching, the graph of $y = -x^6$. Verify by graphing.

   c. Write a rule to determine the shape of a power function based on the sign of its leading coefficient.

# End Behaviour

Recall:
When working in the Cartesian co-ordinate system, we often think of the **four quadrants**.




Complete the following table.

| In this Quadrant, | *x*-coordinates are… | *y*-coordinates are… |
|---|---|---|
| I | positive | positive |
| II | | |
| III | | |
| IV | | |

When we draw a polynomial function, we only ever draw a portion of it, and indicate that it continues on infinitely with arrows. We can classify how it "continues" by talking about its **end behaviour**.

Consider the function $y = 2x + 1$. As the value of $x$ becomes large and positive, the value of $y$ also becomes large and positive. We say that **as *x* approaches positive infinity, *y* approaches positive infinity**. Mathematically, we write as $x \to \infty$, $y \to \infty$. Similarly, as $x \to -\infty$, $y \to -\infty$. We could also say that, from left to right, our function **enters in quadrant III and exits in quadrant I**.

1. Use the graphs of the following functions to complete the chart below.

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| | End Behaviours | | Quadrants | |
|---|---|---|---|---|
| Function | As $x \to \infty$ … | As $x \to -\infty$ … | Enters (Left) | Exits (Right) |
| $y = 2x + 1$ | $y \to \infty$ | $y \to -\infty$ | III | I |
| $y = x^2$ | | | | |
| $y = x^3$ | | | | |
| $y = -x^4$ | | | | |
| $y = -x^5$ | | | | |
| $y = 9 - x^2$ | | | | |
| $y = 2x^3 + 3x + 1$ | | | | |
| $y = 0.5x^4 + 3$ | | | | |
| $y = x^7 - 3x^3$ | | | | |
| $y = 2(x-3)^2 - 1$ | | | | |

2. Based on your results, describe how you can determine the end behaviour of a function without drawing the graph.