**Activity 4.2.4 – Graphing Investigation: Role of *p* for the Power Function** $y=ax^{p}$

**Case I**: *p* > 1

1. Sketch a graph of the following power functions for *p* > 1 on the set of axes below. We will focus on quadrant 1 behavior since for most real world problems the domain is nonnegative. Note: If you are using your graphing calculator, set the WINDOW to *x*: [0,2] and *y*:[0,3]. Label each graph below with its equation.

a. $y=x^{1}$ b. $y=x^{^{3}/\_{2}}$ c. $y=x^{2}$ d. $y=x^{3}$ e. $y=x^{^{7}/\_{2}}$ f. $y=x^{4}$ g. $y=x^{5}$



An important feature of power functions is how they compare to one another when 0 < x < 1 and when x > 1.

1. What is the behavior of these functions over (0,1) when *p* > 1?
2. How do they compare to each other over (0,1) when *p* > 1?
3. What is the end behavior of these functions over (1,∞) when *p* > 1?
4. How do they compare to each other over (1,∞) when *p* > 1and p increases?

**Case II**: 0 < *p* < 1

1. Using your graphing calculator, graph the following functions on the same set of axes. Set the WINDOW to *x*: [0,4] and *y*:[0,2].

a. $y=x^{^{1}/\_{5}}$ b. $y=x^{^{1}/\_{4}}$ c. $y=x^{^{2}/\_{7}}$ d. $y=x^{^{1}/\_{3}}$ e. $y=x^{^{1}/\_{2}}$ f. $y=x^{^{2}/\_{3}}$

1. What is the behavior of these functions over (0,1) when 0 < *p* < 1?
2. How do they compare to each other over (0,1) when 0 < *p* < 1?
3. What is the end behavior of these functions over (1,∞) when 0 < *p* < 1?
4. How do they compare to each other over (1,∞) when 0 < *p* < 1? Remember to adjust your window again.

**Case III**: *p* < 0

1. Using your graphing calculator, graph the following functions on the same set of axes. Set the WINDOW to *x*: [0,3] and *y*:[0,3].
2. $y=x^{\frac{-1}{2}}$ b. $y=x^{\frac{-2}{3}}$ c. $y=x^{-2}$ d. $y=x^{-3}$ e. $y=x^{\frac{-7}{2}}$
3. What is the behavior of these functions over (0,1)?
4. How do they compare to each other over (0,1)?
5. What is the end behavior of these functions over (1,∞)?
6. How do they compare to each other over (1,∞)?
7. When *p* > 0, at what point do all of the power functions intersect?

**Exponential Functions (**$y=b^{x}$**) and Power Functions (**$y=x^{p}$**)**

1. Graph the following exponential functions and power functions where *b* > 0 and *p* > 1 on the set of axes below. Note: If you are using your graphing calculator, set the WINDOW to

*x*: [0,2] and *y*:[0,3]. Label each graph with its equation.

a. $y=2^{x}$ b. $y=3^{x}$ c. $y=4^{x}$ d. $y=x^{2}$ e. $y=x^{3}$ f. $y=x^{4}$



1. Compare the exponential functions to power functions when *b* > 0 and *p* > 1over *x*: [0,3] and *y*:[0,100]. If you did activity 3.6.3 add commnets from that study.
2. Sketch the following exponential functions and power functions on the same set of axes. Label each graph with its equation. Graph in a standard window

a. $y=2^{-x} y=x^{-2}$ b. $y=3^{-x} y=x^{-3}$ c. $ y=4^{-x} y=x^{-4}$

  

1. Compare and contrast exponential decay to power functions raised to a negative exponent.
2. Apply the laws of exponents to perform the indicated operations and simplify.

a. *x*3/2 *x*1/3 b. *x*1/3 *x* 1/6 c. *x*2/3(*x*1/2 + *x*1/4) d. $\frac{x^{\frac{2}{3}}}{x^{\frac{1}{3}}}$ e. $\frac{x^{\frac{1}{2}}}{x^{\frac{3}{4}}}$

 f. $\frac{a^{^{4}/\_{5 }}b^{\frac{1}{5}}}{a^{\frac{1}{3}} b^{\frac{1}{3}}}$ g. $b^{\frac{2}{5 }} b^{\frac{3}{2}}$ h. $x^{\frac{3}{4} } x^{\frac{2}{3}}$ i. (*xy*2*z*)1/3  (*x*5*yz*3)1/2