

Exponential Functions

Introduction

Exponents are a class of functions different from polynomials. With exponential functions the exponent varies while the base remains the same. With polynomial functions the base varies while the exponent remains constant. In this activity we will look at exponential functions of the form $y = Ma^{kx}$, where 'M', 'a', and 'k' are constants.

Let's explore exponential functions. Use your web browser to go to the "Exponential Functions" activity:

<http://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=66>

Below are several questions designed to get you thinking about the activity. Answer them on a separate sheet of paper.

Activity

Initial values

To the right of the 'k' slide bar, type in a 0. Slide the 'a' bar.

Question 1a. What happens to the graph as 'a' changes value?

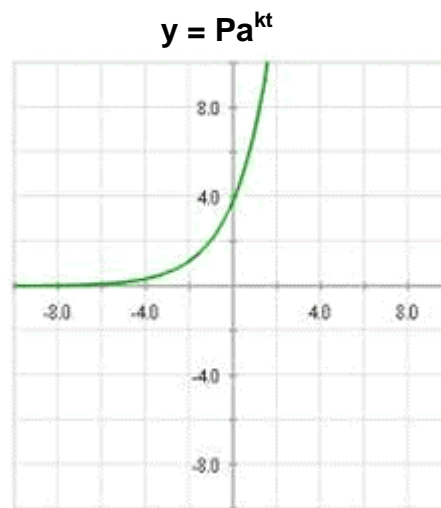
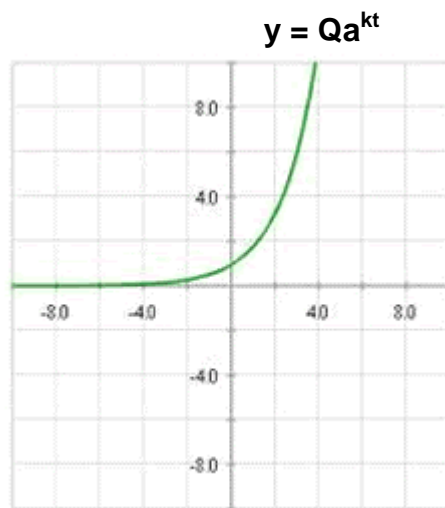
Now slide the 'M' bar.

Question 1b. What happens to the graph as 'M' changes value?

Question 1c. What is the relationship between 'M' and the y-intercept?

Question 1d. What would be the y-intercept for $y = -6(3^{0.1x})$? Check your answer by graphing this function and tracing the graph at the y-axis.

Question 1e. The two graphs below represent $y = Qa^{kt}$ and $y = Pa^{kt}$. Is $Q > P$ or $P > Q$? Explain your answer.



Question 1f. For what values of 'M' is the graph of $y = M(2^{3x})$ strictly increasing? decreasing?

Question 1g. What conjecture can you make about the effect 'M' has on the graph of $y = M(2^{3x})$?

Reflections in the x-axis

Graph $y = 2(4^{0.1x})$ then graph $y = -2(4^{0.1x})$.

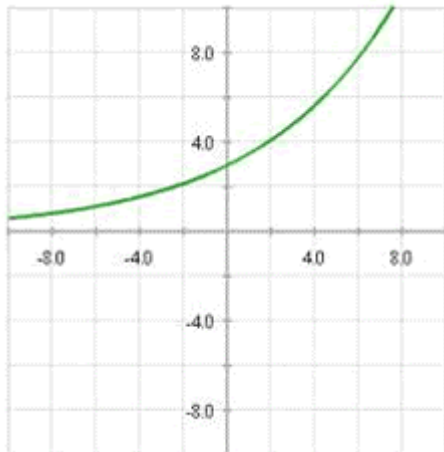
Question 2a. What axis is the first graph reflected in to get the second graph?

Question 2b. What is different about the equations?

Question 2c. What conjecture can you make about reflecting exponential functions in the x-axis and the sign of 'M'?

Question 2d. The graph of $y = 3(5^{0.1x})$ is pictured below. What is the graph of $y = -3(5^{0.1x})$?

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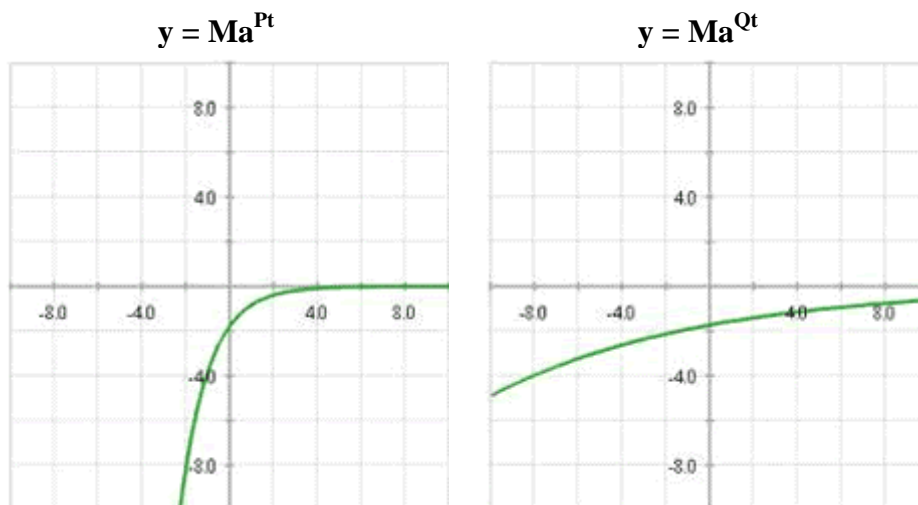
Reflections in the y-axis and the effects of 'k'

Graph $y = 2(4^{0.3x})$. Now slide the 'k' bar left and right.

Question 3a. What happens to the graph when 'k' moves away from zero?

Question 3b. What happens to the graph when 'k' gets close to zero?

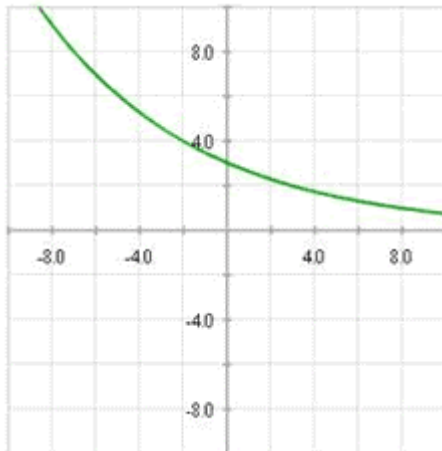
Question 3c. The two graphs below represent $y = Ma^{Pt}$ and $y = Ma^{Qt}$. Is $Q > P$ or $P > Q$? Careful! This is a tricky one. You may want to graph some functions before you answer.



Question 3d. How is the graph of $y = 2(5^{-0.3x})$ different from the graph of $y = 2(5^{0.3x})$?

Question 3e. What axis is the graph of $y = 2(5^{-0.3x})$ reflected in to obtain the graph of $y = 2(5^{0.3x})$?

Question 3f. The graph of $y = 3(2^{-0.2x})$ is pictured below. What is the graph of $y = 3(2^{0.2x})$?



Question 3g. What conjectures can you make about 'k' and the graphs of exponential functions?

The effects of 'a' on the graph

Graph $y = 2(3^{0.3x})$ and drag the 'a' slide bar until $a=1$.

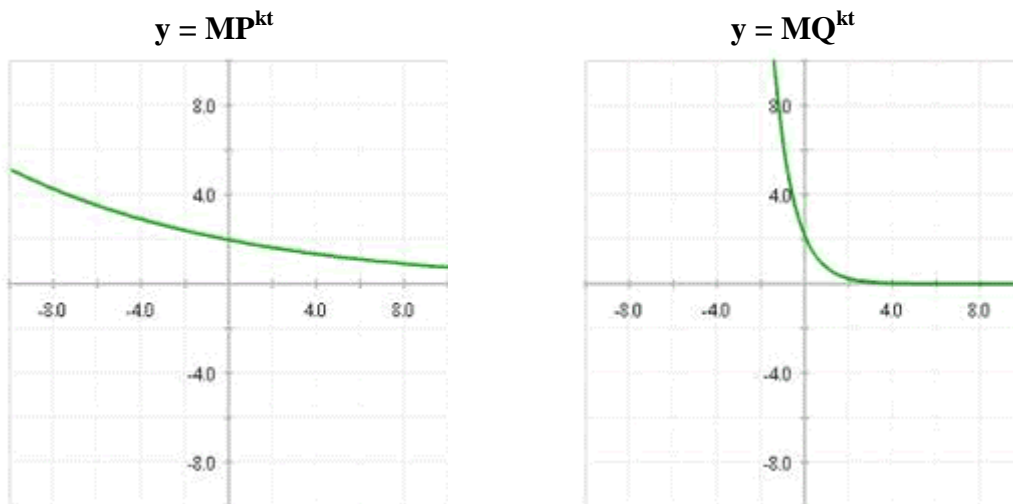
Question 4a. Why the graph is a horizontal line?

Question 4b. What other values for 'a' makes the graph a horizontal line?

Drag 'a' to the left and right.

Question 4c. For what values of 'a' is the function increasing? Decreasing?

Question 4d. The two graphs below represent $y = MP^{kt}$ and $y = MQ^{kt}$. Is $Q > P$ or $P > Q$? Again, this is very tricky!



Question 4e. What conjectures can you make about the effects of 'a' on the graphs of exponential functions?

Conclusion

Exponential functions of the form $y = Ma^{kx}$ can be used to model certain population growths as well as data that increases or decreases rapidly. The value of 'k' can be used to reflect the function in the y-axis. The value of 'M' can be used to reflect the function in the x-axis.