**Effects of Parameters**

An exponential function is a function of the form $f\left(x\right)=a∙b^{x}$. In the previous activity we explored the roles of parameters *a* and *b*. In this activity we will examine the *b* parameter more closely. This parameter determines whether the function is increasing or decreasing and impacts the steepness of the curve.

1. Based on what we have already seen, what does the parameter *a* indicate about the function and the graph?

Now let’s look at functions for which *a* = 2, that is, functions of the form $f\left(x\right)=2∙b^{x}$. Let’s see what happens when we change the value of *b*.

Use your calculator to fill in the tables for questions 2–6. Then plot points by hand and sketch the graph. Answer the questions about each graph.

1. $y=2∙2^{x}$

|  |  |
| --- | --- |
| *x* | *y* |
| –2 |  |
| –1 |  |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |

1. Where is the *y*-intercept?
2. Is the function increasing or decreasing?
3. $y=2∙3^{x}$

|  |  |
| --- | --- |
| *x* | *y* |
| –2 |  |
| –1 |  |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |

1. Where is the *y*-intercept?
2. Is the function increasing or decreasing?
3. How does the steepness of the graph compare with $y=2∙2^{x}$?



1. $y=2∙4^{x}$

|  |  |
| --- | --- |
| *x* | *y* |
| –2 |  |
| –1 |  |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |

1. Where is the *y*-intercept?
2. Is the function increasing or decreasing?
3. How does the steepness of the graph compare with $y=2∙2^{x}$?
4. How does the steepness of the graph compare with $y=2∙3^{x}$?
5. $y=2∙\left(\frac{1}{2}\right)^{x}$

|  |  |
| --- | --- |
| *x* | *y* |
| –4 |  |
| –3 |  |
| –2 |  |
| –1 |  |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |

1. Where is the *y*-intercept?
2. Is the function increasing or decreasing?
3. How is this graph related to the graph in question 2, $y=2∙2^{x}$?



1. $y=2∙\left(\frac{1}{4}\right)^{x}$

|  |  |
| --- | --- |
| *x* | *y* |
| –2 |  |
| –1 |  |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |

1. Where is the *y*-intercept?
2. Is the function increasing or decreasing?
3. How does the steepness of this graph compare with $y=2∙\left(\frac{1}{2}\right)^{x}$?

For questions 7–12, first answer the question. Then check your answer on the calculator. You may have to adjust your window to get a good view of the graphs.

1. Which function, $f\left(x\right)=3\left(1.1\right)^{x}$ or $f\left(x\right)=3\left(1.2\right)^{x}$ is steeper? Explain how you know.
2. Which function, $f\left(x\right)=3\left(1.2\right)^{x}$ or $f\left(x\right)=3\left(1.25\right)^{x}$ is steeper? Explain how you know.
3. Which function, $f\left(x\right)=3\left(1.1\right)^{x}$ or $f\left(x\right)=3\left(0.11\right)^{x}$ is an increasing function? Explain how you know.
4. Which function, $f\left(x\right)=3\left(\frac{6}{7}\right)^{x}$ or $f\left(x\right)=3\left(\frac{7}{6}\right)^{x}$ is a decreasing function? Explain how you know.
5. Which function, $f\left(x\right)=3\left(1+ .02\right)^{x}$ or $f\left(x\right)=3\left(1 –.02\right)^{x}$, is an increasing function? Explain how you know.
6. Which function, $f\left(x\right)=300\left(.7+ .4\right)^{x}$ or $f\left(x\right)=300\left(1.7+.2 \right)^{x}$, is a decreasing function? Explain how you know.

**Domain and Range of Exponential Functions**

1. Look at the table and graph for $y=2∙2^{x}$ in question 2, and answer these questions.
	1. Are there any restrictions on *x*? Can *x* be any positive number? Can *x* be zero? Can *x* be any negative number?
	2. Based on your answer to (a) what is the domain of this function?
	3. Are there any restrictions on *y*? Can *y* be any positive number? Can *y* be zero? Can *y* be any negative number?
	4. Based on your answer to (c) what is the range of this function?
2. Look at the table and graph for$ y=2∙\left(\frac{1}{2}\right)^{x}$ in question 5, and answer these questions.
	1. Are there any restrictions on *x*? Can *x* be any positive number? Can *x* be zero? Can *x* be any negative number?
	2. Based on your answer to (a) what is the domain of this function?
	3. Are there any restrictions on *y*? Can *y* be any positive number? Can *y* be zero? Can *y* be any negative number?
	4. Based on your answer to (c) what is the range of this function?

**Special Cases:** You have looked at functions for which *b* > 1 and for which 0 < *b* < 1. Now consider these special cases.

1. Let *b* = 1. Make a table and sketch a graph of the function $y=2∙1^{x}$



|  |  |
| --- | --- |
| *x* | *y* |
| –2 |  |
| –1 |  |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |

1. What is unusual about this function?

b. What are the domain and range for this function?

1. Let *b* = 0. Make a table and sketch a graph of the function $y=2∙0^{x}$, for values of *x* greater than zero.



|  |  |
| --- | --- |
| *x* | *y* |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |

1. What is unusual about this function?
2. Why is –1 not in the domain of this function?

c. Enter 0^0 in your calculator. What is the result?

1. Let *b* < 0. Make a table for the function $y=2∙(-2)^{x}$.

|  |  |
| --- | --- |
| *x* | *y* |
| –2 |  |
| –1 |  |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |

1. Describe any patterns you see in the table.
2. Enter Y1 = 2\*(–2)^X in your calculator. Use the Zoom4 Decimal Window. Describe what the graph looks like.
3. When exponential functions are studied, usually we only consider cases where *b* > 1 or

0 < *b* < 1. Why do you think this is?