**Warm-Up**

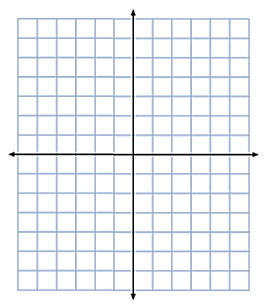
Exponential Functions

*The National Collegiate Athletic Association (NCAA) holds an annual basketball tournament. The nation’s top 64 teams in Division I are invited to play each spring. When a team loses, it is out of the tournament.*

1. Use the empty bracket on the next page to determine how many teams are left in the tournament after the first round of basketball games.
2. Complete & extend the following table until only one team is left.

|  |  |
| --- | --- |
| **After Round** | **Number of Teams Left in Tournament** |
| 0 | 64 |
| 1 |  |
| 2 |  |
|  |  |
|  |  |
|  |  |
|  |  |

1. Graph the points from your table on the graph (**Hint**: Use a scale of 10 on the y-axis).



1. Does this graph represent a type of function you have seen before?
2. How does the number of teams left in each round compare to the number of teams in the previous round?

**NCAA Basketball Men’s Final Four Bracket**

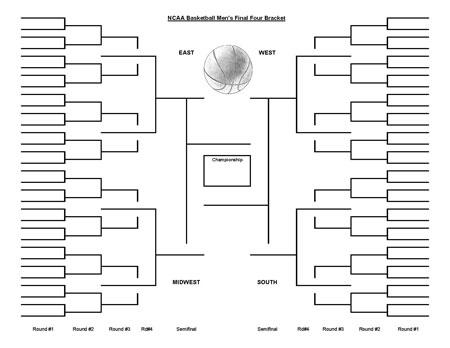
EAST

WEST

MIDWEST

SOUTH

**Championship**



Round #1

Round #2

Round #3

Round #4

Semifinal

Semifinal

Round #4

Round #3

Round #2

Round #1

**L8-1: Introduction to Exponential Functions**

|  |  |
| --- | --- |
| Algebra Objective | Students will be able to model a situation that can be described by an exponential and use the model to answer questions about the situation. |
| Language Objective | Students will interpret situations as growth or decay. |

|  |  |
| --- | --- |
| **Linear Functions** | **Quadratic Functions** |

|  |  |
| --- | --- |
| **Cubic Functions** | **Radical Functions** |

|  |
| --- |
| **Exponential Functions**  Will an exponential function pass the vertical line test? |

|  |
| --- |
| Concept Summary |
| For the function.  We say that is the ***initial value*** and is the ***growth (or decay) factor***.  When (*b* is greater than 1) the function models exponential ***growth***.  When , (*b* is between 0 and 1), the function models exponential ***decay***. |

**Graphing an Exponential Function**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Example #1  **What is the graph of?**  **Step 1:**   |  |  |  | | --- | --- | --- | |  |  |  | |  |  |  | |  |  |  | |  |  |  | |  |  |  | |  |  |  | |  |  |  | |  |  |  | |  |  |  | | **Step 2:** |
| You Try:  What is the graph of?  **Step 1**: Complete the table of values below. |  |

**Identifying Exponential Growth & Decay**

|  |  |
| --- | --- |
| Example #2:  The number of bacteria present in a culture is determined by the function, where is the number of days the culture has been growing.   1. Is the function a ***growth*** or ***decay***? 2. What is the ***initial value***? 3. What is the \_\_\_\_\_\_\_\_\_\_\_\_\_ ***factor***? 4. Find the number of bacteria in a culture that has been growing for 3 days. | You Try:  In 2004, the number of bald eagles present in America was determined by the function, where is the number of years after 2004.   1. Is the function a ***growth*** or ***decay***? 2. What is the ***initial value***? 3. What is the \_\_\_\_\_\_\_\_\_\_\_\_\_ ***factor***? 4. Predict the number of bald eagles in 2020. |

**Converting the growth/decay factor to the rate of increase or decrease**

Use the directives to fill in the missing boxes in the chart below.

|  |  |  |
| --- | --- | --- |
| How does the population, price, etc. changes?  Did it increase or decrease?  **Q**: How far from 100%? | A) Rate of increase  B) Rate of decrease | This is the ***b*** in the equation. |

|  |  |  |
| --- | --- | --- |
| ***Rate (Percent)***  ***Increase or Decrease*** | ***Growth or Decay Factor (Decimal)*** | ***Growth or Decay Factor (Decimal)*** |
| 50% increase | 0.5 |  |
| 35% increase |  |  |
| 4% increase |  |  |
| 3.5% increase |  |  |
| 0.7% increase |  |  |
| increase |  |  |
|  | 3 |  |
| 50% decrease |  |  |
|  | 0.75 |  |
| 2% decrease |  |  |
| 4.1% decrease |  |  |
| 0.8% decrease |  |  |
|  | 1.05 |  |
|  |  |  |
|  | .8 |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Modeling with Exponential Functions**

|  |  |
| --- | --- |
| Example #3  The population of the United States in 1994 was about 260 million, with an average annual rate increase of about 0.7%.   1. What is the ***growth factor*** for the United States? 2. Write an e*quation* that models the future growth of the United States population. To write the equation we will use where is the number of years after 1994 and *y* is the population in millions. 3. Find the population of the United States in 1999. | Example #4  The population of an endangered species of wild cat decreases at a rate of 3.5% per year. You have counted 80 of these animals in the habitat you are studying.   1. What is the ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ factor*** for the United States? 2. Write an e*quation* that models the future decline of the endangered population. To write the equation we will use where *x* the number of years and *y* is the population. 3. Find the population of the species in ten years. |

|  |  |
| --- | --- |
| Example #5  Determine whether the exponential functions model growth or decay. Also, determine the function's percent increase or decrease. | You Try:  Determine whether the exponential functions model growth or decay. Also, determine the function's percent increase or decrease. |

**Classwork L8-1**

Exponential Functions

***Directions***: Determine **a)** whether each function is exponential growth or decay, **b)** identify the growth (or decay) factor, and **c)** find the functions’ percent increase or decrease.

1. 2.

3. 4.

5. **Business** On the federal income tax returns, many self-employed individuals can depreciate the value of the business equipment they purchase. Suppose a computer valued at $6500 depreciates at a rate of 14.3% per year. After how many years is the value of the computer less than $2000?

6. Suppose you are buying a new car. You want the car that will be worth the most after five years. Of the three choices listed at the below, which should you buy? *(****Hint****: You must write and evaluate an exponential function for each car.)*

|  |  |  |
| --- | --- | --- |
| **Car** | **Original Price** | **Expected Depreciation** |
| 1 | $12,455 | 10% |
| 2 | $15,320 | 12% |
| 3 | $17,005 | 15% |

**Homework L8-1**

Introduction to Exponential Functions

***Directions***: Determine **a)** whether each function is exponential growth or decay, **b)** identify the growth (or decay) factor, and **c)** find the functions’ percent increase or decrease.

|  |  |
| --- | --- |
|  |  |
|  |  |

***Directions*:**A) Write an exponential function for each situation. B) Find the value after five years.

1. A population of 250 frogs increases at an annual rate of 22%.
2. A stock priced a t $35 increases at a rate of 7.5% per year.
3. A $17,000 delivery van depreciates at 11% each year.
4. A population of 115 cougars decreases 1.25% each year.

**Warm-Up**

Exponential Functions

***Directions*:** For each annual rate of change, find the corresponding ***growth (or decay) factor***.

1. 45% increase



1. decrease
2. decrease
3. increase
4. increase
5. increase
6. 5% decrease
7. 3% increase



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1. Which of the following statements best describes the correlation between cell phone price and cell phone performance? Choose all that apply. 2. The two variables are strongly correlated. 3. The two variables are positively correlated. 4. The two variables are negatively correlated.  |  | | --- | | 1. I only | | 1. II only | | 1. III only | | 1. I and II only | | 1. I and III only | |
| 1. Which of the following statements best describes the correlation between the temperature outside and the number of people wearing jackets? Choose all that apply. 2. The two variables are weakly correlated.  1. The two variables are positively correlated. 2. The two variables are negatively correlated.  |  | | --- | | 1. I only | | 1. II only | | 1. III only | | 1. I and II only | | 1. I and III only | |

**Classwork L10-1 Answer Key**

Exponential Functions

***Directions***: Determine **a)** whether each function is exponential growth or decay, **b)** identify the growth (or decay) factor, and **c)** find the functions’ percent increase or decrease.

|  |  |
| --- | --- |
| decay; 50% decrease | growth; 100% increase |
| growth; 4% increase | decay; 15% decrease |

5. **Business** On the federal income tax returns, many self-employed individuals can depreciate the value of the business equipment they purchase. Suppose a computer valued at $6500 depreciates at a rate of 14.3% per year. After how many years is the value of the computer less than $2000?

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|  |  |  |
| --- | --- | --- |
| **Car** | **Original Price** | **Expected Depreciation** |
| 1 | $12,455 | 10% |
| 2 | $15,320 | 12% |
| 3 | $17,005 | 15% |

**Homework L10-1 Answer Key**

Introduction to Exponential Functions

***Directions***: Determine **a)** whether each function is exponential growth or decay, **b)** identify the growth (or decay) factor, and **c)** find the functions’ percent increase or decrease.

|  |  |
| --- | --- |
| growth; 70% increase | growth; 500% increase |
| decay; 75% decrease | decay; 55% decrease |

***Directions*:**A) Write an exponential function for each situation. B) Find the value after five years.

5. A population of 250 frogs increases at an annual rate of 22%.

6. A stock priced a t $35 increases at a rate of 7.5% per year.

7. A $17,000 delivery van depreciates at 11% each year.

8. A population of 115 cougars decreases 1.25% each year.