Chapter 5: Exponential Functions

Lesson 1: Exponents & Scientific Notation

Last year, you worked with exponents and the special properties they have. You will be reviewing the basic properties of exponents today to build a foundation for the upcoming unit.

Property	General Rule
Product	$x^a \cdot x^b = x^{a+b}$
Quotient	$\frac{x^a}{x^b} = x^{a-b}$
Power of a Power	$(x^a)^b = x^{ab}$
Power of a Product	$(x^a y^b)^c = x^{ac} y^{bc}$

Exercise #1: Simplify each of the following using the product property.

a) $x^3 \cdot x^5$ b) $x^7 \cdot x^8$ c) $x^{12} \cdot x$ d) $3x^2 \cdot 2x^6$

Exercise #2: Simplify each of the following using the quotient property.

a) $\frac{x^{10}}{x^5}$ b) $\frac{x^{14}}{x^2}$ c) $\frac{x^6}{x^5}$ d) $\frac{8x^4}{2x}$

Exercise #3: Simplify each of the following using the power of a power property.

a) $(x^2)^5$ b) $(x^8)^3$ c) $(x^4)^2$ d) $((x^3)^3)^5$

Exercise #4: Simplify each of the following using the power of a product property.

a) $(3x^2)^3$ b) $(4x^4)^2$ c) $(10x)^4$ d) $(7x^5)^2$

Exercise #5: Simplify each of the following using one or more properties of exponents.

a) $(x^4 \cdot x^3)^2$ b) $(x^3)^4 \cdot (x^2)^5$ c) $(x^3 \cdot x^2 \cdot x^{10})^4$ d) $\frac{(x^7)^8}{(x^2)^2}$

Exercise #6: Express the area of a rectangle, in terms of x, if the length is represented by $5x^3$ and the width is represented by $2x^5$.

Exercise #7: If the expression $\frac{(x^{10})^6 \cdot (x^4)}{(x^2)^4}$ is expressed as x^n, what is the value of n?

Exercise #8: The area of a triangle is represented by $4x^7$. If the height is expressed as $2x^3$, what is the base, in terms of x?

Scientific Notation is a way of writing numbers that are too large or too small to be written in decimal form. A number is in scientific notation if it is written in the form:

$$a \cdot 10^n$$

where a is a number in the interval $1 \le a < 10$ and n is any integer.

Exercise #9: Consider the fact that light travels 6.78 x 10^8 miles in one hour.

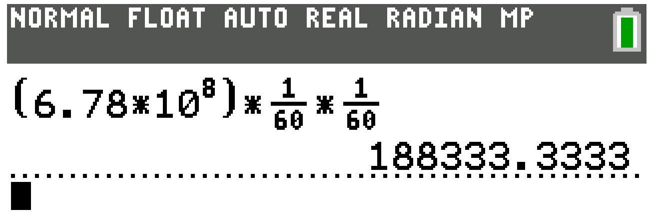
a) How far will a ray of light travel in one year? Set up the conversion below, including units.

b) Using your calculator, input the following conversion. The solution should look like this:

In other words, 5.93928E12 is how the calculator expresses 5.93928 x 10^{12}. However, the calculator will not always express an answer in scientific notation.

c) How far will a ray of light travel in one second? Set up the conversion below, including units.

d) Using your calculator, input the following conversion. The solution should look like this:



e) Now, using your knowledge of the powers of 10, place the above answer in scientific notation. Round the value of a to the nearest hundredth.

Lesson 1 Extra Practice

EP1. Simplify each of the following using the properties of exponents.

a) $(x^4 \cdot x^7)^5$

b) $\left(\frac{x^{18}}{x^6}\right)^3$

c) $(x^5)^3 \cdot (x^4)^2$

d) $\frac{6x^5 \cdot x^4}{3x^5}$

e) $\frac{(2x^2)^3}{4x}$

f) $\frac{(5x^6)^2 \cdot (2x^3)}{10x^{10}}$

EP2. The perimeter of a square can be expressed by $16x^4$ units. What is the side length of the square?

EP3. The National Debt is 2.1×10^{13} dollars. Jeff, the founder of an online marketplace, is worth 1.66×10^{11} dollars. How many times greater is the National Debt than Jeff's net worth? Express your answer in scientific notation.

Lesson 2: Zero and Negative Exponents

In Lesson 1, you were introduced to scientific notation. It was described as a way to express very large, and very small numbers. In that lesson, however, you only worked with very large numbers.

Exercise #1: Complete the table below by using your calculator.

Power	Decimal	Fraction
10^0	1	1
10^{-1}		
10^{-2}		
10^{-3}		

a) Do you see a pattern between the columns? What is the pattern?

b) After you have made an association between the powers and how they can be written as fractions, how do you think you could write 4^{-2} as a fraction? What about 2^{-5}? Is there a rule you could create to simplify negative exponents?

Exercise #2: Use your calculator to simplify the following.

a) 5^0 b) $(-2)^0$ c) 430^0 d) 0^0 e) $(½)^0$

f) Is there a rule you can create for zero exponents?

After you have made rules for negative and zero exponents, turn the page to check your work.

Property	General Rule
Negative Exponents	$x^{-a} = \frac{1}{x^a}$
Zero Exponents	$x^0 = 1$ for all values of x except $x = 0$

Exercise #3: Simplify each of the following powers using the rules of negative and zero exponents.

a) $(2x)^0$

b) $2x^0$

c) $(2x)^{-3}$

d) $2x^{-3}$

Exercise #4: Simplify.

a) $\frac{x^4}{x^8}$

b) $\frac{x^2}{(x^3)^3}$

c) $\frac{x^3 \cdot x^9}{x^{-4}}$

d) $\left(\frac{x^7 \cdot x^{-9}}{x^{-5}}\right)^{-3}$

e) $\frac{x^{10} \cdot x^2}{(x^6)^2}$

f) $\left(\frac{1}{2}\right)^{-3}$

Lesson 2 Extra Practice

EP1. Which of the following are equivalent to 16. Select all that apply.

$\frac{4^4}{4^2}$ $\quad 2^8 \quad$ $\frac{1}{2^{-4}}$ $\quad (4^{-3} \cdot 4^{-2}) \cdot 4^7$

EP2. The number of hospital patients infected with a virus is modeled by the equation $f(t) = 10(3)^t$, where t is the time, in days, since the virus began.

a) What is the value of $f(0)$?

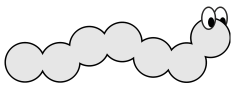
b) What does this value mean in the context of the situation?

EP3. Rewrite the following as an equivalent expression with positive exponents.

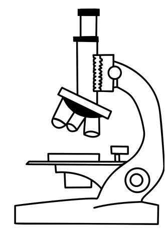
a) $\frac{(18x^5)^2}{(3x^5)^3}$

b) $\frac{(5x)^4}{(5x)^2 \cdot 25x^2}$

EP4. The mass of a caterpillar larva is 10^{-3} grams. During the first two months of its lifespan, the caterpillar can eat 10^{5} times its body weight. About how many grams of food can the caterpillar eat in the first two months of its life?



EP5. A doctor collects a 10^{-2} liter sample of blood from a patient. Upon examining a droplet of blood, or 10^{-5} liter, the doctor determines there are 10^{5} red blood cells in the droplet. How many red blood cells are in the entire blood sample?



EP6. The intensity of sound can be measured using the formula $I = 0.08Pd^{-2}$, where P is the power, in watts, of the sound's source, and d is the distance, in meters, from the sound's source.

If the intensity (I) of a certain sound is 10^{-2} watts per square meter, and a person is standing 30 meters from the sound's source, what is the power (P), in watts, of the sound?

Lesson 3: Equivalent Exponential Expressions

In previous chapters, you solved for an unknown value in a linear equation. In this lesson, the unknown value will be contained in the exponent of one or both of the powers.

Exercise #1: Consider the statement: If $b^x = b^y$ then, $x = y$.

a) What does b represent?

b) What do you notice about the exponents when the bases are the same?

Exercise #2: Using the rule in Exercise #1, find the unknown value.

a) $3^x = 3^4$

b) $12^{12} = 12^{3x}$

c) $2^{10} = 2^{2x-4}$

Exercise #3: The bases may not always be the same. In this case, you would have to determine an equivalent exponential expression that has the same base as your given information. Part "a" has been completed for you.

a) $3^8 = 9^{2x}$

$3^8 = (3^2)^{2x}$

$3^8 = 3^{4x}$

$8 = 4x$

$2 = x$

b) $125^{x+2} = 5^{2(x+5)}$

c) $4^{14x} = 64^{28}$

Exercise #4: In these next examples, you may be required to convert one *or more* expressions so they result in the same base.

a) $49^{x+2} = 343^{3(x-1)}$ b) $100^{3x+2} = 10000^{-2x+8}$ c) $8^{x} = 128^{x+4}$

d) $\frac{1}{16^{x}} = 4^{x-6}$ e) $\frac{1}{216^{x-3}} = 36^{3x-12}$ f) $4^{5-9x} = \frac{1}{8^{x-2}}$

Exercise #5: Eric and Leyla are studying the outbreak of a virus. Eric determines the function $f(t) = 16 \cdot 4^{t}$ that could measure the number of cases of the virus, $f(t)$, over a period of t weeks. Leyla finds the function $g(t) = 4^{t+2}$ could measure the number of cases of the virus, $g(t)$, over a period of t weeks. Justify why both of these functions are acceptable.

Lesson 3 Extra Practice

EP1. For each of the following, solve for the unknown value.

a) $5^{3-2x} = 5^{-x}$

b) $3^{1-2x} = 243$

c) $6^{-2m} = 6^{2-3m}$

d) $6^{3a} \cdot 6^{-a} = 6^{-2a}$

e) $10^{-3n} \cdot 10^{n} = \frac{1}{10}$

f) $5^{4k+8} = 625^{2k-6}$

g) $8^{2a-4} = 16^{2a+4}$

h) $3 \cdot (6)^{2x-3} = 648$

i) $5^{2n+2} = \frac{1}{625}$

EP2. Find the value of k in the equation below when $x = 3$.

$$64^{2x+5} = 4^{kx+20}$$

EP3. Uma has a coin with a value that increases according to the function $f(t) = 200(4)^t$, where $f(t)$ is the value of the coin, and t is the time in years she has owned the coin. Which of the following equations is equivalent to $f(t)$?

1) $g(t) = 200(4)^{2t}$
2) $g(t) = (800)^t$
3) $g(t) = 200(2)^{2t}$
4) $g(t) = 400(2)^t$

EP4. The value of a boat depreciates at a rate given by the function $b(t) = 50000(0.64)^{3t}$, where b(t) is the value of the boat after t years. Which function could also represent the value of the boat after t years?

1) $b(t) = 50000(0.8)^{6t}$
2) $b(t) = 50000(0.32)^{6t}$
3) $b(t) = 50000(0.08)^{6t}$
4) $b(t) = 50000(0.8)^{24t}$

Lesson 4: Exponential Functions

So far, you have covered linear functions. You should recall that linear functions (y=mx+b) are functions that have a slope (rate of change) that remains constant throughout the entire function. Exponential functions have a noticeable difference that you will explore today.

Exercise #1: A radio station calls Jananda to inform him he won a contest and offers him two options to choose from. Option 1 is $1,000,000. Option 2 is $0.01 today, and each day after for the next 30 days, they will double the prize amount from the previous day.

a) Decide which option will yield the most amount of money. How did you arrive at this conclusion? You may want to make a table of values to help you with your decision.

Option 2 would be an example of an exponential function because the prize money is increasing by a ***common ratio***, or ***growth factor***.

General Form of an Exponential Function

$$y = a(b)^x$$

Just as you have learned $y = mx + b$ is the general form of a linear function, you will now be working with exponential functions that have a general form of $y = a(b)^x$, where a represents the y-intercept, and b represents the growth or decay factor.

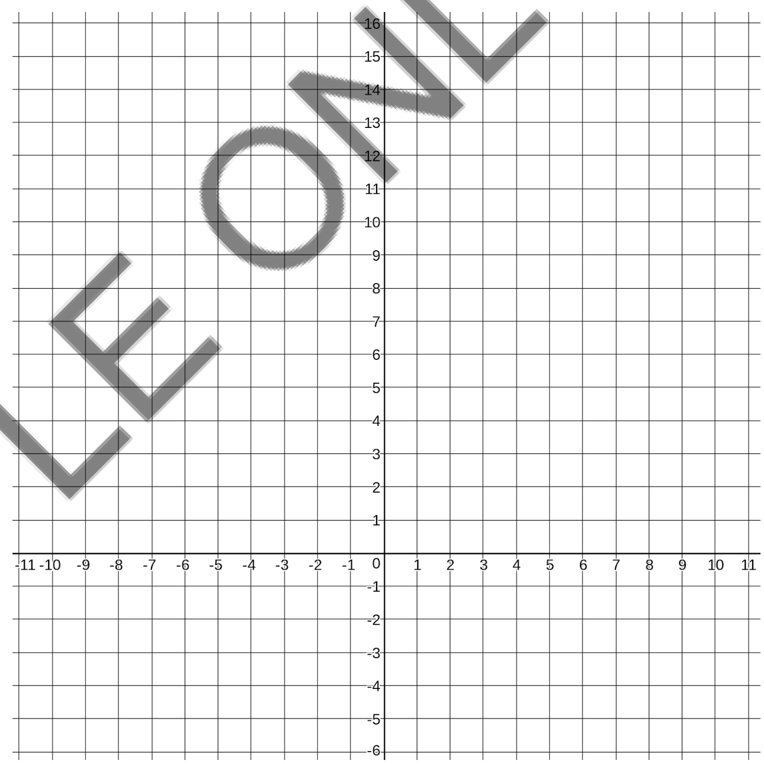
Exercise #2: Identify the y-intercept and growth/decay factors for each of the following.

a) $y = 8(2)^x$ b) $y = 460(10)^x$ c) $f(x) = 100(\frac{1}{2})^x$ d) $f(t) = 8^t$

Exercise #3: Evaluate the function $f(x) = -4(2)^x$ when $x = \{-1,\ 0,\ 3\}$

Exercise #4: Graph $y = 2^x$.

a) Describe the domain and range.



b) What is the y-intercept of the graph? What can you conclude about functions in the form $y = b^x$?

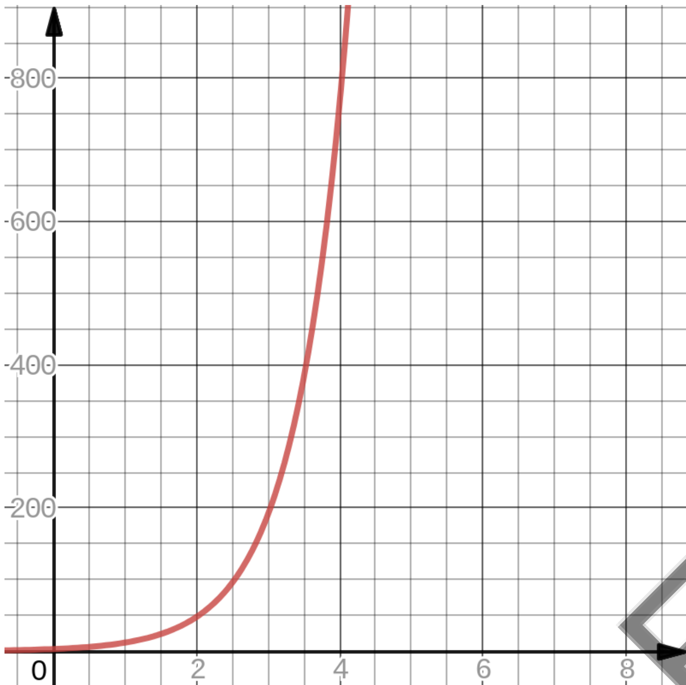
Exercise #5: On the same set of axes above, graph the function $y = (\frac{1}{2})^x$.

a) Describe the domain and range.

b) How does this graph compare to the graph of $y = 2^x$?

Exercise #6: The graph below represents a bacteria population, y, after x days.

a) Write an exponential function that represents the population.



Day	Population
0	3
1	12
2	48
3	192
4	768

b) What is the population after 12 hours?

Exercise #7: The population, $f(t)$, of a certain rural town after t years can be represented by an exponential function whose graph passes through the points (0, 300) and (1, 900). Write a function that represents the population.

Exercise #8: The height, $h(n)$, of a dropped ball is an exponential function of the number of bounces, n. A ball is dropped from an initial height of 30 inches. On its first bounce, the ball reaches a height of 15 inches. On its second bounce, the ball reaches a height of 7.5 inches. Write an equation for the height of the ball as a function of the number of bounces.

Lesson 4 Extra Practice

EP1. For each of the following functions, state the y-intercept and the growth/decay factor.

a) $y = 6(50)^x$ b) $g(x) = \frac{1}{3}(4)^x$ c) $h(t) = 5^t$

EP2. When a piece of paper is folded in half, the total thickness doubles. An unfolded piece of paper is 0.1 millimeters thick. Write an equation to model the total thickness, T(n), as a function of the number of folds, n.

EP3. The bacteria population, f(t), after t hours can be represented by an exponential function whose graph passes through the points (0, 40) and (2, 160). Write a function that represents the population after t hours.

EP4. Consider the exponential function: $f(x) = 2.50(2)^x$

Explain one possible real-life scenario that could be represented by the function.

Lesson 5: Percents

You should recall the percent to decimal and decimal to percent conversions shown in the table below. These will be used quite often with exponential functions.

Decimal to Percent Conversion	Multiply by 100	*Example:* 0.42 x 100 = 42%
Percent to Decimal Conversion	Divide by 100	*Example:* 6% ÷ 100 = 0.06

Exercise #1: Convert the following decimals to percents.

a) 0.75 b) 0.03 c) 0.4 d) 1.25

e) 0.015 f) 0.002 g) 3 h) 1.02

Exercise #2: Convert the following percents to decimals.

a) 20% b) 99.5% c) 3.5% d) 0.5%

e) 200% f) 120% g) 101.6% h) 12.5%

In the remainder of this unit, you will be working with exponential functions that increase or decrease by a percent rate. To maximize your understanding, you will first review percent increase and percent decrease from previous years.

Exercise #3: Solve the following by using your knowledge of percents.

a) Find 50% of 20 b) Find 7% of 28 c) Find 5% of 300

Exercise #4: Solve each of the following by using one operation.

a) 600 increased by 15% b) $360 decreased by 9% c) 650 increased by 1.5%

Exercise #5: Answer each part by performing the necessary operations.

a) A pair of pants is discounted by 20% off the original price of $50. How much are the pants now?

b) A bank account with $500 earns 2% interest each year. How much money is in the account at the end of one year?

c) A 180 degree cup of hot chocolate, cools at a rate of 10% per minute. What is the temperature after one minute?

d) The population of a town increases by 3% each year. The current population is 35,000. What will the population be after 1 year?

Lesson 5 Extra Practice

EP1. Convert each of the following percents to decimals.

a) 13% b) 96.5% c) 45.2% d) $\frac{1}{2}$%

EP2. Convert each of the following decimals to percents.

a) 0.025 b) 0.783 c) 0.013 d) 0.6

EP3. Perform the indicated procedure using only one operation.

a) Increase $250 by 25%

b) Increase a population of 6000 by 2%

c) Decrease $50,000 by 19%

d) Decrease 8250 by 24%

e) Increase 450 by 300%

f) Decrease $700 by 0.5%

EP4. Tickets to a sporting event were $75 in 2016. For the two years that followed, ticket prices increased at a rate of 6% per year.

a) How much did a ticket cost in 2017?

b) How much did a ticket cost in 2018?

c) How did the rate of change of the price of the ticket change from 2016-2017 to 2017-2018?

EP5. Mrs. Goren takes a 400mg ibuprofen capsule. Each hour, the amount of ibuprofen in Mrs. Goren's bloodstream decreases by 12%.

a) What amount remains after one hour?

b) What amount remains after the second hour?

c) How did the rate of change of the amount of milligrams in Mrs. Goren's bloodstream change from the 0-1 hour interval to the 1-2 hour interval?

Lesson 6: Exponential Growth & Decay

In Lesson 4, you learned about exponential functions in the form $y = a(b)^x$. In Lesson 5, you worked with percents. Today, you will combine both of those methods of thinking to conquer exponential growth and decay functions.

The exponential growth and decay formula is represented by:

$$y = a(1 \pm r)^t$$

In this formula, a represents the y-intercept, r represents the percent rate *as a decimal*, and t represents the amount of time that has passed. $y = a(1+r)^t$ is used for exponential growth, while $y = a(1-r)^t$ is used for exponential decay. Can you see the general form of an exponential function within this formula?

Exercise #1: Create an exponential function that has:

a) a y-intercept of 200, and growing at a rate of 3%

b) a y-intercept of 1600, and decaying at a rate of 12%

Exercise #2: Given the following functions, determine if they are growing or decaying, then state the *percent* growth or decay.

a) $f(x) = 500(1.22)^x$

b) $g(x) = 0.25(1.06)^x$

c) $h(x) = 80(0.95)^x$

d) $y = 2500(0.985)^t$

e) $f(t) = (1.2)^t$

f) $p(x) = 7000(0.88)^x$

Exercise #3: Zen wants to open a savings account at a bank. The bank advertises a 3% interest rate for students. He decides to open the account with an initial deposit of $500.

Think about what you already know...

- a = ________ since that is the initial amount.
- Earning interest will result in an increase of money, so you will use (1 + r) instead of (1 - r)
- The value of r = _______ since that is the percent growth written as a decimal

Write the exponential growth formula that models the situation here:

Exercise #4: Enjoy the following poem...

In 2042, what does Papetti do?
He buys a yacht, that costs a lot,
And sails the ocean blue!

The yacht costs $230,000 and each year after Mr. Papetti purchases the yacht, it loses 9% of its value (this is called depreciation).

a) Write an exponential function to determine the value of Mr. Papetti's yacht, C(x), after x years.

b) What will be the value of the yacht after 7 years?

Exercise #5: In January 2013, the population of Long Beach was 31,500. Since then, the population has grown at an annual rate of 4%. If this growth rate continues, to the *nearest person*, what will the population be in January 2019?

Exercise #6: Today, a billionaire is worth $100,000,000,000. The billionaire gives 15% of her money to charity every year.

a) Set up an equation to model the total money remaining, M(t), after t years..

b) How much of this 100 billion dollars will remain, to the nearest cent, after 10 years if she does not make any additional deposits or withdrawals?

Exercise #7: The U.S. Open tennis tournament is an example of an exponential decay model. The tournament begins with 128 players, and each round 50% of the teams are eliminated.

a) Set up an exponential equation to model this situation.

b) Using the "table" function in your calculator, determine after how many rounds will there be one player remaining.

Exercise #8: George and Jane open a bank account in the year 2062 with an initial deposit of $7,000.00 that earns 1.4% interest compounded annually.

a) Set up an equation to model this situation.

b) If they make no additional deposits or withdrawals, and their current balance is $7,823.51 what year is it? Use the "table" function on your calculator.

Lesson 6 Extra Practice

EP1. State the percent at which the following functions are growing/decaying. Then, state the y-intercept.

a) $y = 500(1.5)^x$ b) $f(x) = 0.5(0.905)^x$ c) $P(t) = 30000(1.002)^t$

EP2. The value of a car purchased for $20,000 depreciates at a rate of 12% per year. What will be the value of the car after 3 years? Set up an exponential function, then solve. Round your answer to the *nearest cent*.

EP3. In September 2018, each student at Weber Middle School received a laptop valued at $450.00. Each year, the laptop decreases in value at a rate of 17%. What will the laptop's approximate value be in September 2023?

EP4. On January 1, 1999 the price of gasoline was $1.39 per gallon. If the price increased by 0.5% per month, what was the cost of one gallon of gasoline, to the nearest cent, on January 1, one year later?

Lesson 7: Linear vs. Exponential Models

Earlier this year, you practiced with linear functions and word problems involving linear functions. Recently, you worked with exponential functions and word problems involving exponential functions. Today you will be combining both of those ideas to make a choice whether it is a linear function or an exponential function.

Linear Function	Exponential Function
$y = mx + b$ m is the slope b is the y-intercept (initial amount)	$y = a(b)^x$ b is the growth/decay factor a is the starting value
If the problem is growing or decaying by a constant (same) amount, use a linear function.	If the problem is growing or decaying using multiplication words (i.e. doubling, tripling, halving), or growing by a percent rate, use an exponential function.

Exercise #1: Decide whether each of these scenarios represent a linear or exponential function. Circle "L" for linear and "E" for exponential.

a) Bruce has 200 stamps in his collection and collects 20 new stamps each year. L E

b) A person buys a stock that quadruples every five years. L E

c) A population of a town increases by 7.5% each year. L E

d) The number of pandas decreases by about 50 pandas each year. L E

e) Julia earns \$600 plus \$4 commission per item sold at her job each week. L E

f) Half as much Magnesium-27 remains every 9.45 minutes. L E

Exercise #2: Examine the table below.

x	0	1	2	3	4
f(x)	5	10	20	40	80

Do the values in the table appear to represent a linear or an exponential relationship? Why?

Exercise #3: For each of the tables below, state whether the table represents a linear or exponential function, then write the function that represents each table.

a)

x	0	1	2	3	4
f(x)	120	60	30	15	7.5

b)

x	0	1	2	3	4
f(x)	1200	800	400	0	-400

c)

x	0	1	2	3	4
f(x)	50	55	60.5	66.55	73.205

d)

x	0	1	3	7	15
f(x)	2	4	8	16	32

Exercise #4: While wearing headphones, the bacteria in your ears grow 6 times as fast. For example, at the end of just one minute, an initial amount of 10 bacterial cells grow to 60 bacterial cells. At the end of two minutes, the 60 bacterial cells grow to 360 bacterial cells. Determine if this function is linear or exponential and create an equation to represent the situation.

Exercise #5: Charlise has a prepaid cell phone. She begins with $50.00 as an initial account balance. Each minute Charlise talks on the phone will deduct $0.20 from her balance.

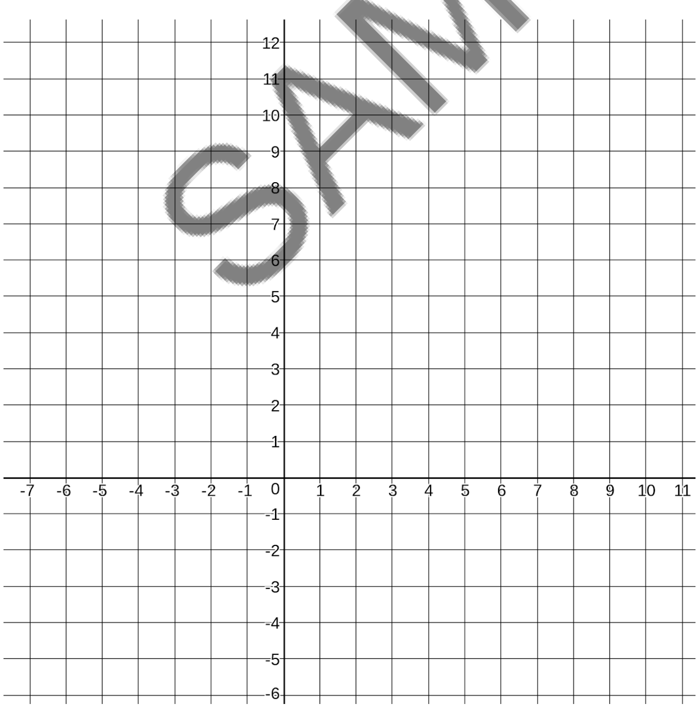
a) Is this scenario linear or exponential? Explain how you determined your answer.

b) Create an equation to represent the remaining balance, $g(x)$, as a function of minutes, x, she spends talking on the phone.

c) Find the value of $g(10)$. Explain what your answer means in the context of the problem.

d) Find the value of x that makes $g(x) = 15$. Explain what your answer means in the context of the problem.

Exercise #6: Consider the points (0, 9) and (1, 3)



a) Write the linear equation that passes through the two points.

b) Write the exponential equation that passes through the two points.

c) Graph both equations on the grid. Label each equation.

Lesson 7 Extra Practice

EP1. Which of the following represents an exponential function? Select all that apply.

1) A car wash charges $9 per car for an exterior wash.
2) An ant colony doubles in size every month.
3) Tyler deposits $300 in his account initially, then $20 each week after.
4) Mia has $500 in her account that earns 1.2% interest compounded annually.

EP2. Based on the table below determine if the values represent a linear or exponential function. Then, create an equation that represents the values in the table.

x	-1	0	1	2
h(x)	200	300	450	675

EP3. The relationship between the views a video receives, V(t), and the time, t, in days the video has been posted can be represented by a function. The table below shows the views the video received after the first two days, with day 0 being the time the user uploaded the video.

t	V(t)
0	1
1	8
2	64

a) Create a function to represent the table above.

b) Based on your function, how many views will the video have after 16 days? Is this reasonable? Explain how you know.

Chapter Review

Part I Questions: For each statement or question, choose the word or expression that, of those given, best completes the statement or answers the question.

CR1. The number of bacteria grown in a lab can be modeled by $P(t) = 200 \cdot 3^{4t}$, where t is the number of hours. Which expression is equivalent to $P(t)$?

1) $200 \cdot 12^{t}$
2) $200 \cdot 9^{2t}$
3) $200^{t} \cdot 3^{4}$
4) $200^{2t} \cdot 3^{2t}$

CR2. Jaydon and Mackenzie are growing bacteria in a laboratory. Jaydon uses the growth function $f(t) = n^{4t}$ while Mackenzie uses the function $g(t) = n^{6t}$, where n represents the initial number of bacteria and t is the time, in hours. If Jaydon starts with 8 bacteria, how many bacteria should Mackenzie start with to achieve the same growth over time?

1) 16
2) 8
3) 4
4) 2

CR3. Connor is saving up to buy a new video game. He puts $1 in a jar. Each month after, he puts twice as much money than the previous month in the jar. Which type of function best models the total amount of money in the jar after a given number of months?

1) linear 2) exponential 3) quadratic 4) square root

CR4. The highest possible grade for a certain test is 100. Each error made results in a five point deduction. Which kind of function describes this situation?

1) linear
2) quadratic
3) exponential growth
4) exponential decay

CR5. A population that initially has 40 gerbils approximately doubles every year. Which function represents this population growth?

1) $g(t) = 2 \cdot 40^{t}$
2) $g(t) = 40 \cdot 2^{t}$
3) $g(t) = 80^{t}$
4) $g(t) = 40 \cdot (1+2)^{t}$

__Open Response Questions__: **For each question, clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc.**

CR6. Caroline invested $1250 in a savings account at a 1.1% annual interest rate. She made no deposits or withdrawals on the account for 3 years. The interest was compounded annually.

Find, to the nearest cent, the balance in the account after 3 years.

CR7. A new boat was purchased for $75,000. Research shows that the boat has an average yearly depreciation rate of 12.5%.

Create a function that will determine the value, $V(t)$, of the boat t years after purchase.

Determine, to the nearest cent, how much the boat will depreciate from year 4 to year 5.

CR8. The function f(x) is shown in the table below. Determine whether f(x) is linear or exponential. Explain your answer.

x	f(x)
-2	9.7
0	6.6
2	3.5
4	0.4