Unit 7 Vocabulary Awareness Chart

Word	+	☑	-	Example	Definition
Common ratio					
Decay factor					
Exponential decay					
Exponential function					
Exponential growth					
Exponential regression					
Arithmetic sequence					
Geometric Sequence					
Growth factor					
Exponential interpolation					
Interest period (time)					
Polynomial					
Monomial					
Binomial					
Trinomial					
Standard form of a polynomial					
Algebra Tiles					

Procedure:
1. Examine the list of words you have written in the first column.
2. Put a + next to each word you know well and for which you can write an accurate example and definition. Your definition and example must relate to the unit of study.
3. Place a ☑ next to any words for which you can write either a definition or an example, but not both.
4. Put a – next to words that are new to you.

This chart will be used throughout the unit. By the end of the unit, you should have the entire chart completed. Because you will be revising this chart, write in pencil.

LINEAR AND EXPONENTIAL FUNCTIONS

1. Make a table of values and graph the following function. Use the domain {-2, -1, 0, 1, 2}

$\boldsymbol{y = 3x}$

x	y

What type of function is this?

What is the slope of the line? _____________ Show how the slope is represented in the table.

2. Graph $\boldsymbol{y = 3^x}$ using the same domain

x	y

What type of function is this?

Find the difference in the y-values for this function as x increases by 1.

Is $y = 3^x$ a linear function? Why or why not?

How do the y-values increase as x increases by 1?

Unit 7, Activity 1, Evaluation: Linear and Exponential Functions

3. Compare the following functions by graphing on the graphing calculator. Use the table on the calculator to complete a table of values for each function.

a) $y = 2^x$

x	***y***

b) $y = 3^x$

x	***Y***

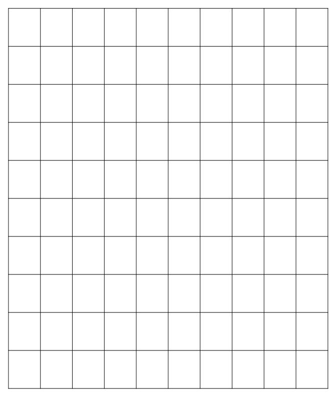
c) $y = 4^x$

x	***y***

4. What happens to the graph as the base is increased? Show this using the table of values.

Graph $y = \frac{1}{3}^{x}$ using the domain {-2, -1, 0, 1, 2}

x	***y***



5. What is the difference between the graphs of the functions of $y = 3^x$ and $y = \frac{1}{3}^{x}$?

6. In the function $y = 3^x$, as the x values increase, what happens to the y values?

7. In the function, $y = \frac{1}{3}^{x}$, as the x values increase, what happens to the y values?

8. $y = b^x$ is an example of an ____________________________________ function. Why?

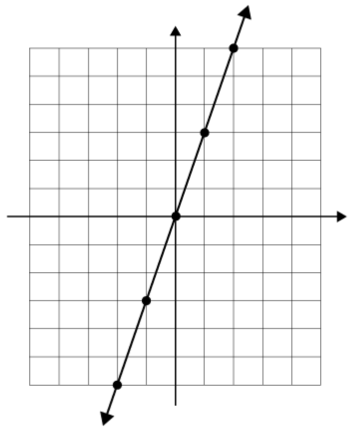
9. $y = b^{-x}$ or $\frac{1}{b}^{x}$ is an example of an _________________________________function. Why?

LINEAR AND EXPONENTIAL FUNCTIONS

1. Make a table of values and graph the following function. Use the domain {-2, -1, 0, 1, 2}

$y = 3x$

x	y
-2	*-6*
-1	*-3*
0	*0*
1	*3*
2	*6*

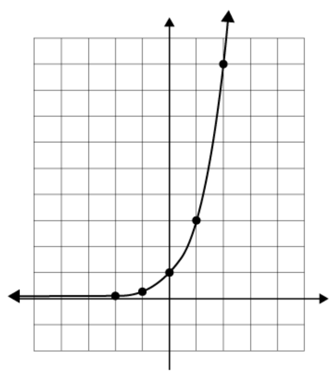


What type of function is this? *linear*

What is the slope of the line? _*3*_______ Show how the slope is represented in the table.

2. Graph $y = 3^x$ using the same domain

x	y
-2	$\frac{1}{9}$
-1	$\frac{1}{3}$
0	*1*
1	*3*
2	*9*



What type of function is this? *exponential*

Find the difference in the y-values for this function as x increases by 1. *The differences are not constant, but they increase by the next power of 3.*

Is $y = 3^x$ a linear function? *No* Why or why not? *It does not increase by a constant value.*

How do the y-values increase as x increases by 1? *They are multiplied by 3.*

3. Compare the following functions by graphing on the graphing calculator. Use the table on the calculator to complete a table of values for each function.

a.) $y = 2^x$

x	y
-2	0.25
-1	0.5
0	1
1	2
2	4

b.) $y = 3^x$

x	y
-2	0.11
-1	0.33
0	1
1	3
2	9

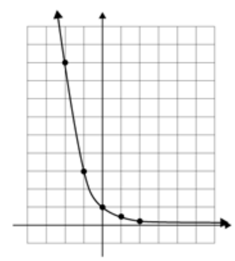
c) $y = 4^x$

x	y
-2	0.06
-1	0.25
0	1
1	4
2	16

4. What happens to the graph as the base is increased? Show this using the table of values.

Graph $y = \left(\frac{1}{3}\right)^x$ using the domain {-2, -1, 0, 1, 2}

x	y
-2	9
-1	3
0	1
1	.33
2	.11



5. What is the difference between the graphs of the functions of $y = 3^x$ and $y = \left(\frac{1}{3}\right)^x$?

They are both exponential, but one increases and the other decreases.

6. In the function $y = 3^x$, as the x values increase, what happens to the y values?

It increases.

7. In the function, $y = \left(\frac{1}{3}\right)^x$, as the x values increase, what happens to the y values?

It decreases.

8. $y = b^x$ is an example of an *exponential growth* function. Why? *The function is exponential because it multiplies at a constant rate. It represents growth because it increases.*

9. $y = b^{-x}$ or $\left(\frac{1}{b}\right)^x$ is an example of an *exponential decay* function. Why? *The function is exponential because it multiplies at a constant rate. It represents decay because it decreases.*

COMPARE AND CONTRAST MAP

Linear Function:

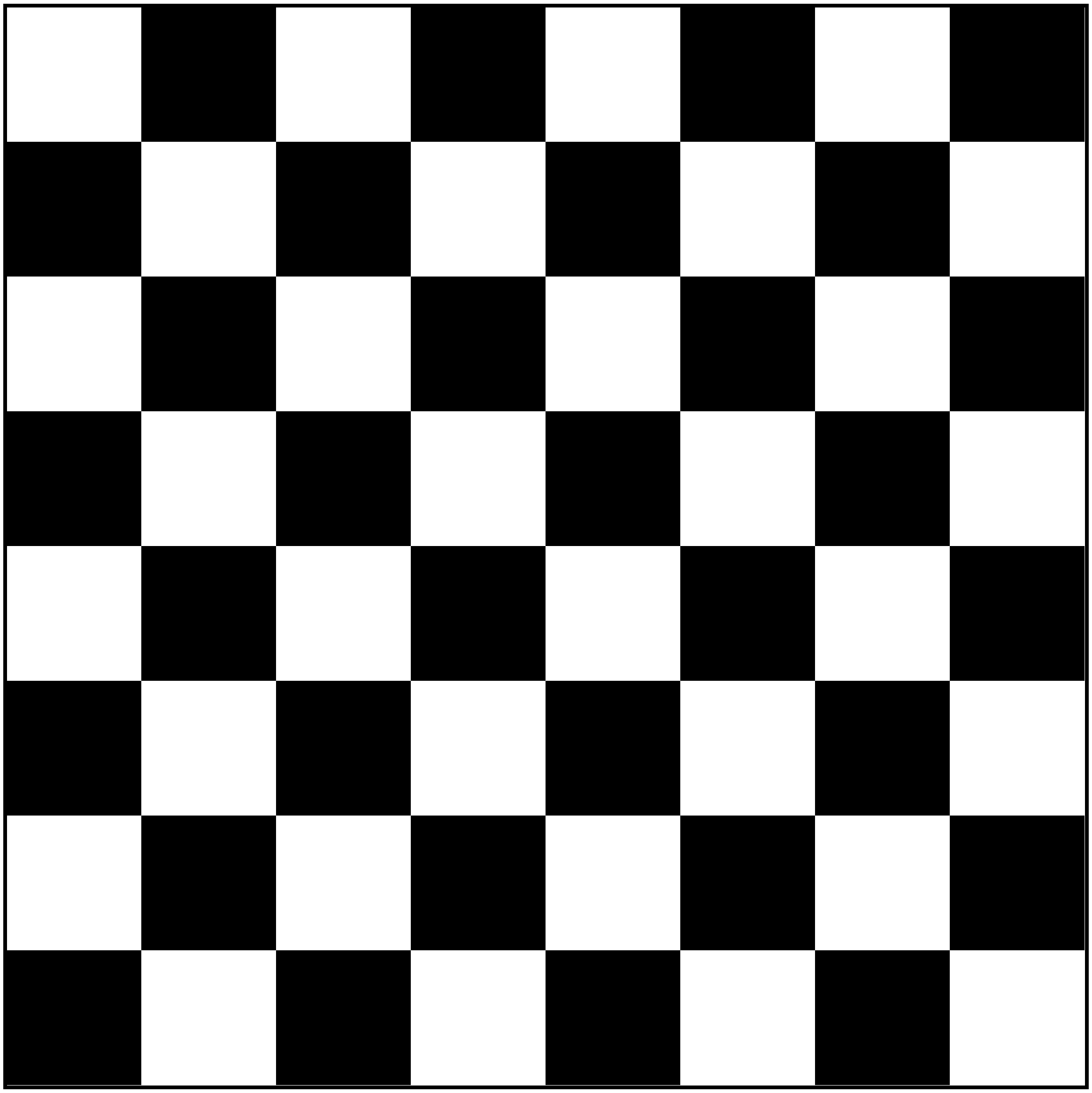
Exponential Function:

Different

Same

Different

Unit 7, Activity 2, Chessboard



Unit 7, Activity 3, Radioactive M&Ms®

Directions:

1. Place 50 atoms of M&Ms® (pieces of candy) in the Ziploc bag.
2. Seal the bag and gently shake for 10 seconds.
3. Gently pour out candy on to the paper plate.
4. Notice the pieces with the print side up. These atoms have "decayed."
5. Count the undecayed pieces (with the print side down) and record the data below.
6. Return the undecayed pieces to the bag. Reseal the bag.
7. Consume the "decayed" atoms.
8. Gently shake the sealed bag for 10 seconds.
9. Continue shaking, counting, and consuming until all the atoms have decayed. Complete the table at each part of the process.
10. Predict the equation that represents this exponential function.
11. Graph the number of undecayed atoms vs. time in your calculator.
12. Find the exponential equation that fits the curve.

Trial	Number of undecayed atoms
0	50

Product of powers	Expanded product	Product as a single power	Explanation
$x^2 \cdot x^3$	$(x \cdot x) \cdot (x \cdot x \cdot x)$	x^5	
$x^5 \cdot x^4$			
$x \cdot x^3$			
$x^2 \cdot x^4$			
$x^m \cdot x^n$			

Quotient of powers	Expanded quotient	Quotient as a single power	Explanation
$\frac{x^5}{x^2}$	$\frac{x \cdot x \cdot x \cdot x \cdot x}{x \cdot x}$	x^3	
$\frac{x^4}{x^3}$			
$\frac{x^9}{x^4}$			
$\frac{x^2}{x^5}$			
$\frac{x^m}{x^n}$			

Power of a power	Expanded power	Power as a single power	Explanation
$(x^2)^3$	$x^2 \cdot x^2 \cdot x^2$	x^6	
$(x^3)^4$			
$(x^5)^2$			
$(x^6)^4$			
$(x^m)^n$			

Unit 7, Activity 6, Exploring Exponents

Power of a fractional power	Expanded power	Power as a single power	Explanation
$\left(x^{\frac{1}{2}}\right)^2$	$x^{\frac{1}{2}} \cdot x^{\frac{1}{2}}$	x	
$\left(x^{\frac{1}{3}}\right)^3$			
$\left(x^{\frac{1}{n}}\right)^n$			

Unit 7, Activity 6, Exploring Exponents with Answers

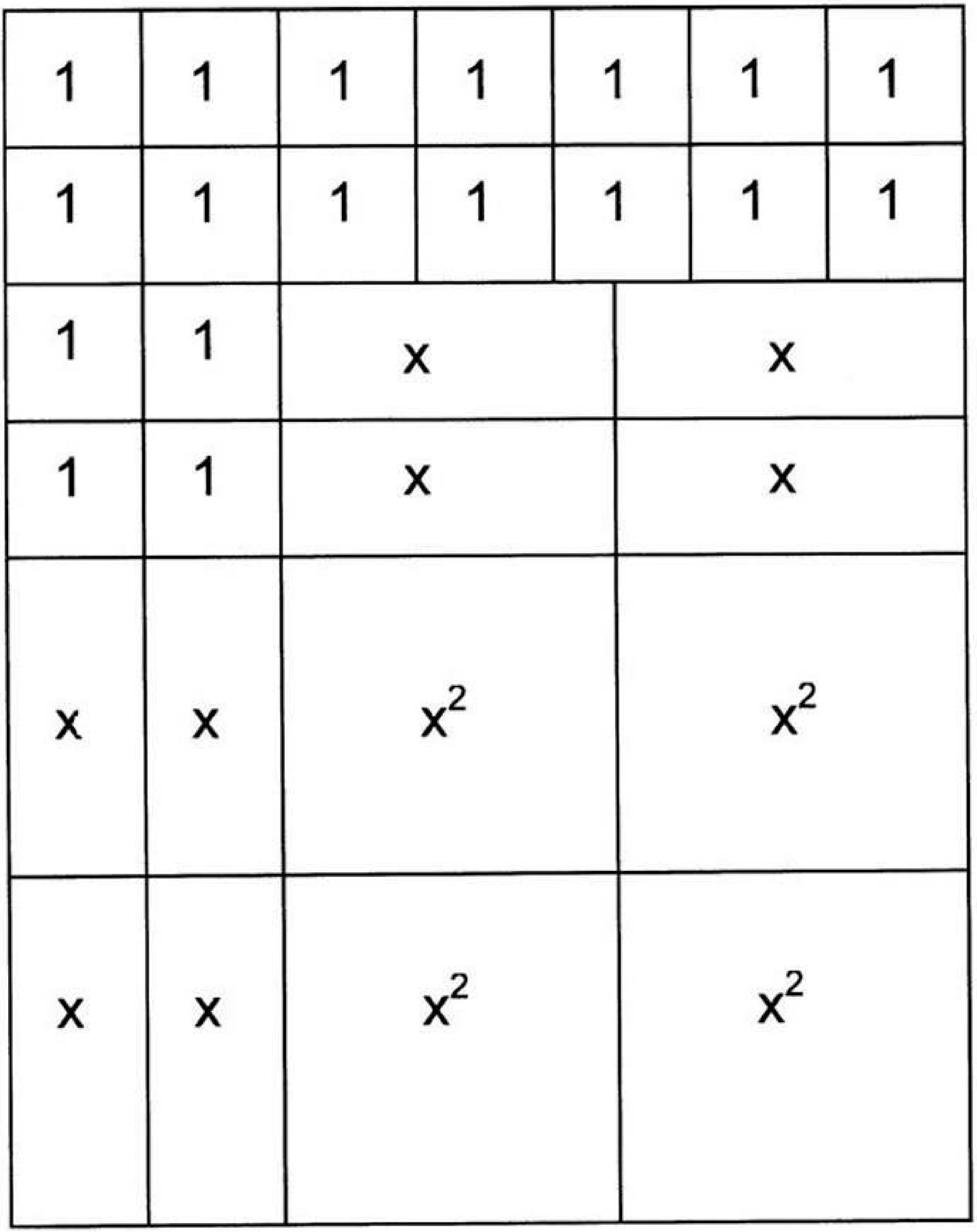
Product of powers	Expanded product	Product as a single power	Explanation
$x^2 \cdot x^3$	$(x \cdot x)\cdot(x \cdot x \cdot x)$	x^5	When you multiply 2 "x"s together times 3 "x"s that are multiplied together, you get 5 "x"s multiplied together which is x^5
$x^5 \cdot x^4$	$(x \cdot x \cdot x \cdot x \cdot x)\cdot(x \cdot x \cdot x \cdot x)$	x^9	When you multiply 5 "x"s together times 4 "x"s that are multiplied together, you get 9 "x"s multiplied together which is x^9
$x \cdot x^3$	$(x)\cdot(x \cdot x \cdot x)$	x^4	When you multiply 1 "x"s times 3 "x"s that are multiplied together, you get 4 "x"s multiplied together which is x^4
$x^2 \cdot x^4$	$(x \cdot x)\cdot(x \cdot x \cdot x \cdot x)$	x^6	When you multiply 2 "x"s together times 4 "x"s that are multiplied together, you get 6 "x"s multiplied together which is x^6
$x^m \cdot x^n$		x^{m+n}	When multiplying variables that have exponents, if the bases are the same, add the exponents.

Quotient of powers	Expanded quotient	Quotient as a single power	Explanation
$\frac{x^5}{x^2}$	$\frac{x \cdot x \cdot x \cdot x \cdot x}{x \cdot x}$	x^3	When you have 5 "x"s that are multiplied together and you divide the product by 2 "x"s multiplied together, 2 "x"s will divide, yielding 1 and 3 "x" s or x^3
$\frac{x^4}{x^3}$	$\frac{x \cdot x \cdot x \cdot x}{x \cdot x \cdot x}$	X	When you have 4 "x"s that are multiplied together and you divide the product by 3 "x"s multiplied together, 3 "x"s will divide, yielding 1, and 1 "x"
$\frac{x^9}{x^4}$	$\frac{x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x}{x \cdot x \cdot x \cdot x}$	x^5	When you have 9 "x"s that are multiplied together and you divide the product by 4 "x"s multiplied together, 4 "x"s will divide, yielding 1 and 5 "x" s or x^5
$\frac{x^2}{x^5}$	$\frac{x \cdot x}{x \cdot x \cdot x \cdot x \cdot x}$	$\frac{1}{x^3}$	When you have 2 "x"s that are multiplied together and you divide the product by 5 "x"s multiplied together, 2 "x"s will divide yielding 1, and 3 "x" s in the denominator of the fraction or $\frac{1}{x^3}$
$\frac{x^m}{x^n}$		x^{m-n}	When dividing variables that have exponents, if the bases are the same, subtract the exponents

Unit 7, Activity 6, Exploring Exponents with Answers

Power of a power	Expanded power	Power as a single power	Explanation
$(x^2)^3$	$x^2 \cdot x^2 \cdot x^2$	x^6	Multiply x^2 together three times, add the exponents to get x^6
$(x^3)^4$	$x^3 \cdot x^3 \cdot x^3 \cdot x^3$	x^{12}	Multiply x^3 together four times, add the exponents to get x^{12}
$(x^5)^2$	$x^5 \cdot x^5$	x^{10}	Multiply x^5 together two times, add the exponents to get x^{10}
$(x^6)^4$	$x^6 \cdot x^6 \cdot x^6 \cdot x^6$	x^{24}	Multiply x^6 together four times, add the exponents to get x^{24}
$(x^m)^n$		x^{mn}	When taking a power to a power, multiply the exponents.

Power of a fractional power	Expanded power	Power as a Single power	Explanation
$\left(x^{\frac{1}{2}}\right)^2$	$x^{\frac{1}{2}} \cdot x^{\frac{1}{2}}$	x	Multiply $x^{\frac{1}{2}}$ two times, add the exponents to get x.
$\left(x^{\frac{1}{3}}\right)^3$	$x^{\frac{1}{3}} \cdot x^{\frac{1}{3}} \cdot x^{\frac{1}{3}}$	x	Multiply $x^{\frac{1}{3}}$ three times, add the exponents to get x.
$\left(x^{\frac{1}{n}}\right)^n$		x	Multiply $x^{\frac{1}{n}}$ n times, add the exponents to get $x^{\frac{n}{n}} = x^1 = x$.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x
x
x
x^2
x^2
x
x
x^2
x^2

Unit 7, Activity 8, Arithmetic and Geometric Sequences

Read the following passages and provide the solutions to the problems below each passage.

1. Two types of number sequences are represented in this activity-arithmetic sequences and geometric sequences. When the terms of a sequence are based on adding a fixed number to each previous term, the pattern is known as an **arithmetic sequence**. The fixed number is called the **common difference**.

Examples: Look at the pattern of -7, -3, 1, 5. What is the common difference between each of the terms? The common difference is +4. So to find the next term in the sequence, you would add 4 to 5 to obtain 9.

Now, determine the common difference for 17, 13, 9, and 5. The common difference is __, and the next term in the sequence is ___.

A rule for finding the nth term of an arithmetic sequence can be found by using the following guidelines: Consider the sequence 7, 11, 15, 19,... in which the common difference is +4. Let n = the term number of the sequence.
Let $A(n)$ = the value of the nth term of the sequence
$A(1) = 7$; $A(2) = 7 + 4 = 11$; $A(3) = 7 + 2(4) = 15$; $A(4) = 7 + 3(4) = 19$; and $A(n) = 7 + (n-1)4$.

If you were asked to find the 10th term of the sequence, $A(10) = 7 + (10 - 1)4 = 43$,

the 20th term would be _________________________.

Thus, the nth term $A(n)$ rule for an arithmetic sequence is $A(n) = a + (n - 1)d$ where a = the first term, n = the term number, and d = the common difference.

Find the common difference of the arithmetic sequence.

2. 9, 13, 17, 21, . . .
3. 5, 5.3, 5.6, 5.9, . . .
4. $2, 1\frac{8}{9}, 1\frac{7}{9}, 1\frac{2}{3}, \ldots$
5. The common difference in an arithmetic sequence is ____________ a positive number.

Find the first, fourth, and tenth terms of the arithmetic sequence described by the given rule.

6. $A(n) = 12 + (n-1)(3)$

7. $A(n) = -6 + (n-1)\left(\frac{1}{5}\right)$

8. $A(n) = -3 + (n-1)(-2.2)$

Geometric Sequences:

Unit 7, Activity 8, Arithmetic and Geometric Sequences

Two types of number sequences are represented in this activity-arithmetic sequences and geometric sequences. When the terms of a sequence are determined by multiplying a term in the sequence by a fixed number to find the next term, the sequence is called a geometric sequence.

Examples: Look at the pattern of 3, 12, 48, 192. What is the common ratio between each of the terms? The common ratio is ×4. So to find the next term in the sequence, you would multiply 4 by 192 to obtain 768.

Now, determine the common ratio for 80, 20, 5, and 1.25. The common ratio is ___, and the next term in the sequence is__________.

A rule for finding the *n*th term of an geometric sequence can be found by using the following guidelines: Consider the sequence 1, 3, 9, 27,... in which the common ratio is ×3. Let *n* = the term number of the sequence.
Let $A(n)$ = the value of the *n*th term of the sequence.
$A(1) = 1$; $A(2) = 1(3) = 3$; $A(3) = 1(3)(3) = 1(3)^2$; $A(4) = 1(3)(3)(3) = 1(3)^3$; and $A(\text{n}) = 1(3)^{n-1}$

If you were asked to find the 10th term of the sequence, $A(10) = 1(3)^9 = 19{,}683$,

the 20th term would be ______________________________________.

Thus, the *n*th term $A(n)$ rule for an geometric sequence is $A(n) = a \cdot r^{n-1}$ where a = the first term, n = the term number, and r = the common ratio.

The common difference or the common ratio can be used to determine whether a sequence is arithmetic or geometric. If there is no common difference or ratio, then the sequence is neither geometric nor arithmetic.

Examples: 2, 4, 6, 8... the common difference is 2 so the sequence is arithmetic.
2, 4, 8, 16 ... the common ratio is 2 so the sequence is geometric.

Find the common ratio of the sequence:
9. 2, –10, 50, –250, . . .
10. –164, –82, –41, –20.5, . . .
11. Find the next three terms of the sequence 3, 9, 27, 81...

Determine whether the sequence is *arithmetic* or *geometric*.
12. –2, 10, –50, 250, . . .
13. Find the first, fourth, and eighth terms of the sequence. $A(n) = -2 \cdot 2^{n-1}$

14. Find the next three terms of the sequence. Then, write a rule for the sequence.
648, 216, 72, 24

Unit 7, Activity 8, Arithmetic and Geometric Sequences with Answers

Read the following passages and provide the solutions to the problems below each passage.

1. Two types of number sequences are represented in this activity-arithmetic sequences and geometric sequences. When the terms of a sequence are based on adding a fixed number to each previous term, the pattern is known as an **arithmetic sequence**. The fixed number is called the **common difference**.

Examples: Look at the pattern of -7, -3, 1, 5. What is the common difference between each of the terms? The common difference is +4. So to find the next term in the sequence, you would add 4 to 5 to obtain 9.

Now, determine the common difference for 17, 13, 9, and 5. The common difference is *-4*, and the next term in the sequence is *1.*

A rule for finding the nth term of an arithmetic sequence can be found by using the following guidelines: Consider the sequence 7, 11, 15, 19,... in which the common difference is +4. Let n = the term number of the sequence.
Let $A(n)$ = the value of the nth term of the sequence.
$A(1) = 7$; $A(2) = 7 + 4 = 11$; $A(3) = 7 + 2(4) = 15$; $A(4) = 7 + 3(4) = 19$; and $A(n) = 7 + (n-1)4$.

If you were asked to find the 10th term of the sequence, $A(10) = 7 + (10 - 1)4 = 43$,

the 20th term would be *A(20) = 7 + (20-1)4 = 83.*

Thus, the nth term $A(n)$ rule for an arithmetic sequence is $A(n) = a + (n - 1)d$ where a = the first term, n = the term number, and d = the common difference.

Find the common difference of the arithmetic sequence.

2. 9, 13, 17, 21, . . . *Answer: +4*
3. 5, 5.3, 5.6, 5.9, . . . *Answer: +0.3*
4. $2, 1\frac{8}{9}, 1\frac{7}{9}, 1\frac{2}{3}, \ldots$ *Answer:* $-\frac{1}{9}$
5. The common difference in an arithmetic sequence is *sometimes* a positive number.

Find the first, fourth, and tenth terms of the arithmetic sequence described by the given rule.

6. $A(n) = 12 + (n-1)(3)$ *Answer: 12, 21, 39*

7. $A(n) = -6 + (n-1)\left(\frac{1}{5}\right)$ *Answer: -6,* $-5\frac{2}{5}$, $-4\frac{1}{5}$

8. $A(n) = -3 + (n-1)(-2.2)$ *Answer: -3, -9.6, -22.8*

Geometric Sequences:

Unit 7, Activity 8, Arithmetic and Geometric Sequences with Answers

Two types of number sequences are represented in this activity-arithmetic sequences and geometric sequences. When the terms of a sequence are determined by multiplying a term in the sequence by a fixed number to find the next term, the sequence is called a geometric sequence.

Examples: Look at the pattern of 3, 12, 48, 192. What is the common ratio between each of the terms? The common ratio is ×4. So to find the next term in the sequence, you would multiply 4 by 192 to obtain 768.

Now, determine the common ratio for 80, 20, 5, and 1.25. The common ratio is *0.25*, and the next term in the sequence is $\frac{5}{16}$ *or 0.3125.*

A rule for finding the *n*th term of an geometric sequence can be found by using the following guidelines: Consider the sequence 1, 3, 9, 27,... in which the common ratio is ×3. Let n = the term number of the sequence.

Let $A(n)$ = the value of the nth term of the sequence,

$A(1) = 1$; $A(2) = 1(3) = 3$; $A(3) = 1(3)(3) = 1(3)^2$; $A(4) = 1(3)(3)(3) = 1(3)^3$; and $A(\text{n}) = 1(3)^{n-1}$.

If you were asked to find the 10th term of the sequence, $A(10) = 1(3)^9 = 19{,}683$.

the 20th term would be

$$\begin{aligned} A(20) &= 1(3)^{20-1} \\ &= 1(3)^{19} \\ &= 1{,}162{,}261{,}467 \end{aligned}$$

Thus, the *n*th term $A(n)$ rule for an geometric sequence is $A(n) = a \cdot r^{n-1}$ where a = the first term, n = the term number, and r = the common ratio.

The common difference or the common ratio can be used to determine whether a sequence is arithmetic or geometric. If there is no common difference or ratio, then the sequence is neither geometric nor arithmetic.

Examples: 2, 4, 6, 8... the common difference is 2 so the sequence is arithmetic.
2, 4, 8, 16 ... the common ratio is 2 so the sequence is geometric.

Find the common ratio of the sequence.

9. 2, –10, 50, –250, . . . *Answer: -5*
10. –164, –82, –41, –20.5, . . . *Answer:* $\frac{1}{2}$
11. Find the next three terms of the sequence 3, 9, 27, 81... *Answer: 243, 729, 2187*
    Determine whether the sequence is *arithmetic* or *geometric*. *Geometric*
12. –2, 10, –50, 250, . . . *Answer: -1250*

13. Find the first, fourth, and eighth terms of the sequence. $A(n) = -2 \cdot 2^{n-1}$

Answer: -2; -16; -256

14. Find the next three terms of the sequence. Then write a rule for the sequence.

648, 216, 72, 24 *Answer: 8,* $\frac{8}{3}, \frac{8}{9}$*;* $A(n) = 648 \cdot \left(\frac{1}{3}\right)^{n-1}$

Unit 7, Activity 9, Vocabulary Self-Awareness Chart 2

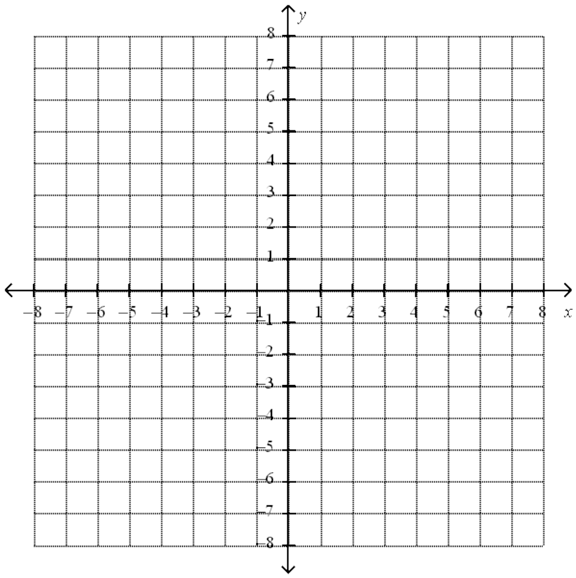
Word	+	☑	-	**Example**	**Definition**
Parabola					
Quadratic Equation in Standard Form					
Zeros					
Completing the Square					
Scatterplot					
Discriminant					
Quadratic Formula					
Vertex					
Axis of Symmetry					
Y-intercept					
X-intercept					
Solutions to a quadratic equation					
Real solution					
Complex Solution					
Roots of a quadratic					
Vertex form of a quadratic equation					

Procedure:
1. Examine the list of words you have written in the first column.
2. Put a + next to each word you know well and for which you can write an accurate example and definition. Your definition and example must relate to the unit of study.
3. Place a ☑ next to any words for which you can write either a definition or an example, but not both.
4. Put a – next to words that are new to you.

This chart will be used throughout the unit. By the end of the unit you should have the entire chart completed. Because you will be revising this chart, write in pencil.

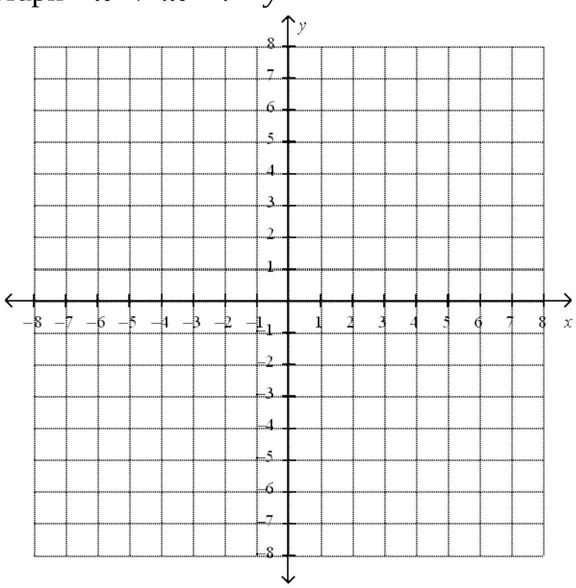
Unit 7, Activity 10, Graphing Quadratic Equations

1. Graph $x^2 + 3x + 2 = y$



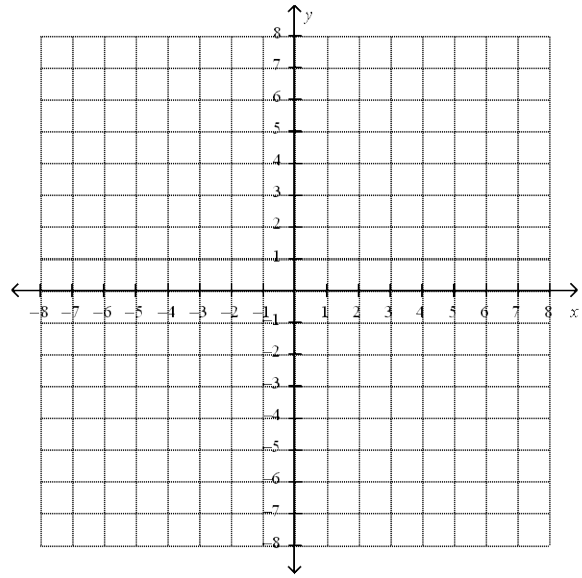
a. Determine the axis of symmetry: ______
b. Determine the vertex: _______
c. Name the solution(s) to
$x^2 + 3x + 2 = 0$: _________

2. Graph $-x^2 + 4x - 4 = y$



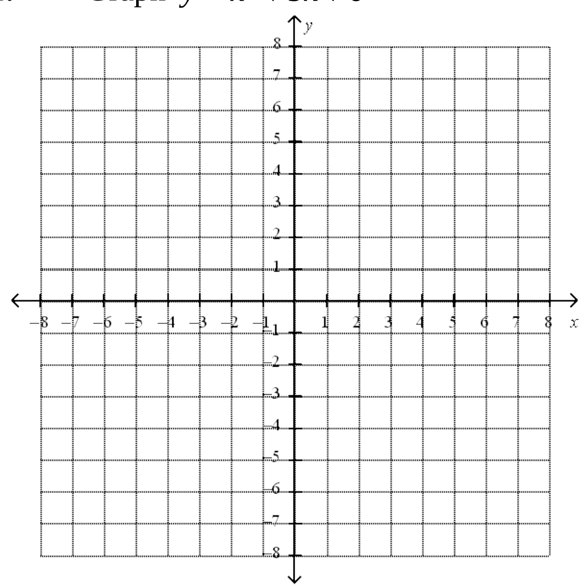
a. Determine the axis of symmetry: ______
b. Determine the vertex: ______
c. Name the solution(s) to
$-x^2 + 4x - 4 = 0$: _________

3. Graph $y = x^2 + 3$



a. Determine the axis of symmetry: _____
b. Determine the vertex: ______
c. Name the solution(s) to
$0 = x^2 + 3$: _________

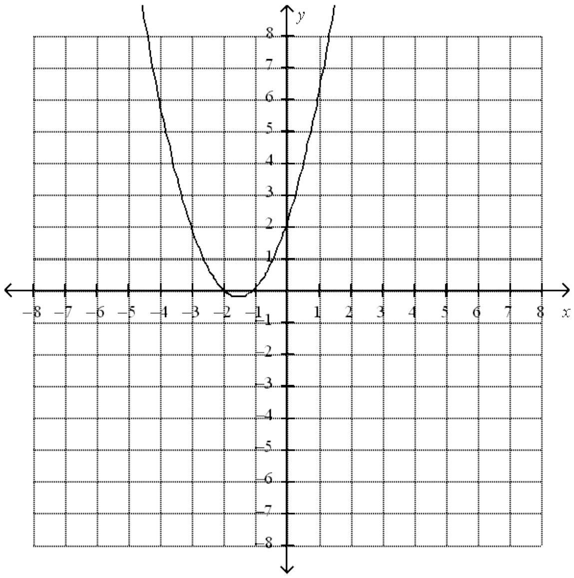
4. Graph $y = x^2 + 5x + 6$



a. Determine the axis of symmetry: ______
b. Determine the vertex: _________
c. Name the solution(s) to
$0 = x^2 + 5x + 6$: _________

Unit 7, Activity 10, Graphing Quadratic Equations with Answers

1. Graph $x^2 + 3x + 2 = y$



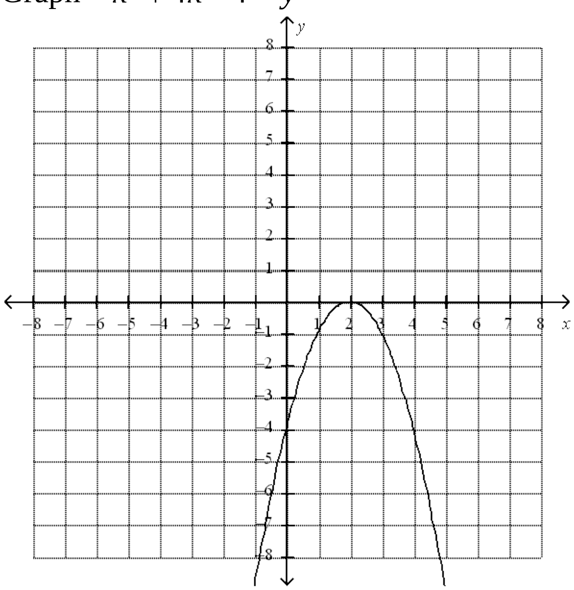
a. Determine the axis of symmetry: _*x = -1*_

b. Determine the vertex: ***(** -1.5, -.25 **)***

c. Name the solution(s) to

$x^2 + 3x + 2 = 0$: *(-2, 0) (-1, 0)*

2. Graph $-x^2 + 4x - 4 = y$



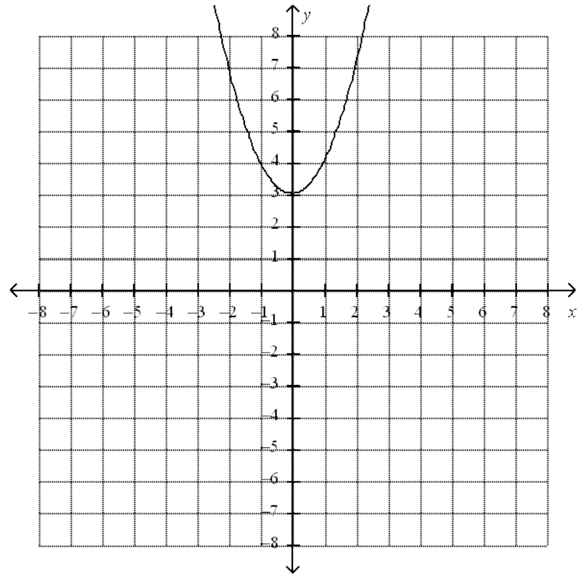
a. Determine the axis of symmetry: _*x = 2*_

b. Determine the vertex: *(2, 0)*

c. Name the solution(s) to

$-x^2 + 4x - 4 = 0$: *(2, 0)*

3. Graph $y = x^2 + 3$



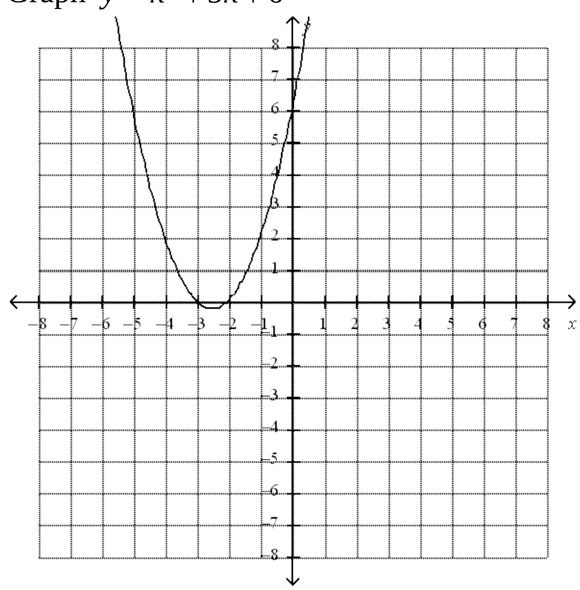
a. Determine the axis of symmetry: _*x = 0*_

b. Determine the vertex: *(0, 3)*

c. Name the solution(s)

$0 = x^2 + 3$: *(No real solution)*

4. Graph $y = x^2 + 5x + 6$



a. Determine the axis of symmetry: _*x = -2.5*_

b. Determine the vertex: ***(** -2.5, -.25)*

c. Name the solution(s) to

$0 = x^2 + 5x + 6$: *(-3, 0) (-2,0)*