How do you find the measure of various angles associated with parts of a circle?

Determine the location of the vertex

Vertex at Center
- Made by 2 radii
- **The angle equals the intercepted arc**

Vertex on Circle
- Made by 2 chords, a chord & tangent, or a secant & tangent
- **The angle equals half of the intercepted arc**

Vertex inside Circle
- Made by 2 chords
- **The angle equals half the sum of the intercepted arcs**

Vertex outside Circle
- Made by 2 secants, a secant & tangent, or 2 tangents
- **The angle equals half the difference of the intercepted arcs**

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by
Dale Graham and
Linda Meyer
Thomas County
Central High
School
Thomasville, Ga.

How do you find the measure of various angles associated with parts of a circle?

Determine the location of the _____

Vertex

Made by

The angle equals

Vertex

Made by

The angle equals

Vertex

Made by

The angle equals

Vertex

Made by

The angle equals

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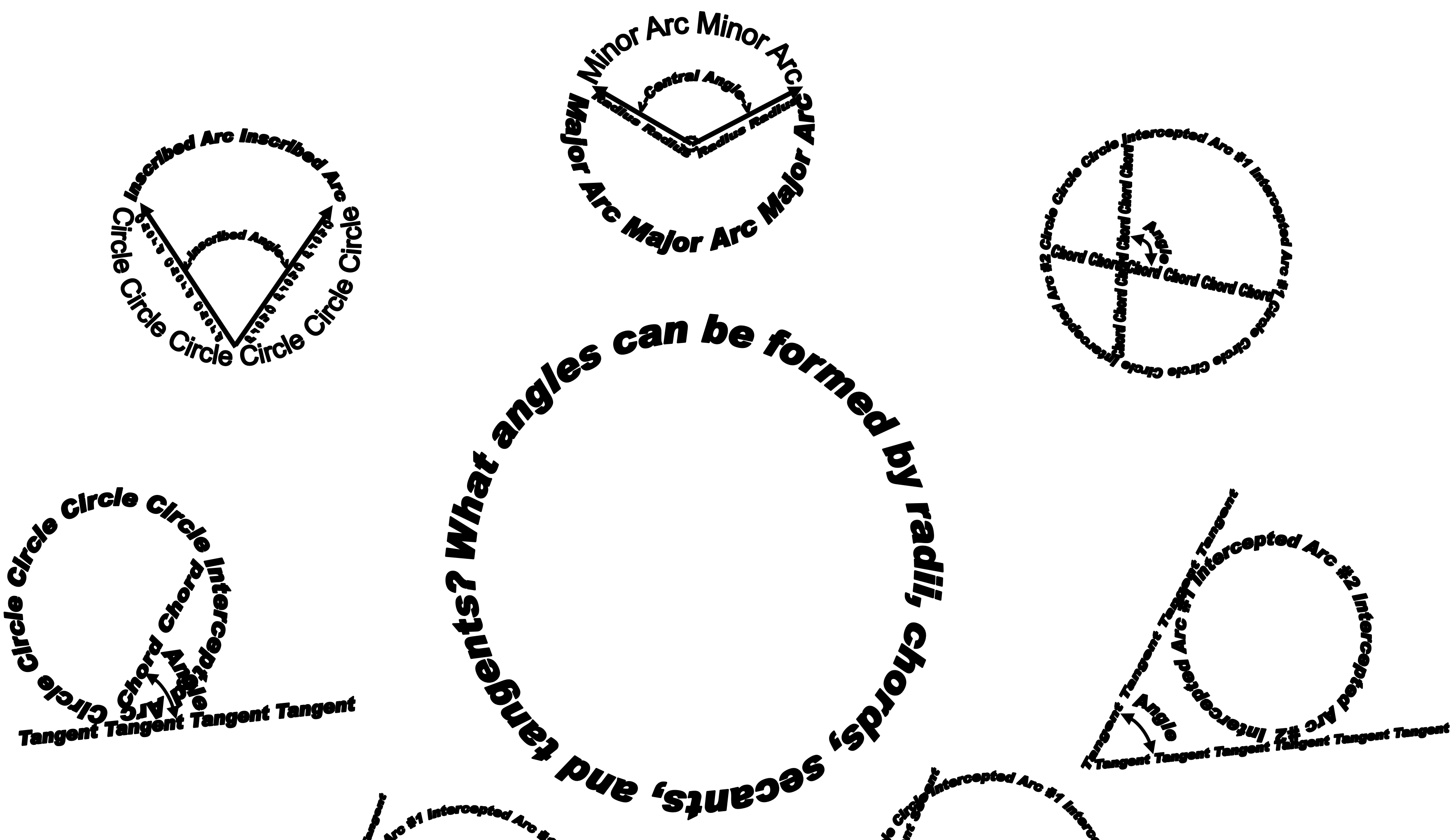

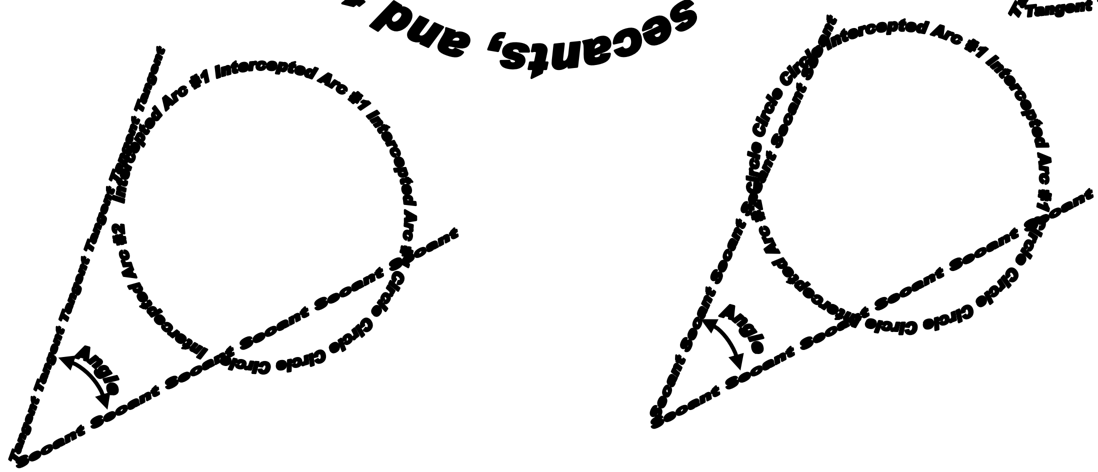

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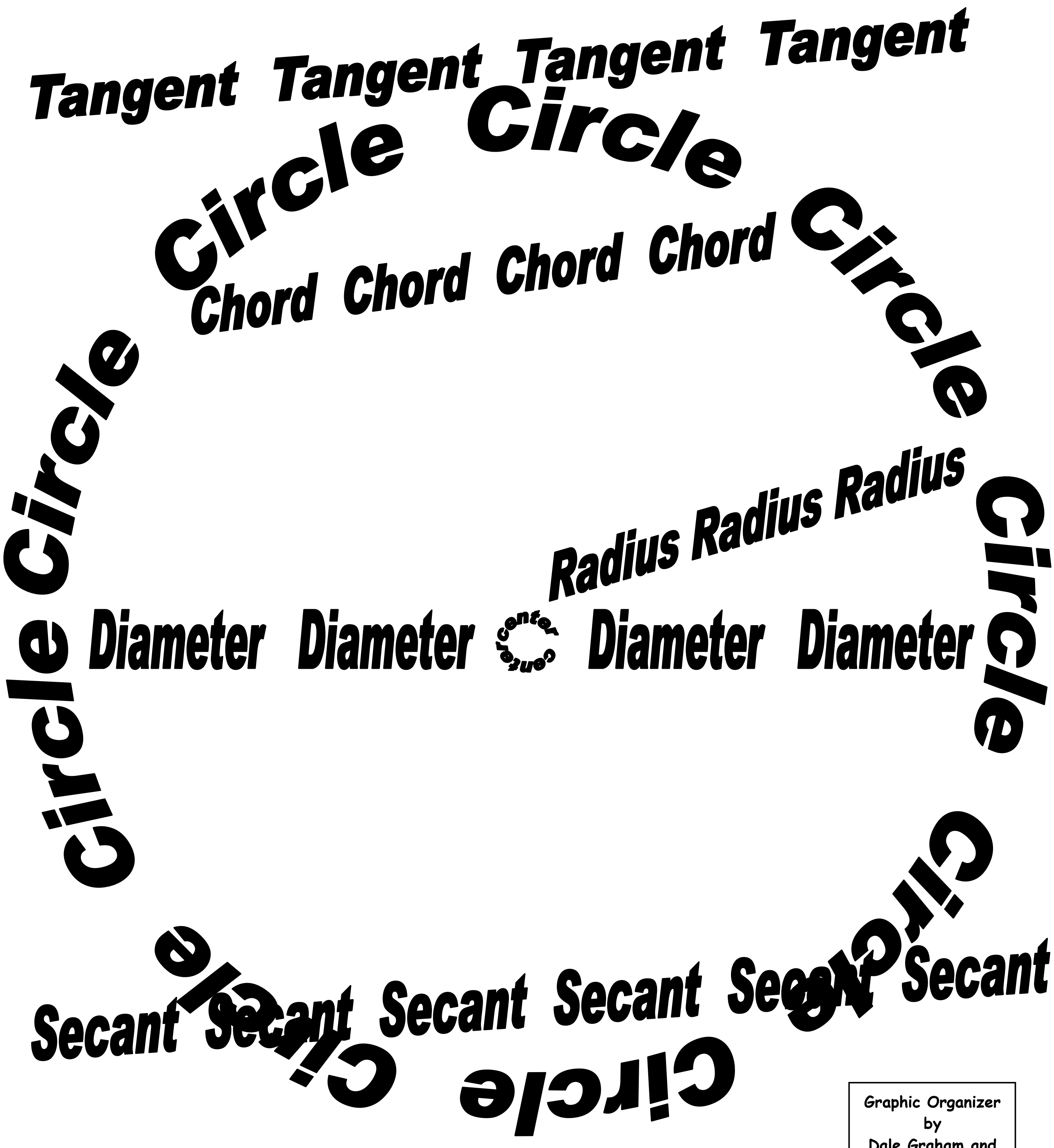
What lines and line segments are associated with a circle?



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Completing the Square: Circle Equations

The technique of completing the square is used to turn a quadratic into the sum of a squared binomial and a number: $(x - a)^2 + b$. The center-radius form of the circle equation is in the format $(x - h)^2 + (y - k)^2 = r^2$, with the center being at the point (h, k) and the radius being "r". This form of the equation is helpful, since you can easily find the center and the radius.

But circle equations are often given in the general format of $ax^2 + by^2 + cx + dy + e = 0$, When you are given this general form of equation and told to find the center and radius of a circle, you will have to "complete the square" to convert the equation to center-radius form. This lesson explains how to make that conversion.

- **Find the center and radius of the circle having the following equation:**
  $4x^2 + 4y^2 - 16x - 24y + 51 = 0$.

Here is the equation they've given you.	$4x^2 + 4y^2 - 16x - 24y + 51 = 0$
Move the loose number over to the other side.	$4x^2 + 4y^2 - 16x - 24y = -51$
Group the *x*-stuff together. Group the *y*-stuff together.	$4x^2 - 16x + 4y^2 - 24y = -51$
Whatever is multiplied on the squared terms (it'll always be the same number), divide it off from every term.	$x^2 - 4x + y^2 - 6y = -\frac{51}{4}$
This is the complicated step. You'll need space inside your groupings, because this is where you'll add the squaring term. Take the *x*-term coefficient, multiply it by one-half, square it, and then add this to both sides of the equation, as shown. Do the same with the *y*-term coefficient. Convert the left side to squared form, and simplify the right side.	$(x^2 - 4x \quad) + (y^2 - 6y \quad) = -\frac{51}{4}$ $-2 \to +4 \qquad -3 \to +9$ $(x^2 - 4x + 4) + (y^2 - 6y + 9) = -\frac{51}{4} + 4 + 9$ $(x - 2)^2 + (y - 3)^2 = \frac{1}{4}$
Read off the answer from the rearranged equation.	The center is at $(h, k) = (x, y) = (2, 3)$. The radius is $r = \text{sqrt}(1/4) = 1/2$

Completing the square to find a circle's center and radius always works in this manner. Always do the steps in this order, and each of your exercises should work out fine. (Also, if you get in the habit of always working the exercises in the same manner, you are more likely to remember the procedure on tests.)

Warning: Don't misinterpret the final equation. Remember that the circle formula is $(x-h)^2 + (y-k)^2 = r^2$. If you end up with an equation like $(x+4)^2 + (y+5)^2 = 5$, you have to keep straight that h and k are *subtracted* in the center-radius form, so you really have $(x-(-4))^2 + (y-(-5))^2 = 5$. That is, the center is at the point $(-4, -5)$, not at $(4, 5)$. Be careful with the signs; don't just "read off the answer" without thinking. Also, remember that the formula says "r^2", not "r", so the radius in this case is $sqrt(5)$, not 5.

In the course of the above procedure, about the only other thing that can be a problem is forgetting the sign on the step where you multiply by one-half. Warning: If you drop a negative, you'll get the wrong answer for the coordinates of the center, so be careful of this. Don't try to do this step in your head: write it out!

Here's one more example of how completing the square works for circle equations:

- **Find the center and radius of the circle with the following equation:**
  $100x^2 + 100y^2 - 100x + 240y - 56 = 0$.

This is the given equation.	$100x^2 + 100y^2 - 100x + 240y - 56 = 0$
Move the loose number over to the other side.	$100x^2 + 100y^2 - 100x + 240y = 56$
Group the x-stuff and y-stuff together.	$100x^2 - 100x + 100y^2 + 240y = 56$
Divide off by whatever is multiplied on the squared terms.	$x^2 - x + y^2 + \frac{12}{5}y = \frac{14}{25}$
Take the coefficient on the x-term, multiply by one-half, square, and add inside the x-stuff and also to the other side. Do the same with the y-term.	$\left(x^2 - x \qquad\right) + \left(y^2 + \frac{12}{5}y \qquad\right) = \frac{14}{25}$
Convert the left-hand side to squared form, and simplify the right-hand side.	$\left(x - \frac{1}{2}\right)^2 + \left(y + \frac{6}{5}\right)^2 = \frac{9}{4}$
If necessary, fiddle with signs and exponents to make your equation match the circle equation's format.	$\left(x - \frac{1}{2}\right)^2 + \left(y - \left(-\frac{6}{5}\right)\right)^2 = \left(\frac{3}{2}\right)^2$
Read off the answer.	The center is at ($^1/_2$, $-^6/_5$) and the radius is $^3/_2$.

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Math 3 Exponential and Logarithmic Functions Name ___________________

Find the inverse of the function

1. $f(x) = 2x^3 - 4$

2. $f(x) = \sqrt[4]{x+2}$

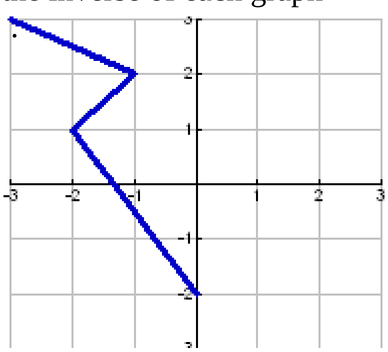
Determine whether the functions are inverses. If not show why.

3. $f(x) = \frac{1}{2}x + 4 \qquad g(x) = 2x + 8$

4. $f(x) = \sqrt{2x+1} \qquad g(x) = \frac{x^2 - 1}{2}$

Sketch the inverse of each graph

5.



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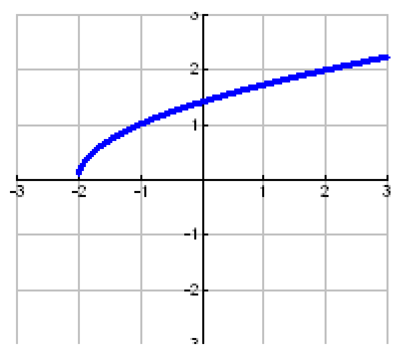

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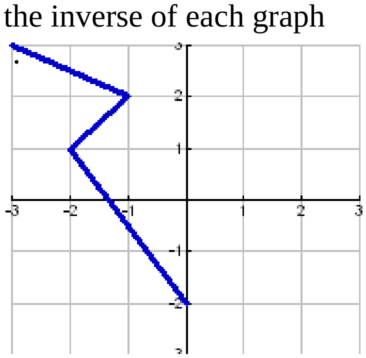

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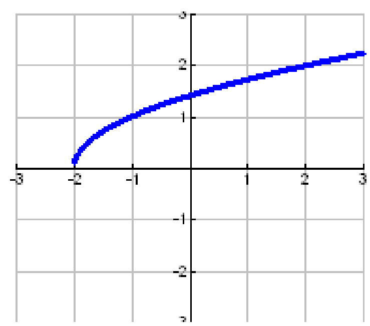


Name________________________
Date_____________Period______

Lab: Review of Inverses

In Math 2 you learned all about inverses.

1. You learned to find inverses algebraically. Find an inverse is as easy as 1-2-3.
    1. Rewrite $f(x)$ as $y =$ (if necessary).
    2. Switch *x* and *y*.
    3. Solve for *y* using inverse operations.

Find the inverse of each (or find $f^{-1}\ x$ of each):

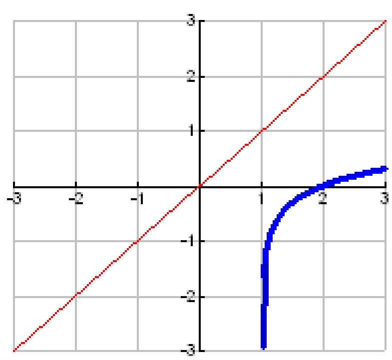
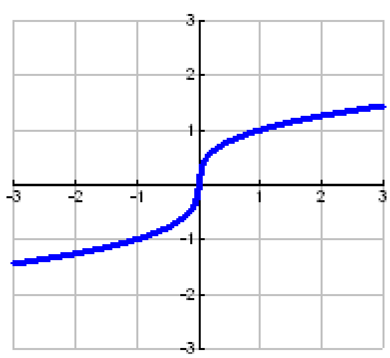
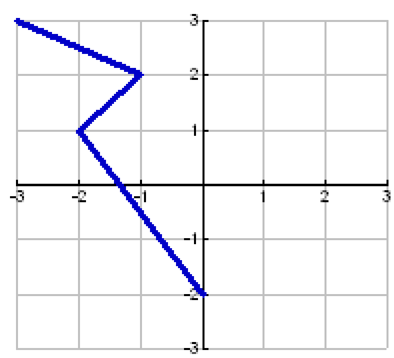
Example 1	Example 2	Example 3
$f(x) = 2x - 6$	$y = 2x^2 + 12$	$f(x) = \sqrt{2x+3} + 4$

Find the inverse of each:

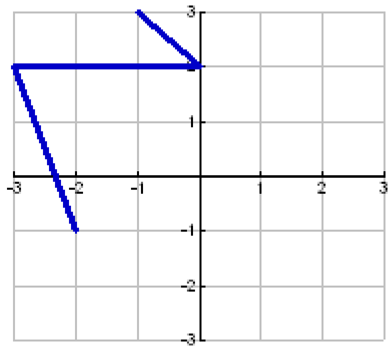
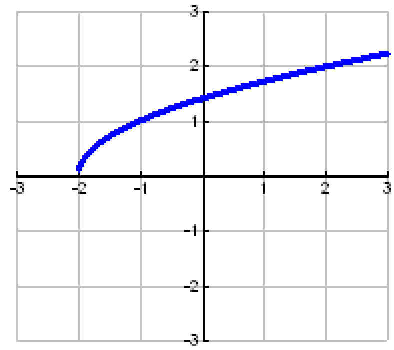
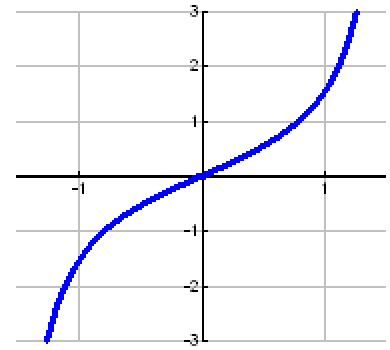
$y = \sqrt{\frac{1}{2}x + 3}$	$y = 3x + 5$	$f(x) = 3x^4 - 24$	$f(x) = \sqrt[3]{x-4} + 10$	$y = \frac{2}{5}x^2 - 3$

2. Next you learned to find the inverse graphically. If two functions are inverses of each other then the graphs are symmetric with respect to the line *y*=*x*.

Sketch the inverse of each.

Example 1	Example 2	Example 3
		

Sketch the inverse of each.

3. Finally you learned to verify if two functions are inverses using composite functions. For two functions to be inverses **both** of the following statements must be true.
    1. $f(g(x)) = x$
    2. $g(f(x)) = x$

Verify that $f(x)$ and $g(x)$ are inverses **using composite functions**.

Example 1	Example 2	Example 3
$f(x)=\frac{1}{2}x+3$ $g(x)=2x-6$	$f(x)=\sqrt{x-2}+5$ $g(x)=(x-5)^2+2$	$f(x)=3x^5$ $g(x)=\sqrt[5]{\frac{x}{3}}$

Verify that $f(x)$ and $g(x)$ are inverses **using composite functions**. If they are not inverse just state not inverses.

$f(x)=\sqrt[3]{x+5}$ $g(x)=\ x-5\ ^{3}$	$f(x)=x^2+5$ $g(x)=\sqrt{x-5}$	$f(x)=4x-15$ $g(x)=\frac{x+15}{4}$

Inverse Functions **Name:____________________**

Math 3 **Date:______________________**

Find the inverse of each function.

1.) $f(x) = 2x + 5$

2.) $f(x) = 3x + 7$

3.) $y = 3 - x$

4.) $f(x) = x^5$

5.) $f(x) = x^2 + 5$

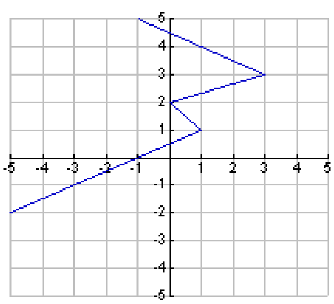
6.) $f(x) = (x-2)^3 + 5$

7.) $f(x) = \sqrt{x} + 5$

8.) $f(x) = \sqrt[4]{x-1}$

Find the inverse of each function.

9.)



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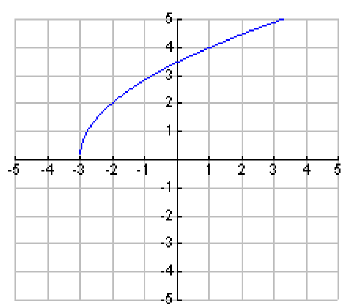

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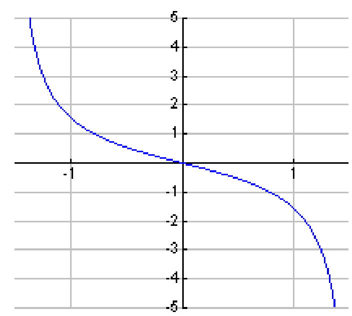

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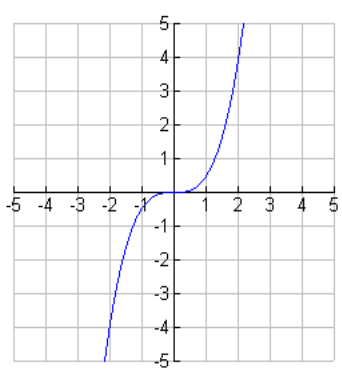

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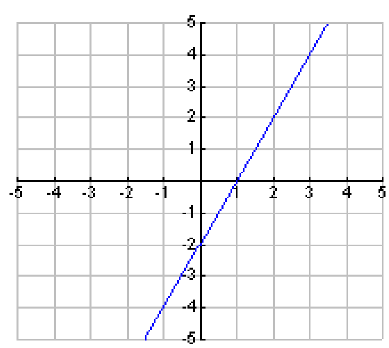
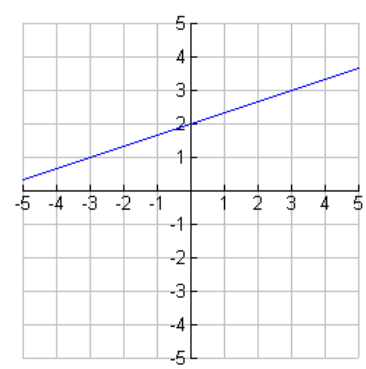


15.)



Determine whether each pair of functions are inverse functions using composite functions.

9.) $f(x) = 3x - 5$

$g(x) = \frac{x+5}{3}$

10.) $f(x) = x - 10$

$g(x) = x + 10$

11.) $f(x) = \frac{2x-3}{5}$

$g(x) = \frac{3x-5}{3}$

12.) $f(x) = 2x$

$g(x) = \frac{2}{x}$

13.) $f(x) = 3x - 7$

$g(x) = \frac{1}{3}x + 7$

14.) $f(x) = 4(x+2)$

$g(x) = \frac{x}{4} - 2$

Writing Roots as Exponents & Simplifying Algebraic Expressions

Thursday, December 16, 2010

Review: Exponents

- We know that exponents can be written in another form.

$$3^4 = 3 \cdot 3 \cdot 3 \cdot 3$$

- We also know we can go the other way

$$5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 = 5^7$$

Review of Exponents

- 1. Any base b raised to the zero power is 1.

$$b^0 = 1$$

- 2. Rewrite negative exponents.

$$b^{-n} = \frac{1}{b^n}$$

- 3. Rewrite negative exponents.

$$\frac{1}{b^{-n}} = b^n$$

- Exponents do not just have to be integers.
- How can I rewrite an exponent if it has a fraction (rational number) as the power?

It becomes a nth root!!

Rule: Exponential to Radical

0011

$$b^{\frac{m}{n}} = \sqrt[n]{b^m}$$

Example(s) One:

Problem	Exponential Notation	Radical Notation
1	$3^{\frac{4}{5}}$	
2	$8^{\frac{1}{3}}$	
3	$5^{\frac{1}{7}}$	
4	$7^{\frac{1}{2}}$	
5	$3^{\frac{2}{3}}$	

- In math we like to go forwards and backwards….
- In the last example we changed from a fractional exponent to a root
- Now lets go from a root to a fractional exponent

Rule: Radical to exponential

$$\sqrt[n]{b^m} = b^{\frac{m}{n}}$$

Example(s)

Two:

Problem	Radical Notation	Exponential Notation
1	$\sqrt[6]{x^5}$	
2	$\sqrt{3}$	
3	$\sqrt{7^2}$	
4	$\sqrt[3]{15}$	
5	$\sqrt[5]{g}$	

Rule: Exponential to Radical

$$b^{\frac{m}{n}} = \sqrt[n]{b^m} = \left(\sqrt[n]{b}\right)^m$$

All 3 of these are equivalent

This part we just learned

We are going to add to this

This will help us simplify algebraic expressions

Simplify each:

Without a calculator. There is a calculator and non-calculator portion of the test.

Example(s) Three:

$\sqrt[3]{1}$	
$\sqrt[3]{8}$	
$\sqrt[3]{64}$	
$\sqrt[4]{81}$	
$(-27)^{\frac{1}{3}}$	
$\left(\sqrt[4]{81}\right)^{2}$	
$(36)^{-\frac{3}{2}}$	
$(-125)^{\frac{2}{3}}$	
$(-32)^{-\frac{2}{5}}$	
$(16)^{\frac{1}{4}}$	

Simplify each:

With a calculator. Round decimal to the hundredths place

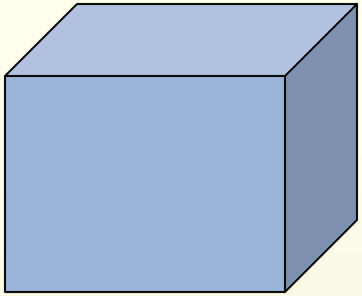
0011

Example(s)
Four:

$6^{\frac{1}{2}}$	
$(-3)^{\frac{2}{3}}$	
$\sqrt[3]{21}$	
$\sqrt[5]{3^2}$	

Example Five:

The cube below has a volume of 343 cubic inches. Find the length of an edge of the cube.



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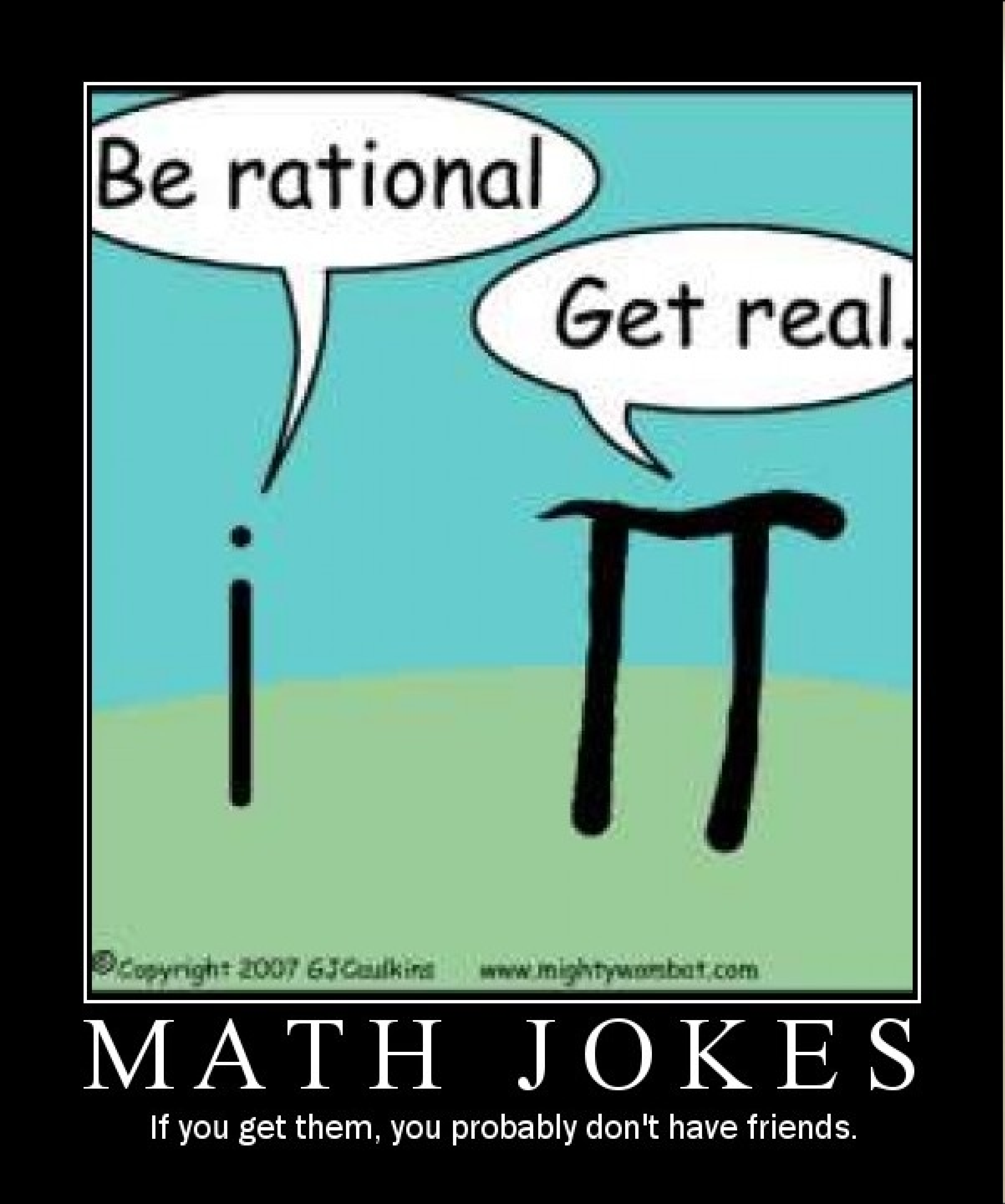
Example Six:

The volume of a basketball is approximately 448.9 cubic inches. Use the formula $V = \frac{4}{3}\pi r^3$ for the volume *V* of a sphere to estimate the radius *r* of the basketball.



What is tomorrows TOD?

Properties of Rational Exponents (Using the properties to simplify)

Properties of Rational Exponents

Product of Powers	$a^m \cdot a^n$	
Power of Power	$(a^m)^n$	
Power of Product	$(ab)^m$	
Negative Exponents	a^{-m}	
Zero Exponent	a^0	
Quotient	$\frac{a^m}{a^n}$	
Power of Quotient	$\left(\frac{a}{b}\right)^m$	

Example(s) One

Use properties of rational exponents to simplify the expression.

A. $9^{\frac{1}{2}} \cdot 9^{\frac{3}{4}}$

B. $\left(7^{\frac{2}{3}} \cdot 5^{\frac{1}{6}}\right)^{3}$

C. $\dfrac{3^{\frac{5}{6}}}{3^{\frac{1}{3}}}$

D. $\left(\dfrac{16^{\frac{2}{3}}}{4^{\frac{2}{3}}}\right)^{4}$

Practice

Use properties of rational exponents to simplify the expression.

A. $x^{\frac{1}{3}} \cdot x^{\frac{4}{3}}$

B. $\left(x^{\frac{5}{6}}\right)^{-3}$

C. $\dfrac{7^{\frac{3}{5}}}{7^{\frac{2}{3}}}$

D. $\left(\dfrac{64}{x}\right)^{\frac{2}{3}}$

Properties of Radicals

Product	$\sqrt[n]{a \cdot b}$	
Quotient	$\sqrt[n]{\frac{a}{b}}$	

Example(s) Two

Write in simplest form

A. $\sqrt[5]{27} \cdot \sqrt[5]{9}$

B. $\dfrac{\sqrt[3]{192}}{\sqrt[3]{3}}$

Practice

Write in simplest form

A. $$\frac{\sqrt{10}\cdot\sqrt{21}}{\sqrt{15}}$$

B. $$\frac{\sqrt[4]{162}}{\sqrt[4]{2}}$$

Example(s) Three

Write in simplest form

A. $\sqrt[5]{128}$

B. $\sqrt[4]{162}$

C. $\sqrt[3]{\dfrac{5}{9}}$

Practice Write in simplest form

A. $\sqrt[3]{81}$

B. $\sqrt[5]{1701}$

C. $\sqrt[3]{\frac{3}{5}}$

Example(s) Four Write in simplest form

A. $2(12^{\frac{2}{3}}) + 7(12^{\frac{2}{3}})$

B. $\sqrt[4]{48} - \sqrt[4]{3}$

Practice

Write in simplest form

A. $\sqrt[3]{250} - \sqrt[3]{2}$

B. $6\sqrt[4]{6} + 2\sqrt[4]{6}$

Example(s) Five

Write in simplest form

A. $\sqrt[5]{32x^{15}}$

B. $\left(36m^{4}n^{10}\right)^{\frac{1}{2}}$

C. $\sqrt[3]{\frac{a^{9}}{b^{6}}}$

Practice Write in simplest form

A. $\sqrt[3]{8x^3y^6z^4}$

B. $\sqrt{\dfrac{x^3}{x^4}}$

C. $\dfrac{\sqrt[3]{x^3y^2z^7}}{\sqrt[3]{xy^4}}$

Example(s) Six

Write in simplest form

A. $\dfrac{5}{h-\sqrt{t}}$

Try One

A. $\dfrac{6}{x+\sqrt{y}}$

The First Taste of Exponentials

In this task, you will be collecting growth and decay data using M&M candies. Begin by collecting the data for parts A and B of the task. Then go back and answer the questions. You may work together in a group but each of you will have your own data set, and thus your own answers. Finally, in part C, write a summary of the main components of the exponential equation $y = ab^x + k$.

Part A: Exponential Growth

1. Begin with one M&M candy in your shaking cup. Each roll consists of the following actions.

   Shake up the candies in your cup and turn them out onto the plate. For each candy that is showing an M, add a candy from your supply cup. Record the total number of candies on the plate in the table below. Put all the candies on the plate into your shaking cup. End of roll.

   Continue the rolls until you have done 10 rolls, or you have a total of 50 candies recorded, whichever comes first.

Roll	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Total Number of Candies										

2. a. Enter the data into your calculator, and plot it. Describe the trend of the data.

   b. Write an exponential equation to model your data. (Assume k = 0) Paste a graph link picture of your equation on top of your data in the space below.

3. a. Using your exponential model, how many candies would you have at the end of 25 rolls?

b. How many rolls would your model require to accumulate 1,000,000 candies?

4. a. What is the practical meaning for B in your exponential equation? (Hint: It's related to rolling M&M's)

b. What is the practical meaning of A? Why is it the sign it is?

5. a. Using your developed exponential growth equation, write the equation in logarithmic form.

b. How can this equation be used to answer question 3b?

c. Show how you would solve your logarithmic equation to determine how many rolls would be needed to reach 3,500,000 candies. How many rolls?

6. Write a paragraph describing the general $y = \log_b x$ function and explain each variable and how it relates to exponential functions.

Part B

1. This time, start with 35 candies in your cup. Each roll consists of the following actions:

   Shake the candies in the cup and roll them out onto the plate. Remove each candy that shows an M. Count the remaining candies on your plate, and record that number in the table below. Put the candies on the plate back into your shaking cup. End of Roll.

   Continue the rolls until there is one candy left, or you reach 10 rolls, whichever comes first.

Roll	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Total Number of Candies										

2. a. Enter the data into your calculator, and plot it. Describe the trend of the data.

   b. Write an exponential equation to model your data. (Assume k = 0) Paste a graph link picture of your equation on top of your data in the space below.

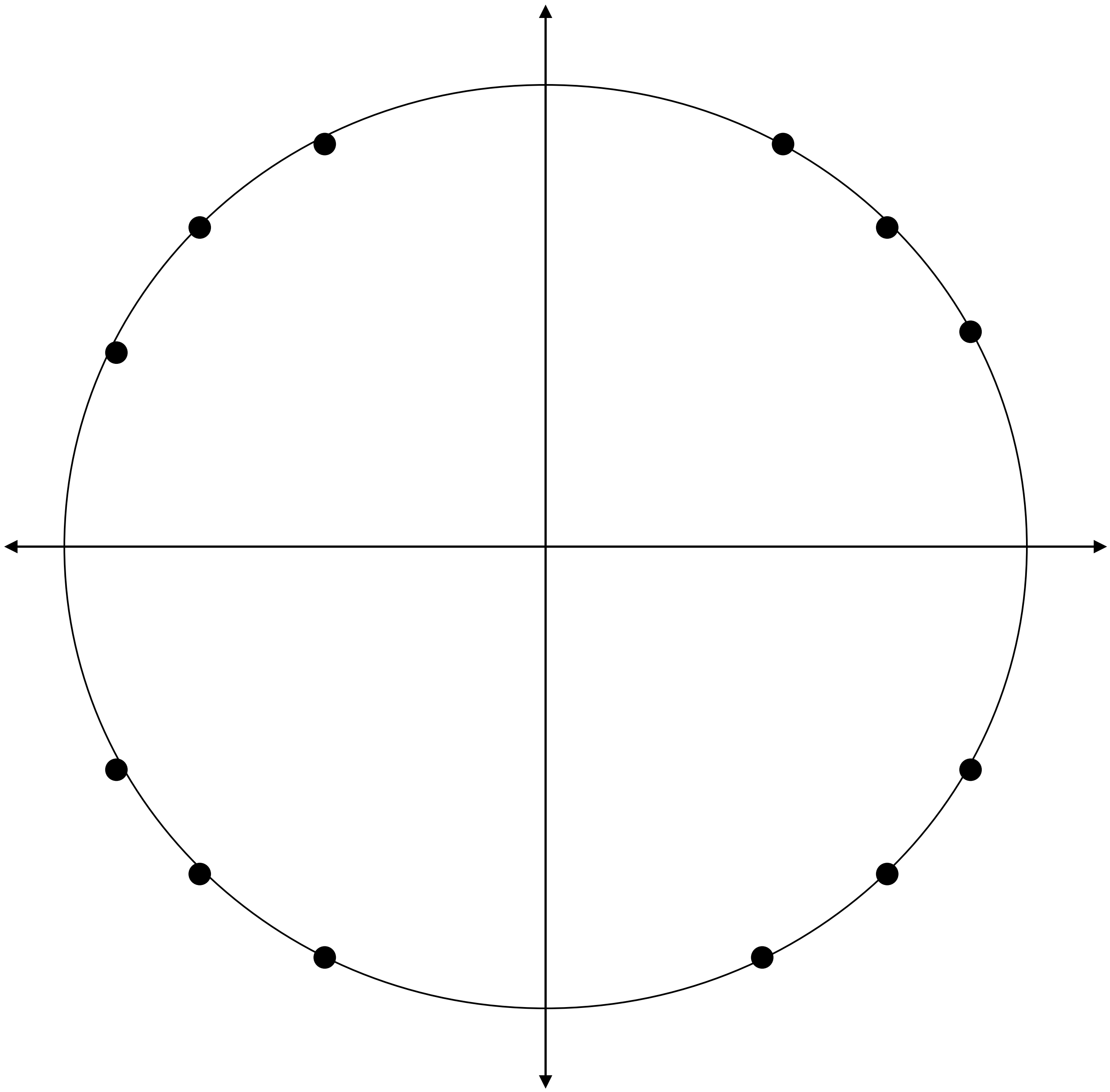
3. a. What is the practical meaning for B in your exponential equation? (Hint: It's related to rolling M&M's)

   b. What is the practical meaning of A? Why is it the sign it is?

Part C

Write a paragraph that details the parts of the exponential equation $y = ab^x + k$. **In terms of the graph**, what does a mean? What does the sign of a mean? What does b mean? What would change, if $k \neq 0$?

What are the most common ordered pairs on the Unit Circle?



Graphic Organizer by Dale Graham and Linda Meyer
Thomas County Central High School; Thomasville GA

The Vertical Motion Lab

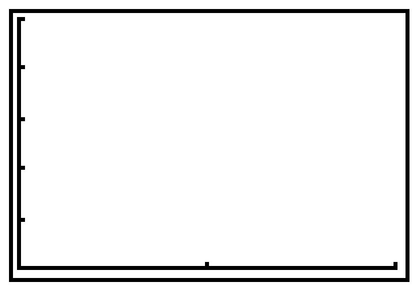
The purpose of the lab is to collect data on a falling object, create quadratic models to represent the data, and analyze the data using those models.

The Data

1. A ball is dropped from a height of 5 feet from the ground, and the data is recorded into your calculator. The time is stored in L_1 and the height is in L_2. State the units used for each list.

2. The data in L_1 does not start at 0 (due to the data collection process), so you need to adjust the time. At the top of L_1, enter the formula $L_1 – L_1(1)$ and press [ENTER]. The list should now start at 0.

3. Create a scatter plot of the data, and sketch your graph in the window provided.



4. Does the data appear linear, exponential, or quadratic?

Your Model Equation

5. State the vertical motion model discussed in class.

6. What is the initial velocity and initial height in this experiment? Be sure to include units in your answer.

7. Use the information in Step 6 to create an equation to model the data. State the model.

8. Graph your model equation along with the scatter plot. Does your equation model the data well? Explain.

The Regression Model

9. Use the TI-83 to perform a quadratic regression for the data, then state the model.

10. In this model, what should *a* represent?

11. In this model, what should *b* represent?

12. In this model, what should *c* represent?

13. Are the values for *a*, *b*, and *c* what you expect. Explain.

14. Graph the regression model equation along with the scatter plot. Does it model the data well? Explain.

The Analysis

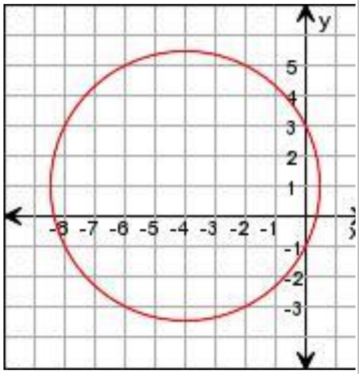
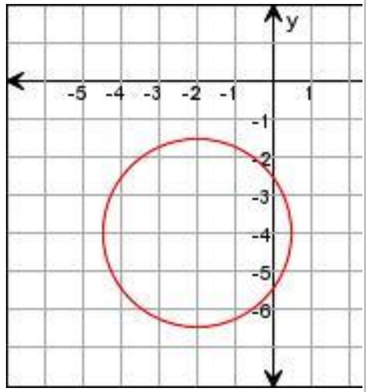
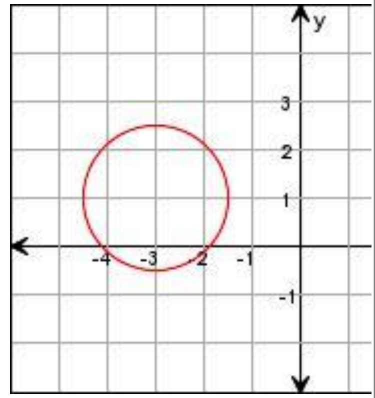
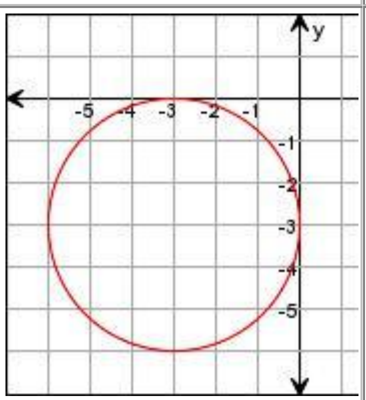
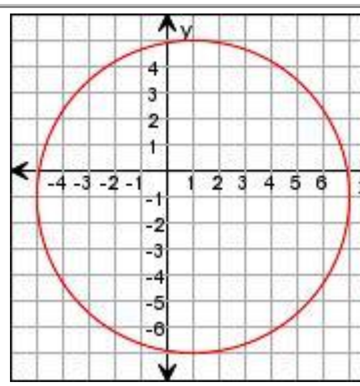
15. Which equation seems to model the data better, yours or the TI-83's?

16. Use the regression model to find how long the ball was in the air.

17. Use your model to find how long the ball was in the air.

18. Neither model equation was perfect. What factors could have caused this?

Write the standard equation for each circle.

1. 	2. 	3. 
4. 	5. 	6.