Algebra 1: ***Hutschenreuter*** **Name ______________________________**
Chapter 9 Notes

9.1 "Solving Quadratic Equations by Finding Square Roots"

*All positive, REAL numbers have ***2 square roots when solving an equation***: a positive square root and a negative square root.
Ex 1: If $x^2 = 9$ what could x be? $(\ \_\ )^2 = 9$ and $(\ \_\ )^2 = 9$ so x could be **x =** **or** **x =**

Radicand: the expression inside a square root symbol
Given √9…9 is the radicand

- We write √9 = ±3 to save time (only ± if solving an equation)
- Zero has only one square root-zero itself
- Negative numbers do not have real square roots
  (i.e √-3 is NOT REAL…it is imaginary! This is Algebra II stuff!)

Perfect Squares: numbers whose square roots are integers or quotients of integers

Ex 2: $\sqrt{\frac{4}{9}} =$ Ex 3: $\sqrt{16} =$

Ex 4: $\sqrt{7} =$ Ex 5: $-\sqrt{11} =$ Ex 6: $\sqrt{36} =$

Ex 7: $\sqrt{-25} =$ Ex 8: $\sqrt{0} =$ Ex 9: $\sqrt{\frac{16}{64}} =$

Radical Expression: an expression involving square roots

- A square root is a "grouping symbol", so operations inside the square root must be performed first!

Ex 10: $\frac{3+\sqrt{10-6}}{21}$

Ex 11: $\sqrt{b^2-4ac}$ evaluate when a = -2, b = -8, and c = 3

Use a calculator to evaluate the expressions. Round the answers to the nearest hundredth.

Ex 12: $\frac{6\pm4\sqrt{2}}{-1}$ Ex 13: $\frac{3\pm4\sqrt{5}}{4}$

Quadratic Equation In Standard Form

$$ax^2 + bx + c = 0$$

-Has an "x^2"
-May or may not have an "x" or a constant
-Properly written in descending order
-The "a" value is the leading coefficient, $a \neq 0$

When b = 0, the equation becomes $ax^2 + c = 0$

How to solve $ax^2 + c = 0$

1st: Isolate the x^2 term on one side

2nd: Take the square root √ of both sides; place ± in front of the square root … ±√

Ex 14: $x^2 - 25 = 0$

Ex 15: $x^2 + 7 = 0$

Ex 16: $6x^2 - 54 = 0$

Ex 17: $x^2 - 3 = 0$

Falling Object Model:

When an object is dropped, the speed it falls continues to increase

The height can be approximated by the following model:

$\mathbf{h = -16t^2 + s}$

h = height in feet
t = number of seconds object has fallen
s = initial height of object

Ex 18:

In physical science class students have an egg dropping contest. The goal is to create a container for an egg to be dropped from 32 feet without breaking the egg. How long will it take for the egg container to hit the ground?

height = -16(time)^2 + initial height   h =

Time (sec)	0.0	1.0	1.1	1.2	1.3	1.4	1.5
Height (feet)							

9.2 "Simplifying Radicals"

<u>Product Property</u>- the square root of a product equals the product of the square roots of the factors

$\sqrt{ab} = \sqrt{a}\sqrt{b}$ when a and b are positive numbers

Ex 1: $\sqrt{9 \cdot 4} =$

<u>Quotient Property</u>- the square root of a quotient equals the quotient of the square roots of the numerator and denominator

$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$ when a and b are positive numbers

Ex 2: $\sqrt{\frac{9}{4}} =$

For an expression to be in simplest form, the following must be true:

1) No perfect square factors other than 1 are in the radicand

   Ex 3: $\sqrt{12} =$

2) No fractions are in the radicand

   Ex 4: $\sqrt{\frac{3}{49}} =$

3) No radicals appear in the denominator of a fraction

   Ex 5: $\frac{2}{\sqrt{16}} =$

Simplify the following radical expressions:
Suggestion: breakdown the radicand into two factors, where one of them is a perfect square (4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144 …)
Hint: use the biggest perfect square possible

Ex 6: $\sqrt{40} =$

Ex 7: $\sqrt{125} =$

Ex 8: $\frac{\sqrt{48}}{\sqrt{81}} =$

Ex 9: $3\sqrt{\frac{12}{6}} =$

Ex 10: $\sqrt{3}\sqrt{3} =$

Ex 11: $3\sqrt{63}\sqrt{2} =$

Ex 12: $-\sqrt{9} \cdot \frac{\sqrt{25}}{\sqrt{81}} =$

Ex 13: $\frac{\sqrt{12}\sqrt{36}}{\sqrt{3}} =$

9.3 "Graphing Quadratic Functions"

Quadratic Function: A function that can be written in the standard form $y = ax^2 + bx + c$, where $a \neq 0$

Parabola: the shape of the graph of a quadratic function, which looks like a "U" shape.

- If a is positive, the graph opens upward like a ___________ ☺
- If a is negative, the graph opens downward like a ___________ ☹

Vertex: The lowest point of a parabola that opens up

The highest point of a parabola that opens down

Axis of Symmetry: the line passing through the vertex that divides the parabola into two symmetric parts that are mirror images of each other

Important Features of Quadratic Functions:

- The equation in standard form is $y = ax^2 + bx + c$
- If $a > 0$, the parabola opens upward
- If $a < 0$, the parabola opens downward
- The vertex of the parabola always has an x-coordinate of $\frac{-b}{2a}$
- The axis of symmetry is the vertical line … $x = \frac{-b}{2a}$

Given the quadratic equation, tell whether the graph opens up or down. Write the equation of the axis of symmetry (AOS).

Ex1: $y = x^2 + 6x - 2$

Ex2: $y = 5x^2 - 3x + 2$

Ex3: $y = -x^2 + 8$

<u>Steps for Graphing Quadratic Functions</u>:

1) Write the equation in standard form: $y = ax^2 + bx + c$

2) Find the x-coordinate of the vertex & AOS = $-b/2a$

3) Make an x/y table of coordinates
*pick 2 x-values more than and 2 x-values less than the vertex x-coordinate

4) Plot the points and connect them with a smooth curve to form a parabola

*Remember if the a-value is positive you should have a "smile", if the a-value is negative you should have a "frown"

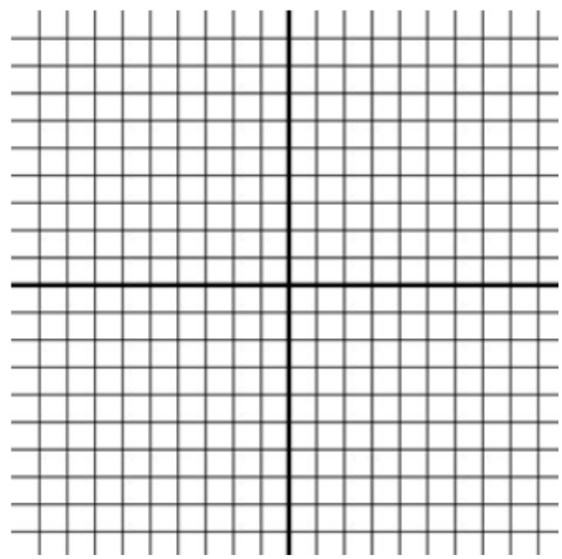
Ex 4: Graph $y = 5x^2 + 10x + 7$

The x-coordinate of the vertex =

Table

x	y

AOS: __________



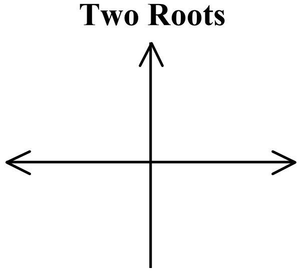
9.5 "Solving Quadratic Equations by the Quadratic Formula"

<u>Recall</u>: Quadratic equations look like $ax^2 + bx + c$

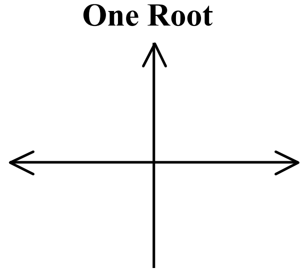
Where the graph crosses the x-axis are the x-intercepts
The x-intercepts are also called the __________ or ___________ of the function

A parabola can cross the x-axis twice, once, or not at all

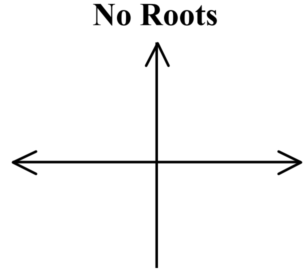
Two Roots



One Root



No Roots



*You can solve for the roots of a quadratic equation using the quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$ where a ≠ 0

*The ± part of the equation gives us two solutions, if the graph crosses the x-axis in two places…

Steps:

1) Write the equation in standard form ($ax^2 + bx + c$)
2) Plug the values for a, b, and c into the equation and solve for x!

Ex 1: Solve $2x^2 + 4x - 6 = 0$

Ex 2: Solve $3x^2 = 12$

Vertical Motion Models

Object is DROPPED: $\mathbf{h = -16t^2 + s}$

h = height t = time s = initial height

Object is THROWN: $\mathbf{h = -16t^2 + vt + s}$

v = initial velocity (feet/second)

v > 0 when moving upward v < 0 when moving downward

Ex 3: In a game of lawn darts the velocity is approximately -4 feet/sec when it leaves your hand, which is about 5 feet above ground. How long does it take for the lawn dart to hit the ground?

9.7 "Graphing Quadratic Inequalities"

Is the ordered pair a solution?

Ex 1: $y < x^2 - 3x - 2$ (3,-5)

Ex 2: $y > 4x^2 - 7x$ (2, -10)

<u>Graphing Quadratric Inequalities is just like graphing Linear Inequalities</u>:

1) Find the vertex, use the equation to make a table, and plot the points
2) Draw the parabola using a solid line (for $\geq$ or $\leq$) or a dashed line (for $<$ or $>$)
3) Test a point either inside the parabola or outside the parabola (but not on the line)
4) If the point is a solution, shade the region containing the point. If the point is NOT a solution, shade the opposite region

Ex 3: $y < x^2 + 3x + 2$

Find the AOS…remember $x = -b/2a$

x	y

AOS: _____________