# **Lesson Objectives**

* 1. Zero Product Property
  2. Solve by Factoring GCF
  3. Solve by Factoring into binomial factors
  4. Solve by Square Root Method
  5. Solve by the Quadratic Formula
  6. Using the Discriminant
  7. Solve by Graphing (find *x*-intercepts) on Calculator

# **Zero Product Property**

**If *a* ∙ *b* = 0, then either *a* = 0 or *b* = 0.**

* **EXAMPLE:** Solve. [\*Beecher 3.2.1]

By the Zero Product Property,

**Set each** factor (parentheses) **equal to zero**: or

Solve each equation.

(both are solutions) or

# Solve by **Factoring GCF**

* **EXAMPLE:** Solve the quadratic equation. [3.2-1]

**NEVER** divide by a variable….ever! Don’t do this: no, No, NO!!! Bad! Stop it!

Very illegal!

Set your equation **equal** to **ZERO**! (subtract 54*x*)

Then, you can **FACTOR out the GCF:** (GCF is 9*x*)

(GCF outside on the LEFT)

Now, use the **Zero Product Property**: or

Solve each equation:

**or**  (both are solutions)

# Solve by **Factoring into Binomial Factors**

* **EXAMPLE:** Solve the equation by factoring. [\*Blitzer 1.5.3-Setup & Solve]

Set your equation **equal** to **ZERO**! (subtract 3x and subtract 40)

→

Try to factor:

Open 2 sets of parentheses with variable in the first position:

=

Next, we need 2 integers whose SUM is -3 and whose PRODUCT is -40

|  |  |  |
| --- | --- | --- |
| To finish factoring, we need 2 numbers: | | |
| **Product = -40**  (opposite signs) | **Sum = -3**  (opposite signs means SUBTRACT) | **Winner?** |
|  |  | NO |
|  |  | NO |
|  |  | NO |
|  |  | YES. Use + 5 – 8 |

factors into:

Rewrite the equation in factored form

By the Zero Product Property, set each factor (parentheses) equal to zero:

or

So, or (both are solutions)

The solution set is .

# Solve by the **Square Root** Method

The **Square Root Method** is used when only the **SQUARED** term and the **CONSTANT** term are present. That is, the **Square Root Method** is used when your equation is of the form: .

There is no *x* term – only an *x*2 term and a constant term.

* **EXAMPLE:** Solve the quadratic equation. Check the answer. [3.2.5]

Because no “*x*” term, **ISOLATE** the **SQUARED** part: (add 256)

Continue to **ISOLATE** the **SQUARED** part: (divide by 4)

(take square root)

(What number could you square to get 64?)

**REALLY IMPORTANT!** Don’t forget the symbol! or

* **EXAMPLE:** Solve the following equation. [3.2.29]

First, **ISOLATE** the **SQUARED** part. (DONE!)

Take the **SQUARE ROOT** both sides:

Simplify square root, if needed. Don’t forget the “plus or minus”

Solve for *x* by subtracting 21:

(proper format is rational part first, followed by the irrational part)

Can also be written as:

# Solve by the **Quadratic Formula**

The **Quadratic Formula:** Given (with *a* ≠ 0)

the solutions are: or

Make sure you do the following:

* + - 1. Set your equation **EQUAL** to **ZERO**, if needed.
      2. Correctly identify the values for *a*, *b*, and *c*.
      3. Watch out for negatives! (Use parentheses)
* **EXAMPLE:** Solve the quadratic equation. [3.2-4]

Set your equation **equal** to **ZERO**! (subtracted 14)

You can try to factor first. If it doesn’t factor, use the **Quadratic Formula**.

NOTE: You can ALWAYS use Q.F. for ANY quadratic equation, even if other methods do (or don’t) work.

Use **Quadratic Formula**: with

Plug in your values:

Simplify inside the square root (no decimals!)

Simplify the square root itself:

(pairs and spares, Section R.7)

Now update the solution above:

The common denominator is 2. **PULL them APART!**

Reduce each fraction (ignore square root part)

The solutions are: or

Mrs. E! Is there…maybe…an EASIER way to do that last example? Let’s revisit it:

* **EXAMPLE:** Solve the quadratic equation. [3.2-4]

There is an interesting opportunity here! Look at just the LEFT side of the equation – do NOT set it equal to zero.

Let’s **factor** that.

Revisit the equation:

Put factored form on the LEFT. Use **square root** property.

Simplify. Don’t forget the symbol. Subtract 3.

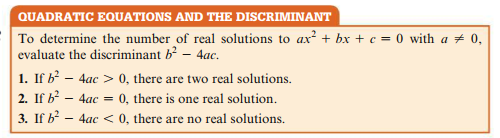
The solutions are: or

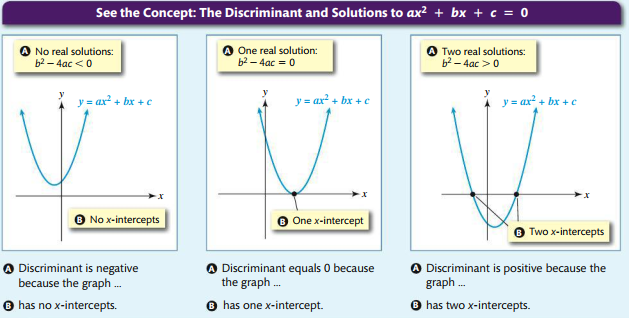
# Using the **Discriminant**

Recall the **Quadratic Formula:** Given (with *a* ≠ 0)

the solutions are:

The expression inside the square root (the *radicand*), the , is called the **discriminant**, which can determine the **number of solutions** to the quadratic equation.



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* **EXAMPLE:** Use the discriminant to determine the number of real solutions.

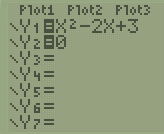
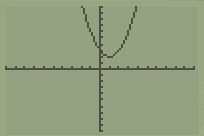
[3.2-29]

Since the discriminant (negative), the equation will have:

**NO** **real solutions**.

Another (easier?) way: **GRAPH** the equation on calculator

(use *x* as your variable)

(Put left side equation in Y1, right side in Y2) (standard window Zoom 6)

Because the parabola does **NOT** have any *x*-intercepts,

then that also means it only has **NO real solutions**.

# Solve by **Graphing** (**finding *x*-intercepts**) on **Calculator**

To solve a quadratic equation by graphing:

1. Set your equation **equal** to **ZERO**, if needed. Go to **Y=** on calculator. 
2. Put **left** side of equation into **Y1** and

**right** side (zero) into **Y2** on calculator (use *x* as your variable).

1. Graph starting with standard window, ZOOM 6.

You may need to Zoom In or Out (ENTER), if needed.

1. Does your graph (parabola) cross or touch *x*-axis?

If YES, go to STEP 5 to find *x*-intercepts.

If NO, then stop – your equation has **no real solutions**.

1. Press **2ND**, **TRACE**, **5** (Intersect). 
2. Press DOWN Arrow to switch to Y2=0

and move cursor to where the parabola is touching *x*-axis.

1. Press **ENTER** three times.
2. You should see the word INTERSECTION with

*x* = some number and *y* = 0. This is an ***x*-intercept**.

1. The **solution** is the ***x*-coordinate** of that *x*-intercept (round the amount accordingly).
2. Repeat STEPS 5 through 9 if there is a second *x*-intercept. It will be the second **solution**.

* **EXAMPLE:** Use a calculator to find the graphical solution to the equation.   
  Round to the nearest thousandth.

[3.2-16]

Set your equation equal to zero (add 8*n* and add 5)

Go to Y= on calculator. Use *x* as your variable.

|  |  |  |  |
| --- | --- | --- | --- |
| Y1 =  Y2 = 0 | ZOOM 6 to graph | 2nd TRACE 5  Left *x*-int. | 2nd TRACE 5 again  Right x-int. |
|  |  |  |  |

The solutions to the equation are  **or**  (rounded)

Sources Used:

1. MyLab Math for *College Algebra with Integrated Review*, Beecher, Pearson Education Inc.
2. MyLab Math for *College Algebra*, 7th Edition, Blitzer, Pearson Education Inc.
3. MyLab Math for *College Algebra with Modeling and Visualization*, 6th Edition, Rockswold, Pearson Education Inc.
4. Wabbitemu calculator emulator version 1.9.5.21 by Revolution Software, BootFree ©2006-2014 Ben Moody, Rom8x ©2005-2014 Andree Chea. Website <https://archive.codeplex.com/?p=wabbit>