Algebra 1

April 14 – April 17

Time Allotment: 40 minutes per day

Student Name: _____

Teacher Name: _____

Teacher emails: Vanessa.steger@greatheartsnorthernoaks.org and melanie.brintnall@greatheartsnorthernoaks.org. Ms. Brintnall will be teaching Mrs. Chubb's Algebra 1 class for the remainder of the school. If you were in Mrs. Chubb's class, you should email Ms. Brintnall for help if needed!

Algebra 1
April 14 – April 17

Packet Overview

Date	Objective(s)	Page Number
Monday, April 13	Holiday	
Tuesday, April 14	Derive the quadratic formula.	3-7
Wednesday, April 15	Relate the quadratic formula to the number of roots in a quadratic equation.	8-10
Thursday, April 16	Analyze a quadratic function by finding its roots and graphing it.	11-14
Friday, April 17	Solve quadratic equations fluently using all three methods.	15-16

Dear Algebra 1 students,

We have loved seeing you on Zoom office hours! With mini whiteboards on our end and pencils and packets on yours we are winning at completing the square! 😊 Even if you can't log into office hours, *please email us* with any questions you have. We often attach pictures of our work based on your question to our responses, so you will get something specific and helpful back to any questions.

If you and your parents decide to use Google classroom, we have a video posted as well that takes you through the example problem from Friday 4/17's lesson and connects that with the derivation of the quadratic formula that we review during Tuesday 4/14's lesson. It would be good to watch this video at any point during the week, but Tuesday before you start the rest of the work is the day we recommend. *Watching this video is not required to complete the work in this packet – it is there as a supplemental resource to be helpful.*

Class	Day/Time this Week
1st Period Ms. Steger	Wednesday, 10:00 – 10:50am
2nd Period Ms. Steger	Wednesday, 11:00 – 11:50am
3rd Period Ms. Brintnall	Wednesday, 1:00 – 1:50pm
4th Period Ms. Brintnall	Tuesday & Thursday, 10:00 – 10:50am

Know that we are thinking of you as you continue learning remotely! No question is too small, so *please* send us an email if you are wondering about anything! We would love to hear how you are doing 😊

With much love, Ms. Steger and Ms. Brintnall

HOW TO TURN IN PACKETS

This week Great Hearts Texas has rolled out different tools to help you as students turn work in and get feedback on it. Your families can choose one of these two ways (please note – you will get feedback from your teacher faster if you use Google classroom because we don't have to wait for the physical papers to de-germ 😊)

1. Google classroom – you will scan/take pictures of whatever pages you showed work on (this could be a printed version of this packet or loose-leaf)

OR

2. Dropping paper off at school – whatever you drop off for us must have **your name, Algebra 1, and your teacher's name on the very front and the papers should be stapled together.**

Whether you are using Google classroom to turn work in or paper, you should keep your work organized by labeling each day and keeping any loose-leaf papers together in one stapled packet.

- ***I see where I will turn in my daily work (any paper you show work on, which could be this packet itself or loose-leaf pages) on the Google classroom website.***

- ***OR If I choose to turn my papers in at school instead, I will have my name, Algebra 1 and my teacher's name on the very front and all papers will be stapled together.***

Academic Honesty

I certify that I completed this assignment independently in accordance with the GHNO Academy Honor Code.

Student signature:

_____

I certify that my student completed this assignment independently in accordance with the GHNO Academy Honor Code.

Parent signature:

_____

Tuesday April 14

Algebra 1 Unit: Chapter 12 Quadratic Equations
Lesson 1: 12-3 The Quadratic Formula

Objective: Derive the quadratic formula.

A linear equation is a 1st degree equation. A quadratic equation is a _____ degree equation. This year we have talked about two ways of solving quadratic equations.

Look at these two methods of solving the same equation carefully.

Factoring

$x^2 - 4x = 5$

$-5 \quad\quad -5$

$x^2 - 4x - 5 = 0$

	x	-5
x	x^2	$-5x$
$+1$	$+1x$	-5

← not a square (the sides are not the same)

$(x-5)(x+1) = 0$

$\_ \cdot \_ = 0$

means one of the quantities has to be zero.

$x = 5$ and $x = -1$ will make the statement true

Completing the square

$x^2 - 4x = 5$

	x	-2
x	x^2	$-2x$
-2	$-2x$	$+4$

← we are making this a square by splitting $-4x$ in half

$x^2 - 4x + 4 = 5 + 4$

$\sqrt{(x-2)^2} = \sqrt{9}$

$|x-2| = 3$

$x - 2 = 3 \quad\quad x - 2 = -3$

$+2 \quad +2 \quad\quad +2 \quad +2$

$x = 5 \quad\quad x = -1$

1. What is SIMILAR about these two methods?

_____

_____

2. What is DIFFERENT about these two methods?

_____

_____

3. Solve by FACTORING: $x^2 - 6x = -5$.

4. Solve by COMPLETING THE SQUARE: $x^2 - 6x = -5$

5. #3 and #4 solve the same equation but with two different methods. You SHOULD get the same answers for both methods. Did you? If not, look for a mistake and describe it if you find it (or, write a question down if you can't figure out why your answers are different).

_____

_____

On Thursday of last week, you learned *another* method of solving quadratic equations called the Quadratic Formula.

Our main purpose today is to *derive* this formula using our steps from completing the square. To derive means "to obtain (a function or equation) from another by a sequence of logical steps." We gave you those steps in last week's packet, but this time, you will FILL OUT THE BLANKS (where the arrows point) of the steps yourself to make sure the sequence of logical steps make sense to you.

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Procedure	Explanation
1. $ax^2+bx+c=0$	1. The standard form of the quadratic equation is set equal to 0.
2. $4a(ax^2+bx+c)=0(4a)$ $4a^2x^2+4abx+4ac=0$	2. Is "b" even or odd? Is "a" a perfect square? We don't know, so we must multiply by 4a.
3.	3. Factor to complete the square/ build a PST.
4. $(4a^2x^2+4abx+b^2)+4ac=b^2$	4. Add b^2 to both sides & group the terms so they form a PST we can factor.
5. $(2ax+b)^2+4ac=b^2$	5. Factor.
6. $-4ac \quad -4ac$ $(2ax+b)^2=b^2-4ac$	6. Remember, our goal is to isolate x. Follow SADMEP & subtract 4ac from both sides.
7.	7. Our equation may look strange, but we follow the same next step - take the square root of both sides
8. $2ax+b=\sqrt{b^2-4ac} \quad 2ax+b=-\sqrt{b^2-4ac}$	8. Account for both solutions.
9. $2ax+b=\sqrt{b^2-4ac}$ $-b \quad -b$ $\frac{2ax}{2a}=\frac{-b+\sqrt{b^2-4ac}}{2a}$ $x=\frac{-b+\sqrt{b^2-4ac}}{2a}$	9. Solve.
$2ax+b=-\sqrt{b^2-4ac}$ $-b \quad -b$ $\frac{2ax}{2a}=\frac{-b-\sqrt{b^2-4ac}}{2a}$ $x=\frac{-b-\sqrt{b^2-4ac}}{2a}$	
we can combine our answers to write it as	
$x=$	

(drawing an area model helps with the factoring)

The Quadratic Formula: For quadratic equations: $ax^2+bx+c=0$,

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

Note: If I have the quadratic equation $x^2=3x-2$, I CANNOT use the quadratic formula right away. Why? Because this equation is not in standard form to begin with. **I only know the values of *a*, *b*, and *c* when the equation is in standard form.**

I need to subtract $3x$ and add 2 on both sides of the equation so that the right side of the equation is zero.

$x^2-3x+2=0$ NOW I can use the quadratic formula where $a=1$, $b=-3$, and $c=2$.

Okay, now we are refreshed on Thursday of last week and we are ready to do some quadratic formula practice. One has been done for you as an example. You can show your work in this packet or on a piece of loose-leaf. Either way, at the end of the week you will turn these problems in under the Daily Work for this week on the Google Classroom.

Original equation: $x^2=3x-2$ $-3x+2 \quad -3x+2$	**Equation in standard form:** $x^2-3x+2=0$

Plug these values into the quadratic formula and simplify:

$a=1$
$b=-3$
$c=2$

$$\frac{--3\pm\sqrt{(-3)^2-4(1)(2)}}{2(1)} \qquad \frac{3\pm\sqrt{1}}{2} \qquad \frac{3+1}{2}=\frac{4}{2}=2$$

$$\frac{3\pm\sqrt{9-8}}{2} \qquad \frac{3\pm1}{2} \qquad \frac{3-1}{2}=\frac{2}{2}=1$$

Solutions: $x=$ 2 **and** $x=$ 1

6. Original equation: $x^2 = 5x + 24$	**Equation in standard form:**
Plug these values into the quadratic formula and simplify: $a =$____ $b =$____ $c =$____	
Solutions: $x =$ _____ **and** $x =$ _____	

7. Original equation: $4x^2 - 1 = -8x$	**Equation in standard form:**
Plug these values into the quadratic formula and simplify: $a =$____ $b =$____ $c =$____	
Solutions: $x =$ _____ **and** $x =$ _____	

8. Original equation: $x^2 = 2x + 48$	**Equation in standard form:**
Plug these values into the quadratic formula and simplify: $a =$____ $b =$____ $c =$____	
Solutions: $x =$ _____ **and** $x =$ _____	

Nice, you now know how to solve a quadratic equation three different ways – factoring, completing the square, and using the quadratic formula. You are finished for today!

Wednesday, April 15

Algebra 1 Unit: Chapter 12 Quadratic Equations
Lesson 2: 12-4 The Discriminant

Objective: Relate the quadratic formula to the number of roots in a quadratic equation.

A 1st degree equation graphed creates a line. A 2nd degree equation graphed creates a _____.

Solutions are also called x-intercepts, _____, and _____.

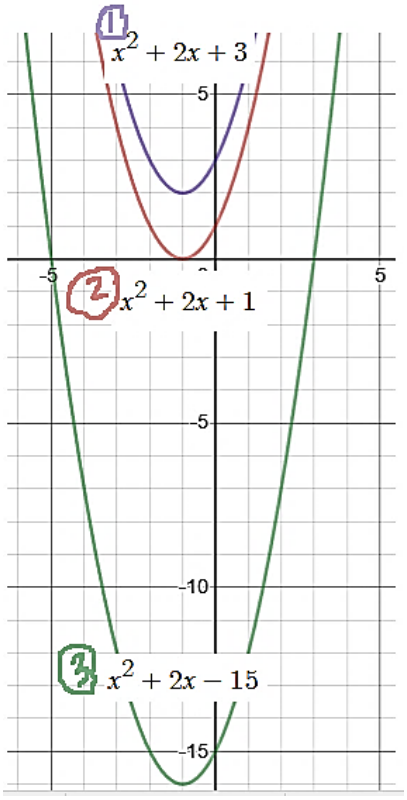
When we want to simplify a radical like $\sqrt{144}$ we think to ourselves, "What times itself is equal to 144?" **12.**

If the answer is unclear, like $\sqrt{140}$, we simplify the radical $\sqrt{4 \cdot 35} = \sqrt{4} \cdot \sqrt{35} = 2\sqrt{35}$ and either leave our answer in its exact form ($2\sqrt{35}$) or approximate it. $\sqrt{35}$ is just a little smaller than $\sqrt{36}$ which is 6, so $2\sqrt{35} \approx 2 \cdot 5.8 = 11.6$.

What about $\sqrt{-16}$? What number times *itself* is -16?

(answer: NO real number!)

So let's say we have three parabolas defined by the equations. Fill out the sections of the table to compare the three parabolas. You can check your answers as you go along.



	Number of roots on the graph (circle one)	Solve using the quadratic formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
1. $x^2 + 2x + 3$ $a =$____ $b =$____ $c =$____	0 1 2	
2. $x^2 + 2x + 1$ $a =$____ $b =$____ $c =$____	0 1 2	
3. $x^2 + 2x - 15$ $a =$____ $b =$____ $c =$____	0 1 2	

Okay now that you have compared three parabolas, look at my work for solving these two slightly different equations. How many ROOTS (synonyms: solution, x-intercept, zero) do these equations have?

$x^2 + 4x$

$a = 1$

$b = 4$

$c = 0$

$x = \dfrac{-4 \pm \sqrt{(4)^2 - 4(1)(0)}}{2(1)}$

$x = \dfrac{-4 \pm \sqrt{16 - 0}}{2}$

$x^2 + 4x + 4$

$a = 1$

$b = 4$

$c = 4$

$x = \dfrac{-4 \pm \sqrt{(4)^2 - 4(1)(4)}}{2(1)}$

$x = \dfrac{-4 \pm \sqrt{16 - 16}}{2}$

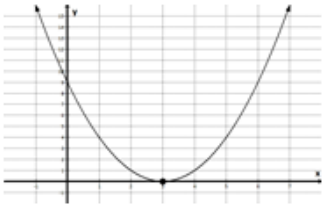
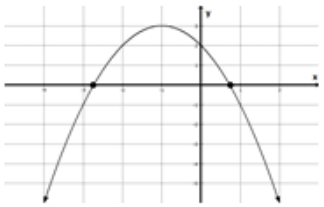
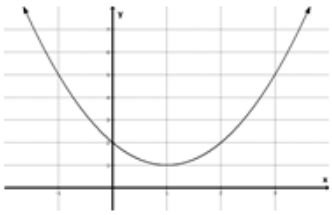
Number of roots: _____ Number of roots: _____

Which PART of the quadratic formula seems related to the number of roots an equation has? You should not use all of these words, but some vocabulary words that you may need to use are radical, radicand, numerator, denominator.

_____

_____

Because the value of $b^2 - 4ac$ discriminates, or points out differences, between different quadratic equations, it is called the <u>discriminant</u>. The discriminant is the radicand of the quadratic formula.

Discriminant	Number of roots	Example	Graph
$b^2 - 4ac = 0$	**1 real root** Touches x axis once	$y = x^2 - 6x + 9$ $b^2 - 4ac =$ $(-6)^2 - 4(1)(9) =$ $36 - 36 = \mathbf{0}$	
$b^2 - 4ac > 0$	**2 real roots** Touches x axis twice	$y = -x^2 - 2x + 2$ $b^2 - 4ac =$ $(-2)^2 - 4(-1)(2) =$ $4 + 8 = \mathbf{12}$	
$b^2 - 4ac < 0$	**No real roots** Doesn't touch x axis – no x-intercepts	$y = x^2 - 2x + 2$ $b^2 - 4ac =$ $(-2)^2 - 4(1)(2) =$ $4 - 8 = \mathbf{-4}$	

4. In your own words, WHY does a positive discriminant lead to two solutions?

_____

_____

5. In your own words, WHY does a negative discriminant mean that there are NO solutions?

_____

_____

Fill out each part of the following problems. #6 is done for you as an example.

6. Equation: $0.5a^2 + 1.2a = -3$	$a = 0.5$ $b = 1.2$ $c = 3$	Value of the discriminant $b^2 - 4ac$ $(1.2)^2 - 4(0.5)(3)$ $1.44 - 2(3)$ $1.44 - 6$ -4.56 6.00 -1.44 4.56	Number of roots none
7. Equation: $2z^2 + 5z - 3 = 0$	$a =$____ $b =$____ $c =$____	Value of the discriminant	Number of roots
8. Equation: $4m^2 = -20m - 25$	$a =$____ $b =$____ $c =$____	Value of the discriminant	Number of roots
9. Equation: $n^2 + 64 = 16n$	$a =$____ $b =$____ $c =$____	Value of the discriminant	Number of roots
10. Equation: $-6x^2 + x - 1 = 0$	$a =$____ $b =$____ $c =$____	Value of the discriminant	Number of roots

You now understand how part of the quadratic formula (the discriminant) indicates how many x-intercepts we should expect from that parabola. You are finished for today!

Thursday April 16

Algebra 1 Unit: Chapter 12 Quadratic Equations
Lesson 1: 12-3 The Quadratic Formula

Objective: Analyze a quadratic function by finding its roots and graphing it.

We are going to start today with looking at completed work exploring a parabola and identifying important parts about it. I put the questions first so that you would have a sense of what you are looking for as you explore the next two pages. DON'T TRY TO ANSWER THESE WITHOUT LOOKING AT PAGES 12 and 13 IN DETAIL! Again, I only put the questions first so you could see some key terms before you start looking at the handwritten portions.

Using pages 12 and 13, answer the following questions *with 1-2 complete sentences*:

1. Why do we use a table of values?

_____

_____

2. How did I know that I needed more values in my table of values?

_____

_____

3. What does the discriminant tell us about the parabola?

_____

_____

4. What did completing the square tell us about the parabola?

_____

_____

5. How did I estimate the roots to be at $x \approx 4.2$ and $x \approx -1.4$?

_____

_____

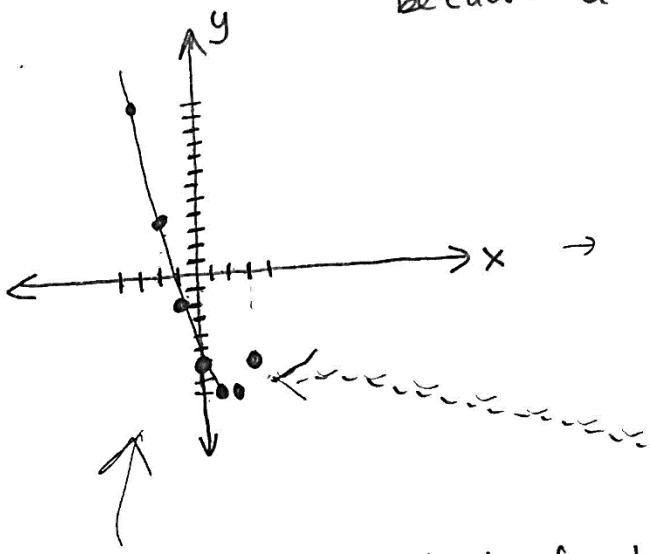
Below I explore the quadratic equation $y = x^2 - 3x - 6$. Notice:

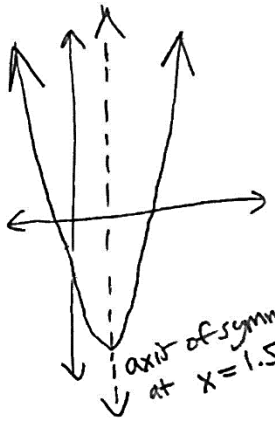
1) I immediately noted whether this would be a concave up or down parabola (so I knew which shape to expect from the beginning).

2) I made a table of values with five pretty easy x's *showing a LOT of work. No messing up with negatives!*

$y = x^2 - 3x - 6$ ← I know this is a concave up parabola because $a = 1$ (positive).

x	y
0	$0^2 - 3(0) - 6$ -6
1	$(1)^2 - 3(1) - 6$ $1 - 3 - 6$ $-2 - 6$ -8
-1	$(-1)^2 - 3(-1) - 6$ $1 + 3 - 6$ $4 - 6$ -2
-2	$(-2)^2 - 3(-2) - 6$ $4 + 6 - 6$ 4
-3	$(-3)^2 - 3(-3) - 6$ $9 + 9 - 6$ $18 - 6$ 12





With my current table of values, I haven't seen the vertex yet. I need some more positive x's!

x	y
2	$(2)^2 - 3(2) - 6$ $4 - 6 - 6$ $-2 - 6$ -8
3	$(3)^2 - 3(3) - 6$ $9 - 9 - 6$ -6

← With these two points I see symmetry with the other points. Therefore, I know the vertex is between $x = 1$ and $x = 2$!

I could have further explored this parabola by finding out immediately how many roots it had and what they were. I show that work below (and I used completing the square just to keep that method fresh in our minds!)

$y = x^2 - 3x - 6$

$a=1$, $b=-3$, $c=-6$

$b^2 - 4ac$

$(-3)^2 - 4(1)(-6)$

$9 - 4(-6)$

$9 + 24$

33

positive discriminant tells me that there are two x-intercepts. This is consistent with my graph.

Finding the x-intercepts using completing the square:

$0 = x^2 - 3x - 6$

odd, I would like it to be even, so I multiply by 4 to keep the quadratic term a perfect square!

$4(0) = (x^2 - 3x - 6)4$

$0 = 4x^2 - 12x - 24$

$+33 \qquad +33$

	$2x$	-3
$2x$	$4x^2$	$-6x$
-3	$-6x$	9

$33 = 4x^2 - 12x + 9$

$\sqrt{33} = \sqrt{(2x-3)^2}$

$\sqrt{33} = |2x-3|$

$2x - 3 = \pm\sqrt{33}$

$2x = 3 \pm \sqrt{33}$

$x = \frac{3 \pm \sqrt{33}}{2}$

x-intercepts are these x values

$\sqrt{25} < \sqrt{33} < \sqrt{36}$

$5 < \sqrt{33} < \sqrt{6}$

these match our graph too!

$\sqrt{33} \approx 5.8$

$\frac{3 \pm 5.8}{2}$

$\frac{8.8}{2} = 4.2$

$\frac{-2.8}{2} = -1.4$

Whether we explore a parabola using its graph, the discriminant, the quadratic formula, or completing the square, *the information revealed is consistent… if the math is done correctly.* 😊

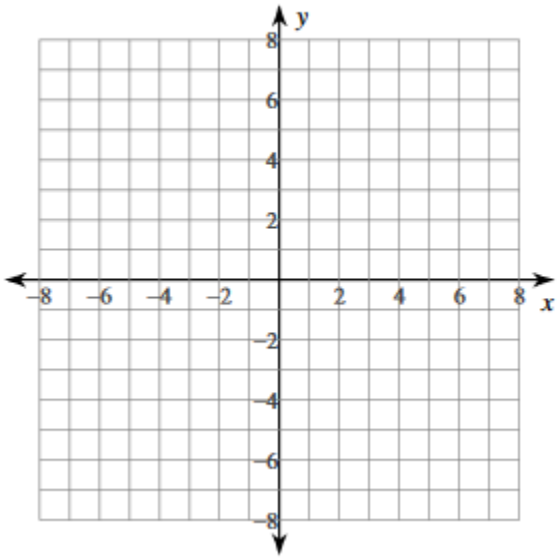
Now you will analyze the parabola $y = -x^2 - 6x - 10$ using similar knowledge:

6. Is this parabola concave up or concave down? How do you know?

7. What is the value of the discriminant, and what does that tell you about the number of x-intercepts this parabola has?

8. Make a table of values SHOWING LOTS OF WORK to avoid mistakes and GRAPH the parabola.

$y = -x^2 - 6x - 10$



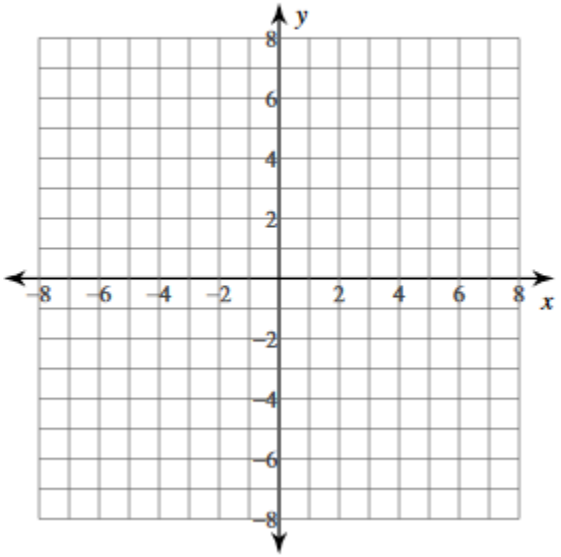
Now you will analyze the parabola $f(x) = x^2 + 2x - 1.$

9. Is this parabola concave up or concave down? How do you know?

10. What is the value of the discriminant, and what does that tell you about the number of x-intercepts this parabola has?

11. Make a table of values SHOWING LOTS OF WORK to avoid mistakes and GRAPH the parabola.

$f(x) = x^2 + 2x - 1$



<u>You are finished for today!</u>

Friday, April 17

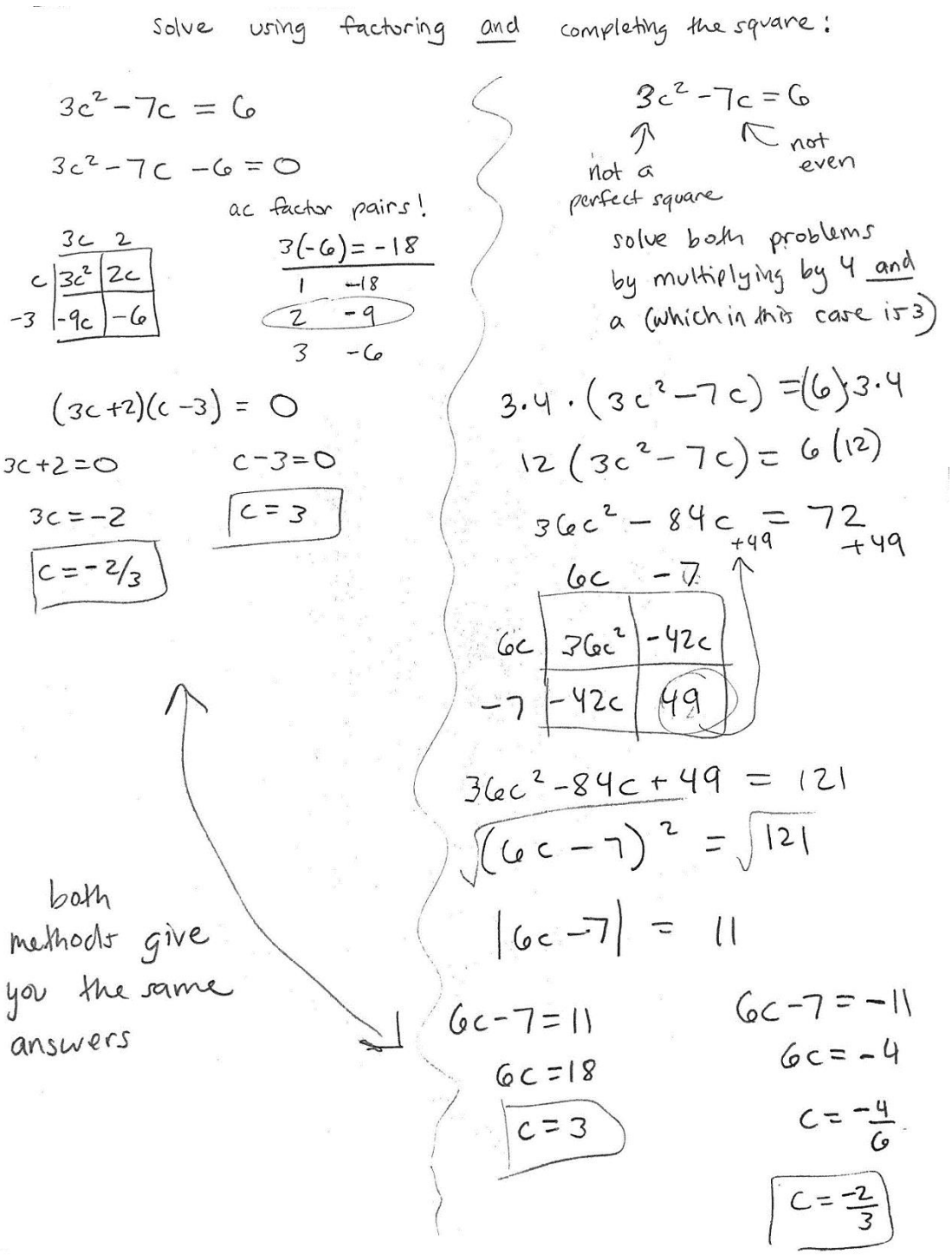
Algebra 1 Unit: Chapter 12 Quadratic Equations
Lesson 4: Review and Quiz

Objective: Solve quadratic equations fluently using all three methods.

This week we have discussed three methods of solving a quadratic equation (factoring, completing the square, and the quadratic formula). We have also analyzed quadratics using the discriminant and graphs.

On our minor assessment for this week, we are going to ask you to solve quadratics using these methods. To prepare for this:

1. Review the example shown on this page.
2. Practice on a separate sheet of paper (this does not have to be turned in with daily work). Check your answer from the key at the end.



Solve using ALL THREE METHODS:

$$2y^2 = 9y - 9$$

Minor Assessment (Quiz)

Please read these boxes carefully before starting on the minor assessment.

- ☐ I understand that I am NOT allowed to use this packet during my quiz.
- ☐ I understand that I am NOT allowed to use my own loose-leaf packet during my quiz.
- ☐ I understand that while Ms. Steger and Ms. Brintnall estimate that the quiz will take 15 minutes, it is okay to spend the time I need.
- ☐ I understand that I am NOT allowed to ask a parent, family member, or friend for help during my quiz.
- ☐ I understand that I am NOT allowed to use the internet or any other resource to help with my quiz.

*****Once you have read through the above statements and checked each box, you should get a fresh piece of paper and TITLE IT *exactly as you see below*** *(following directions is something we are checking for as we grade – make sure that your heading matches what we have below).*

The page you just titled is what you will scan/take a picture of and drop into the Minor Assessment assignment on Google Suite (or, it is the last page of your packet of work that you drop off at school)

Your name	Friday April 17 Quiz

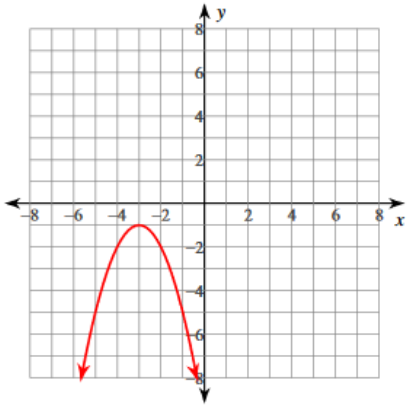
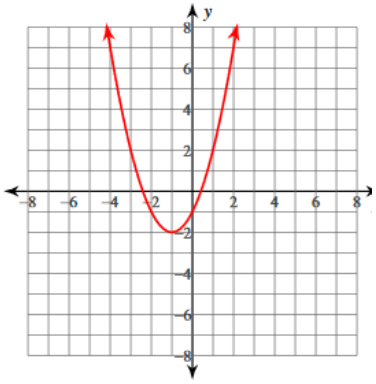
Solve the equations *using the method given*.

1. Solve by FACTORING: $6n^2 + 4 = 10n$
2. Solve by COMPLETING THE SQUARE: $b^2 - 3b = 5$
3. Solve by using the QUADRATIC FORMULA. $6x = 3 - 2x^2$

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

You are now finished for the week! Remember to upload your pictures of the daily work and minor assessment to the Google Classroom, OR prepare one packet of papers with your name, Algebra 1, and your teacher's name on the very front stapled together to drop off at school. Again, we are checking for following directions when grading! 😊

Answer Key for the Daily Work

Lesson 1 (Tuesday)	#1 and #2 are free response 3. $x = 1, x = 5$ 4. $x = 1, x = 5$ 6. $x = 8, x = -3$ 7. $x = \frac{-2 \pm \sqrt{5}}{2}$ 8. $x = 8, x = -6$ #5 is free response
Lesson 2 (Wednesday)	1. no solution 2. $x = -1$ 3. $x = -5, 3$ #4 and #5 are free response. #6 is done as an example. 7. 49, two roots 8. 0, one root 9. 0, one root 10. -23, none
Lesson 3 (Thursday)	#1-5 are free response 6. Hint: look at the coefficient of the quadratic term! 7. -4, since in the quadratic formula this means $\sqrt{-4}$ and this is not a real number, there are no x-intercepts. 8. graph on right  9. Hint: look at the coefficient of the quadratic term! 10. 8, since in the quadratic formula this means you have something plus OR minus $\sqrt{8}$, there are two x-intercepts 11. graph on right. 
Lesson 4 (Friday)	Practice problem answer: $y = 3$ and $y = \frac{3}{2}$ You should get this same answer when you solve by factoring AND when you complete the square AND when you use the quadratic formula.