TOPIC 8 and 9 – Polynomial Operations

Chapter 17 – Lesson 1: Understanding Polynomial Expressionss

Monomials are expressions that consist of a ___________________, _____________, or ______________________ of numbers and variables with whole number ____________________. However, monomials ____________________ have a variable in its ______________________.

Monomials					Not Monomials				
4	x	$-4xy$	$0.25x^3$	$\frac{xy}{4}$	$4+x$	$x-1$	$0.7x^{-2}$	$0.25x^{-1}$	$\frac{y}{x^3}$

Term	Is this a monomial	Explain your reasoning
$5ab^3$		
x^2		
$\sqrt{y}$		
2^2		
$\frac{5}{k^2}$		
5x + 7		
$x^2 + 4ab$		
$\frac{k^2}{4}$		
$16^{\frac{1}{3}}$		

Classifying Polynomials

- Classified by number of ______________ and ________________
- Degrees are calculated by adding the ____________ in each _______________, NOT ____________________. The term with the ______________ exponent determines the _______________.

$7x^2 - 5x^3y^3$	$3^2 + 2n^3 + 8n$
$3x^2y^2 + 3xy^2 + 5xy$	$8ab^2 - 3a^2b$

Writing Polynomials in Standard Form

- Written in order from the _______________ degree to ___________ degree
- First number is called the __________________________________
- Make sure to _____________________ like terms

$20x - 4x^3 + 1 - 2x^2$	$z^3 - z^6 + 4z$	$10 - 3x^2 + x^5 + 4x^3$
$18y^5 - 3y^8 + 10y$	$10x + 13 - 15x^2$	$-3b^2 + 2b - 7 + 6b^3 + 12b^4 + 7$
$-2y^3 - 8y^2 + y^2 + 2y^3$	$p^2q^3 - 4p^5q^4 - 4p^2q^3 + 3p^5q^4$	$3p^2q^2 - 3p^2q^3 + 4p^2q^3 - 3p^2q^2 + pq$
$3(a + b) - 6(b + c) + 8(a - c)$	$ab - a^2 + 4^2 - 5ab + 3a^2 + 10$	

Evaluating Polynomials

A skyrocket is launched from a 6-foot-high platform with an initial speed of 200 feet per second. The polynomial $-16t^2 + 200t + 6$ gives the height in feet that the skyrocket will rise in t seconds. How high will the rocket rise if it has a 5-second fuse?
Lisa wants to measure the depth of an empty well. She drops a ball from a height of 3 feet into the well and measures how long it takes the ball to hit the bottom of the well. She uses a stopwatch, starting when she lets go of the ball and ending when she hears the ball hit the bottom of the well. The polynomial $-16t^2 + 0t + 3$ gives the height of the ball after t seconds where 0 is the initial speed of the ball and 3 is the initial height the ball was dropped from. Her stopwatch measured a time of 2.2 seconds. How deep is the well? (Neglect the speed of sound and air resistance).

Chapter 17 – Lesson 2 and 3: Adding and Subtracting Polynomials

Adding

$5x^2 + 2x - 1$ and $4x^2 - x + 2$	$3y^3 + 2y + 1$ and $y^2 - 1$	$(-6x^2 + 2)$ and $(-4x^2)$
$(-x^3 + 2)$ and $(-4x^3 + y + x)$	$(y - 7)$ and $(3y + 18)$	
A box company owns two factories in different parts of the country. The profit for each factory is modeled by a polynomial with x representing the number of boxes each produces. Solve by adding the polynomials. The models needed in each situation are provided. 	The first factory makes a profit of $-0.03x^2 + 20x - 500$, and the second makes $-0.04x^2 + 25x - 1000$. What is the polynomial modeling the box company's total profit if both factories make the same number of boxes?	The company plans to open a third factory with a projected profit of $-0.03x^2 + 50x - 100$. What will be the total profit of the box company, written as a polynomial, if the projected profit is correct?

Subtracting

$(5x+2)-(-2x^2-3x+4)$	$(y^2+y-1)-(-2y^2+y+1)$	$(2q^2-q-8)-(2q^2+q-4)$
$(2ab-b+a)-(2b^2+b+a+4)$	$(-x^3+y^2+y-x)-(-x^3+y+x)$	$(18z+12)-(11z-5)$

The cost in dollars of producing x toothbrushes is given by the polynomial $400{,}000+3x$, and the revenue generated from sales is given by the polynomial $20x-0.00004x^2$. Write a polynomial expression for the profit from making and selling x toothbrushes. Then find the profit for selling 200,000 toothbrushes.	The revenue made by a car company from the sale of y cars is given by $0.005y^2+10y$. The cost to produce y cars is given by the polynomial $20y+1{,}000{,}000$. Write a polynomial expression for the profit from making and selling y cars. Find the profit the company will make if it sells 30,000 cars.

Chapter 18 – Lesson 1 and 2: Multiplying Monomials and Polynomials

When multiplying monomials and polynomials, always remember:

- Multiply numbers with ________________
- Exponent rules __________________
- Combine _______________ as needed

$(6x^3)(-4x^4)$	$(5xy^2)(7xy)$	$3x(3x^2+6x-5)$	**Design** Harry is building a fish tank that is a square prism. He wants the height of the tank to be 6 inches longer than the length and width. If he needs the volume to be as close as possible to 3500 in^3, what should be the length of the tank? Round to the nearest inch.
$2xy(5x^2y+3xy^2+7xy)$	$2a^2(5b^2+3ab+6a+1)$	$(18y^2x^3z)(3x^8y^6z^4)$	**Engineering** Diane needs a piece of paper whose length is 4 more inches than the width, and the area is as close as possible to 50 in^2. To the nearest whole inch, what should the dimensions of the paper be?

Multiplying Binomials

$(x+1)(x-2)$	$(2x+4)(x+3)$	$(x^2+3)(x+2)$
$(3x^2-2x)(x+5)$	$(3x+1)(x^3+4x^2-7)$	Orik has designed a rectangular mural that measures 20 feet in width and 30 feet in length. Laura has also designed a rectangular mural, but it measures x feet shorter on each side. When x = 6, what is the area of Laura's mural?

Chapter 18 – Lesson 3: Special Products of Binomials

Perfect Square Trinomials

$(a+b)^2 - Perfect\ Square$	$(a-b)^2$ - $Perfect\ Square$	$(a-b)(a+b)$ $-Difference\ of\ Squares$
$(x+4)^2$	$(x-5)^2$	$(x+6)(x-6)$
$(3x+2y)^2$	$(4x-3y)^2$	$(x^2+2y)(x^2-2y)$
$(-x+3)^2$	$(3-x^2)^2$	$(7+x)(7-x)$

Modeling with Special Products

A designer adds a border with a uniform width to a square rug. The original side length of the rug is (x-5) feet. The side length of the entire rug including the original rug and the border is (x + 5) feet. What is the area of the border? Evaluate the area of the border if x = 10 feet.	
A square patio has a side length of (x – 3) feet. It is surrounded by a flower garden with a uniform width. The side length of the entire square area including the patio and the flower garden is (x + 3) feet. Write an expression for the area of the flower garden.	

Chapter 19 – Lesson 1: Understanding Quadratic Functions

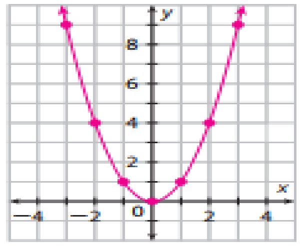
Linear						Exponential						Quadratic				
-2	-1	0	1	2		-2	-1	0	1	2		-2	-1	0	1	2
5	7	9	11	13		2	4	8	16	32		0	1	4	9	16

Quadratic Function -	Simplest quadratic function –

Parabola	Axis of symmetry	Vertex	Minimum/Maximum

Understanding Parent quadratic Function

x	$f(x) = x^2$
−3	$f(x) = x^2 = (-3)^2 = 9$
−2	4
−1	1
0	0
1	1
2	4
3	9



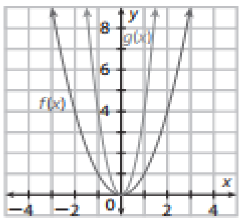
Domain:

Range:

Vertical Stretch

$g(x) = ax^2$ with $|a| > 1$.

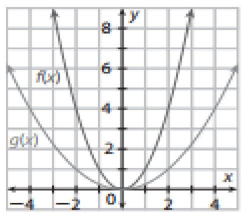
The graph of $g(x)$ is narrower than the parent function $f(x)$.



Vertical Compression

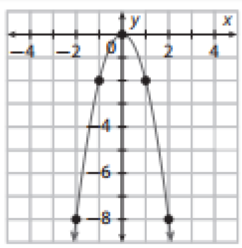
$g(x) = ax^2$ with $0 < |a| < 1$.

The graph of $g(x)$ is wider than the parent function $f(x)$.



$g(x) = -2x^2$

x	$g(x) = 2x^2$
−3	−18
−2	−8
−1	−2
0	0
1	−2
2	−8
3	−18



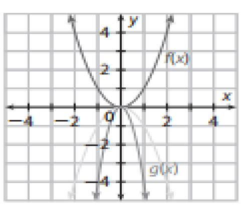
Domain:

Range:

Vertical Stretch

$g(x) = ax^2$ with $|a| > 1$.

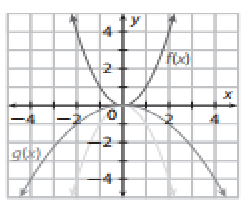
The graph of $g(x)$ is narrower than the parent function $f(x)$.



Vertical Compression

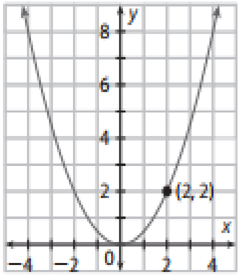
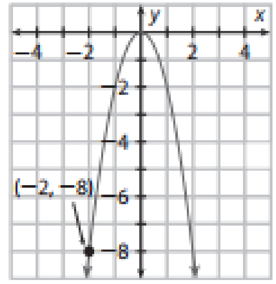
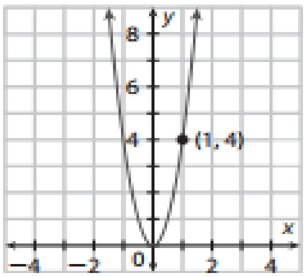
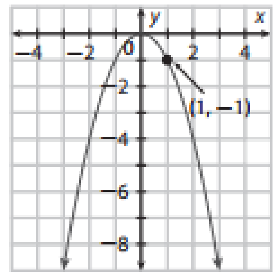
$g(x) = ax^2$ with $0 < |a| < 1$.

The graph of $g(x)$ is wider than the parent function $f(x)$.



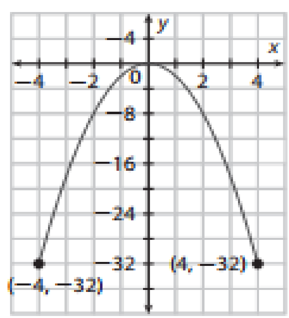
Writing Quadratic Functions from Graphs

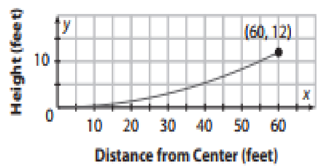
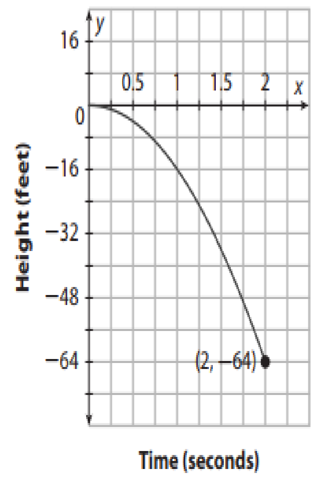
1) Write formula for quadratic
2) ____________ x and y values with points from graph, but not __________

Modeling with Quadratic Function

For each model, describe what the vertex, *y*-intercept, and endpoint(s) represent in the situation it models, and then determine the equation of the function.

This graph models the depth in yards below the water's surface of a dolphin before and after it rises to take a breath and descends again. The depth d is relative to time t, in seconds, and $t = 0$ is when dolphin reaches a depth of 0 yards at the surface.		The y-intercept occurs at the vertex of the parabola at $(0, 0)$, where the dolphin is at the surface to breathe. The endpoint $(-4, -32)$ represents a depth of 32 yards below the surface at 4 seconds before the dolphin reaches the surface to breathe. The endpoint $(4, -32)$ represents a depth of 32 yards below the surface at 4 seconds after the dolphin reaches the surface to breathe. The graph is symmetric about the y-axis with the vertex at the origin, so the function will be of the form $y = ax^2$, or $d(t) = at^2$. Use a point to determine the equation. $d(t) = at^2$ $-32 = a(4)^2$ $-32 = a \cdot 16$ $-2 = a$ The function is $d(t) = -2t^2$.

Satellite dishes reflect radio waves onto a collector by using a reflector (the dish) shaped like a parabola. The graph shows the height *h* in feet of the reflector relative to the distance *x* in feet from the center of the satellite dish.	 	
The graph shows the height *h* in feet of a rock dropped down a deep well as a function of time in *t* seconds	 	

How does the *a* affect the graph of $f(x) = ax^2$?

Value of *a*	Type of Transformation	Graph Opens
$a > 1$		
$0 < a > 1$		
$-1 < a > 0$		
$a = -1$		
$a < 1$		

Chapter 19 – Lesson 2: Transforming Quadratic Functions –

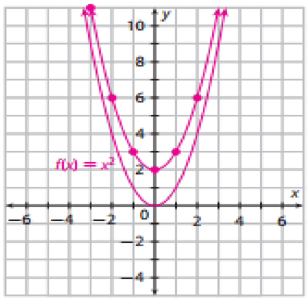
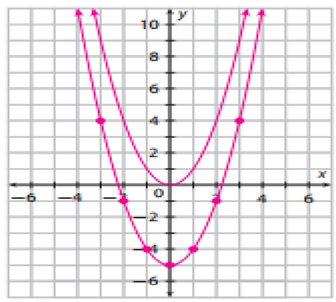
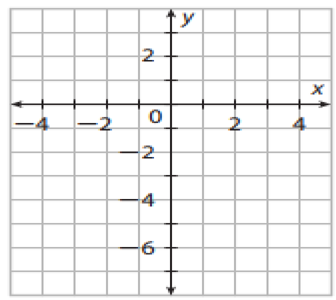
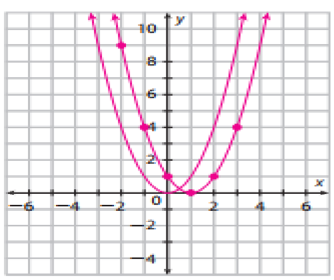
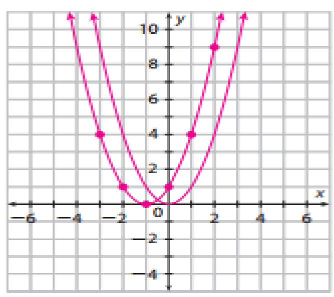
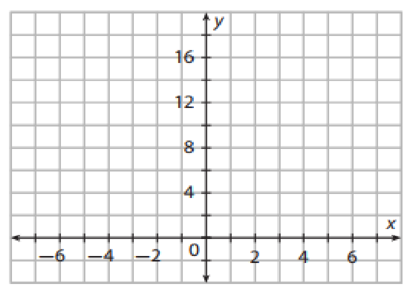
$$g(x) = a(x-h)^2 + k$$

All quadratic graphs with x^2 have a vertex of ________.

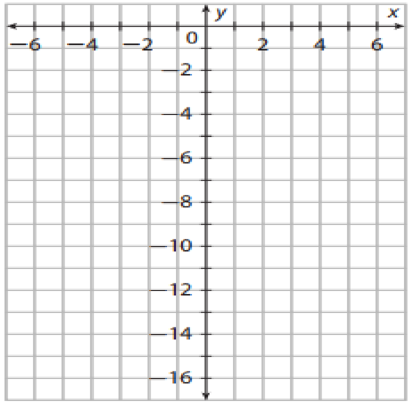
K shifts the parent function _______ or __________.

h shifts the parent function _______ or __________. (Always ____________!!!!!)

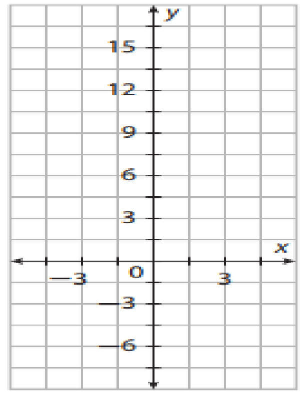
To graph in this format, you must always graph the ________________ FIRST!!!!

$g(x) = x^2 + 2$ 	$g(x) = x^2 - 5$ 	$g(x) = x^2 - 7$ 
$g(x) = (x-1)^2$ 	$g(x) = (x+1)^2$ 	$g(x) = (x-2)^2$ 

$g(x) = -3(x+1)^2 - 2$



$g(x) = 2(x-1)^2 - 7$



<u>Chapter 19 – Lesson 3: Interpreting Vertex Form and Standard Form</u>

Quadratic functions must be able to be written in __________________________ form.

y = -2x + 20	y + $3x^2$ = -4
y – 4x + x^2 = 0	X + 2y = 14x + 6

<u>Changing from vertex form to standard form -</u> Expand, Multiply, and Simplify!!!!

Rewrite a quadratic function from vertex form, $y = a(x-h)^2 + k$, to standard form, $y = ax^2 + bx + c$.

$y = 4(x-6)^2 + 3$	$y = -3(x+2)^2 - 1$

Writing a Quadratic Function given a Table of Values

Use each table to write a quadratic function in vertex form, $y = a(x - h)^2 + k$. Then rewrite the function in standard form, $y = ax^2 + bx + c$.

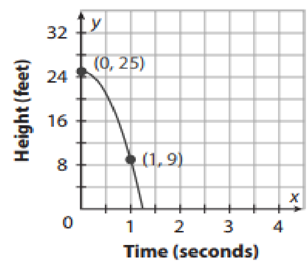
- Find vertex
- Substitute h and k
- Use any points to find a
- Write in vertex form
- Expand, multiply, and simplify for standard

x	y
−6	9
−4	1
−3	0
−2	1
0	9

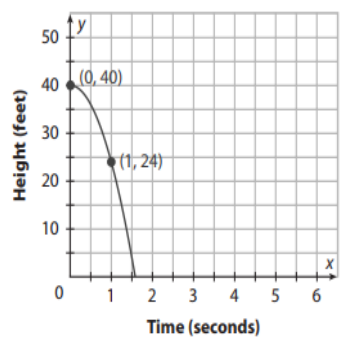
x	y
0	13
−1	1
−2	−3
−3	1
−4	13

Writing a Quadratic Function given a Table of Values

A house painter standing on a ladder drops a paintbrush, which falls to the ground. The paintbrush's height above the ground (in feet) is given by a function of the form $f(t) = a(t - h)^2$ where t is the time (in seconds) after the paintbrush is dropped.



A rock is knocked off a cliff into the water far below. The falling rock's height above the water (in feet) is given by a function of the form $f(t) = a(t - h)^2 + k$ where t is the time (in seconds) after the rock begins to fall.



Reminders:

Chapter 20 – Lesson 1: Connecting Intercepts and Zeros

Finding the vertex and axis of symmetry from standard form

<table>
<tr>
<td>

- use axis formula
- substitute to find vertex

</td>
<td>$f(x) = x^2 + 8x - 14,$</td>
<td>$y = 6x^2 + 24x + 14.$</td>
</tr>
</table>

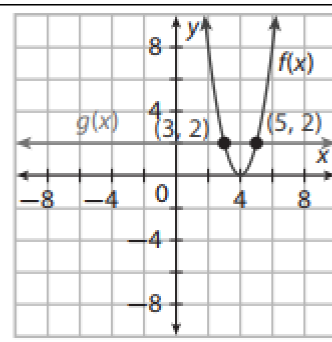
Using zeros to solve quadratic equations graphically

A **zero of a function** is an x value that makes the value of the function ____. These are the __ intercepts.

<table>
<tr>
<td>

- Rewrite equation to equal 0.
- Replace 0 with y
- Find vertex
- Create a table with points on both sides of the vertex and find the zeros of the function (y zone)
- Graph vertex and zeros and connect

</td>
<td>$2x^2 - 5 = -3$</td>
<td>



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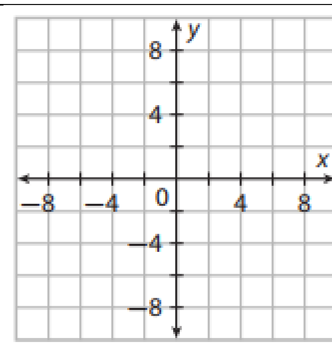
<td></td>
<td>$6x + 8 = -x^2$</td>
<td>



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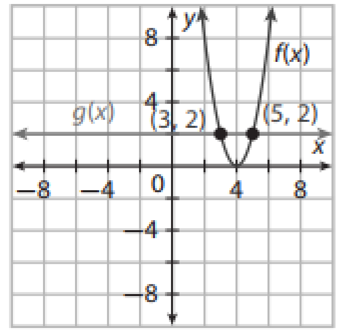
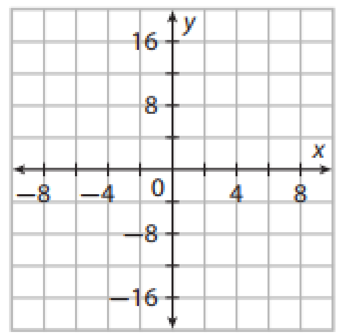
</table>

Using Points of intersection to solve quadratic equations graphically

You can also solve by rewriting in the form $ax^2 + bx = c$ and using the expressions on ________ sides of the equal sign to define a function.

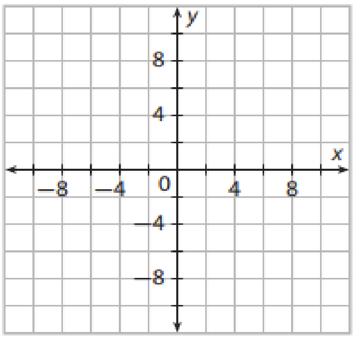
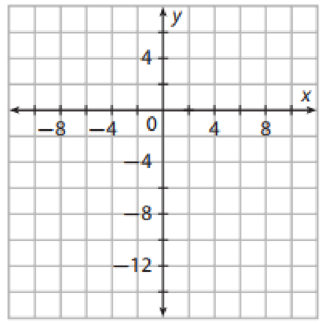
• Rewrite in $ax^2 + bx = c$ • Create 2 separate functions • Graph vertex and linear function • Identify points of intersection • Connect dots • F(x) = g(x) when x equals ___ and ____	$2(x-4)^2 - 2 = 0$	
	$3(x-5)^2 - 12 = 0$	

Modeling a Real World Problem

Nature A squirrel is in a tree holding a chestnut at a height of 46 feet above the ground. It drops the chestnut, which lands on top of a bush that is 36 feet below the squirrel. The function $h(t) = -16t^2 + 46$ gives the height in feet of the chestnut as it falls, where t represents time. When will the chestnut reach the top of the bush?
Nature An egg falls from a nest in a tree 25 feet off the ground and lands on a potted plant that is 20 feet below the nest. The function $h(t) = -16t^2 + 25$ gives the height in feet of the egg as it drops, where t represents time. When will the egg land on the plant?

<u>Chapter 20 – Lesson 2 and 3: Connecting Intercepts and Linear Factors and applying the zero product property to solve equations</u>

Graph each quadratic function and each of its linear factors. Then identify the x-intercepts and the axis of symmetry of each parabola.

$y = (x - 2)(x - 6)$ 	$y = (x - 5)(x + 2)$ 

Write each function in standard form. Determine x–intercepts and zeros of each function.

$y = -2(x + 5)(x + 1)$	$y = 5(x - 3)(x - 1)$

Given two quadratic functions $f(x) = (x - a)(x - b)$ and $g(x) = k(x - a)(x - b)$, where k is any non-zero real constant, examine the x–intercepts for each quadratic function.

For the given two intercepts and three values of k generate three quadratic functions. Write the functions in factored form and standard form.	
x-intercepts: 1 and 8; $k = 1$, $k = -4$, $k = 5$	x–intercepts: -7 and 3; $k = 1$, $k = -5$, $k = 7$

Understanding the Zero Product Property

(x+3)(x+8)=0	(x-15)(x+7)=0

Solving Quadratic Equations Using the Distributive Property and the Zero Product Property - "__________" and "__________"

$3x(x-4)+5(x-4)=0$	$-9(x+2)+3x(x+2)=0$
7x(x – 11) – 2x + 22 = 0	$-8x(x+6)+3x+18=0$

Solving Real-World Problems Using the Zero Product Property

The height of one diver above the water during a dive can be modeled by the equation $h=-4(4t+5)(t-3)$, where h is height in feet and t is time in seconds. Find the time it takes for the diver to reach the water.	The height of a golf ball after it has been hit from the top of a hill can be modeled by the equation $h=-8(2t-4)(t+1)$, where h is height in feet and t is time in seconds. How long is the ball in the air?

Date	Chapter/Lesson	Materials	Assessment	Home Learning	Rigor
	17.1: Understanding Polynomial Expressions	Guided Notes			○ Conceptual understanding ○ Skill and fluency ○ Application
	17.2: Adding Polynomials				○ Conceptual understanding ○ Skill and fluency ○ Application
	17.3: Subtracting Polynomials				○ Conceptual understanding ○ Skill and fluency ○ Application
	18.1: Multiplying MOnomials				○ Conceptual understanding ○ Skill and fluency ○ Application
	18.2: Multiplying Polynomials				○ Conceptual understanding ○ Skill and fluency ○ Application
	18.3: Special Products of Binomials				○ Conceptual understanding ○ Skill and fluency ○ Application
	19.1: Understanding Quadratic Functions	Guided Notes			○ Conceptual understanding ○ Skill and fluency ○ Application
	19.2: Transforming Quadratic Functions				○ Conceptual understanding ○ Skill and fluency ○ Application

	19.3: Interpreting Vertex Form and Standard Form				○ Conceptual understanding ○ Skill and fluency ○ Application
	20.1: Graphing Exponential Functions				○ Conceptual understanding ○ Skill and fluency ○ Application
	20.2: Connecting Intercepts and Zeros				○ Conceptual understanding ○ Skill and fluency ○ Application
	20.3: Using Graphs and Properties to Solve Equations with Exponents				○ Conceptual understanding ○ Skill and fluency ○ Application
	Chapter and Standardized Test Review				○ Conceptual understanding ○ Skill and fluency ○ Application
	Topic Assessment				○ Conceptual understanding ○ Skill and fluency ○ Application