7.1 Exploring Quadratic Relations

Gummy bears and Frogs Activity or Desmos "Will it hit the hoop?" https://teacher.desmos.com/activitybuilder/custom/56e0b6af0133822106a0bed1

Review

Functions: A specific type of relation that occurs when each element in the domain is only associated with one element in the range. Graphically we can decide if a relation is a function by using the vertical line test.

Some Types of Relations:

Linear Relation (line)

y = mx + b (slope-intercept form) OR **ax + by = c** (standard form) OR **ax+by+c=0** (general form)

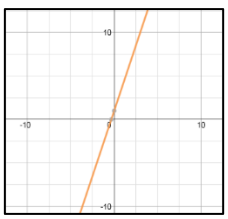
- The exponent on the x variable is _____ (1^{st} degree polynomial)

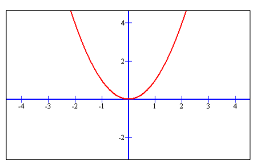
Quadratic Relation (parabola)

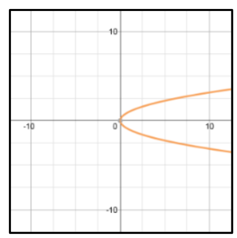
$y = ax^2 + bx + c$, where $a \neq 0$ (standard form) **$y = a(x-p)^2+q$, where $a \neq 0$** (vertex form)

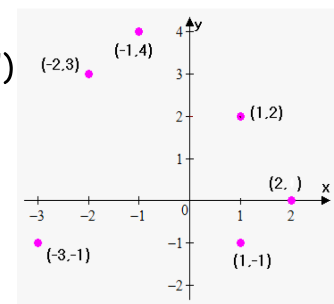
- The largest power of x is ______ (______ degree polynomial)
- Why can $a \neq 0$?

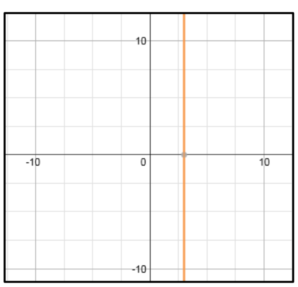
EXAMPLE #1: Which of the following relations are functions?

a) 

b) 

c) 

d) 

e) 

g) {(6, 3), (1, 7), (12, 10), (5, 3)}

h) {(4, 2), (5, 7), (4, 6), (9, 15)}

EXAMPLE #2: Which of the following are quadratic? Why or why not??

a) $f(x) = 7x^2$

b) $f(x) = 5x + 8$

c) $y = (x+2)(x-1)$

d) $f(x) = 2x(x-3)$

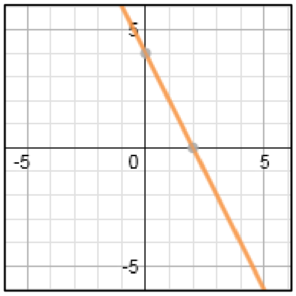
e) $f(x) = 3x^2 + 7x + 8$

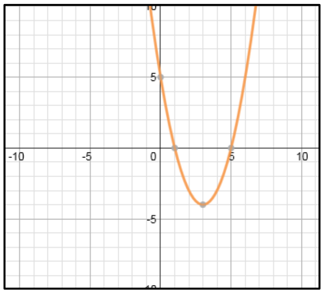
f) $y = 4x^3 – 3x^2$

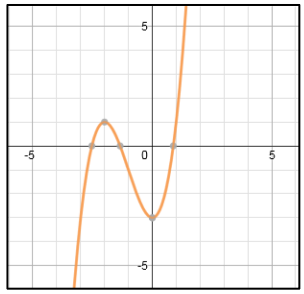
g) $y = x(x - 6)^2$

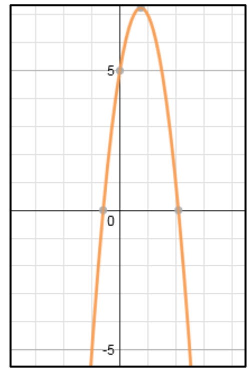
h) $g(x) = 6(x + 3)^2 + 8$

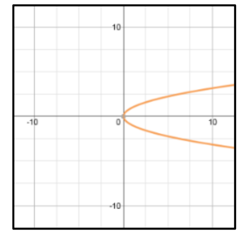
EXAMPLE #3: Which of the following are quadratic functions?











7.1/2 Properties of Graphs of Quadratic Functions (Day1)- Concept #5/6

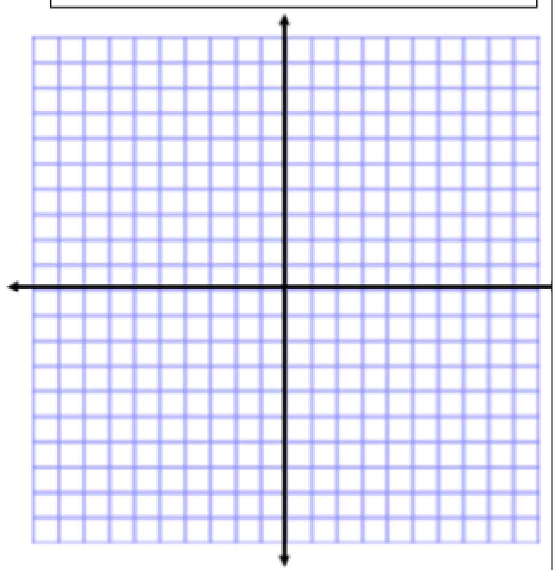
PART 1:

- Complete the table in column 1
- Graph the ordered pairs from the table onto the graph in column two. Join the points in a smooth curve
- Ignore column 3 for now……..

THE FUNCTION USING A TABLE	THE GRAPH	THE CHARACTERISTICS

x	$y = -2x^2 - 8x - 9$	y
-4		
-3		
-2		
-1		
0		
1		
2		

a = ____ b = ____ c = _____



X Intercept:

Y Intercept:

Vertex:

Is the Vertex a Maximum or Minimum?

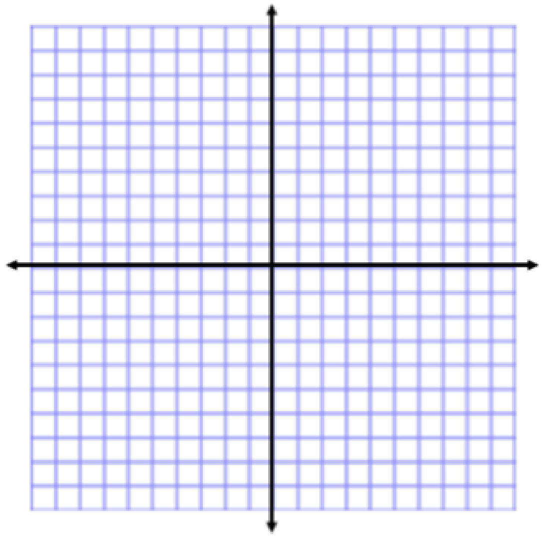
Axis of Symmetry:

Domain:

Range:

x	$y = -x^2 + 2x -5$	y
-2		
-1		
0		
1		
2		
3		
4		

a = ____ b = ____ c = _____



X Intercept:

Y Intercept:

Vertex:

Is the Vertex a Maximum or Minimum?

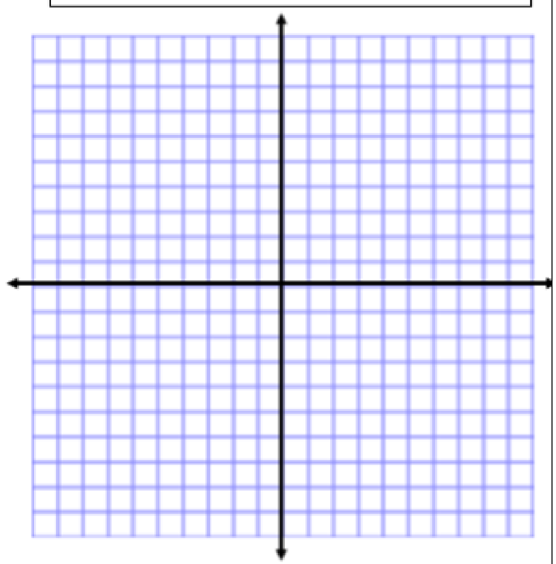
Axis of Symmetry:

Domain:

Range:

x	$y = 2x^2 + 12x + 10$	y
-6		
-5		
-4		
-3		
-2		
-1		
0		

a = ____ b = ____ c = _____



X Intercept:

Y Intercept:

Vertex:

Is the Vertex a Maximum or Minimum?

Axis of Symmetry:

Domain:

Range:

PART 2:

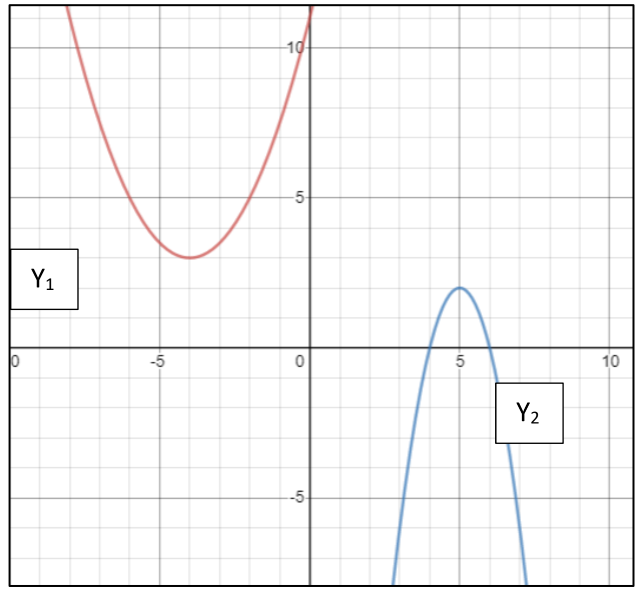
Q: What pattern do you see in the above graphs compared to their equations? How does the value of ‘a’ affect the graph? What does the value of ‘c’ tell you about the graph?

7.1/2 Day1 Assignment Pg 360 #1,2 Pg 370 # 7

7.1/2 Properties of Graphs of Quadratic Functions (Day2)- Concept #5/6

1. VERTEX:

- An ordered pair (x, y) located at the top or bottom of the curve of a parabola
- A vertex at the top of the parabola is called a MAXIMUM
- A vertex at the bottom of the curve is called a MINIMUM
- What are the coordinates of the vertices for Y_1 and Y_2?



Note: If I (or a textbook) gives you a grid where the graph goes right to the edge, it is implied that arrowheads exist at that point. **If YOU draw the graph you must include the arrowheads**

2. AXIS OF SYMMETRY:

- An "imaginary" vertical line that goes through the vertex of a parabola and cuts it into two symmetrical halves
- It is always written in equation form as x = The # that is the x coordinate of the vertex
- Draw the axis of symmetry in for both graphs. What is the equation of the axis of symmetry for both Y_1 and Y_2?

3. DOMAIN:

- Describes the complete list of x values that the graph will cover/use when the entire graph is considered
- Describes how far left and right the graph will spread
  - NOTE: When drawing a graph of a parabola that goes on forever, you must draw arrowheads. When given a textbook question or test question of a digitally drawn image of a parabola that extends to the edges of the graph you need to assume that there are arrowheads at the end (most computer programs will not allow them to be added on).
- What is the domain for Y_1 and Y_2?

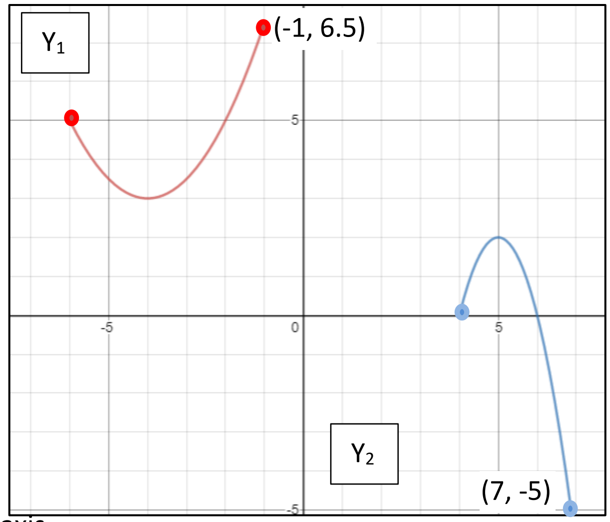
4. RANGE:

- Describes the complete list of y values that the graph will cover/use when the entire graph is considered
- Describes how down and up the graph will spread

  NOTE: Use the same arrowhead rule as described above in the domain.
- What is the range for Y_1 and Y_2?

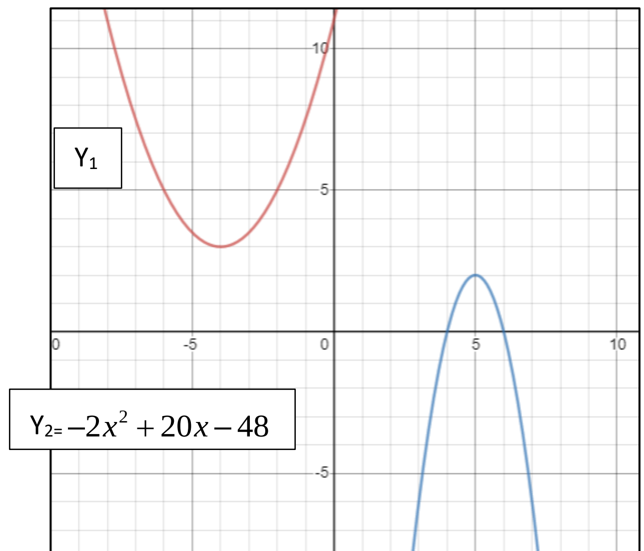
- When a real life problem is modeled by a quadratic function, the domain and range may need to be restricted to values that have meaning in the context of the problem.

If the graph was changed to the following, what would the domain and range be?



5. Y INTERCEPT:

- Describes the coordinate where the graph crosses the y axis
- When a parabola is in standard form y = $ax^2 + bx + c$, the value of "c" will be the y intercept – the coordinates of the y intercept will then be (0, c)



6. X INTERCEPTS:

- Describes the coordinate(s) where the graph of the parabola crosses the x axis
- It is possible to have one, two or no x intercepts
- In this course, the following terms also mean the same thing as x intercepts (and I may use these words interchangeably)

X intercepts = Roots = Zeros = Solutions

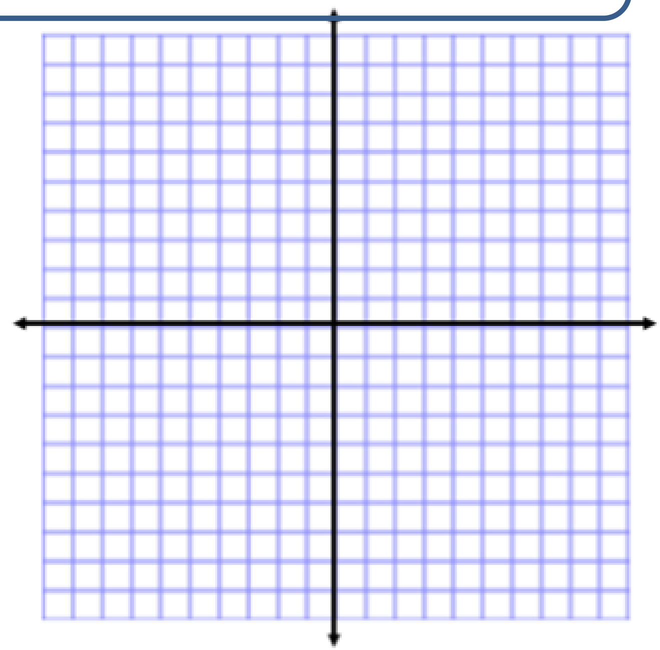
EXAMPLE #1: Determine the vertex, the y intercept, the x intercept(s), the equation of the axis of symmetry, max. or min. value, domain, range and sketch the following function: $y = -x^2+2x+8$

Method 1: Create a table of values, sketch the parabola and "read" the necessary information off of the graph. If you are not given values of x to use, choose a reasonable list and keep adding until your graph is a parabola in shape!

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

➡

(x,y)



- VERTEX:
- Y Intercept:
- X Intercept(s):
- Domain:

- Equation of Axis of Symmetry:
- Maximum or minimum value
- Range:

GO BACK TO THE NOTES FROM YESTERDAY AND FILL IN COLUMN THREE IN ALL EXAMPLES!

THE VALUE OF "a": Given a parabola in the form of $y = ax^2 + bx + c$

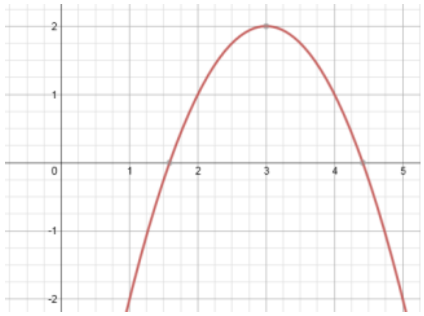
- If the value of "a" is positive, the parabola is concave up (opens up) and the vertex will be at the bottom and will be a maximum
- If the value of "a" is negative, the parabola is concave down (opens down), the vertex will be at the top and will be a minimum

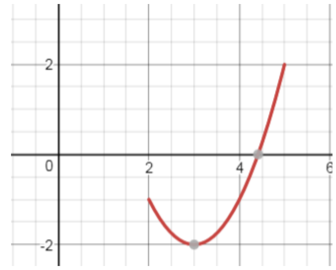
EXAMPLE #2: a) State whether the parabola's will have a maximum or minimum? B) State the coordinates of the y intercept? C) Find an additional ordered pair for each function.

ii) $y = -5x^2+8x+3$

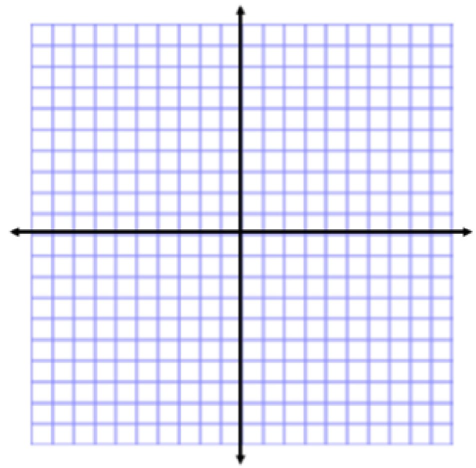
ii) $y = 7x^2+2x+5$

EXAMPLE #3: State whether the parabola has a maximum or minimum value. State its value. State the domain and range.





EXAMPLE #4: The points (4, 3) and (8, 3) lie on the same parabola. Sketch the points and predict the equation of the axis of symmetry.



Q: Can you think of a method to determine the axis of symmetry without graphing?

7.1/2 (Day 2) Assignment Pg 369 #2,3,5,6, 9ab,10, 11ab (Create a suitable table of values)

<u>CH. 7 (Day 3) Review of Factoring</u>

y = (x – 4)(x + 3) ⟺ **y = x²- x - 12**

FACTORED FORM EXPANDED FORM

Note: **Factoring quadratics is the inverse operation of expanding**

Greatest Common Factor

EXAMPLE #1: FACTOR THE FOLLOWING:

a) $f(x) = -2x^2 - 8x$

b) $y = 6x^2 - 9x + 30$

c) $-15x^2y^6 - 10x^3y^9 + 15x^{11}$

Trinomials Where a = 1

EXAMPLE #2: Factor the following:

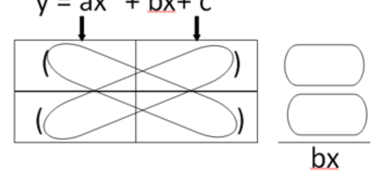
a) $y = x^2 - 10x + 16$

b) $y = x^2 + 2x - 8$

c) $f(x) = x^2 + 13x + 40$

FACTORING WHEN "A" IS A NUMBER OTHER THAN 1:

$y = ax^2 + bx + c$



ANSWER WILL BE:

y = (   )(   )

Trinomials Where a ≠1

EXAMPLE #3: Factor the following

a) $y = 2x^2 - 10x - 12$

b) $f(x) = -x^2 + 12x - 35$

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

d) $y = 3x^2 - 20x - 7$

e) $y = 8x^2 - 18x - 5$

f) $y = 5x^2 + 7x - 6$

Difference of Squares

What do we need in order for a question to be a difference of squares?

-
-
-

EXAMPLE #4: Factor the following

a) $y = x^2 - 4$

b) $f(x) = 4x^2 - 25$

FACTORING FLOWCHART:

Putting it all Together

1. **ALWAYS CHECK FOR GCF FIRST, factor it out if there is one**
2. **Do you have ax^2+bx+c where a = 1? Do the "easy factoring"**
3. **Do you have ax^2+bx+c where a is NOT 1? Use the "Window" method of factoring or decomposition**
4. **Do you have $ax^2 - b$ where "a" and "b" are perfect squares? Use difference of squares**

EXAMPLE #5: Factor the following

a) $h(x) = 2x^2 - 10x - 12$

b) $y = 2x^2 + 18x + 28$

c) $f(x) = 4x^2 - 100$

d) $y = -9x^2 + 48x + 36$

CH. 7 (Day 3) Review of Factoring Assignment

1. Factor the following questions:

a)	$y = 15x^2 - 65x + 20$	b)	$g(x) = 18x^2 + 15x - 18$
c)	$y = 12x^2 - 52x - 40$	d)	$f(x) = 24x^2 - 2x - 70$
e)	$y = 4x^2 + 4x - 48$	f)	$y = -5x^2 + 40x - 35$
g)	$h(x) = -3m^2 - 18m - 24$	h)	$f(x) = 10x^2 + 80x + 120$
i)	$y = 7x^2 - 35x + 42$	j)	$y = 18x^2 - 2$
k)	$f(x) = 16x^2 - 1$	l)	$g(x) = -x^2 + 1$
m)	$y = 16x^2 - 81$	n)	$h(x) = 2 - 8x^2$

2. Factor fully . Use the strategy that you prefer.

a)	$9k + 6$	b)	$3x^2 - 6x^4$	c)	$-3c^2 - 13c^4 - 12c^3$
d)	$x^2 + 12x - 28$	e)	$y^2 - 2y - 48$	f)	$8a^2 + 18a - 5$
g)	$15a^2 - 65a + 20$	h)	$s^2 + 11s + 30$	i)	$2x^2 + 14x + 6$
j)	$3x^2 + 15x - 42$	k)	$15a^3 - 3a^2b - 6ab^2$	l)	$w^2 + 10w - 24$
m)	$3c^2d - 10cd - 2d$	n)	$f^2 + 17f + 16$	o)	$4t^2 + 9t - 28$
p)	$h^2 - 25j^2$	q)	$6x^2 - 17xy + 5y^2$	r)	$28a^2 - 7a^3$
s)	$25t^2 + 20tu + 4u^2$	t)	$3x^2 - 3x - 60$	u)	$18m^2 - 2n^2$

SOLUTIONS:

1.

a)	$y = 5(x - 4)(3x - 1)$	b)	$g(x) = 3(2x + 3)(3x - 2)$	c)	$y = 4(3x + 2)(x - 5)$
d)	$f(x) = 2(3x + 5)(4x - 7)$	e)	$y = 4(x + 4)(x - 3)$	f)	$y = -5(x - 7)(x - 1)$
g)	$h(x) = -3(x + 4)(x + 2)$	h)	$f(x) = 10(x + 6)(x + 2)$	i)	$y = 7(x - 3)(x - 2)$
j)	$y = 2(3x - 1)(3x + 1)$	k)	$f(x) = (4x - 1)(4x + 1)$		
l)	$g(x) = -(x - 1)(x + 1)$ or $g(x) = (1 - x)(1 + x)$	m)	$y = (4x - 9)(4x + 9)$		
n)	$h(x) = 2(1 - 2x)(1 + 2x)$				

2.

a)	$3(3K + 2)$	b)	$3x^2(1 - 2x^2)$	c)	$-c^2(3 + 13c^2 + 12c)$
d)	$(x + 14)(x - 2)$	e)	$(y - 8)(y + 6)$	f)	$(4a - 1)(2a + 5)$
g)	$5(3a - 1)(a - 4)$	h)	$(s + 5)(s + 6)$	i)	$2(x^2 + 7x + 3)$
j)	$3(x + 7)(x - 2)$	k)	$3a(5a^2 - ab - 2b^2)$	l)	$(w + 12)(w - 2)$
m)	$d(3c^2 - 10c - 2)$	n)	$(f + 16)(f + 1)$	o)	$(4t - 7)(t + 4)$
p)	$(h - 5j)(h + 5j)$	q)	$(3x - y)(2x - 5y)$	r)	$7a^2(4 - a)$
s)	$(5t + 2u)^2$	t)	$3(x - 5)(x + 4)$	u)	$2(3m - n)(3m + n)$

7.5 Solving Quadratic Equations by Factoring (Day 4) – Concept #7

Zeros: The value(s) which make an expression equal to zero **Roots:** The value(S) that are the solution(s) to a mathematical equation

X- Intercepts: Points on the graph of a relation where the relation crosses the x-axis. These are the points for which the y-value is 0.

The x-intercepts are also called the **'zeros'** of the function, or the **'roots'** of the function.

Zero Product Property: If $a \times b = 0$ then a = 0 or b= 0 (ex./ (ax-n)(bx-m) =0 then ax-n=0 or bx-m=0)

Example #1 a) Solve. $75p^2 - 192 = 0$

b) Determine the zeros of $y = -2(2x-7)(4x-1)$

c) Determine the roots of $4x^2 + 28x + 49 = y$

d) Solve. $1.4t^2 + 5.6t = 16.8$

QUESTION: *What is the difference between the answers for the following questions:*

a) Find the x intercept of $y = x^2 + 5x + 4$

b) Solve $0 = x^2 + 5x + 4$

Would it make sense to switch these questions so that they looked like this instead:

a) Solve $y = x^2 + 5x + 4$

b) Find the x intercepts of $x^2 + 5x + 4 = 0$

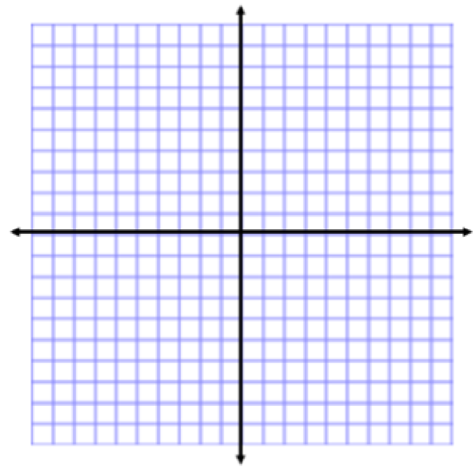
RULE: A question will ask you to "solve" if ____________________________________

A question will ask you to find the x intercepts/the zero's/the roots if ______________________________________

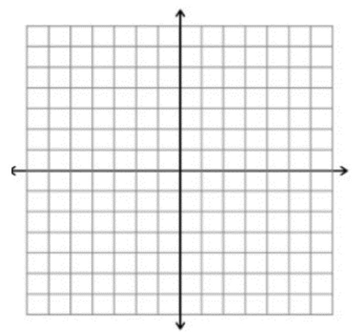
Step 1: An x-intercept/root/solution/zero is when y = 0, so set the function equal to 0.
Step 2: Factor your trinomial into two sets of brackets using your preferred method
Step 3: Solve for the x-intercepts.
Step 4: Find the vertex (algebraically) and the y intercept.
Step 5: Graph by sketching all the above points.

EXAMPLE #2: **a)** Find the zeros of the following and sketch.

$$y = x^2 - 10x + 16$$



b) $f(x) = -2x^2 - 8x$



c) Verify your zeros algebraically to (b)

Example #3 Suppose your best friend solved the quadratic equation as shown:

$4x^2 = 9x$

$$\frac{4x^2}{x} = \frac{9x}{x}$$

$4x = 9$

$x = \frac{9}{4}$ or 2.25

Is this solution correct? If not, identify the error. Then, solve the quadratic correctly.

7.5 Assignment: page 405 #1 -3 4ad, 6(acd), 9-11

7.4 Factored Form of a Quadratic Function (Day 5) - Concept #8

RULE: When a quadratic in the form $y = ax^2 + bx + c$ is factored and written in the form $Y = a(qx – r)(sx – t)$, then the following is true:

- The x intercepts are at x = ☐ and x = ☐
- The axis of symmetry will always be ______________________________ of the above two x intercepts
- The y intercept is the value of _____ of the equation in standard form. To find it in factored form you need to ____
- The value of a affects the following characteristics of a parabola by:
  - Direction of opening:
  - Vertical Stretch affecting width:

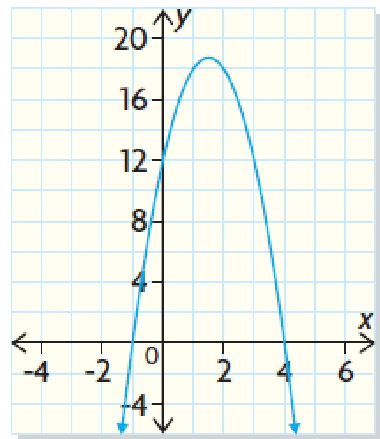
EXAMPLE #1:

a) A parabola has roots of x = 7 and x = -6. What factors did those roots come from?

b) A parabola has roots of x = 0 and x = 1. What factors did those roots come from?

d) A parabola has roots of x = $\frac{2}{3}$ and x = -5. What factors did those roots come from? (Factors do not contain fractions!)

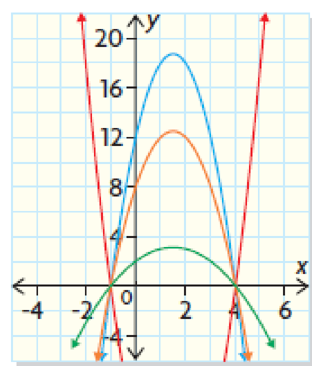
<u>Example #2</u> - Determine the function that defines the parabola. Write the function in standard form $y = ax^2 + bx + c$ (Concept #8)



Step 1: Find the x-intercepts

Step 2: Write the factored form of the quadratic function.

Step 3: Since there are infinitely many parabolas that have these two zeros (ours is the tallest parabola facing downward), we need to find the value of a.



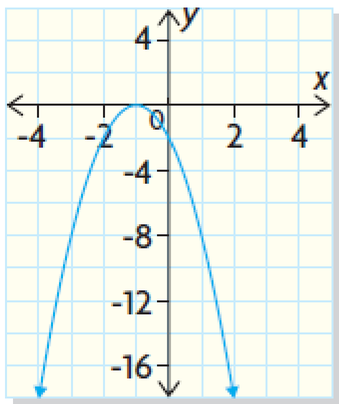
- Choose any other point that you know **lies on** the parabola.
  This point will serve as an (x,y) point that satisfies the quadratic equation.

  Since the y-intercept is 12, we'll use the point
  (,)

In factored form, the quadratic function is:

In standard form, the quadratic function is:

Example #3- Determine the quadratic function of the graph below written in factored form? And standard form?



EXAMPLE #4: Find **AN** equation of a parabola that has roots at $-\frac{4}{3}$ and 5.

EXAMPLE #5: Find **THE** equation of the parabola in factored form that has roots at $-\frac{4}{3}$ and 5 and passes through the point (-1, 30)

7.4 Assignment: p. 391 #1,3, 4acdf, 5acdf, 11,13

7.7 Solving Quadratic Equations using the Quadratic Formula (Day6)- Concept #9

What we know so far:

- **SOLVING** a quadratic equation means to find the x intercepts of it. We also call this finding the roots, the zero's or the solutions.
- We can graph the quadratic to find the x intercepts using table of values or key points.
- We can solve the quadratic equation (Set y=o) then factor and solve to find the x intercepts

PROBLEMS WITH THESE METHODS:

- Graphing by hand using a table of values can be time consuming – we don't always know which values of x to start with in the table
- Some quadratics won't factor because their zeros are not rational numbers.

https://www.youtube.com/watch?v=O8ezDEk3qCg (Quadratic Formula Song)

The roots of a quadratic equation in the form **a**x^2 + **b**x + **c** = 0, where a ≠ 0, can be determined by using the quadratic formula

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

The **<u>Quadratic Formula</u>** allows us to find the 'roots', 'zeros' or x-intercepts of **<u>any</u>** quadratic equation, regardless if we can fully factor it or not. However, we often try solving for the x-intercepts by factoring first, as this method is usually quicker.

<u>Example #1:</u> a)Solve the equation using the **quadratic formula**. **Remember to set the equation equal to zero first!**

$x^2 + 5x = -8-x$ a=_____ b=_____ c=_____

b) Could you have solved by factoring?

<u>Example #2:</u> Given $2x^2 + 8x - 5 = 0$, find the zero's using the quadratic formula. State your answer as an exact value (leave as a reduced radical) and approx.. value to the nearest thousandth (3 decimal places).

b) Could you have found the zeros by factoring?

Example #3: Find the roots for the quadratic $y = x^2 + 9x + 23$, using the quadratic formula.

What does this mean about the graph of the corresponding quadratic?

Example #4: a)Find the x- intercepts of $y - 13x - 5 = 6x^2$ using the quadratic formula. b) Could you have solved the x- intercepts by factoring?

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

NOTE

- $b^2 - 4ac$ (Found in the quadratic Formula) is called the ___________________________
  - If the discriminant simplifies to a **perfect square**, then the quadratic equation could also have been solved by ___________________.
  - If the discriminant simplifies to a **negative** number, then there is ____________________________________ (the parabola will not cross or touch the x-axis).
  - If the discriminant simplifies to **zero**, there is _________ solution (the vertex lies on the _______________).

7.7 Assignment: page 428 # 1 (solve only), 2,4, 6

<u>Extra Questions:</u> 1) Determine x –intercept(s) and vertex for each of the following quadratic functions:

a) $y = -x^2 + 6x - 5$ b) $y = \frac{1}{3}x^2 - 2x + 3$

2) Use the quadratic formula to solve each of the following quadratic equations.

a) $x^2 - 2\sqrt{2}x + 2 = 0$ b) $\sqrt{3}x^2 - 7x = -2\sqrt{3}$

<u>Solutions</u> #1a) x = 1 and x = 5; vertex: (3, 4) b) x = 3; vertex: (3, 0) hmm… ☺ **#2a)** x = 1.414 OR $x = \sqrt{2}$

b) x = 3.464 and x = 0.577 OR $x = 2\sqrt{3}$ *and* $\frac{\sqrt{3}}{3}$

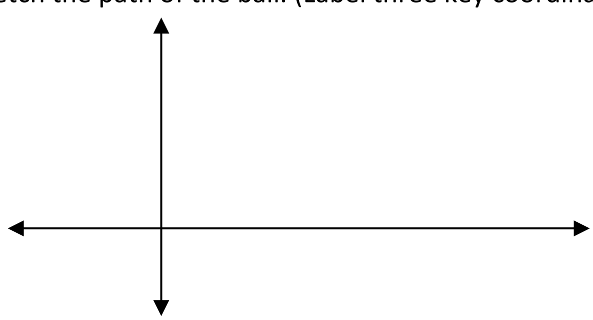
<u>7.3/4/5/7/8: Applications of Quadratics Functions in Standard Form $y = ax^2+bx+c$ –Concept #10 (Day 7)</u>

Example 1: A ball is thrown into the air and follows the path given by $h(t) = -5t^2 + 20t + 1$, where *h* represents height in meters and *t* represents time in seconds.

a) Determine ***the initial height*** of the ball.

b) Determine the ***vertex***.

c) Sketch the path of the ball. (Label three key coordinates and the axes.)



d) What is the ball's ***maximum height***? ______

e) How long does it take for the ball to reach its ***maximum height***? ______

f) What is the height of the ball after 3 seconds?

g) What are the domain and range of this function?

Example #2 (Pg 407 #14)

Samuel is hiking along the top of the First Canyon on the South Nahanni River in the Northwest Territories. When he knocks a rock over the edge, it falls into the river, 1260m below. The height of the rock, h(t), at t seconds can be modelled by the following function: $h(t) = -25t^2 - 5t + 1260$

a) How long will it take the rock to reach the water?

c) Sketch the path of the rock.

d) What is the domain and range of the function?

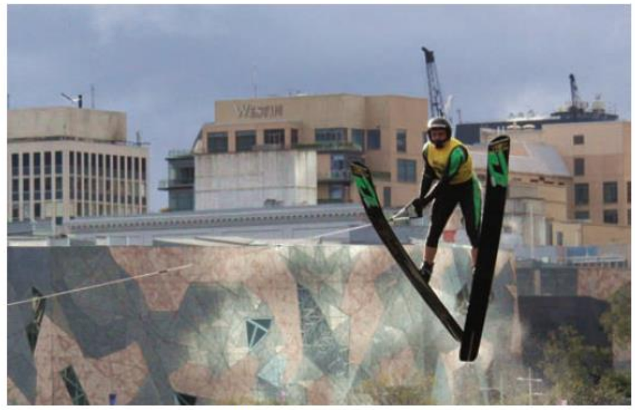
d) Demonstrate the solution using your graphing calculator, if time permits.

<u>Example #3- Pg 374 Ex.1</u>

The flight time for a long-distance water ski jumper depends on the initial velocity of the jump and the angle of the ramp. For one particular jump, the ramp has a vertical height of 5 m above water level. The height of the ski jumper in flight, $h(t)$, in metres, over time, t, in seconds, can be modelled by the following function:

$$h(t) = 5.0 + 24.46t - 4.9t^2$$

a) How long does this water ski jumper hold his flight pose?



The skier holds his flight pose until he is 4.0 m above the water.

b) What is the highest height the ski jumper reaches? Use technology to help you answer these question

NOTE: You will need access to a graphing calculator for this assignment. Students intending to take AP Calculus should purchase one at this time if possible (see my course outline for recommendations). If not, you can download an online graphing calculator at http://wabbitemu.org/ **or you can create an account and use an online version of the TI 84 at** https://www.cemetech.net/projects/jstified/.

<u>7.3/4/5/7/8 (</u>Concept # 10)- Assignment: Pg 371 #12-14 Pg 407 #13(Solve by factoring) Pg 428 #8, 10 Pg 380 #7,9 (Use Graphing Calc)

If needed:

Example 4

The entry to the main exhibit hall in an art gallery is a parabolic arch. The arch can be modelled by the function

$$h(w) = -0.625w^2 + 5w$$

where the height, $h(w)$, and width, w, are measured in feet. Several sculptures are going to be delivered to the exhibit hall in crates. Each crate is a square-based rectangular prism that is 7.5 ft high, including the wheels. The crates must be handled as shown, to avoid damaging the fragile contents.

FOUNDATIONS 20 – QUADRATIC WORD PROBLEMS (Assignment) CONCEPT #10 (SUNDEEN)

Answer the following questions on a piece of loose leaf using the method indicated. Show answers to the nearest thousandth if not indicated otherwise.

1. METHOD: SOLVE ALGEBRAICALLY THEN CHECK ANSWERS WITH GRAPHING CALC.

The profits of Mr. Unlucky's company can be represented by the equation y = -3x 2 + 18x - 4 , where y is the amount of profit in hundreds of thousands of dollars and x is the number of years of operation. He realizes his company is on the downturn and wishes to sell before he ends up in deb t.

a) When will Unlucky's business show the maximum profit?

b) What is the maximum profit?

c) After how many years will it be too late to sell his business? (When will is business not be making a profit?)

2. METHOD: SOLVE USING GRAPHING CALCULATOR

Jocelyns and Kelly built rockets from assembly kits and are going to launch them at the same time to see whose rocket flies higher. If Jocelyn's rocket's height, in feet can be described by the equation J(x) = -16x2+180x while Kelly's is represented by K(x)=-16x2+240x.

a) Who won the contest?
b) How long does it take for Jocelyns rocket to land? How long does it take for Kelly's rocket to land?
c) To the nearest tenth of a second, what was the difference in time for the two different rockets to reach their respective max heights?

3. METHOD: SOLVE ALGEBRAICALLY THEN CHECK ANSWER WITH GRAPHING CALC.

A ball rolls down a slope and travels a distance $d = 6t + \frac{t^2}{2}$ feet in t seconds. Find when the distance is 17 feet.

Note: $t \geq 0, t \varepsilon \mathbb{R}$

4. METHOD: SOLVE USING GRAPHING CALCULATOR

The number of horsepower needed to overcome a wind drag on a certain automobile is given by $N(s)=0.005s^2+0.007s-0.031$, where *s* is the speed of the car in miles per hour. How much horsepower is needed to overcome the wind drag on this car if it is traveling 50 miles per hour? At what speed will the car need to use 200 horsepower to overcome the wind drag?

5. METHOD: SOLVE USING GRAPHING CALCULATOR

For the years of 1983 to 1990, the number of mountain bike owners m (millions) in the US can be approximated by the model $m=0.337t^2-2.265t+3.962, 3\le t\le 10$ where t=3 represents 1983 and t=10 represents 1990.

a) In which year did 2.5 million people own mountain bikes?
b) In what year was the number of mountain bike owners at a minimum?

6. METHOD: SOLVE ALGEBRAICALLY THEN CHECK ANSWERS WITH GRAPHING CALC.

The path of a high diver is given by $y=-\frac{4}{9}x^2+\frac{24}{9}x+10$ where y is the height in feet above the water and x is the horizontal distance from the end of the diving board in feet. What is the maximum height of the diver and how far out from the end of the diving board is the diver when he hits the water?

7.6 Vertex Form of the Quadratic Function $y = a(x-h)^2 + k$ or $y = a(x-p)^2 + q$

Have students discover what each variable does to the graph:

Use marble slides a teacher activity in desmos https://teacher.desmos.com/marbleslides-parabolas

Or on the desmos calculator open the graph: parabolas: Vertex form

MARBLESLIDES ACTIVITY:

1. GOAL: Manipulate the equation so that the purple ball is guided along the graph in such a way that it knocks out ALL the yellow stars
2. RULES: The equation you are given is in the form **$y = a(x – h)^2 + k$**. Each question gives you guidelines about what you may change and how many of the parameters of a, h and k you are allowed to change
   - You may change the values of a, h and k to any value (you must not let a=0)
   - You can not change the power of the exponent (it must remain as squared)
   - In some questions, you may also change the domain of the graph. To change a domain in Desmos you must use the domain description inside curly brackets after you type in the equation. For example $y=(x+3)^2+1$ {x>1} will only graph the parabola to the right of 1. If you were to type in $y=(x+3)^2+1$ {-3>x>1} the parabola would only show up between -3 and 1 along the x axis.

7.6 Vertex Form of the Quadratic Function (Day 1) $y=a(x-h)^2+k$ or $y=a(x-p)^2+q$ -

Concept #11 and 12

VERTEX-GRAPHING FORM

Foundations 20 textbook uses: $y = a(x-h)^2 + k$ or Pre- Calculus 20 textbook uses: $y=a(x-p)^2+q$

- the vertex is at ____________ or ___________
- if a > 0 (is positive), the parabola opens________
- if a < 0 (is negative), the parabola opens ________

Note: a ≠0

- the equation of the axis of symmetry is ___________or _________

The graph of the function can be sketched more easily using this form.

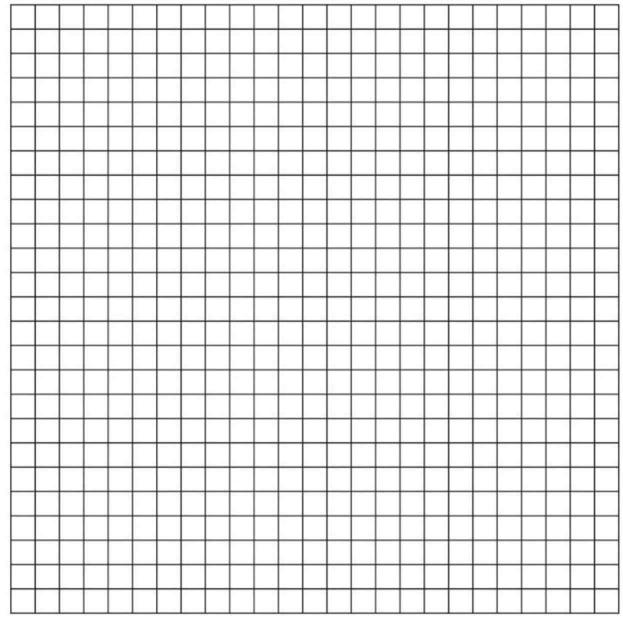
Example1: For each quadratic function below, identify the following: **(CONCEPT #11)**

a) $f(x) = (x-3)^2 + 9$ b) $m(x) = 2(x+7)^2 - 3$ c) $r(x) = -2x^2 + 5$

i) Does the parabola open up or down? Max or Min?			
ii)Coordinates of the vertex			
iii)Equation of axis of symmetry			
iv)Domain ad Range			
v) How many zeros the function will have?			
vi) x and y– intercepts (Solve the x- int. using the square root property)			

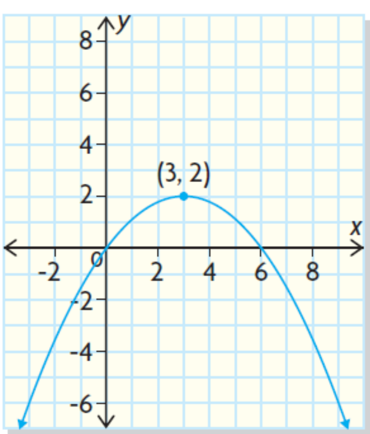
Example #2: Sketch the graph of the following function: $f(x) = 2(x-3)^2 - 4$ & State the domain and range.**(Concept #11)**

- Which way does it open?
- Where is the vertex?
- Where is the axis of symmetry?
- What are the x- intercepts?



- What is the y-intercept?
    - Reflect this point about the axis of symmetry to find the y intercepts reflection point

Example #3: Determine the equation of the quadratic function in vertex form**(Concept #12)**



7.6 (Day 1) Assignment: pg 417 #1bde, 2ace, 3,4, 5, 7, 11, 14

7.6 Application of Quadratics using Vertex Form (Day2)

VERTEX FORM $y=a(x-h)^2+k$ or $y=a(x-p)^2+q$

Example #1: Given the equation $y=x^2+4$. If the graph is shifted down 2 units, which equation describes the new graph?

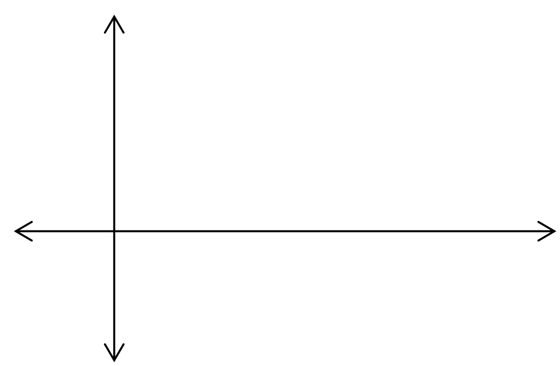
a) $y=x^2+6$ b) $y=(x-2)^2+2$ c) $y=(x-2)^2+4$ d) $y=x^2+2$

Example #2: Given $y=-2(x-3)^2$ If the function is shifted 8 units to the right and 3 units up, write an equation that describes the new function.

Example #3: Rewrite the following equation in standard form. $y=-\frac{1}{4}(x+2)^2+1$

Example #4: A toy rocket is shot up in the air from a hill. Its height in meters above ground, *h*, is recorded after *t* seconds. The path the rocket follows is given by the following equation: $h(t)=-4(t-6)^2+149$

a) What is the initial height of the rocket?
b) Sketch the path of the rocket. (Label your sketch)
c) When will the rocket reach its maximum height?
d) What is the maximum height of the rocket?
e) How long does the toy rocket remain in the air for?



Example #5:

A bridge with a parabolic archway has zeros located at (2, 0) and (32, 0).The arch has a maximum height of 112.5 ft.

a) Determine the equation of the archway in vertex form.

b) State the domain and range of the function describing the arch.

Example #6: A soccer ball is kicked from the ground. After 2 seconds, the ball reaches its maximum height of 20 m. It lands on the ground at 4s.

a) Determine the quadratic function that models the height of the kick. Write it in vertex- graphing form.
b) Determine any restrictions that must be placed on the domain and range of the function.
c) What is the height of the ball after 1 s?
d) When was the ball at the same height on the way down?

7.6 (Day 2) Assignment

Pg 420 #13, 15, 16, 17 – 19 (Choose 2 questions from 17-19)

1. Given $y - 1 = 2(x + 1)^2$. If the equation is shifted left 5 units, which equation describes the new graph?
   a. $y - 6 = 2(x - 4)^2$
   b. $y - 1 = 2(x - 4)^2$
   c. $y - 1 = 2(x + 6)^2$
   d. $y - 1 = 2(x + 5)^2$
   e. $y - 1 = 2(x - 6)^2$
2. If the given function $y = (x - 1)^2 + 3$ is shifted up 3 units and left 4 units, which equation describes the new graph?
   a. $y = (x - 4)^2 + 3$
   b. $y - 3 = (x + 4)^2$
   c. $y - 7 = (x + 2)^2$
   d. $y = (x - 5)^2$
   e. $y = (x + 3)^2 + 6$
3. If the given function $y = (x + 3)^2 + 4$ is shifted down 5 units, which equation describes the new function?
   a. $y = (x + 3)^2 + 9$
   b. $y = (x + 3)^2 - 1$
   c. $y = (x + 8)^2 + 4$
   d. $y = (x - 2)^2 + 4$
   e. $y = -5(x + 3)^2 + 4$

4. Given $y = x^2$. If the function is shifted 4 units to the left, write an equation that describes the new function.

If time permits Dan Meyer 3 act task

"Will it hit the hoop?" https://betterlesson.com/lesson/584563/quadratic-modeling-day-1