QUIZ DATE: _____ & _____ TEST DATE: _____

Math 2 Name _____

Unit 2 – Quadratic Functions Date _____ Pd ____

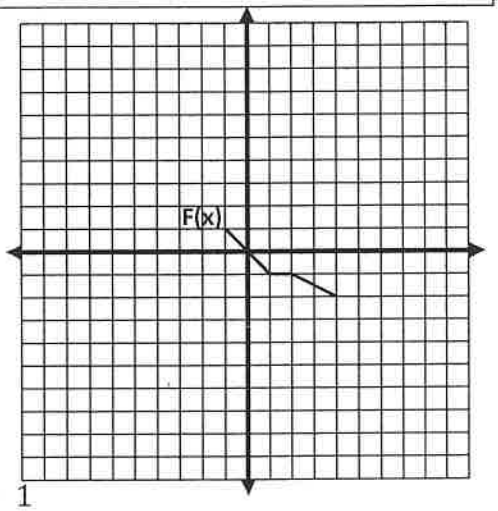
Lesson 1 – Transformations

➢ **Review:**

- A _____ is any set of ordered pairs.
- _____: set of all x values in a relation
- _____: set of all y values in a relation
- A _____ is a relation in which each element of the domain is paired with exactly one element of the range.
- Graphically, a function must pass the _____ _____ _____ (VLT) in order to be classified as a function.

➢ Examine the graph of $F(x)$ to the right:

x	$F(x)$
–1	
1	
2	
4	



1. Is $F(x)$ a function? Why or why not?
2. What is the domain of $F(x)$?
3. What is the range of $F(x)$?
4. Evaluate each of the following key points on $F(x)$:

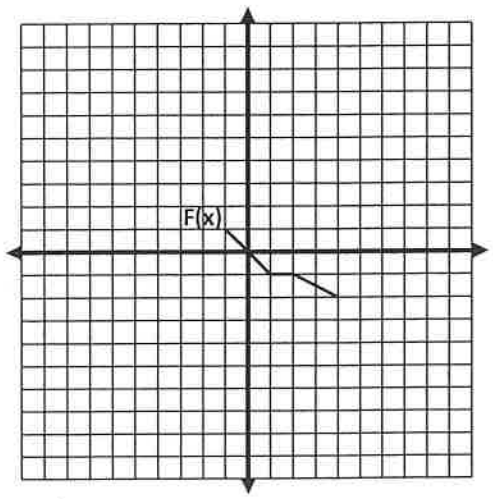
$F(1) =$ _____ $F(-1) =$ _____ $F($_____$) = -2$ $F($_____$) = 1$

❖ Remember that $F(x)$ is another name for the **y-values** → the equation of the function is $y = F(x)$.

➢ Now let's try graphing: $y = F(x) + 4$.

➢ Complete the table below for this new function and then graph on the coordinate.

x	y
–1	
1	
2	
4	

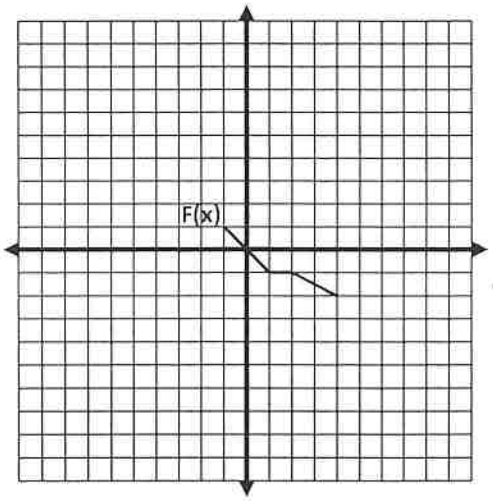


Describe the transformation:

Did the transformation affect the domain or the range of the function?

➢ Graph: $y = F(x) - 3$.

x	y
−1	
1	
2	
4	



Describe the transformation:

Did the transformation affect the domain or the range of the function?

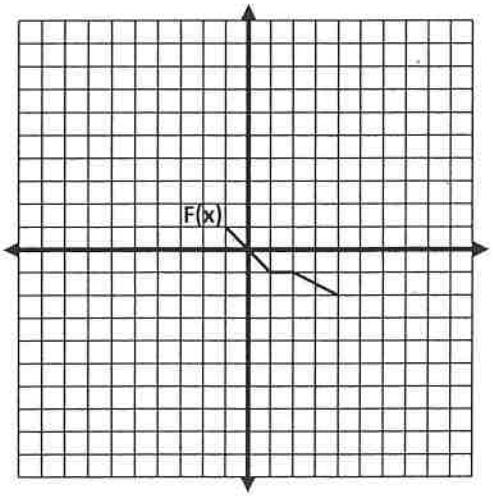
❖ **Checkpoint**: Describe the affect for the following functions.

Equation	**Effect to the graph**
Example: $y = F(x) + 18$	Translate up 18 units
1. $y = F(x) - 10$	
2. $y = F(x) + 3$	
3. $y = F(x) + 32$	
4. $y = F(x) - 1$	

➢ Graph: $y = F(x + 4)$.

Describe the transformation:

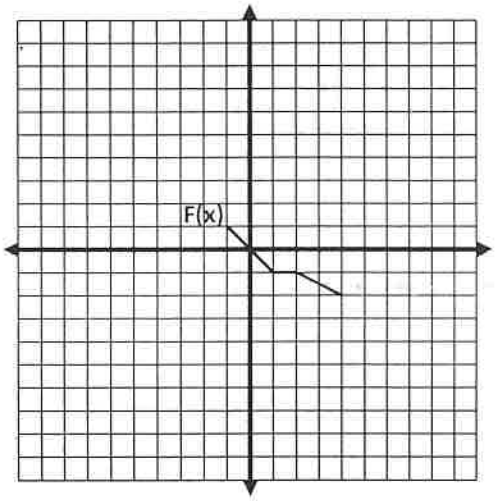
Did the transformation affect the domain or the range of the function?



➢ Graph: $y = F(x - 3)$.

Describe the transformation:

Did the transformation affect the domain or the range of the function?



❖ **Checkpoint**: Describe the affect for the following functions.

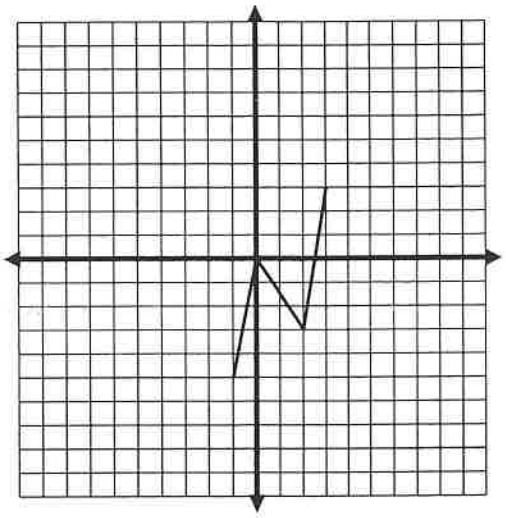
Equation	Effect to the graph
Example: $y = F(x + 18)$	Translate left 18 units
1. $y = F(x - 10)$	
2. $y = F(x) + 7$	
3. $y = F(x + 48)$	
4. $y = F(x) - 22$	
5. $y = F(x + 30) + 18$	

❖ **Checkpoint**: Write the equation for each translation:

Equation	Effect to the graph
Example: $y = F(x + 8)$	Translate left 8 units
1.	Translate up 29 units
2.	Translate right 7
3.	Translate left 45
4.	Translate left 5 and up 14
5.	Translate down 2 and right 6

➢ Now let's look at a new function.
Its notation is $H(x)$.

x	$H(x)$



1. What are the key points?
(List them in the chart)

2. Describe the effect on the graph for each of the following.

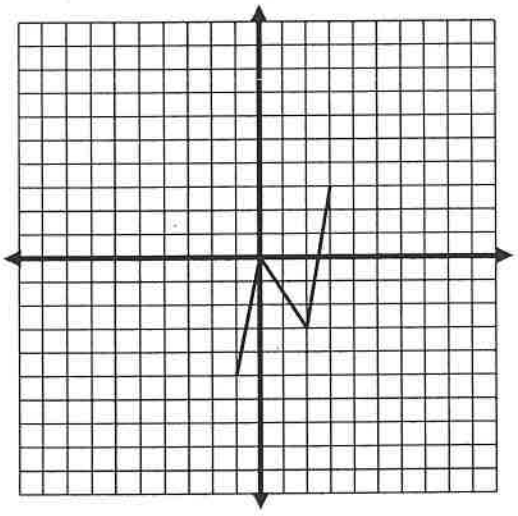
a. $H(x-2)$ _____

b. $H(x)+7$ _____

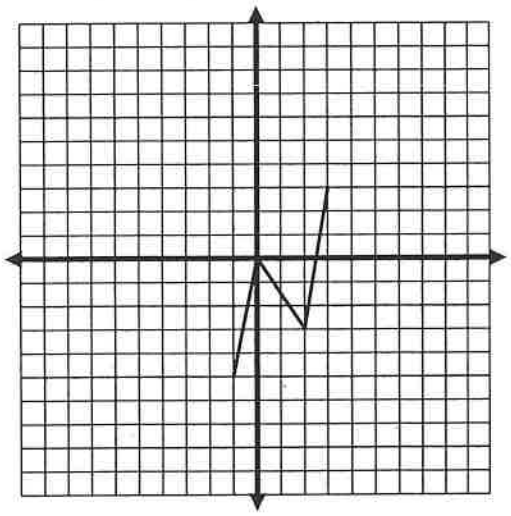
c. $H(x+2)-3$ _____

3. Use your answers to questions 1 and 2 to help you sketch each graph *without using a table*.

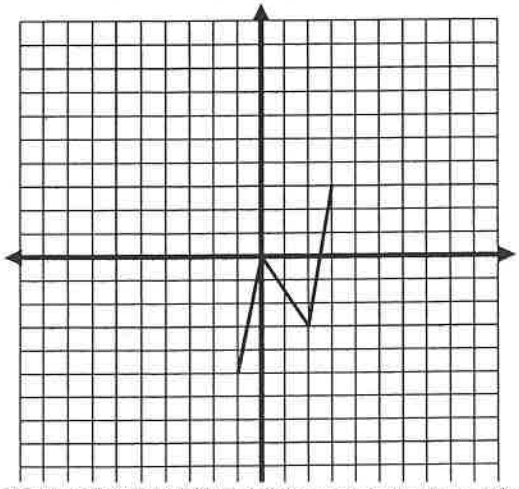
a. $y = H(x-2)$



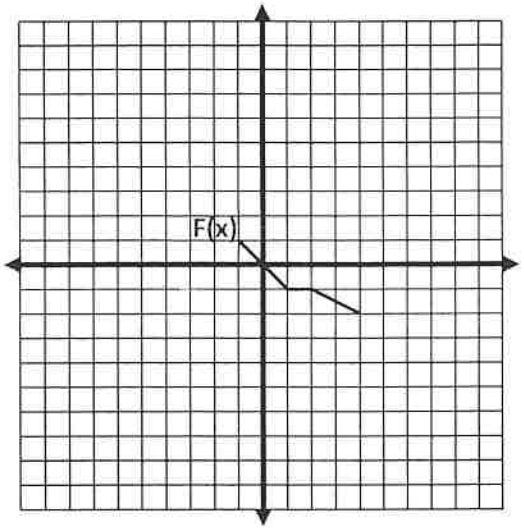
b. $y = H(x)+7$



c. $y = H(x+2)-3$



Recall that the equation: $y = F(x)$



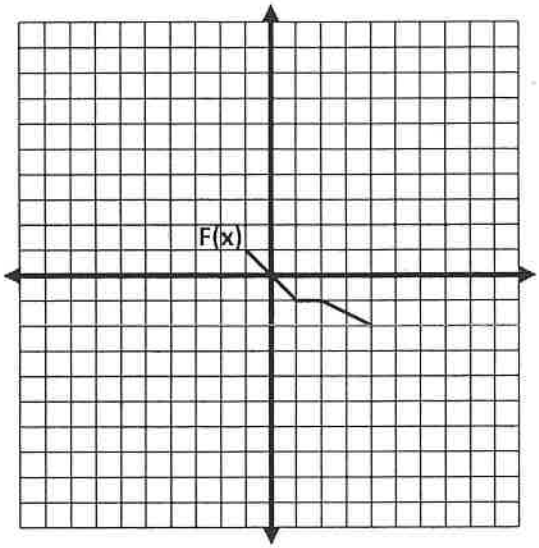
➢ Now let's graph: $y = -F(x)$

$(x, y) \rightarrow (\quad\quad\quad\quad)$

Describe the transformation:

Did the transformation affect the domain or the range of the function?

➢ Now let's graph: $y = F(-x)$



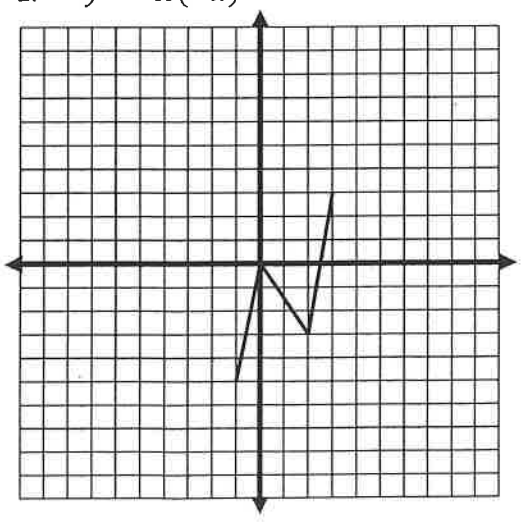
$(x, y) \rightarrow (\quad\quad\quad\quad)$

Describe the transformation:

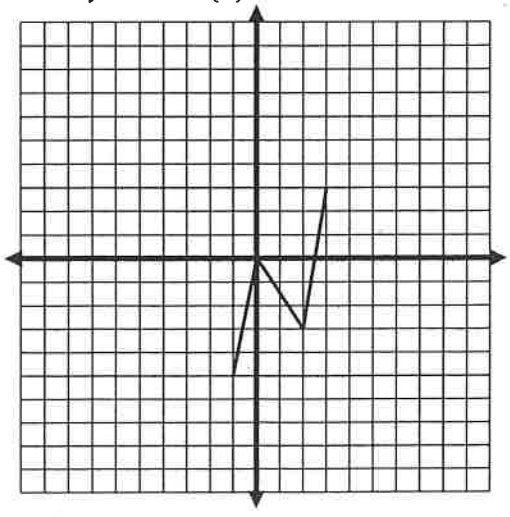
Did the transformation affect the domain or the range of the function?

❖ **Checkpoint: $H(x)$ is shown on each grid. Graph without making a table**

1. $y = H(-x)$



2. $y = -H(x)$

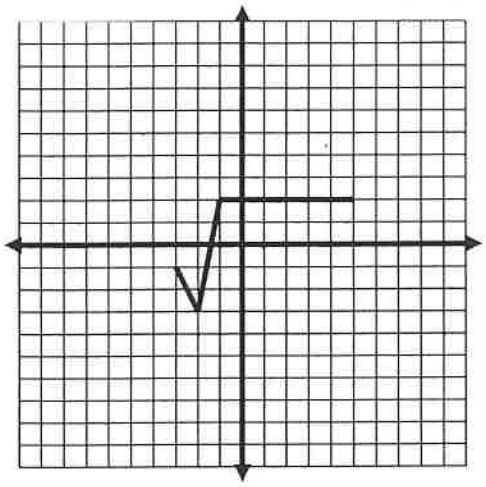


Math 2
Unit 2 – Quadratic Functions
Lesson 1 – Transformations **Homework**

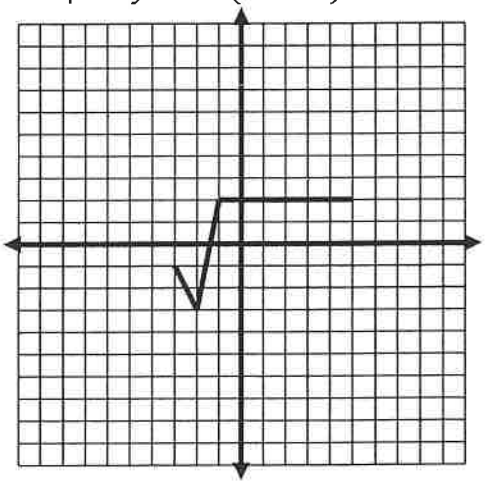
Name_____
Date_____ Pd____

I. On each grid, $G(x)$ is graphed. Graph the given function.

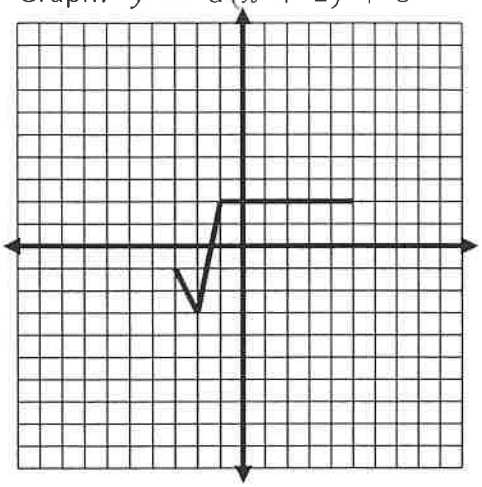
1. Graph: $y = G(x) - 6$.



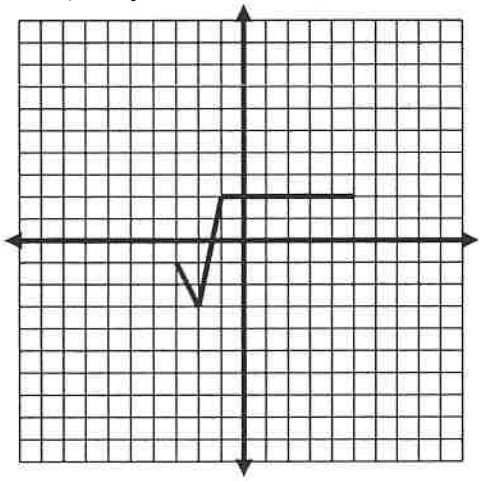
2. Graph: $y = G(x + 6)$



3. Graph: $y = G(x + 2) + 5$



4. Graph: $y = G(x - 4) - 5$



II. Using the understanding you have gained so far, describe the effect to the following functions.

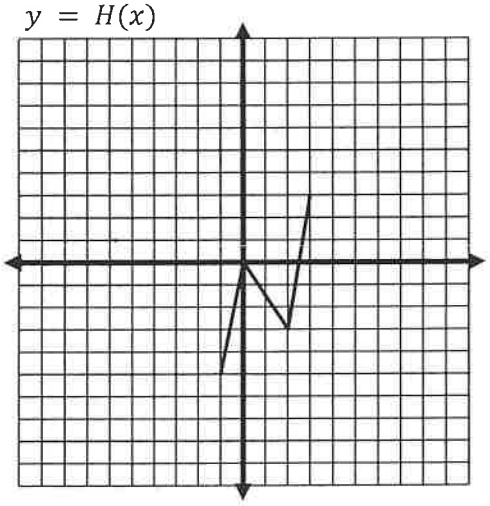
Equation	Effect to the graph
5. $y = F(x) + 82$	
6. $y = F(x - 13)$	
7. $y = F(x + 9)$	
8. $y = F(x) - 55$	
9. $y = F(x - 25) + 11$	

III. Using the understanding you have gained so far, write the equation that would have the following effect on the graph.

Equation	Effect to the graph
10.	Translate left 51 units
11.	Translate down 76
12.	Translate right 31
13.	Translate right 8 and down 54
14.	Translate down 12 and left 100

IV. Determine the domain and range of each parent function. Write the answer in interval notation.

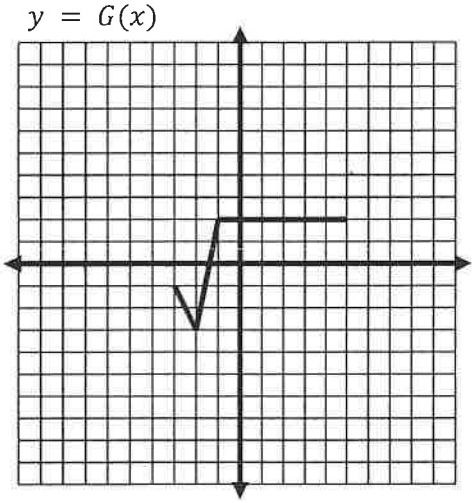
15. $y = H(x)$



Domain: _____

Range: _____

16. $y = G(x)$



Domain: _____

Range: _____

V. Consider a new function $y = P(x)$.
Domain is $[-2, 2]$ and range is $[-3, 1]$.

- Use your understanding of transformations of functions to determine the domain and range of each of the following functions.

17. $P(x) + 5$

Domain: _____

Range: _____

18. $P(x + 5)$

Domain: _____

Range: _____

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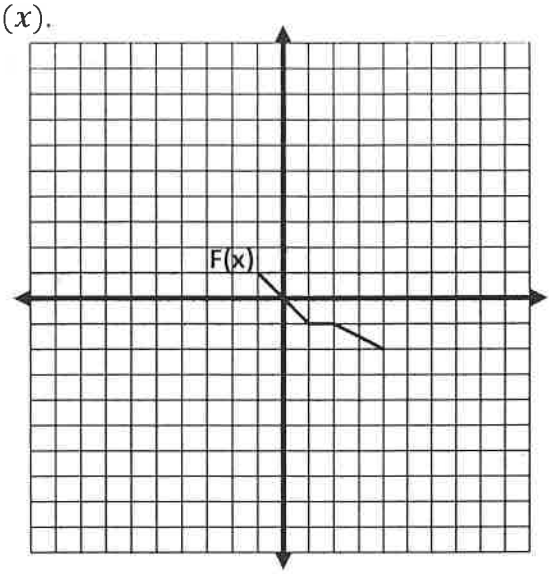
Math 2
Unit 2 – Quadratic Function
Lesson 2 – Transformations Continued

Name_____
Date: _____ Pd: _____

➢ Now let's return to the function whose equation is $y = F(x)$.



Complete the chart with the key points.

x	$F(x)$

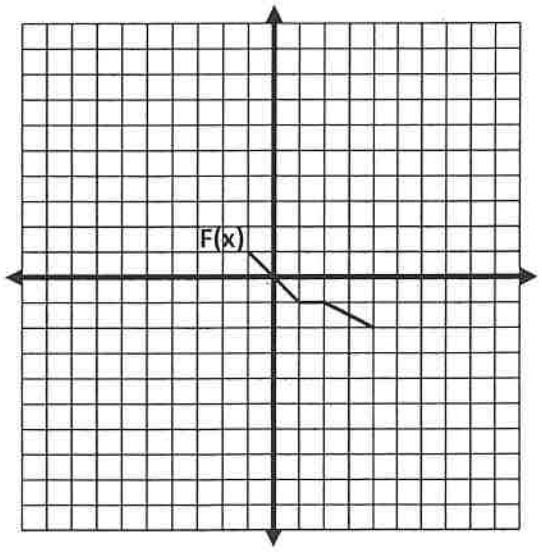
➢ Let's suppose that $y = 4F(x)$

$(x, y) \rightarrow$ ( )

Describe the transformation:

Did the transformation affect the domain or the range of the function?

➢ Graph: $y = \frac{1}{2}F(x)$.



$(x, y) \rightarrow$ ( )

Describe the transformation:

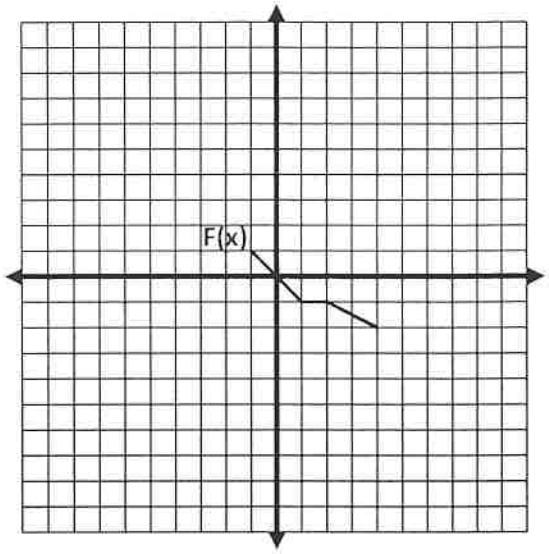
Did the transformation affect the domain or the range of the function?

➢ Graph: $y = -3F(x)$.

$(x, y) \rightarrow$ ( )

Describe the transformation:

Did the transformation affect the domain or the range of the function?



➢ **Checkpoint: Let's revisit $H(x)$.**

1. Describe the effect on the graph for each of the following.

   Example: $-5H(x)$ Each point is reflected in the x-axis and is 5 times as far from the x-axis.

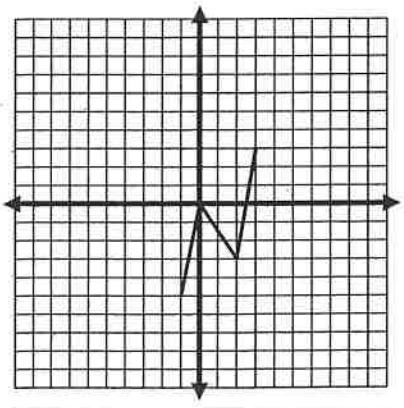
   a. $3H(x)$ _____

   b. $-2H(x)$ _____

   c. $\frac{1}{2}H(x)$ _____

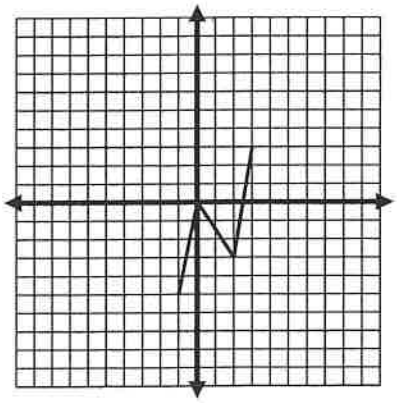
2. Sketch each graph *without using a table*.

a. $y = 3H(x)$



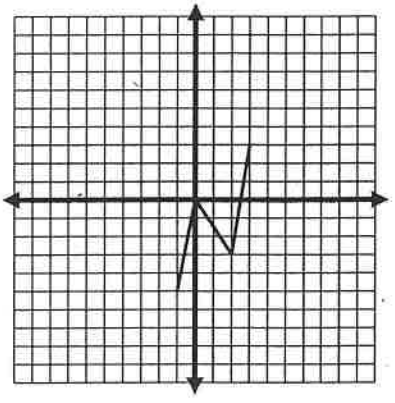
$(x, y) \rightarrow$ ( )

b. $y = -2H(x)$



$(x, y) \rightarrow$ ( )

c. $y = \frac{1}{2}H(x)$



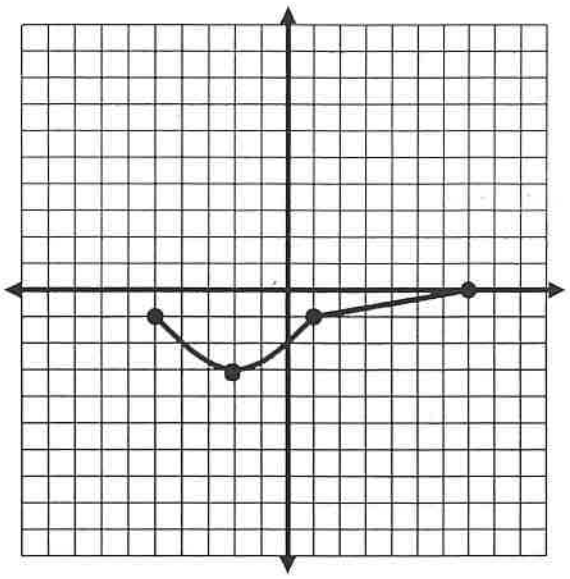
$(x, y) \rightarrow$ ( )

pg. 9

➢ The graph of $D(x)$ is shown.

List the key points of $y = D(x)$.
(List them in the chart)

x	$H(x)$



Since $D(x)$ is our original function, we will refer to it as the **parent function**.

Note: In transformational graphing where there are multiple steps, it is important to perform the translations last.

➢ **Example:** Let's explore the steps to graph $y = 2D(x + 3) + 5$, without using tables.

Step 1. The transformations represented in this new function are listed below in the order they will be performed. (See note above.)

- Vertical stretch by 2 (Each point moves twice as far from the x-axis.)
- Translate left 3.
- Translate up 5.

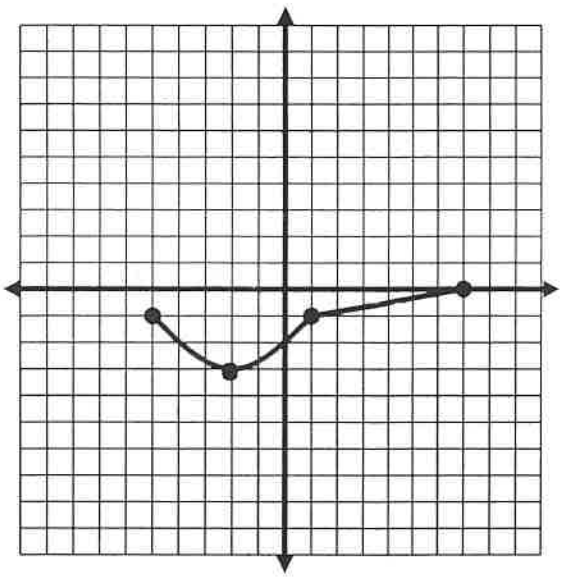
Step 2. On the graph, put your pencil on the left-most point, $(-5, -1)$.

- Vertical stretch by 2 takes it to $(-5, -2)$. (Note that the originally, the point was 1 unit away from the x-axis. Now, the new point is 2 units away from the x-axis.)
- Starting with your pencil at $(-5, -2)$, translate this point 3 units to the left. Your pencil should now be on $(-8, -2)$.
- Starting with your pencil at $(-8, -2)$, translate this point up 5 units. Your pencil should now be on $(-8, 3)$.
- Plot the point $(-8, 3)$. It is recommended that you do this using a different colored pencil.

Step 3. Follow the process used in Step 2 above to perform all the transformations on the other 3 points.

Step 4. After completing Step 3, you will have all four key points for the graph. Be sure you use a curve in the appropriate place.

➢ Graph: $y = -D(x) - 4$

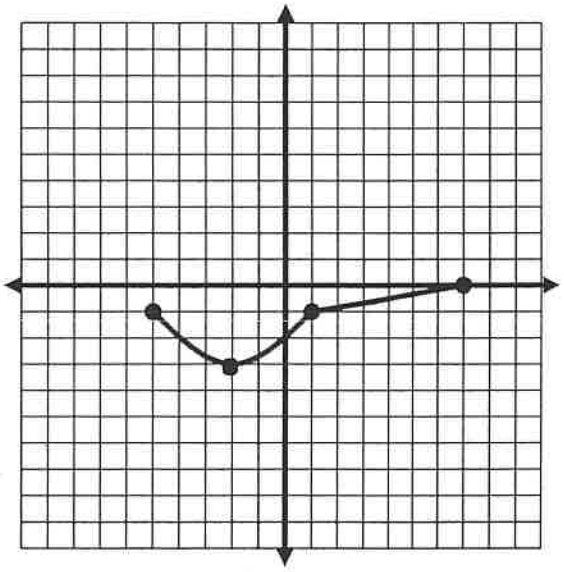


1. List the transformations needed to sketch the graph.
   (Remember, to be careful with order.)
   - _____
   - _____

2. Plot the new points and sketch the graph.

3. $(x, y) \rightarrow$ ( )

➢ Graph: $y = 3D(-x)$



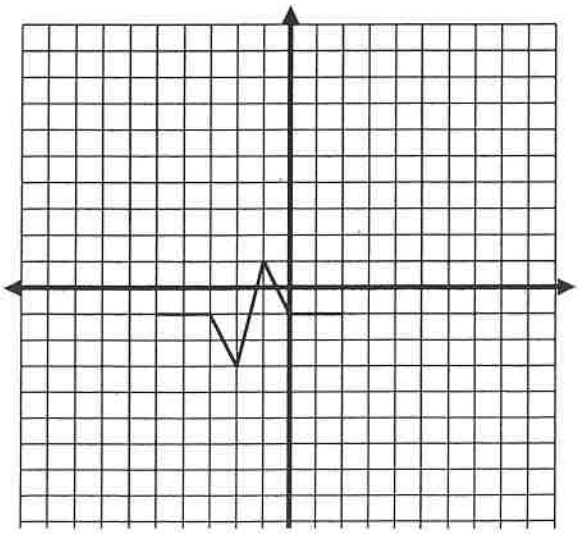
1. List the transformations needed to sketch the graph.
   (Remember, to be careful with order.)
   - _____
   - _____

3. Plot the new points and sketch the graph.

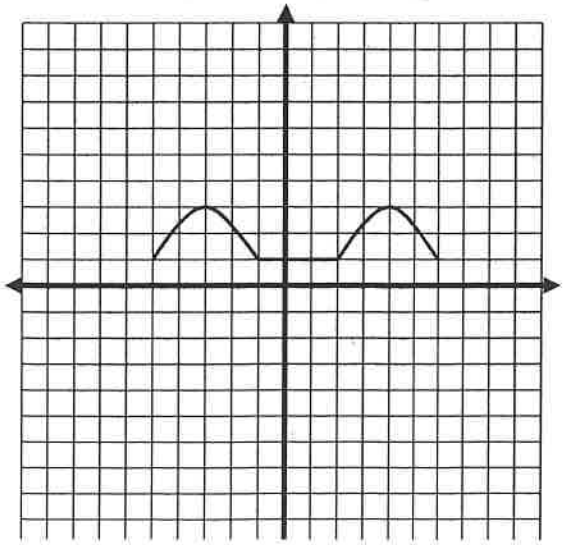
3. $(x, y) \rightarrow$ ( )

➢ **Checkpoint:**

1. Graph: $y = 3C(x) + 5$

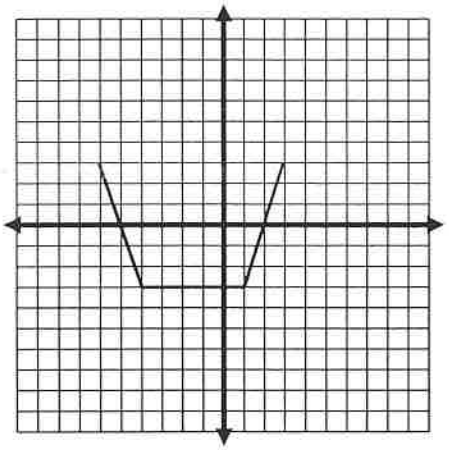


2. Graph: $y = -G(x - 3) - 6$



Math 2
Unit 2 – Quadratic Functions
Lesson 2 – Transformations HOMEWORK

Name_____
Date_____Pd____

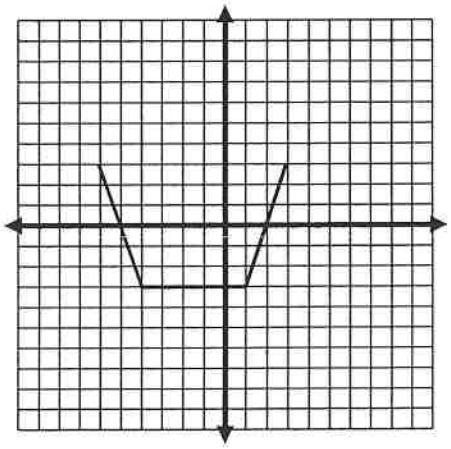


➢ This is the function: $y = B(x)$

1. Mark the key points with points on the graph.
2. What is the domain of $y = B(x)$?
3. What is the range of $y = B(x)$?

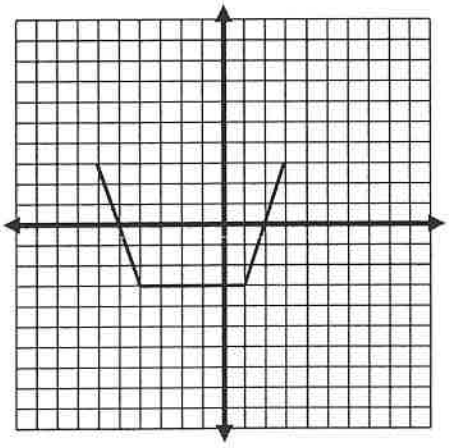
➢ For each of the following, examine the transformation on the graph of $y = B(x)$ and then graph the new function.

4. $y = -B(x)$



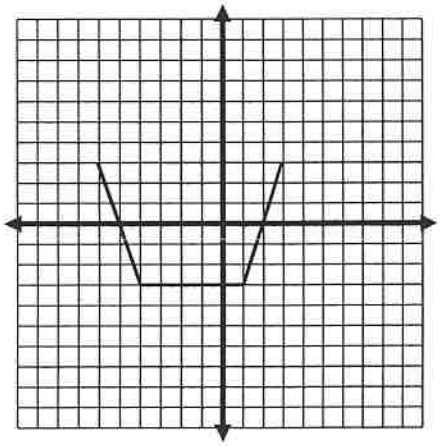
D:_____ R:_____

5. $y = B(-x)$



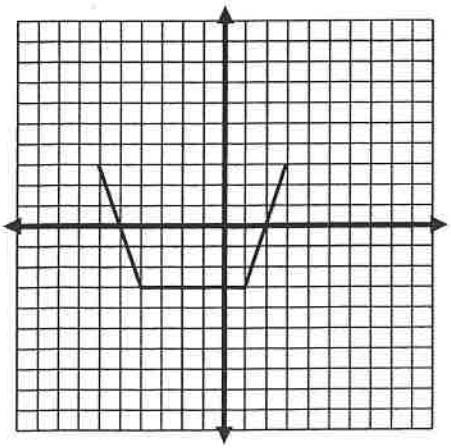
D:_____ R:_____

6. $y = \frac{1}{3}B(x)$



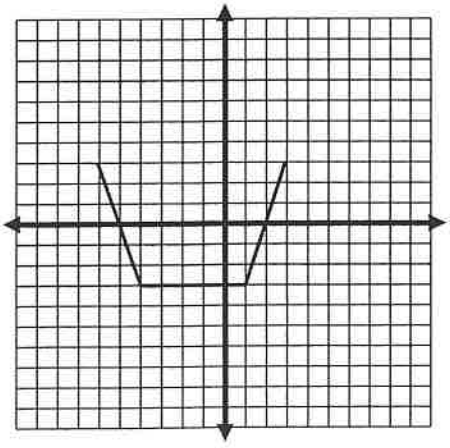
D:_____ R:_____

7. $y = 3B(x)$



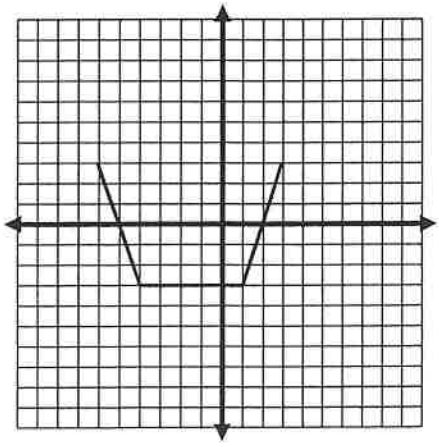
D:_____ R:_____

8. $y = B(x - 3)$



D:_____ R:_____

9. $y = B(x + 2) - 1$



D:_____ R:_____

10. List the transformations needed to graph the following. Remember that translations are done last.

a. $y = 2F(x) + 2$

_____

b. $y = \frac{1}{3}F(x - 6)$

_____

c. $y = -F(x) - 12$

_____

d. $y = 3F(-x)$

_____

e. $y = -5F(x)$

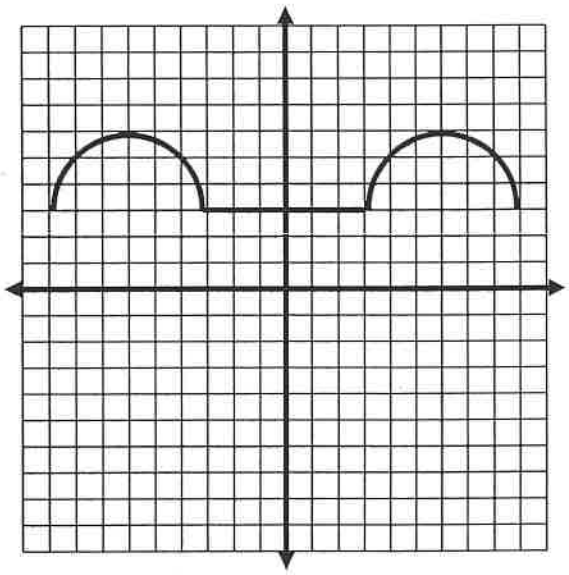
_____

11. Let: $y = M(x)$

a. How can you tell your graph is a function?

b. What is the domain:_____

c. What is the range:_____



d. Write an equation for your function that will have the following effects.

- Stretch vertically by 2 and translate left 4 _____
- Reflect in the x-axis and compress vertically by $\frac{1}{2}$ _____
- Translate up 6 and right 4_____

Math 2
Unit 2 – Quadratic Functions
Lesson 3 – Graphs of Quadratic Functions

Name_____
Date_____Pd_____

I. Parts of a Quadratic Graph: $y = x^2$

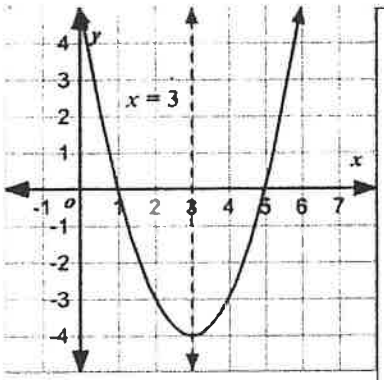
A) The graph of a quadratic function is called a _____.

B) All quadratic functions have either a _____ or a _____ located at the _____.

C) The _____ of _____ is a line of reflection that runs vertically through the vertex and divides the parabola into two equal parts. It is always written as $\boxed{x =}$.

D) The ____ – _____ is where the parabola crosses the y – axis.

E) The ____ – _____ is where the parabola crosses the x – axis. These are also referred to as the _____ or _____ of the quadratic function.



Vertex:

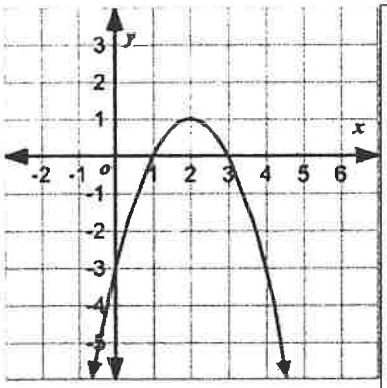
Maximum or Minimum

Axis of Symmetry:

y – intercept:
x – intercepts:

Domain:

Range:



Vertex:

Maximum or Minimum

Axis of Symmetry:

y – intercept:
x – intercepts:

Domain:

Range:

II. Ways to write quadratic functions:

A) **Standard Form:** $y = ax^2 + bx + c$

B) **Vertex Form:** $y = a(x - h)^2 + k$

- Vertex: (h, k)
- Translation left or right: h
- Translation up or down: k
- Dilation: If $a > 1$ *the graph stretches*; $0 < a < 1$ *the graph compresses*
- Reflection: a *is negative*

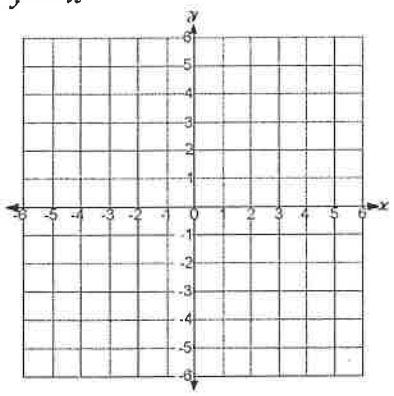
pg. 14

❖ Example: Complete the following chart using the vertex form, $y = a(x - h)^2 + k$, of a quadratic function.

Function	Vertex	Left/Right Translation	Up/Down Translation	Dilation (Stretch or Compress)	Reflection (Yes or No)	Domain	Range
1. $y = x^2$ (Parent Function)							
2. $y = (x + 2)^2 + 3$							
3. $y = x^2 - 3$							
4. $y = 2(x - 5)^2$							
5. $y = -3x^2 + 1$							
6. $y = \frac{1}{2}(x + 1)^2 - 4$							

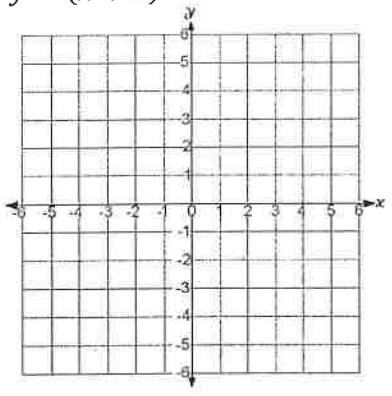
III. Graphing quadratic functions using vertex form.

1. $y = x^2$



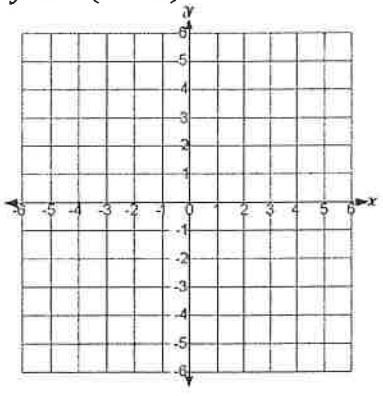
Vertex_____

2. $y = (x + 2)^2 - 3$



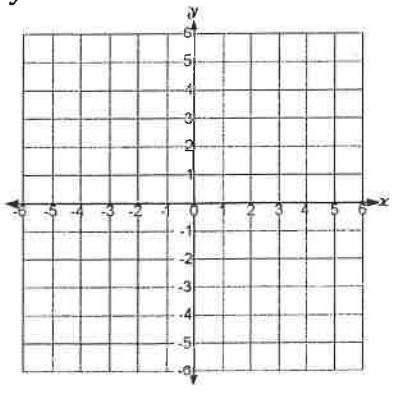
Vertex_____

3. $y = -(x - 1)^2$



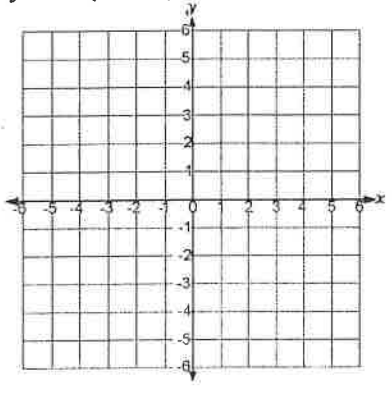
Vertex_____

4. $y = x^2 - 2$



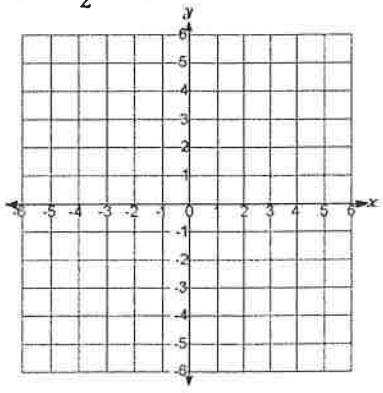
Vertex_____

5. $y = 2(x - 3)^2 - 4$



Vertex_____

6. $y = \frac{1}{2}x^2 + 1$



Vertex_____

Math 2
Unit 2 – Quadratic Functions
Lesson 3 – Graphs of Quadratic Functions – HOMEWORK

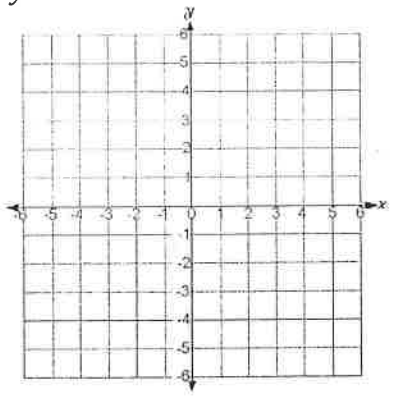
Name_____
Date_____ Pd_____

I. Complete the following chart using the vertex form, $y = a(x - h)^2 + k$, of a quadratic function.

Function	Vertex	Left/Right Translation	Up/Down Translation	Dilation (Stretch or Compress)	Reflection (Yes or No)	Domain	Range
1. $y = x^2$ (Parent Function)							
2. $y = x^2 - 7$							
3. $y = -2(x + 1)^2$							
4. $y = (x - 3)^2 + 8$							
5. $y = 4x^2$							
6. $y = -\frac{2}{3}(x - 2)^2$							
7. $y = -x^2$							
8. $y = \frac{1}{2}(x + 6)^2 - 2$							
9. $y = -x^2 + 9$							
10. $y = -\frac{1}{4}(x - 4)^2$							

II. Graph each of the following quadratic functions using the vertex form $y = a(x-h)^2 + k$. Name the vertex, domain and range.

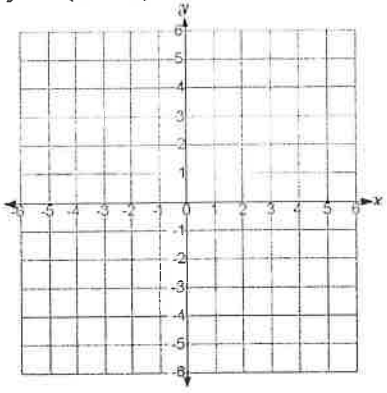
1. $y = x^2$



Vertex_____

Domain:_____ Range:_____

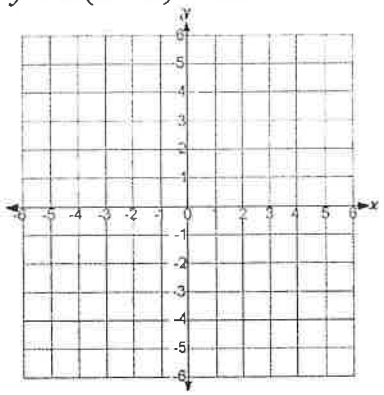
2. $y = (x+3)^2 - 2$



Vertex_____

Domain:_____ Range:_____

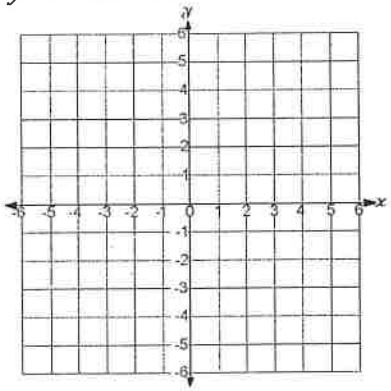
3. $y = 4(x-5)^2 - 5$



Vertex_____

Domain:_____ Range:_____

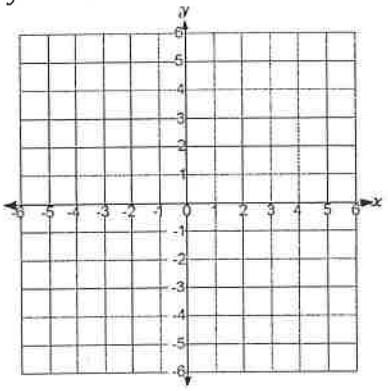
4. $y = -2x^2 + 4$



Vertex_____

Domain:_____ Range:_____

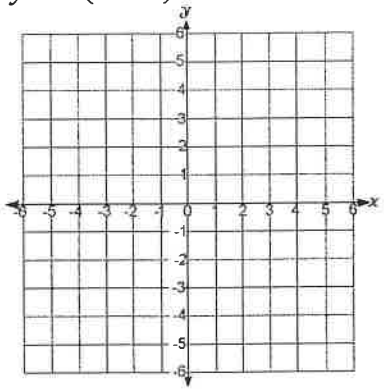
5. $y = -x^2$



Vertex_____

Domain:_____ Range:_____

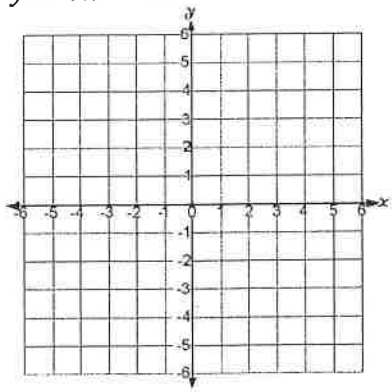
6. $y = 2(x-2)^2 - 4$



Vertex_____

Domain:_____ Range:_____

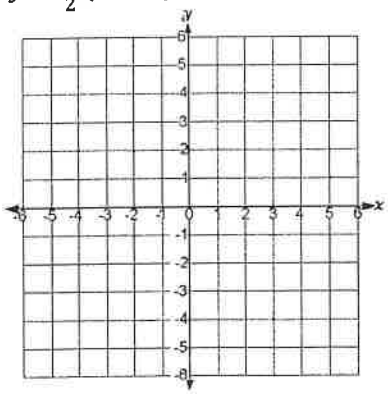
7. $y = 3x^2 - 6$



Vertex_____

Domain:_____ Range:_____

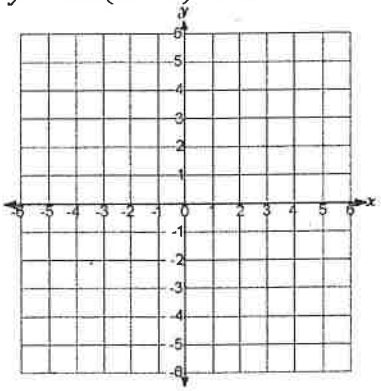
8. $y = \frac{1}{2}(x+2)^2$



Vertex_____

Domain:_____ Range:_____

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



Vertex_____

Domain:_____ Range:_____

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Math 2
Unit 2 – Quadratic Functions
Lesson 4 – Operations with Polynomials

Name_____
Date_____Pd____

- A **POLYNOMIAL** is a monomial or the sum of two or more monomials.
- A polynomial is in simplest form when there are no parentheses and no like terms.

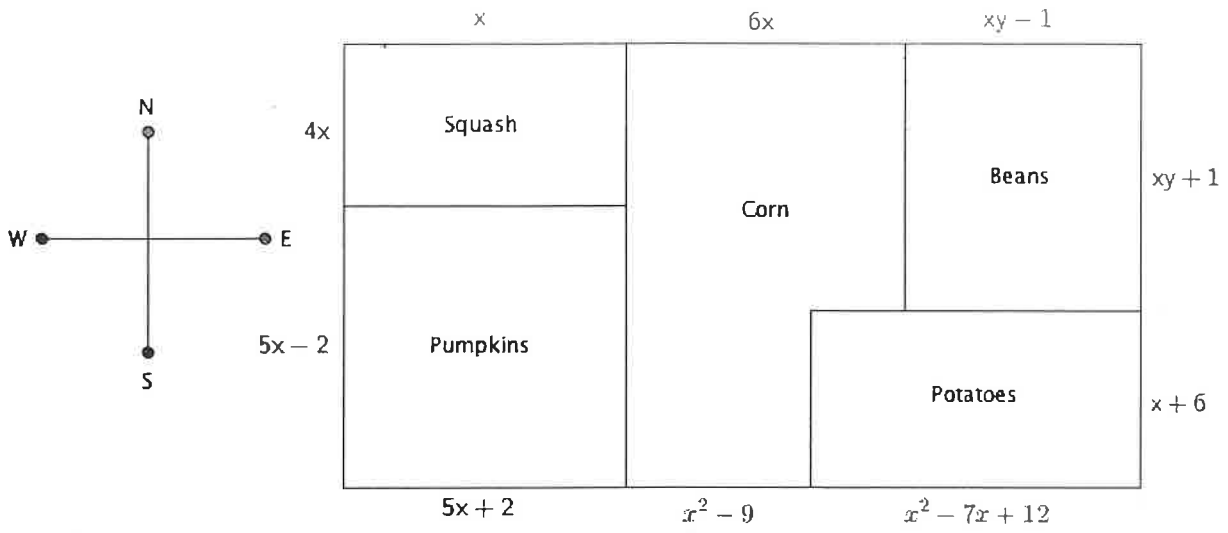
  - Operations with Polynomials
    - **Addition**: Combine Like Terms
    - **Subtraction**: Distribute (-1) and then combine like terms
    - **Multiplication**: FOIL or Box Multiplication or Distribute and then combine like terms
    -

- EXAMPLES:

1. **Add:** $(4x^3 + 2x^2 + 5x + 8) + (3x^3 - 4x^2 - 9x + 2)$	2. **Add:** $(7p^2 - 4p) + (3p^2 + 2p - 5)$
3. **Subtract:** $(4x^3 + 2x^2 + 5x + 8) - (3x^3 - 4x^2 - 9x + 2)$	4. **Subtract:** $(7p^2 - 4p) - (3p^2 + 2p - 5)$
5. **Multiply:** $(x - 2)(x + 3)$	6. **Multiply:** $(2x - 5)(3x + 1)$
7. **Multiply:** $(4x - 1)^2$	8. **Multiply:** $(3x - 1)(2x^2 + 5x - 2)$

➢ **Applications of Polynomials:**

1. Farmer Bob is planting a garden this spring. He wants to plant squash, pumpkins, corn, beans, and potatoes. His plan for the field layout in feet is shown in the figure below. Use the figure and your knowledge of polynomials, perimeter, and area to solve the following:



a. Write a polynomial expression in simplest form that represents the length of the south side of the field.

b. Write a polynomial expression in simplest form that represents the perimeter of the pumpkin field.

c. Write a polynomial expression in simplest form that represents the area of the potato field.

d. Write a polynomial expression in simplest form that represents the area of the bean field.

e. Write a polynomial expression in simplest form that represents the perimeter of the entire garden.

Math 2
Unit 2 – Quadratic Functions
Lesson 4 – Polynomials HOMEWORK

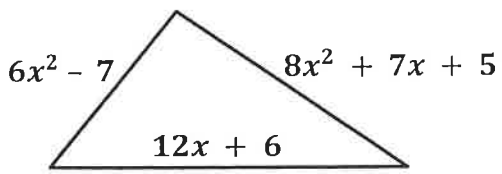
Name_____
Date_____Pd____

Perform the indicated operation:

1. $(3x-4)+(-2x+1)$	2. $(7y^3-6y^2+3y-9)+(-8y^3+y^2+4)$
3. $(x^3+5x^2-7x+3)+(4x^3-2x^2+3x-11)$	4. $(-6p^3+9pq^2-7q^3)+(-5p^3-13p^2q+12q^3)$
5. $(p^2-7p+5)-(10p^2-7p+8)$	6. $(7y^3-6y^2+3y-9)-(-8y^3+y^2+4)$
7. $(2q^2-q-15)-(q^2+3q-11)$	8. $(x^3-3x^2)+(3x^3-5x-12)-(-x^3-8x^2+4x-9)$
9. $(2x-1)(5x+3)$	10. $(3x+1)(3x-1)$
11. $(3x-7)^2$	12. $(4-7x^3)^2$
13. $(3c+5d)(2c-7d)$	14. $(x-4)(x^2+4x+16)$

15. For a rectangle with length of $3x+4$ and width of $10x+18$, what is the area width of the rectangle?

16. Find the perimeter of the triangle:



Factoring

Finding a Greatest Common Factor (GCF)

2 TERMS

3 TERMS

4 TERMS

1. If a polynomial can not be factored, it is _____.
2. Always check for a _____ first!!!
3. Count the number of terms to see which method to try.
4. Always check to see if your polynomial can be factored further.
5. You can always check your factors by multiplying the factors back together.

Date: _____

Math 2
Unit 2 – Quadratic Functions
Lesson 5 – Factoring (GCF, Grouping, Perfect Squares)

Name_____
Date_____ Pd____

I. Greatest Common Factor (GCF) → if possible, always do this FIRST.

A. $24a^2b - 18ab^2$	B. $5x^2y - 20xy^2z + 35y^3z^2$	C. $2x^3yz^3 - 7xy^5z^2$

II. Factoring by Grouping (4 term polynomials) → Group by 2's

A. $4x - 20 + 3xy - 15y$	B. $15ab^2 - 3a + 10b^2 - 2$
C. $3a^2 - ab - 12a + 4b$	D. $16x^3 - 128x^2 + 2x - 16$

II. Difference of Two Squares Factoring → $\boxed{a^2 - b^2 = (a - b)(a + b)}$ *** Always check for a GCF first!!!!

A. $x^2 - 9$	B. $x^2 - 49$	C. $x^2 - 36y^2$
D. $16x^2 - 1$	E. $x^2 + 25$	F. $-1 + x^2$
G. $24x^5 - 54xy^6$	H. $4x^2 - 64$	I. $x^4 - 16$

Math 2 Name _____

Unit 2 – Quadratic Function Date: _____ Pd: _____

Lesson 5 – Factoring (GCF, Grouping, Perfect Squares) – HOMEWORK

FACTOR COMPLETELY:

1. $15x^2y - 10xy^2$	**2.** $2x^3y - x^2y + 5xy^2$	**3.** $7k^2 + 9k$
4. $2p^3 + 5p^2 + 6p + 15$	**5.** $m^3 - m^2 + 2m - 2$	**6.** $12xy - 28x - 15y + 35$
7. $16r^2 - 169$	**8.** $x^2 - 49$	**9.** $2y^2 - 242$
10. $x^2 + 64$	**11.** $x^4 - 81$	**12.** $25 - 4x^2$
13. $4x^6 - 4x^2$	**14.** $45x^2 - 80y^2$	**15.** $16 - 81x^2$

Math 2
Unit 2 – Quadratic Functions
Lesson 6 – Factoring (Trinomials)

Name_____
Date_____ Pd____

I. Factoring Trinomials → $\boxed{x^2 + bx + c}$ "SHORTCUT" *** Always check for a GCF first!!!

A. $x^2 + 9x + 20$	B. $x^2 - 7x + 10$	C. $x^2 + 3x - 40$
D. $x^2 - 3x - 10$	E. $2x^2 - 8x - 90$	F. $x^4 - 7x^2 + 12$

IV. Factoring Trinomials → $\boxed{a}x^2 + bx + c$ "Illegal Move" *** Always check for a GCF first!!!!

A. $2x^2 + 7x + 6$	B. $2x^2 - 9x + 4$	C. $3x^2 + 5x + 2$
D. $6x^2 - 4x - 42$	E. $6x^2 + 11xy + 4y^2$	F. $5x^4 - 17x^2 + 14$

Math 2
Unit 2 – Quadratic Functions
Lesson 6 – Factoring (Trinomials) – HOMEWORK

Name_____
Date_____Pd____

Factor Completely:

1. $x^2 - 2x - 48$	2. $x^2 + 10x + 24$	3. $x^2 - 8x + 12$
4. $x^2 + 2x - 8$	5. $x^2 - x - 72$	6. $x^2 - 3x - 18$
7. $x^2 - 5x - 36$	8. $x^2 + 9x + 14$	9. $x^2 + 5x - 36$
10. $x^2 - x - 12$	11. $3x^2 - 2x - 5$	12. $2x^2 + 3x - 9$
13. $3x^2 - 8x + 4$	14. $5x^2 + 19x + 12$	15. $2x^2 + 11x = 5$
16. $2x^2 + 5x + 2$	17. $7x^2 + 53x + 28$	18. $9x^2 + 66x + 21$

Math 2
Unit 2 – Quadratic Functions
Lesson 7 – Solve by Factoring

Name_____
Date_____ Pd____

- **Solving Quadratic Equations by Factoring →** Equation must be equal to 0 and factored completely

A. $(x-4)(3x-1)=0$ $x=$ _____	B. $x^2-5x-6=0$ $x=$ _____	C. $3x^2-5x+2=0$ $x=$ _____
D. $x^2-3x=0$ $x=$ _____	E. $x^3-3x^2=10x$ $x=$ _____	F. $x^2=36$ $x=$ _____

Math 2
Unit 2 – Quadratic Functions
Lesson 7 – Solve by Factoring – HOMEWORK

Name_____
Date_____ Pd____

- Solve each equation by factoring: **(You should be finding 2 solutions!!)**

1. $x^2 - 5x = 0$ $x =$_____	**2.** $x^2 + x - 30 = 0$ $x =$_____
3. $3x^2 - 5x = 0$ $x =$_____	**4.** $4x^2 - 25 = 0$ $x =$_____
5. $4x^2 - 13x - 12 = 0$ $x =$_____	**6.** $4x^2 - 17x = -4$ $x =$_____
7. $6x^2 + 7x = 3$ $x =$_____	**8.** $18x^2 - 34x + 16 = 0$ $x =$_____