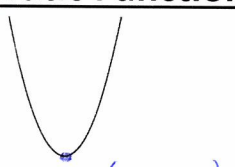
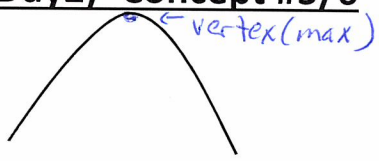
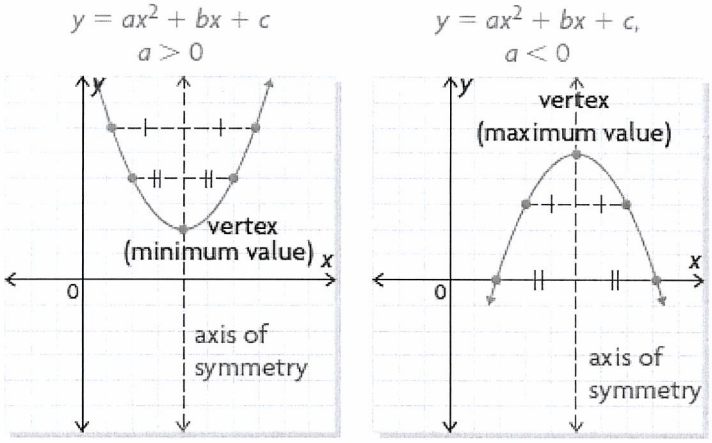
7.1/2 Properties of Graphs of Quadratic Functions(Day2)- Concept #5/6

- Identify the vertex on each of these parabolas





- A parabola that is defined by the equation $y = ax^2 + bx + c$ has the following characteristics:
  - If the parabola opens down ($a<0$), the vertex of the parabola is the point with the greatest y-coordinate. The y-coordinate of the vertex is the maximum value of the function.
  - If the parabola opens up ($a>0$), the vertex of the parabola is the point with the least y-coordinate. The y-coordinate of the vertex is the minimum value of the function.
  - Vertex = (x, y) at the max or min point on the curve. Notation: (p, q ← pre-calc text uses; h, k ← Foundations text uses)
  - The parabola is **symmetrical** about the vertical line (the axis of symmetry).
    - The axis of symmetry passes through the vertex and is always written in the form of an equation, like x = (x-coordinate of the vertex). $x = p$ or $x = h$



Note: Symmetrical points have the same y-coordinate

- Domain – all the possible **x-values** that would lie on the graph
  - For quadratic functions, the domain is the set of real numbers
    - Notation: $D: \{x \mid x \in \mathbb{R}\}$ (set)
    - Interval Notation: $(-\infty, \infty)$
- Range – all the possible **y-values** that would lie on the graph
  - For quadratic functions, the range is a subset of real numbers and includes the y-value of the vertex and all the numbers either larger or smaller than it

Interval Notation $[K, \infty)$ or $(-\infty, K]$ $R: \{y \mid y \leq \text{or} \geq K$ (y-coordinate of the vertex), $y \in \mathbb{R}\}$

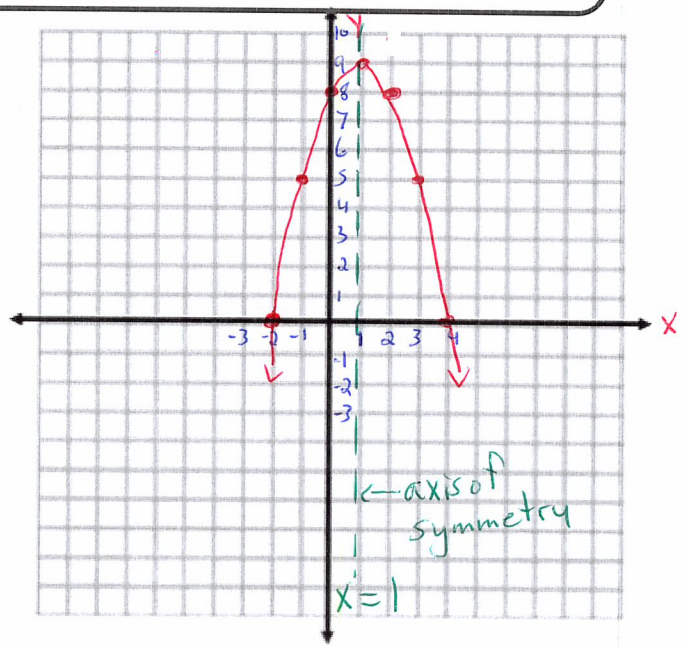
- When a real life problem is modeled by a quadratic function, the domain and range may need to be restricted to values that have meaning in the context of the problem (whole numbers)

EXAMPLE #1: Determine the vertex, the y intercept, the x intercept(s), the equation of the axis of symmetry, 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
-2	$y=-(-2)^2+2(-2)+8$ $y=-4-4+8$	0
-1	$y=-(-1)^2+2(-1)+8$ $=-1-2+8$	5
0	$y=-(0)^2+2(0)+8$	8
1	$y=-(1)^2+2(1)+8$ $=-1+2+8$	9
2	$y=-(2)^2+2(2)+8$ $=-4+4+8$	8
3	$y=-(3)^2+2(3)+8$ $=-9+6+8$	5
4	$y=-(4)^2+2(4)+8$ $=-16+8+8$	0

(x,y)
(-2,0)
(-1,5)
(0,8)
(1,9)
(2,8)
(3,5)
(4,0)



- VERTEX: (1,9)
- Y Intercept: (0,8)
- X Intercept(s): (-2,0) and (4,0)
- Axis of Symmetry: x=1 Maximum at y=9
- Domain: $\{x \mid x \in \mathbb{R}\}$
- Range: $\{y \mid y \leq 9, y \in \mathbb{R}\}$

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

EXAMPLE #3: a) Predict 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.

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

a<0 therefore the parabola will open down.

A) Maximum.

B) (0,3)

C) If x=1 $y = -5(1)^2+8(1)+3$
 $= -5+8+3$
 $= 6$
 (1,6)

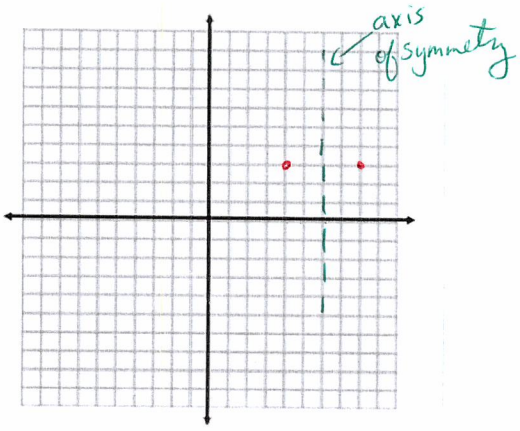
b) $y = 7x^2+2x+5$

A) Minimum ~~bc~~ because a>0 so opens up.

B) (0,5)

C) x=1 $y = 7(1)^2+2(1)+5$
 $y = 7+2+5$
 $y = 14$
 (1,14)

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?

Equation of axis of symmetry:

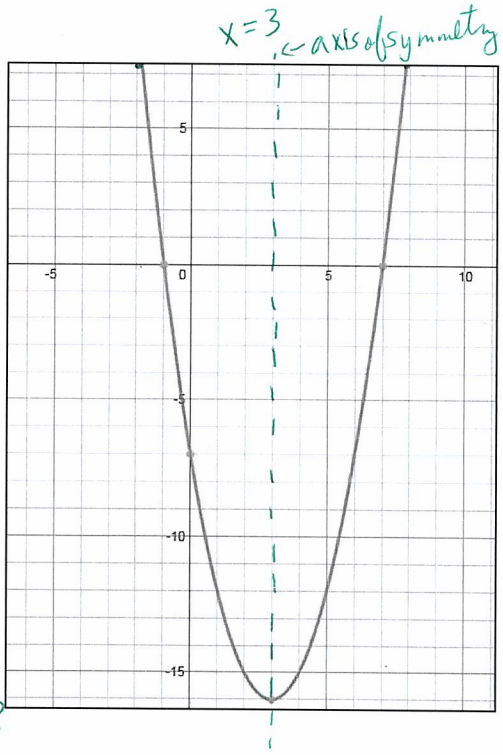
$x = \frac{4+8}{2}$ ← (x-coordinates of each point)

equation of axis of symmetry → $x = 6$

Note can only use symmetrical points (points that have the same y-value) The axis of symmetry must be the same distance from these points

EXAMPLE #5:

Given the following graph, identify the equation of the axis of symmetry, the coordinates of the vertex, if there is a maximum or minimum value and what that value is, the domain, the range, the x intercept(s) and the y intercept.



Equations of the axis of symmetry: $x = 3$

Vertex (Coordinates) : $(3, -16)$ (x, y)

maximum or minimum: Minimum value at $y = -16$

Value of max or min: $y = -16$

x intercept(s): $(-1, 0)$ $(7, 0)$

y intercept: $(0, -7)$

domain:

- If it had arrowheads: $\{x \mid x \in \mathbb{R}\}$
- If it stops at the edge of the graph: $\{x \mid -2 \leq x \leq 8, y \in \mathbb{R}\}$

range:

- If it had arrowheads: $\{y \mid y \geq -16, y \in \mathbb{R}\}$
- If it stops at the edge of the graph: $\{y \mid -16 \leq y \leq 7, y \in \mathbb{R}\}$

Assignment Pg 369 #1, 3-6, 9-11 (Create a suitable table of values)