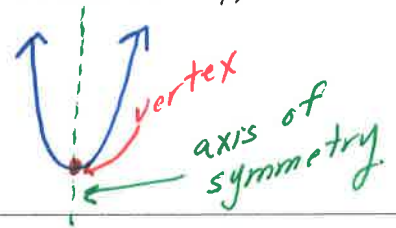


The graph of a quadratic equation is a U-shaped curve called a parabola

The vertical line that passes through the vertex is called the axis of symmetry.

Quadratic function:  $f(x) = ax^2 + bx + c$  when  $a$  does not equal 0

- The x-coordinate of the vertex is  $x = \frac{-b}{2a}$  (substitute this x value to find y)
- The axis of symmetry is the vertical line  $x = \frac{-b}{2a}$
- The y-intercept is  $(0, c)$



For each of the following examples:

- Find the y-intercept
- The equation of the axis of symmetry
- Find the x coordinate of the vertex
- Make a table of values
- Graph the function

**Ex 1**  $f(x) = x^2 + 6x + 8$

y-int

$(0, 8)$

x-coordinate of the vertex

$x = \frac{-b}{2a} = \frac{-6}{2(1)} = -3$

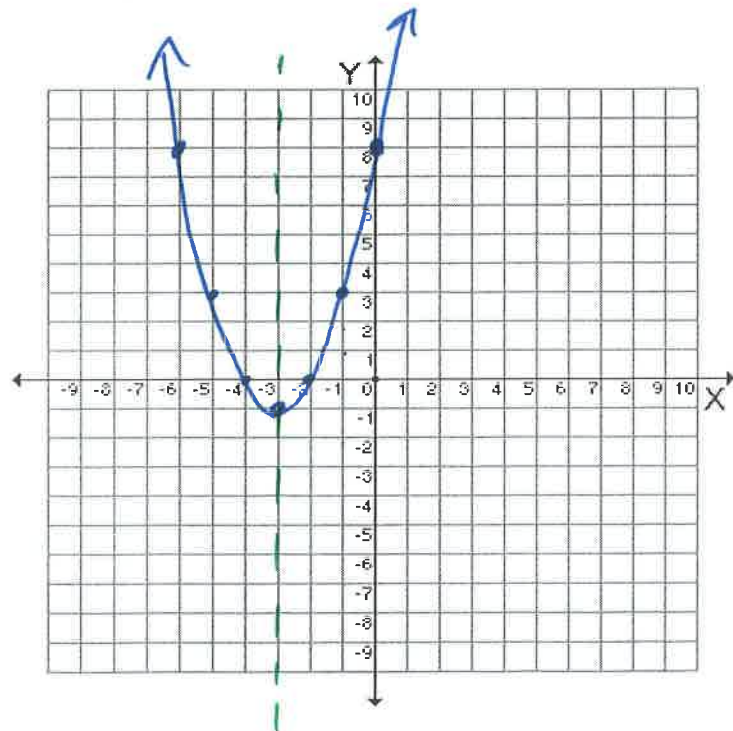
Axis of Symmetry:

$x = -3$

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x	$x^2 + 6x + 8$	f(x)	(x, f(x))
-1	$(-1)^2 + 6(-1) + 8$	3	(-1, 3)
-2	$(-2)^2 + 6(-2) + 8$	0	(-2, 0)
-3	$(-3)^2 + 6(-3) + 8$	-1	(-3, -1)
-4	$(-4)^2 + 6(-4) + 8$	0	(-4, 0)
-5	$(-5)^2 + 6(-5) + 8$	3	(-5, 3)

Vertex



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

y-int  
(0, 2)

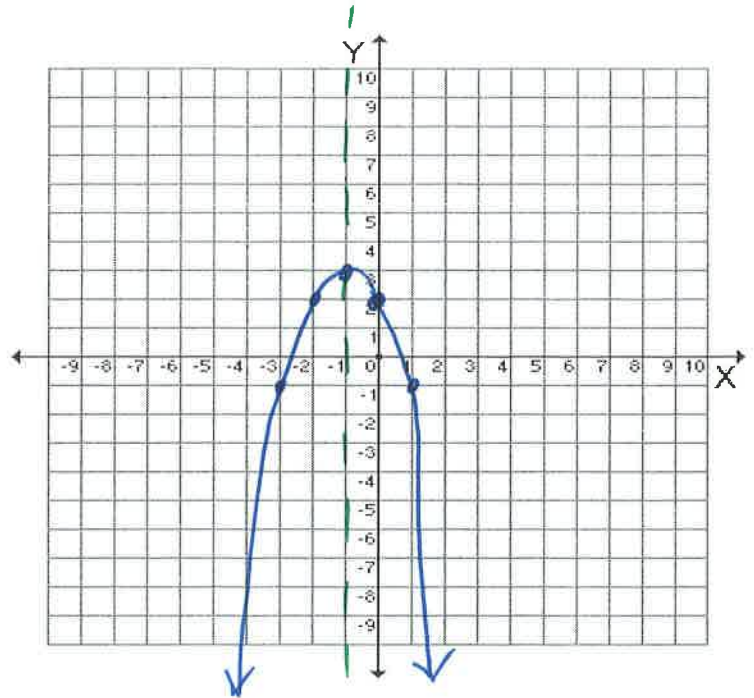
x-coordinate of the vertex

$$x = \frac{-b}{2a} = \frac{-(-2)}{2(-1)} = \frac{2}{-2} = -1$$

Axis of Symmetry:

$$x = -1$$

x	$-x^2 - 2x + 2$	f(x)	(x, f(x))
-3	$-(-3)^2 - 2(-3) + 2$	-1	(-3, -1)
-2	$-(-2)^2 - 2(-2) + 2$	2	(-2, 2)
-1	$-(-1)^2 - 2(-1) + 2$	3	(-1, 3)
0	$-(0)^2 - 2(0) + 2$	2	(0, 2)
1	$-(1)^2 - 2(1) + 2$	-1	(1, -1)



Ex 3  $f(x) = 2x^2 - 4x + 3$        $a=2$     $b=-4$     $c=3$

y-int  
(0, 3)

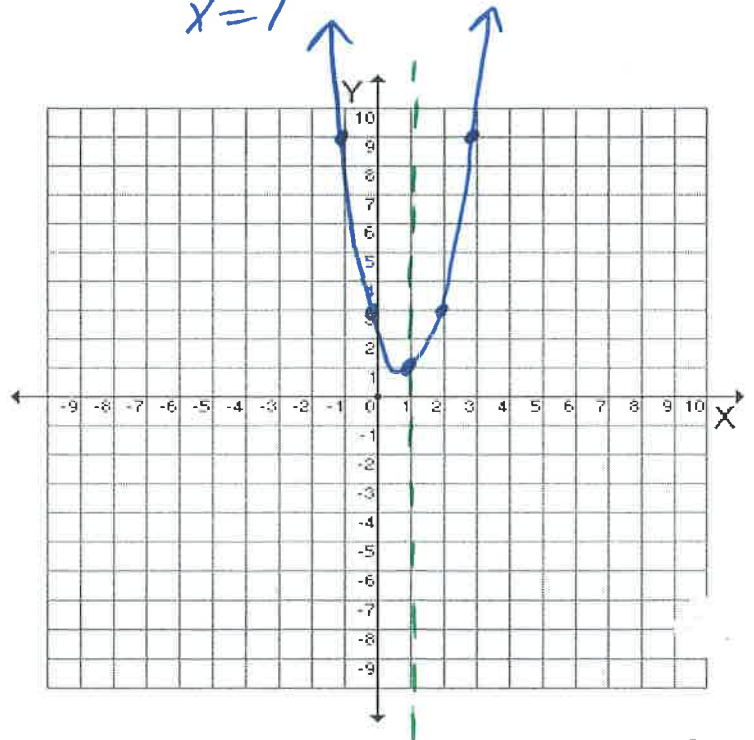
x-coordinate of the vertex

$$x = \frac{-b}{2a} = \frac{-(-4)}{2(2)} = \frac{4}{4} = 1$$

Axis of Symmetry:

$$x = 1$$

x	$2x^2 - 4x + 3$	f(x)	(x, f(x))
-1	$2(-1)^2 - 4(-1) + 3$	9	
0	$2(0)^2 - 4(0) + 3$	3	
1	$2(1)^2 - 4(1) + 3$	1	
2	$2(2)^2 - 4(2) + 3$	3	
3	$2(3)^2 - 4(3) + 3$	9	



## Maximum and Minimum Values

- If  $a$  is positive, the parabola opens up ↗
- If  $a$  is negative, the parabola opens down ↘
- On a parabola that opens up, the lowest point is called the minimum
- On a parabola that opens down, the highest point is called the maximum
- The maximum or minimum value is the  $y$ -coordinate of the vertex.

For each of the following examples:

1. Determine whether the functions has a max or minimum
2. Find the max or min value
3. State the domain and range of the function

Ex 4  $f(x) = 2x^2 - x + 10$  ↗

$$x = \frac{-b}{2a} = \frac{-(-1)}{2(2)} = \frac{1}{4}$$

Min: 9.875    D:  $(-\infty, \infty)$   
R:  $[9.875, \infty)$

$$f\left(\frac{1}{4}\right) = 2\left(\frac{1}{4}\right)^2 - \frac{1}{4} + 10$$

$$2\left(\frac{1}{16}\right) - \frac{1}{4} + 10 = \frac{1}{8} - \frac{2}{8} + \frac{80}{8} = \frac{79}{8} = 9.875$$

Ex 5  $f(x) = -x^2 - 4x + 10$  ↘

$$x = \frac{-b}{2a} = \frac{-(-4)}{2(-1)} = \frac{4}{-2} = -2$$

Max: 14    D:  $(-\infty, \infty)$   
R:  $(-\infty, 14]$

$$f(-2) = -(-2)^2 - 4(-2) + 10$$

$$-4 + 8 + 10 = 14$$

Ex 6  $f(x) = 20 + 6x - x^2$  ↘

$$x = \frac{-b}{2a} = \frac{-6}{2(-1)} = 3$$

Max: 29    D:  $(-\infty, \infty)$   
R:  $(-\infty, 29]$

$$f(3) = 20 + 6(3) - (3)^2$$

$$20 + 18 - 9 = 29$$

Assignment: