

# 8-2 Quadratic Functions (Part # 1)

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# Example 1

image.png

- A) The vertex is  $(4,3)$
- B) The vertex is  $(-3,-3)$

# Example 2 - Vertex Formula

image.png

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

1. we get the a, b, c in the formula  $y = ax^2 + bx + c$

- $a = 2$

- $b = 4$

- $c = 0$

2. then we plug in a, b into the formula

- $x = -b / (2a)$

- $x = -4 / (2 \cdot 2) = -4/4 = -1$

- so the axis of symmetry is  $x = -1$

- to find the vertex

- so the known vertex data is  $(-1, y)$

- to find y for the vertex we need to plug -1 into the formula  $y = 2x^2 + 4x$

- $y = 2 \cdot (-1)^2 + 4 \cdot (-1) = -6$

- so the vertex is (-1, -6)

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B)  $y = -x^2 + 4x - 5$

1. we get the a, b, c in the formula  $y = ax^2 + bx + c$

- $a = -1$

- $b = 4$

- $c = -5$

2. then we plug in a, b into the formula

- $x = -b / (2a)$

- $x = -4 / (2 * -1) = -4 / -2 = 2$

- so the axis of symmetry is  $x = 2$

- to find the vertex

- so the known vertex data is (2, y)

- to find y for the vertex we need to plug 2 into the formula  $y = -x^2 + 4x - 5$

- $y = -2^2 + 4 * 2 - 5 = -1$

- so the vertex is  $(2, -1)$

# Example 3 + up/down test

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## up/down test

- opens upwards because a is Positive
- opens downward because a is Negative

## Example 3

1. a)  $y = x^2 + 3x + 4$ 
  - opens upwards because a is Positive
2. b)  $y = -3x^2 + 5x$ 
  - opens downward because a is Negative
3. c)  $y = 2x - x^2 + 6$ 
  - opens downward because a is Negative

# Example 4 Graph $f(x) = x^2 - 2x - 8$

## Steps to Graph $ax^2 + bx + c$

- Find the vertex and the axis of symmetry. Sketch these in.
- Find the x-intercept by plugging in 0 for y.
- Find the y-intercept by plugging in 0 for x.
- Reflect your points across the axis of symmetry and connect your dots with a smooth U-shaped (not V-shaped) curve.

## Graph $f(x) = x^2 - 2x - 8$

[image.png](#)

for now, I'm just gonna type my work and figure out what to do next

1. find the line of symmetry -
  1.  $a = 1, b = -2, c = -8$
2. use this to find the vertex
  1.  $x = (b/2a)$
  2.  $x = -(-2) / 2(1) = 1$
3. since we know that the along the x axis at 1 will be the vertex we replace x with 1 in the original formula
  1.  $x=1$
  2.  $y = x^2 - 2x - 8$
  3.  $y = 1^2 + -2 * 1 - 8 = 1 - 2 - 8 = -9$
  4.  $y = -9$
4. the vertex is (1, -9)
5. since the vertex is -1,-9 we know that x=1 is the axis of symmetry
6. finding the y-intercept is the easiest to start with because we just replace x with 0
7.  $x = 0 \mid y = x^2 - 2x - 8$
8.  $y = 0 - 8 = -8$
9. y-intercept = (0,-8)
10. so so To find the x-intercepts, you can set y equal to zero and solve for x:
11.  $y = 0 \mid x = (-b \pm \sqrt{b^2 - 4ac}) / 2a$ 
  1.  $x = -(-2) \pm \sqrt{(-2)^2 - 4(1)(-8)} / 2(1)$   
 $x = (2 \pm \sqrt{4 + 32}) / 2$

$$x = (2 \pm \sqrt{36}) / 2$$

$$x = (2 \pm 6) / 2$$

$$x = 8 / 2 \text{ or } x = -4 / 2$$

$$x = 4 \text{ or } x = -2$$

$$\text{sooooo } (-2,0) \text{ \& } (4,0)$$

12. so since we know 3 y axis points on the graph and the axis of symmetry we can get another point without doing much work

1. symmetry line =  $x = 1$ ,

2. calc'd x-intercept 0,-8

1. the symmetry line is 1 and the known point is 0 since  $1-0 = 1$  we can add that to the x coordinate of y and keep the same y coordinate to get the mirrored point making another point on the graph (2,-8)

3. since we need one more point for the graph we can choose say  $x=3$ ,  $| x^2 - 2x - 8$

1.  $y = 3^2 - 3*2 - 8 = -5$

1. soooo the new point is (3,-5) if we mirror that along 1,-9 we get (-1, -5 ) because 3 is 2 more than 1, and 2 less than 1 is -1. we also keep the same y coordinate

4. so all points are:

1. (1, -9)

2. (0,-8)

3. (2, -8)

4. (3,-5)

5. (-1,-5)

# Example 5: Graph $y = x^2 + 2x + 3$

Find the vertex and the axis of symmetry. Sketch these in.

- Find the x-intercept by plugging in 0 for y.
- Find the y-intercept by plugging in 0 for x.
- Reflect your points across the axis of symmetry and connect your dots with a smooth U-shaped (not V-shaped) curve.

fix the following

- $a = 1, b = 2, c = 3$
  - $x^2 + 2x + 3$
1. find the line of symmetry -
    1.  $x = (b/2a)$
    2.  $x = -(2) / 2(1) = -1$
  2. use this to find the vertex
  3. since we know that the along the x axis at -1 will be the vertex we replace x with -1 in the original formula
    1.  $x = -1$
    2.  $y = x^2 - 2x - 8$
    3.  $y = (-1)^2 + -2 * (-1) - 8 = 1 - 2 - 8 = -9$
    4.  $y = -9$
  4. the vertex is  $(-1, -9)$
  5. since the vertex is  $(-1, -9)$  we know that  $x = -1$  is the axis of symmetry
  6. finding the y-intercept is the easiest to start with because we just replace x with 0
  7.  $x = 0 \mid y = x^2 - 2x - 8$
  8.  $y = 0 - 8 = -8$
  9. y-intercept =  $(0, -8)$
  10. so so To find the x-intercepts, you can set y equal to zero and solve for x:
  11.  $y = 0 \mid x = (-b \pm \sqrt{b^2 - 4ac}) / 2a$ 
    1.  $x = -(-2) \pm \sqrt{(-2)^2 - 4(1)(-8)} / 2(1)$   
 $x = (2 \pm \sqrt{4 + 32}) / 2$   
 $x = (2 \pm \sqrt{36}) / 2$   
 $x = (2 \pm 6) / 2$   
 $x = 8 / 2$  or  $x = -4 / 2$   
 $x = 4$  or  $x = -2$

sooooo (-2,0) & (4,0)

12. so since we know 3 y axis points on the graph and the axis of symmetry we can get another point without doing much work

1. symmetry line =  $x = 1$ ,

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1. the symmetry line is 1 and the known point is 0 since  $1-0 = 1$  we can add that to the x coordinate of y and keep the same y coordinate to get the mirrored point making another point on the graph (2,-8)

3. since we need one more point for the graph we can choose say  $x=3$ , |  $x^2 - 2x - 8$

1.  $y = 3^2 - 3*2 - 8 = -5$

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4. so all points are:

1. (1, -9)

2. (0,-8)

3. (2, -8)

4. (3,-5)

5. (-1,-5)

# Example 6: Graph $y = 2x^2 - 8x$

- Find the vertex and the axis of symmetry. Sketch these in.
- Find the x-intercept by plugging in 0 for y.
- Find the y-intercept by plugging in 0 for x.
- Reflect your points across the axis of symmetry and connect your dots with a smooth U-shaped (not V-shaped) curve.

# Example 7: $h = 16t^2 + 72t + 520$

Suppose a particular “star” is projected from a firework at a starting height of 520 feet with an initial upward velocity of 72 ft/sec.

The equation:

$$h = 16t^2 + 72t + 520$$

gives the star’s height  $h$  in feet at time  $t$  in seconds.

a) How long will it take for the star to reach its maximum height?

b) What is the maximum height?