

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

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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 $(-1, -6)$

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

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

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

- 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 -1 into the formula $y = 2x^2 + 4x$

- $y = -2^2 + 4 \cdot 2 - 5 = -1$

- 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. $y = 3^2 - 3 \cdot 2 - 8 = -5$

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 = $x = 1$,
 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 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?