8-2 Quadratic Functions (Part # 1)

Example 1

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- 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*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*-1^2+4*-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*-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 * 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

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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 | 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 | x = (-b ± sqrt(b^2 - 4ac)) / 2a
    1. x = (-(-2) ± sqrt((-2)^2 - 4(1)(-8))) / 2(1)
       x = (2 ± sqrt(4 + 32)) / 2

x = (2 ± sqrt(36)) / 2
x = (2 ± 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 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 fallowing

- 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 | 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 | x = (-b ± sqrt(b^2 - 4ac)) / 2a
    1. x = (-(-2) ± sqrt((-2)^2 - 4(1)(-8))) / 2(1)
       x = (2 ± sqrt(4 + 32)) / 2
       x = (2 ± sqrt(36)) / 2
       x = (2 ± 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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    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?