MPM2D Class #: _____ Date: _____

Quadratic Relations - Analysis and Applications

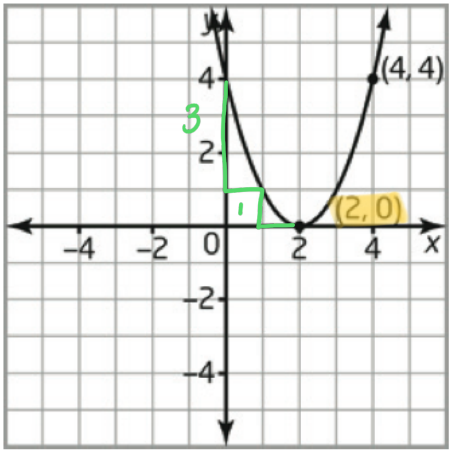
Example 1

Write an equation for each parabola.

$y = a(x-h)^2 + k$

Two ways to solve...

a)



① By inspection... vertex is at (2, 0). So $h = 2$ and $k = 0$. Regular step pattern, 1, 3, ... so $a = 1$.

$\therefore y = 1(x-2)^2 + 0$ or $y = (x-2)^2$

② Using algebra... vertex is at (2, 0) and another point is at (4, 4). Substitute: h k, x y

$y = a(x-h)^2 + k$

$4 = a(4-2)^2 + 0$

$4 = a(2)^2$

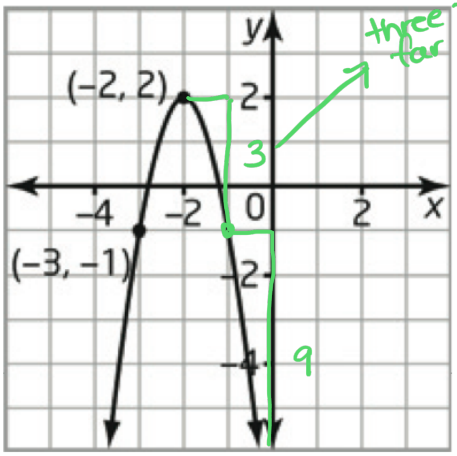
$4 = 4a$

$\frac{4}{4} = \frac{4a}{4}$

$1 = a$

$\therefore$ equation is $y = (x-2)^2$

b)



Again, can solve by inspection or by using algebra.

① By inspection... vertex is at (-2, 2) and step pattern is over 1, down 3 so $a = 3$

$\therefore y = -3(x-(-2))^2 + 2$

$y = -3(x+2)^2 + 2$

② Using algebra

(-2, 2) h k

(-3, -1) x y

$y = a(x-h)^2 + k$

$-1 = a(-3-(-2))^2 + 2$

$-1 = a(-3+2)^2 + 2$

$-1 = a(-1)^2 + 2$

$-1 = a + 2$

$-1 - 2 = a + 2 - 2$

$-3 = a$

$\therefore$ equation is $y = -3(x+2)^2 + 2$

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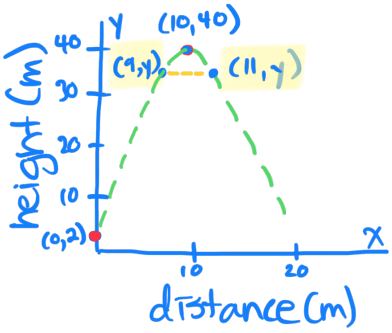
2. At a fireworks display, a firework is launched from a height of 2 m above the ground and reaches a maximum height of 40 m at a horizontal distance of 10 m.

↓ some other point!

↑ vertex!

a) Determine an equation to model the flight path of the firework.

Start with a sketch!



Let x be the horizontal distance from where the firework was fired, in metres.

Let y be the height above the ground, in metres.

(10,40) (0,2) Substitute.

h k x y

$y = a(x-h)^2 + k$

$2 = a(0-10)^2 + 40$

$2 = a(-10)^2 + 40$

$2 = 100a + 40$

$-40 \quad -40$

$\frac{-38}{100} = \frac{100a}{100}$

$-0.38 = a$

∴, equation is $y = -0.38(x-10)^2 + 40$

b) The firework continues to travel an additional 1 m horizontally, after it reaches the maximum height, before it explodes. What is its height when it explodes?

Vertex is at (10,40). One metre further is (11,y). We need to find "y". Substitute:

$y = -0.38(x-10)^2 + 40$

$y = -0.38(11-10)^2 + 40$

$y = -0.38(1)^2 + 40$

$y = -0.38 + 40$

$y = 39.62$

∴, the height of the firework when it explodes is 39.62 m.

c) At what other horizontal distance is the firework at the same height as in part b)?

Since a parabola is symmetrical, the firework is also at a height of 39.62 m at a horizontal distance of 9 m.