Finding the Equation of Quadratic Relation | MPM2D

To get the equation of a quadratic relation in vertex form, you need two things:

1) The vertex (h, k)
2) The step pattern (a)

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

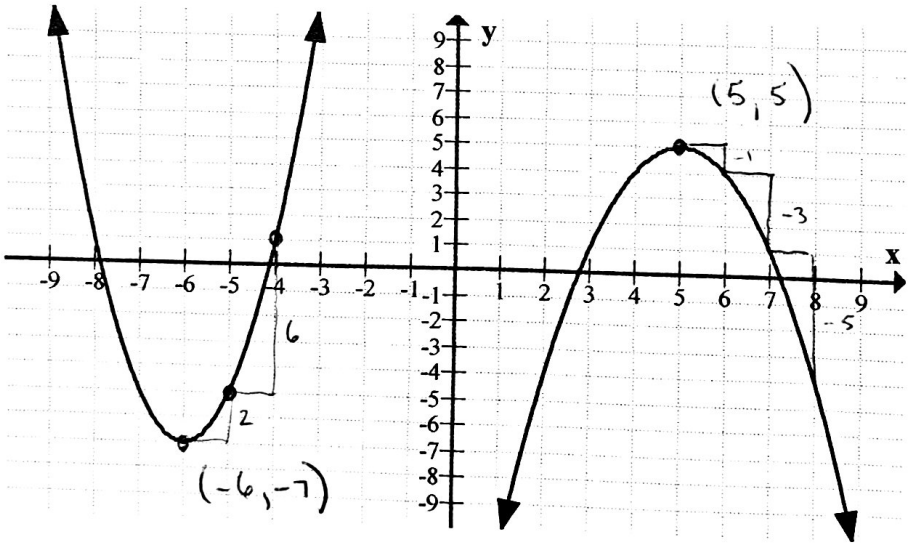
Example: If the vertex of a parabola is (-2, 4), and it has a step pattern of -2, -6, -10, what is the equation?

$y = -2(x+2)^2 + 4$

Example: If the vertex of a parabola is (3, -5), and the step pattern is 0.5, 1.5, 2.5, what is the equation?

$y = \frac{1}{2}(x-3)^2 - 5$

Sometimes you may be able to read the vertex and step pattern right from a graph, and create an equation that way. Consider the two quadratic relations below.



Left Parabola		Right Parabola	
Vertex	$(-6, -7)$	Vertex	$(5, 5)$
Step Pattern	$2, 6, 10$	Step Pattern	$-1, -3, -5$
Equation	$y = 2(x+6)^2 - 7$	Equation	$y = -(x-5)^2 + 5$

Finding the Equation of Quadratic Relation | MPM2D

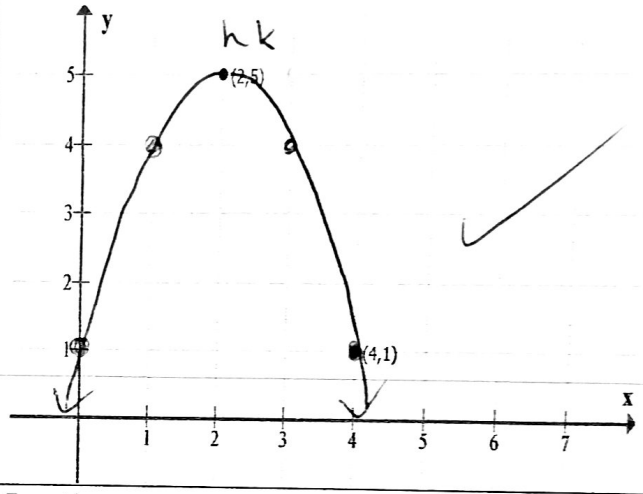
When creating an equation, sometimes it is impossible to read off the step pattern. You may be only given another point on the graph. In these cases, we can use algebra.

Example: Find the equation of the parabola with a vertex of (2, 5) through the point (4, 1).

h k x y

Vertex Form:	$y = a(x - h)^2 + k$
Sub in Vertex:	$y = a(x-2)^2 + 5$
Sub in Point:	$1 = a(4-2)^2 + 5$
Square and Solve:	$1 = 4a + 5$ $-5 \quad -5$ $\frac{-4}{4} = \frac{4a}{4}$ $-1 = a$

Sketch:



Equation:

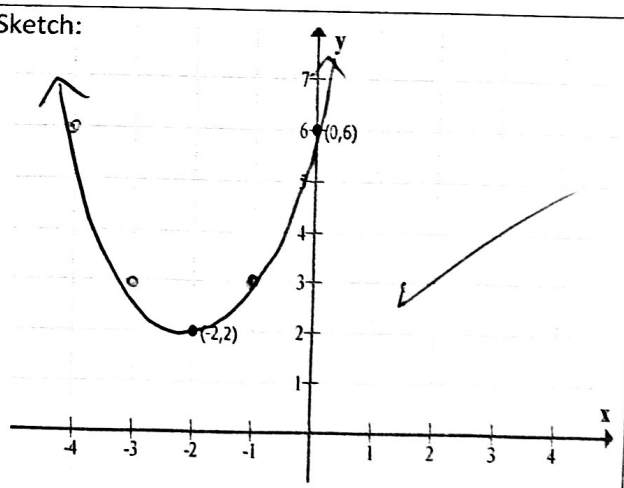
$y = -(x-2)^2 + 5$

h k x y

Example: Find the equation of the parabola with a vertex of (-2, 2) through the point (0, 6).

Vertex Form:	$y = a(x - h)^2 + k$
Sub in Vertex:	$y = a(x+2)^2 + 2$
Sub in Point:	$6 = a(0+2)^2 + 2$
Square and Solve:	$6 = 4a + 2$ $-2 \quad -2$ $\frac{4}{4} = \frac{4a}{4}$ $1 = a$

Sketch:



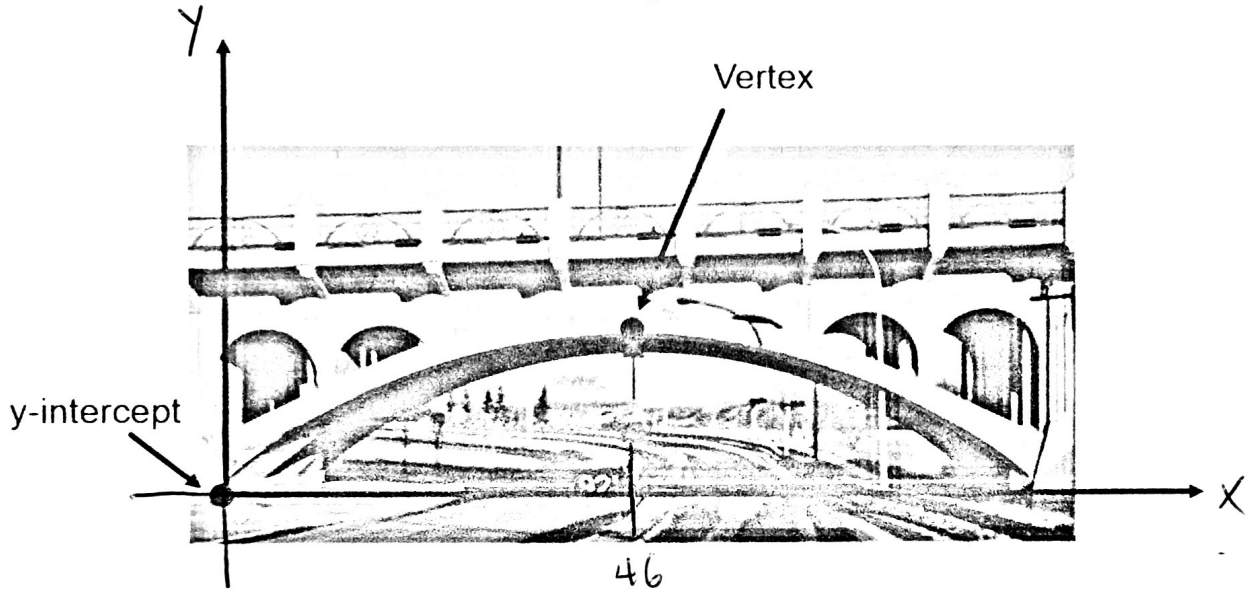
Equation:

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

You will be expected to be able to find the equation without having to make a graph, and without the structure above.

Finding the Equation of Quadratic Relation | MPM2D

Application: The underside of highway overpass is in the shape of a parabola. The underside is 19 feet high at its highest point, and is 92 feet wide at the base.
Our goal is to model this underside with a quadratic relation.



a) Using the above information, state the coordinates of the vertex, and the y-intercept of this quadratic relation.

Vertex = $(46, 19)$ y-intercept = $(0, 0)$

b) Determine the equation of the quadratic relation modeling this underside. Round your a-value to three decimal places.

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

$y = a(x-46)^2 + 19$

$0 = a(0-46)^2 + 19$

$0 = 2116a + 19$

$-19 \quad -19$

$\frac{-19}{2116} = \frac{2116a}{2116}$

$a = \frac{-19}{2116} \doteq -0.009$

$y = -0.009(x-46)^2 + 19$

c) Transport trucks pass under the overpass 25 feet from the base of the underside. How tall are the trucks allowed to be?

$y = -0.009(25-46)^2 + 19$

$y = -0.009(441) + 19$

$y = 15.031$ ft

MAXIMUM VEHICLE HEIGHT ?

15 ft!