

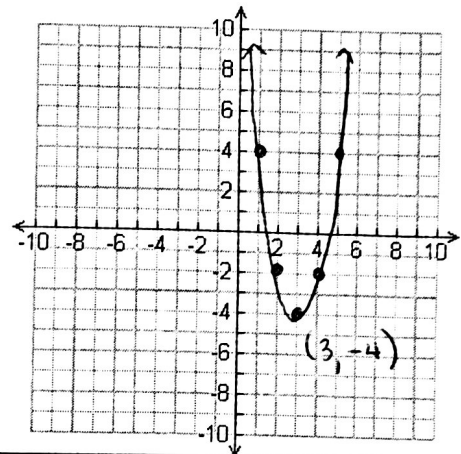
The Vertex Form of a Quadratic Relation | MPM2D

We would like to be able to sketch quadratic relations without using technology. Consider the following quadratic relation as we describe the transformations that would occur, and then determine the vertex and the step pattern.

$$y = 2(x - 3)^2 - 4$$

Transformations:

- translated vertically $\downarrow 4$
- translated horizontally $\rightarrow 3$
- stretched by a factor of 2



| | | | |
|---------|-----------|---------------|-------------------------|
| Vertex: | $(3, -4)$ | Step Pattern: | $2(1, 3, 5) = 2, 6, 10$ |
|---------|-----------|---------------|-------------------------|

The vertex form of a quadratic relation is given by:

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

Where:

k tells you....

- \hookrightarrow The vertical translation
- \hookrightarrow The y-value of the vertex

h tells you...

- \hookrightarrow The horizontal translation
- \hookrightarrow The x-value of the vertex

Vertex
is (h, k)

a tells you...

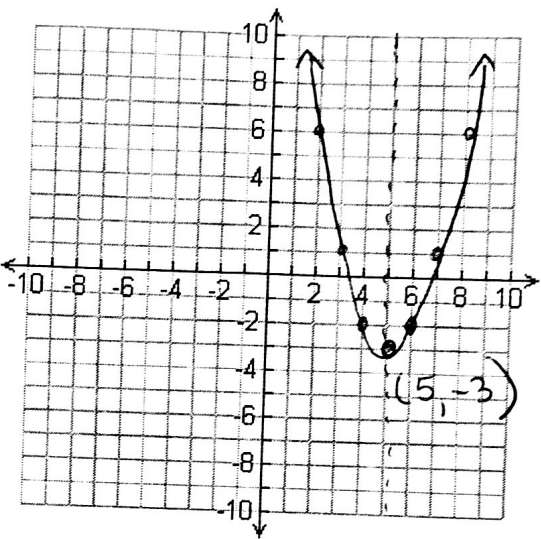
- \hookrightarrow The stretch/compression factor
- \hookrightarrow If the parabola opens \uparrow or \downarrow .
- \hookrightarrow The step pattern $1a, 3a, 5a$

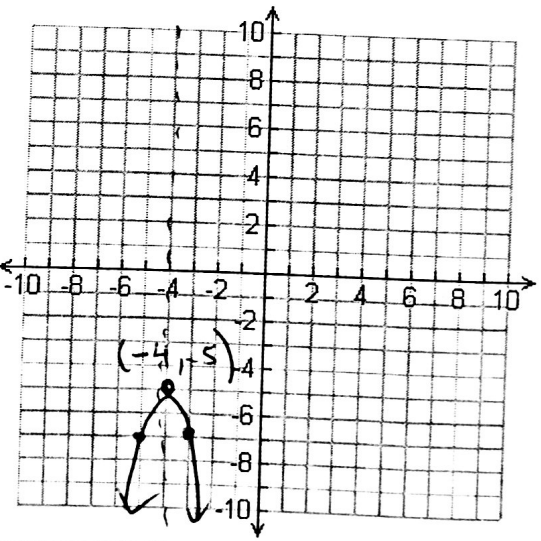
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In order to make a sketch of a quadratic relation in vertex form, you just need to follow two steps:

- 1) Write down the vertex, and then plot it.
- 2) Write down the step pattern, and use it to draw the rest of the graph.

Using your knowledge of transformations, graph the following quadratic relations and describe the indicated properties of each.

| | |
|---------------------------------------|---|
| Relation #1: $y = (x - 5)^2 - 3$ | Graph:  |
| Vertex: $(5, -3)$ | |
| Axis of Symmetry: $x = 5$ | |
| Stretch Factor: None ($a = 1$) | |
| Direction of Opening: \uparrow | |
| Step Pattern: $1, 3, 5$ | |
| Values "x" may take: All real numbers | |
| Values "y" may take: $y \geq -3$ | |

| | |
|---------------------------------------|--|
| Relation #2: $y = -2(x + 4)^2 - 5$ | Graph:  |
| Vertex: $(-4, -5)$ | |
| Axis of Symmetry: $x = -4$ | |
| Stretch Factor: $a = -2$ | |
| Direction of Opening: \downarrow | |
| Step Pattern: $-2, -6, -10$ | |
| Values "x" may take: All real numbers | |
| Values "y" may take: $y \leq -5$ | |

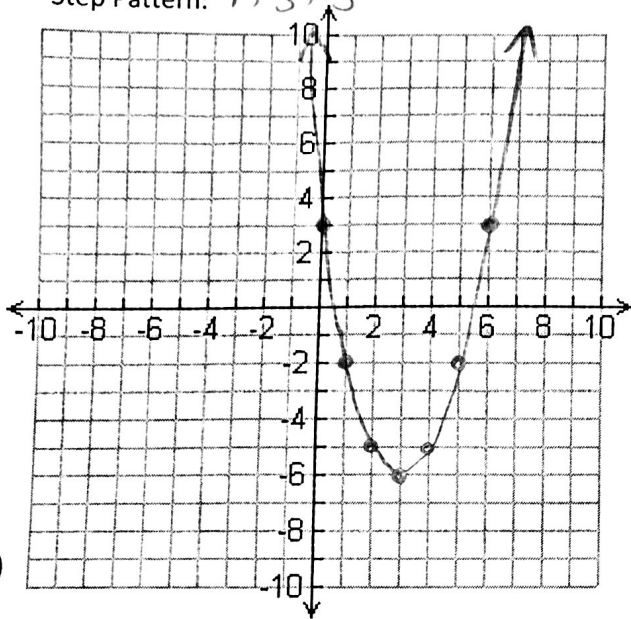
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1) Using your knowledge of vertex form, graph the following quadratic relations.

a) $y = (x-3)^2 - 6$

Vertex: $(3, -6)$

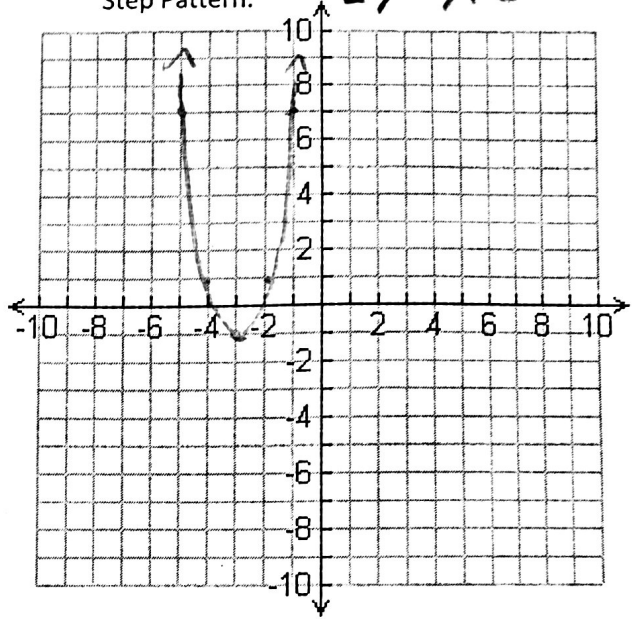
Step Pattern: $1, 3, 5$



b) $y = 2(x+3)^2 - 1$

Vertex: $(-3, -1)$

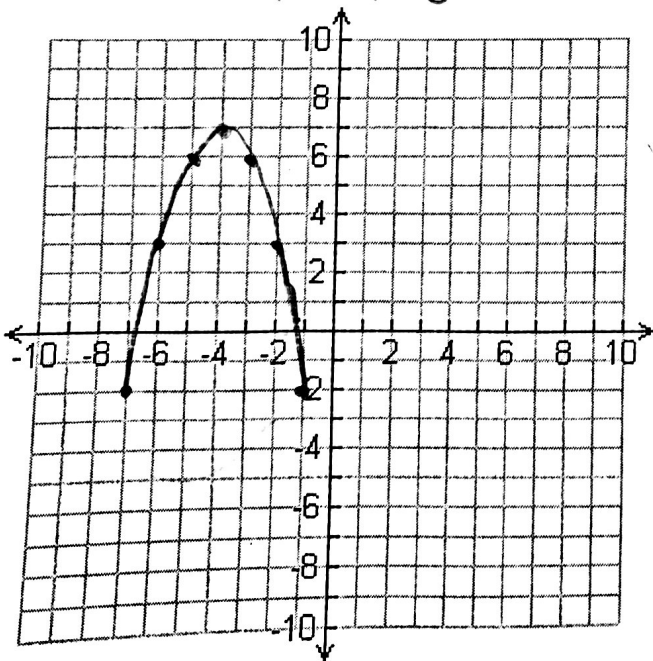
Step Pattern: $2, 6, 10$



c) $y = -(x+4)^2 + 7$

Vertex: $(-4, 7)$

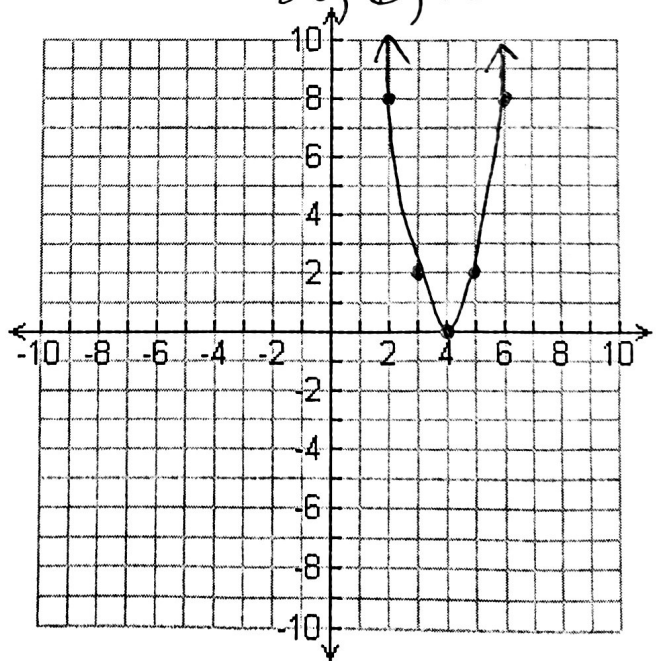
Step Pattern: $-1, -3, -5$



d) $y = 2(x-4)^2 + 0$

Vertex: $(4, 0)$

Step Pattern: $2, 6, 10$

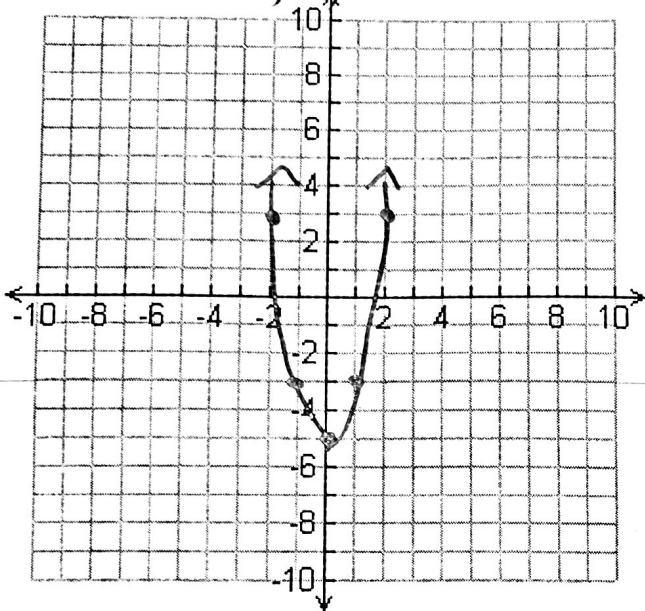


The Vertex Form of a Quadratic Relation | MPM2D

e) $y = 2x^2 - 5 = 2(x-0)^2 - 5$

Vertex: $(0, -5)$

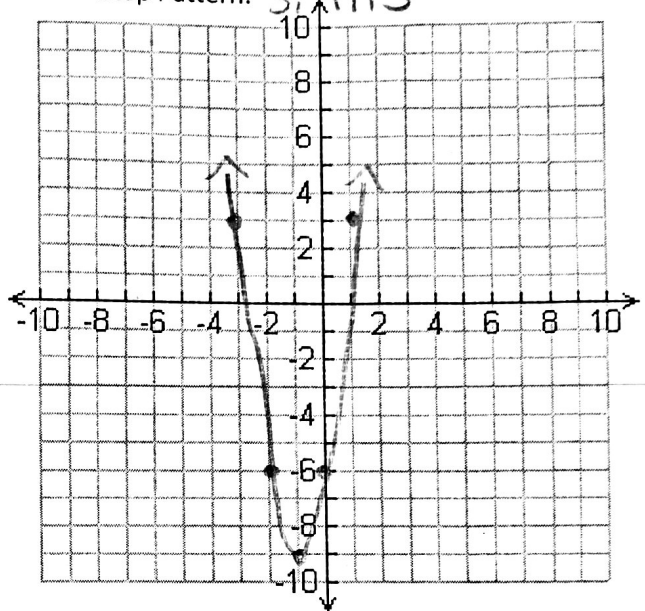
Step Pattern: $2, 6, 10$



f) $y = 3(x+1)^2 - 9$

Vertex: $(-1, -9)$

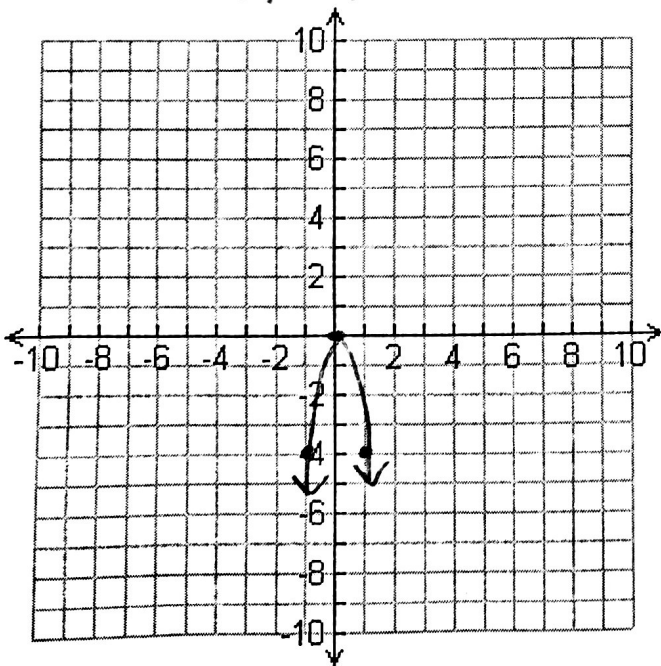
Step Pattern: $3, 9, 15$



g) $y = -3x^2$

Vertex: $(0, 0)$

Step Pattern: $-3, -9, -15$



h) $y = 2(x-6)^2 - 5$

Vertex: $(6, -5)$

Step Pattern: $2, 6, 10$

