Lesson 2 - Quadratic Function. Parabola

Grade 10

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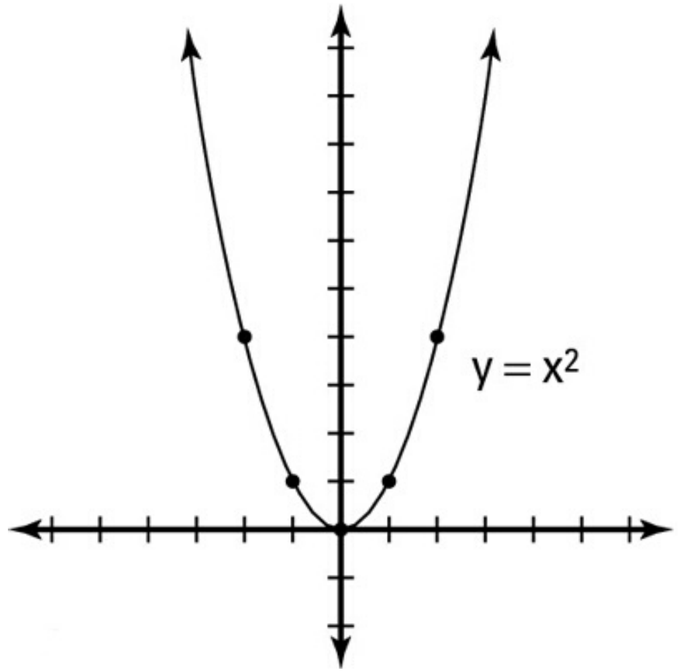
Consider the function $y = x^2$

In order to graph this function, let's create a table of values for it

x	–3	–2	–1	0	1	2	3
y	9	4	1	0	1	4	9

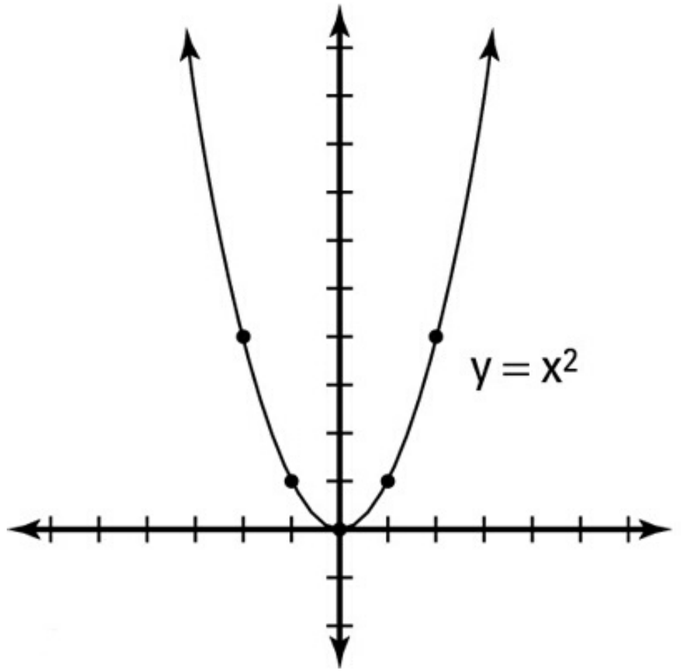
Now let's plot these ordered pairs on a Cartesian Plane and connect, forming a curve. This graph is called a PARABOLA.



Properties of the Function $y = x^2$

Domain: all real numbers $x \in R$
Range: $y \geq 0$ and passes through the origin (0,0)

The graph of the function is a parabola, which is symmetric about the y-axis, because $(-x)^2 = x^2$
Y-axis is the **axis of symmetry** of the parabola in this case and the point of intersection of the axis of symmetry and the graph is the **vertex of the parabola** with the coordinates (h,k)



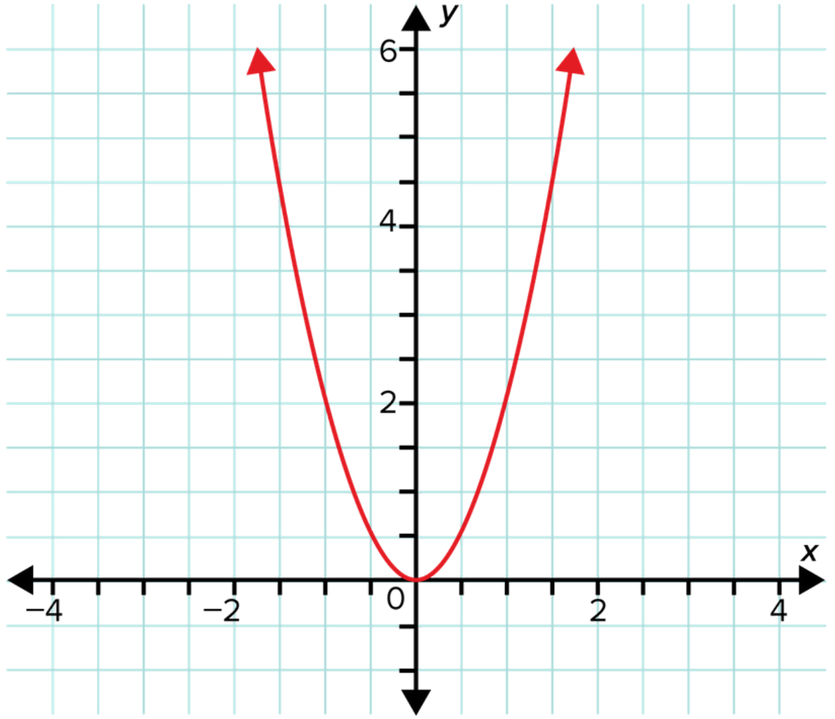
When the leading coefficient is not 1

Consider the function $y = 2x^2$

Let's graph it using the table of values

x	-3	-2	-1	0	1	2	3
y	18	8	2	0	2	8	18

If we compare the two functions and their graphs, we can clearly see that when the leading coefficient is 2, then the corresponding y-values for the same x-values are double the original (times 2).



Function of the form $y = a x^2 + bx + c$

Quadratic Function in Standard Form

$a \neq 0$ b, c are given numbers

Function of the form $y = a(x - h)^2 + k$

Quadratic Function in Vertex Form

the graph of this function is a parabola with the vertex (h, k)

if $a > 0$, then parabola opens up

if $a < 0$, then parabola opens down

the axis of symmetry is parallel to the y-axis and passes through $x = h$

Completing The Square

In order to convert from **standard** to **vertex** form

$$y = 3x^2 - 12x + 8$$

$$y = 3(x^2 - 4x) + 8$$

$$y = 3(x^2 - 2 \cdot 2x + 4) - 12 + 8$$

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

Vertex at $(2, -4)$

Axis of Symmetry $x = 2$

Determining x and y intercepts

To find the **x-intercept**, substitute **0 for y** in the equation of the function and solve for x.
To find the **y-intercept**, substitute **0 for x** in the equation of the function and solve for x.

Determining Max or Min point

Functiion $y = a x^2 + bx + c$ has a MAXIMUM value $y_{\max} = k$ if $a > 0$ or a MINIMUM value $y_{\min} = k$ if $a < 0$, at $h = -\frac{b}{2a}$

The value of k is called the OPTIMAL VALUE (Max or Min)

Th Vertex (at Max or Min) has the coordinates (h, k)

Putting It All Together

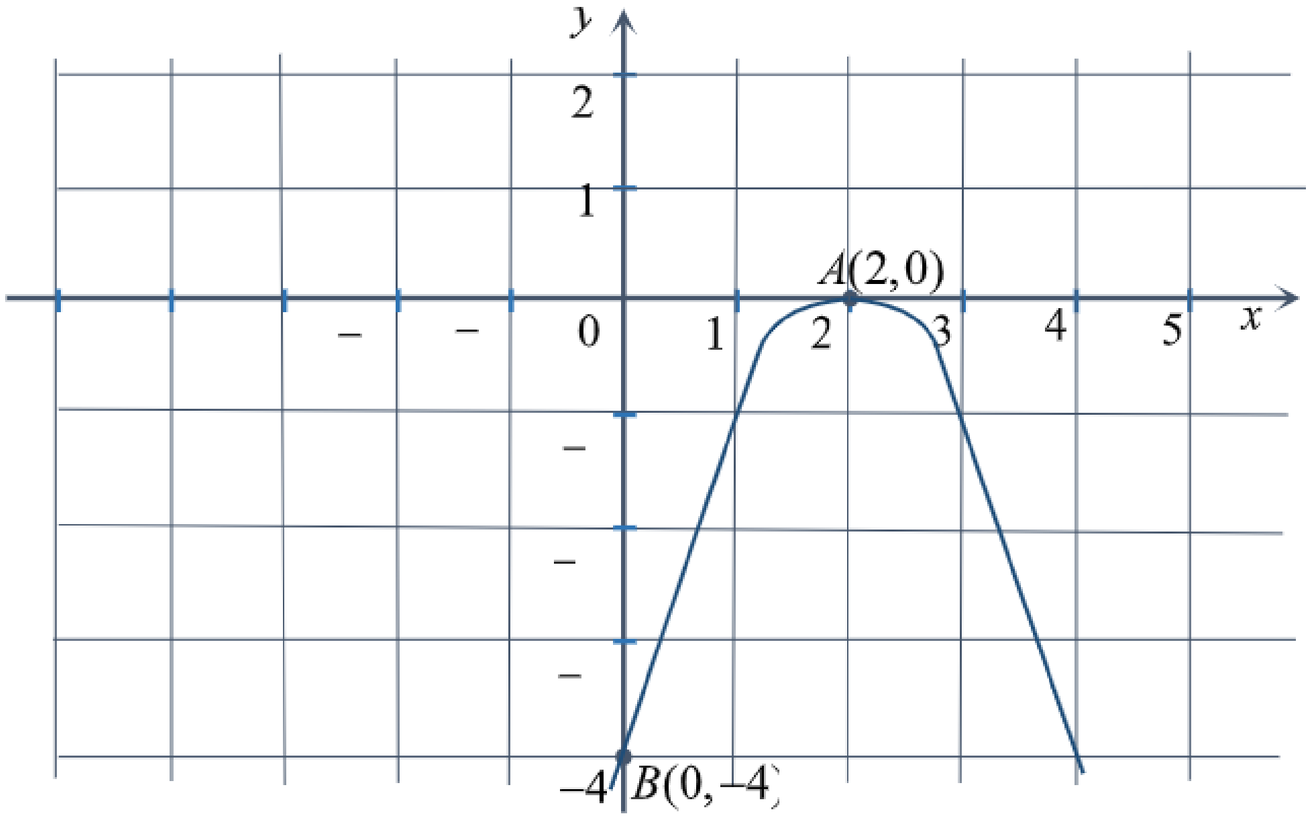
Given the quadratic function $y = -x^2 + 4x - 4$

- State the Vertex Form equation of the function
- Determine the coordinates of the Max/Min point of the function
- Determine the x and y intercepts
- Sketch the graph of the function

Putting It All Together

Given the quadratic function $y = -x^2 + 4x - 4$

Sketch the graph of the function



Putting It All Together

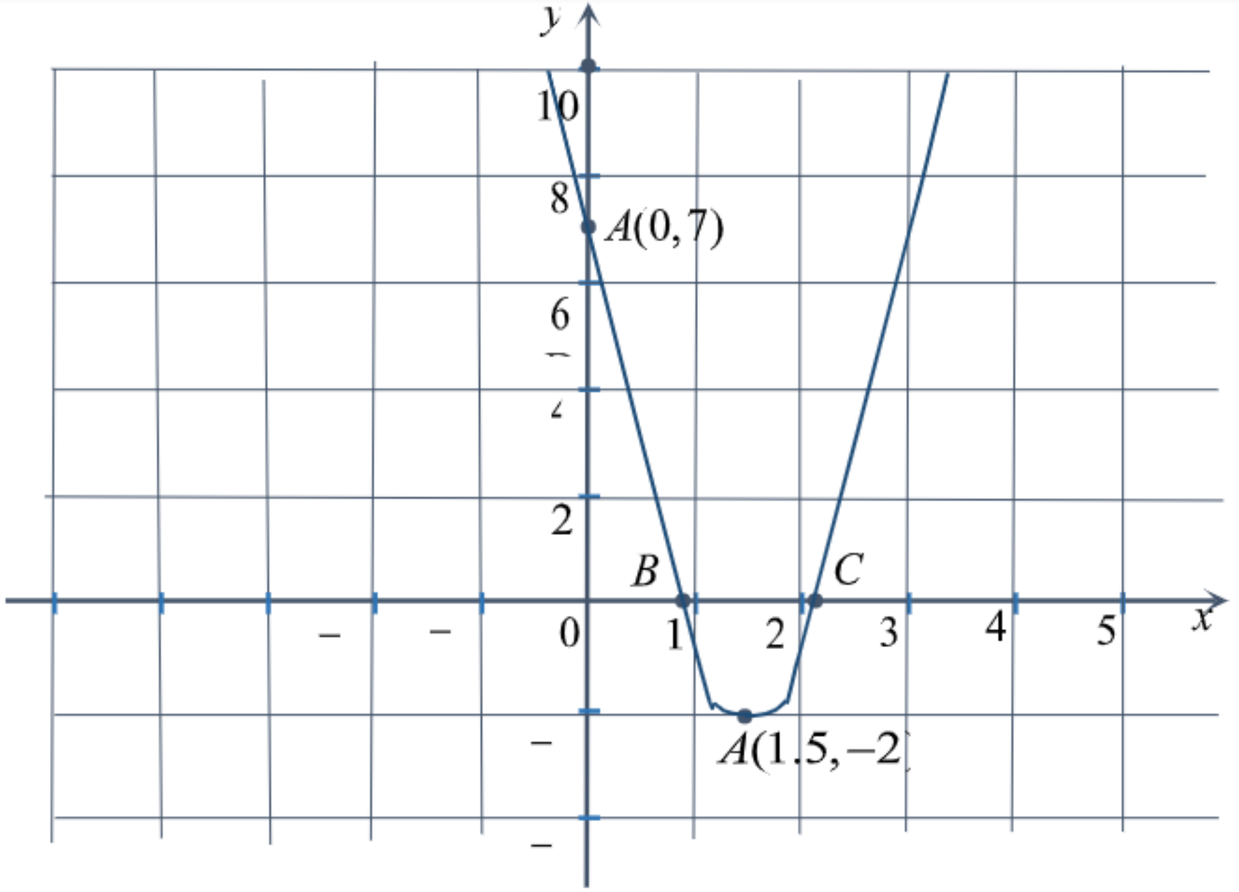
Given the quadratic function $y = 4x^2 - 12x + 7$

- State the Vertex Form equation of the function
- Determine the coordinated of the Max/Min point of the function
- Determine the x and y intercepts
- Sketch the graph of the function

Putting It All Together

Given the quadratic function $y = 4x^2 - 12x + 7$

Sketch the graph of the function



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