

4.1 Properties of a Quadratic Function

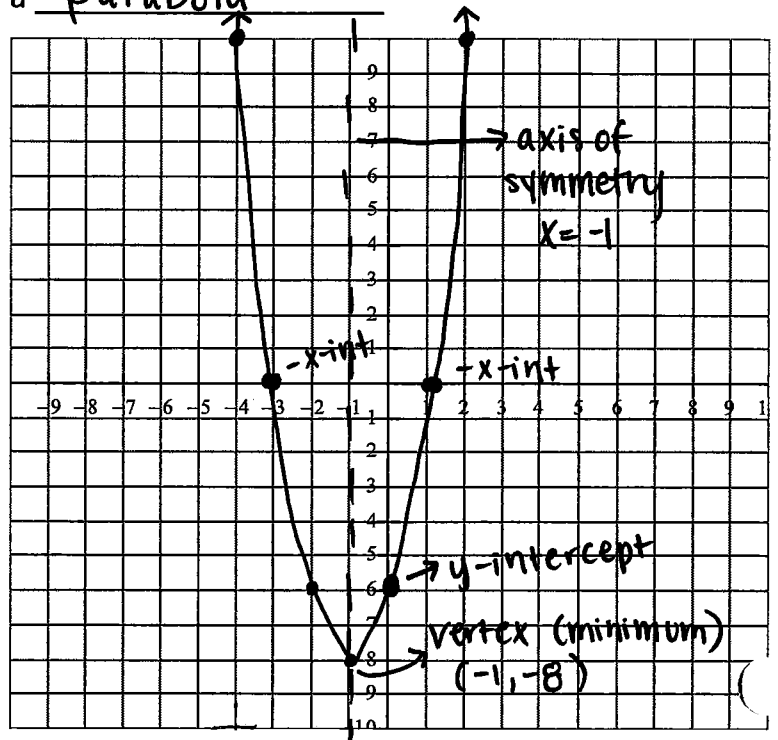
highest-degree is "2"
 $y = x^2$ $y = 2x^2 + 4x - 3$

- A quadratic function is a polynomial of the second degree.
- The graph of a quadratic is called a parabola

Example #1: Sketch a graph of the curve $y = 2x^2 + 4x - 6$ on the grid and determine the characteristics listed below:

x	y
-4	10
-3	0
-2	-6
-1	-8
0	-6
1	0
2	10
3	24
4	42

$y = 2(-4)^2 + 4(-4) - 6$
 $y = 10$



Vertex = the lowest point of the graph (if it opens up), and the highest point of the graph (if it opens down).	$(-1, -8)$
When the coefficient of x^2 is positive, the parabola opens up and its vertex is called the minimum . When the coefficient of x^2 is negative, the parabola opens down and its vertex is a maximum point.	minimum
Equation of the Axis of Symmetry = the equation of the line which intersects the vertex of the graph and divides the graph into two equal halves.	\rightarrow x-coordinate of vertex $x = -1$
y-Intercept = the point at which the graph crosses the y-axis. Note this is where $x = 0$	$(0, -6)$
x-Intercept = the point at which the graph crosses the x-axis. Note this is where $y = 0$	$(-3, 0), (1, 0)$
Domain = all possible values of x	$x \in \mathbb{R}$
Range = all possible values of y	$y \geq -8$ \rightarrow always the y-coordinate of vertex

Sometimes the x -intercepts cannot be identified from the table or graph, so we need to find them another way. This can be completed by solving the quadratic equation by setting $y = 0$. Note that the x -intercepts of the graph of a quadratic function are called the zeros of the function because they are the values of x when the function is set to 0.

Example #2: Given the quadratic equation, $y = -2x^2 - 6x + 20$, determine the following, without graphing.

a) Determine the zeros of the graph. $\rightarrow y = 0$

$$0 = \frac{-2x^2 - 6x + 20}{-2}$$

$$x = -5 \text{ and } x = 2$$

$$0 = x^2 + 3x - 10$$

$$0 = (x+5)(x-2)$$

b) Determine the y -intercept $\rightarrow x = 0$

$$y = -2(0)^2 - 6(0) + 20$$

$$y = 20$$

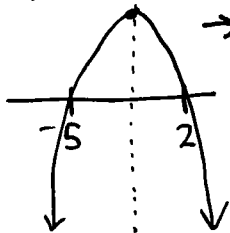
c) Determine whether the vertex will be a maximum point or a minimum point.



coefficient of " x " is negative so graph opens down.

\therefore there is a maximum point.

d) Determine the axis of symmetry.



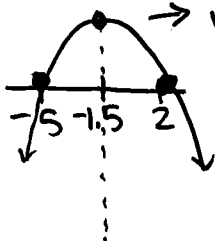
\rightarrow this is what we know

Axis of symmetry is in the middle.

$$\frac{-5+2}{2} = -1.5$$

$$x = -1.5$$

e) Determine the vertex of the graph.



\rightarrow vertex is where $x = -1.5$

$$y = -2x^2 - 6x + 20$$

$$y = -2(-1.5)^2 - 6(-1.5) + 20$$

$$y = 24.5$$

$$\therefore \text{Vertex } (-1.5, 24.5)$$