

5.2: Finding Critical Points from Standard Form

The standard form of a quadratic equation is: $ax^2 + bx + c$ and you can determine many key features of the equations' graph.

AXIS OF SYMMETRY	$x = \frac{-b}{2a}$ (a & b come from standard form)
VERTEX:	$(\frac{-b}{2a}, \text{plug in } \frac{-b}{2a} \text{ for } x)$
The parabola opens up if:	a is positive
The parabola opens down if:	a is negative
The vertex is a	MINIMUM when the parabola opens <u>up</u> and is a MAXIMUM when the parabola opens <u>down</u> .
The y - INTERCEPT is the point (0, <u>c</u>)	
The parabola will stretch vertically (more narrow) if a ≥ 1 and will compress vertically (more wide) if a ≤ 1 .	Neither stretched/compressed when $a=1$

Example 1: Given each Quadratic Equation State the vertex, the axis of symmetry, and y-intercept of each graph. Does the graph open up or down? Is the vertex a minimum or a maximum?

a) $y = -2x^2 + 4x - 8$
 $a = -2$ $b = 4$ $c = -8$

$$x = \frac{-b}{2a} = \frac{-4}{2(-2)} = \frac{-4}{-4} = 1$$

$$y = -2(1)^2 + 4(1) - 8$$

$$= -2 + 4 - 8 = -6$$

Vertex: $(1, -6)$

Axis of Symmetry: $x = 1$

y-intercept: $(0, -8)$

Direction of Opening: Down ↻

Min/Max? Max (max value is -6)

Stretch or Compress? Stretch

b) $y = x^2 + 3x - 9$
 $a = 1$ $b = 3$ $c = -9$

$$x = \frac{-b}{2a} = \frac{-3}{2(1)} = \frac{-3}{2}$$

* $y = (-\frac{3}{2})^2 + 3(-\frac{3}{2}) - 9$
 $= -11.25$

Vertex: $(-1.5, -11.25)$

Axis of Symmetry: $x = \frac{-3}{2}$ or $x = -1.5$

y-intercept: $(0, -9)$

Direction of Opening: Up ↻

Min/Max? Min (min value is -11.25)

Stretch or Compress? Neither

* Feel free to plug in as seen into a calculator

$$c) y = -x^2 + 8x + 9$$

$$a = -1 \quad b = 8 \quad c = 9$$

$$x = \frac{-8}{2(-1)} = \frac{-8}{-2} = 4$$

$$\begin{aligned} * y &= -(4)^2 + 8(4) + 9 \\ &= -16 + 32 + 9 \\ &= 25 \end{aligned}$$

* Plug into calculator or work by hand

$$e) y = 3x^2 - 12x + 12$$

$$a = 3 \quad b = -12 \quad c = 12$$

$$x = \frac{12}{2(3)} = \frac{12}{6} = 2$$

$$\begin{aligned} y &= 3(2)^2 - 12(2) + 12 \\ &= 12 - 24 + 12 \\ &= 0 \end{aligned}$$

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

$$\text{Vertex: } (4, 25)$$

$$\text{Axis of Symmetry: } x = 4$$

$$y\text{-intercept: } (0, 9)$$

Direction of Opening: Down \downarrow

Min/Max? Max (max value is 25)

Stretch or Compress? Neither

$$\text{Vertex: } (2, 0)$$

$$\text{Axis of Symmetry: } x = 2$$

$$y\text{-intercept: } (0, 12)$$

Direction of Opening: Up \uparrow

Min/Max? Min (min value is 0)

Stretch or Compress? Stretch

Vertex:

Axis of Symmetry:

y-intercept:

Direction of Opening:

Min/Max?

Stretch or Compress?