

Standard Form-Characteristics

Standard Form: $y = ax^2 + bx + c$

Finding **vertex**: $(-\frac{b}{2a}, f(-\frac{b}{2a}))$

Ex 1. $y = x^2 + 4x + 1$

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

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

$$= 4 - 8 + 1$$

$$= -4 + 1 = -3$$

$$(-2, -3)$$

Ex 2. $y = -2x^2 - 12x - 5$

$$x = \frac{-(-12)}{2(-2)} = \frac{12}{-4} = -3$$

$$y = -2(-3)^2 - 12(-3) - 5$$

$$= -18 + 36 - 5$$

$$= 18 - 5 = 13$$

$$(-3, 13)$$

Finding **axis of symmetry**: $x = -\frac{b}{2a}$

Ex 3. $y = -3x^2 - 6x - 2$

$$x = \frac{-(-6)}{2(-3)} = \frac{6}{-6} = -1$$

$$x = -1$$

Ex 4. $y = 2x^2 + 5x + 8$

$$x = \frac{-5}{2(2)} = -\frac{5}{4}$$

$$x = -\frac{5}{4}$$

Finding **extrema**:

*The graph has a MINIMUM if the $a > 0$ because the graph opens up.

*The graph has a MAXIMUM if the $a < 0$ because the graph opens down.

The smallest or largest y-value corresponds to the y-coordinate of the vertex.

Ex 5. $y = 5x^2 - 20x - 13$

min at -33

$$x = \frac{-(-20)}{2(5)} = \frac{20}{10} = 2$$

$$y = 5(2)^2 - 20(2) - 13$$

$$= 20 - 40 - 13 = -20 - 13 = -33$$

Ex 6. $y = -x^2 + 8x + 2$

max at 18

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

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

$$= -16 + 32 + 2 = 16 + 2 = 18$$

Finding **y-intercept**:

*Let $x=0$so plug in 0 for x.

Ex 7. $y = -9x^2 - 6x + 2$

$$= -9(0)^2 - 6(0) + 2$$

$$= 0 + 0 + 2$$

$$= 2$$

$$(0, 2)$$

Ex 8. $y = x^2 + 5x - 12$

$$= 0^2 + 5(0) - 12$$

$$= 0 + 0 - 12$$

$$= -12$$

$$(0, -12)$$

PRACTICE

Find the vertex, axis of symmetry, extrema, and y-intercept for each quadratic. Show your work.

1. $y = 2x^2 - 4x + 3$

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

$y = 2(1)^2 - 4(1) + 3$
 $= 2 - 4 + 3$
 $= -2 + 3 = 1$

Vertex: (1, 1)
AOS: $x = 1$
extrema: min at 1
y-int: (0, 3)

2. $y = -x^2 + 2x + 2$

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

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

Vertex: (1, 3)
AOS: $x = 1$
extrema: max at 3
y-int: (0, 2)

3. $y = 2x^2 - 8x + 1$

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

$y = 2(2)^2 - 8(2) + 1$
 $= 8 - 16 + 1$
 $= -8 + 1 = -7$

Vertex: (2, -7)
AOS: $x = 2$
extrema: min at -7
y-int: (0, 1)

4. $y = x^2 - 8x + 2$

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

$y = (4)^2 - 8(4) + 2$
 $= 16 - 32 + 2$
 $= -16 + 2 = -14$

Vertex: (4, -14)
AOS: $x = 4$
extrema: min at -14
y-int: (0, 2)

5. $y = -x^2 + 4x - 7$

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

$y = -(2)^2 + 4(2) - 7$
 $= -4 + 8 - 7$
 $= 4 - 7 = -3$

Vertex: (2, -3)
AOS: $x = 2$
extrema: max at -3
y-int: (0, -7)