

Vertex Form - Characteristics

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

where (h, k) is the vertex.

* Remember, when inside of parenthesis, think OPPOSITE. *

FINDING VERTEX: (h, k)

1. $y = 2(x-3)^2 + 5$ $(3, 5)$

2. $y = -(x+6)^2 + 8$ $(-6, 8)$

3. $y = \frac{1}{3}(x+1)^2 - 4$ $(-1, -4)$

4. $y = -(\frac{1}{2}x - 10)^2 - 7$ $(10, -7)$

FINDING AXIS OF SYMMETRY: $x = h$

1. $y = (-x+5)^2 - 1$ $x = -5$

2. $y = (x+2)^2 + 6$ $x = -2$

3. $y = -(x-7)^2 - 3$ $x = 7$

4. $y = 4(x-11)^2 + 9$ $x = 11$

FINDING EXTREMA:

- If there is a negative in front, graph opens down, so there is a maximum.
- If there is no negative in front, graph opens up, so there is a minimum.
- The smallest/largest y-value corresponds to the y-coordinate of the vertex.

1. $y = -3(x-5)^2$ max at 0
2. $y = (x+6)^2 - 10$ min at -10
3. $y = \frac{1}{2}(x-1)^2 + 2$ min at 2
4. $y = -x^2 - 8$ max at -8

FINDING Y-INTERCEPT: Let $x = 0$

1. $y = (x+1)^2 - 4$ 2. $y = -2(x-6)^2$

$$= (0+1)^2 - 4$$

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

$$= 1 - 4$$

$$= -3 \quad (0, -3)$$
2. $y = -2(x-6)^2$

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

$$= -2(-6)^2$$

$$= -2(36)$$

$$= -72 \quad (0, -72)$$
3. $y = -(x+7)^2 + 2$ 4. $y = 3(x-8)^2 + 5$

$$= -(0+7)^2 + 2$$

$$= -(7)^2 + 2$$

$$= -49 + 2$$

$$= -47 \quad (0, -47)$$
4. $y = 3(x-8)^2 + 5$

$$= 3(0-8)^2 + 5$$

$$= 3(-8)^2 + 5$$

$$= 3(64) + 5$$

$$= 192 + 5$$

$$= 197 \quad (0, 197)$$

PRACTICE

For each, identify the vertex, AOS, extrema, and y-intercept. (use another sheet of paper.)

1. $y = (x-10)^2 - 9$
2. $y = -x^2 + 4$
3. $y = 2(x+6)^2 - 1$
4. $y = (x-4)^2 + 3$
5. $y = -6(x+3)^2$
6. $y = -3x^2 + 18x - 1$

$$\textcircled{1} y = (x-10)^2 - 9$$

V: (10, -9)
AOS: $x=10$
ext: min at -9
y-int: (0, 91)

$$\begin{aligned} &= (0-10)^2 - 9 \\ &= (-10)^2 - 9 \\ &= 100 - 9 \\ &= 91 \end{aligned}$$

$$\textcircled{2} y = -x^2 + 4$$

V: (0, 4)
AOS: $x=0$
ext: max at 4
y-int: (0, 4)

$$\begin{aligned} &= -0^2 + 4 \\ &= 0 + 4 \\ &= 4 \end{aligned}$$

$$\textcircled{3} y = 2(x+6)^2 - 1$$

V: (-6, -1)
AOS: $x=-6$
ext: min at -1
y-int: (0, 71)

$$\begin{aligned} &= 2(0+6)^2 - 1 \\ &= 2(6)^2 - 1 \\ &= 2(36) - 1 \\ &= 72 - 1 \\ &= 71 \end{aligned}$$

$$\textcircled{4} y = (x-4)^2 + 3$$

V: (4, 3)
AOS: $x=4$
ext: min at 3
y-int: (0, 19)

$$\begin{aligned} &= (0-4)^2 + 3 \\ &= (-4)^2 + 3 \\ &= 16 + 3 \\ &= 19 \end{aligned}$$

$$\textcircled{5} y = -6(x+3)^2$$

V: (-3, 0)
AOS: $x=-3$
ext: max at 0
y-int: (0, -54)

$$\begin{aligned} &= -6(0+3)^2 \\ &= -6(3)^2 \\ &= -6(9) = -54 \end{aligned}$$

$$\textcircled{6} y = -3x^2 + 18x - 1$$

$$x = \frac{-(-18)}{2(-3)} = \frac{-18}{-6} = 3$$

$$y = -3(3)^2 + 18(3) - 1$$

$$\begin{aligned} &= -3(9) + 54 - 1 \\ &= -27 + 54 - 1 \\ &= 27 - 1 \\ &= 26 \end{aligned}$$

V: (3, 26)
AOS: $x=3$
ext: max at 26
y-int: (0, -1)