4.2 – Graph Quadratic Functions in Vertex Form and Intercept Form

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

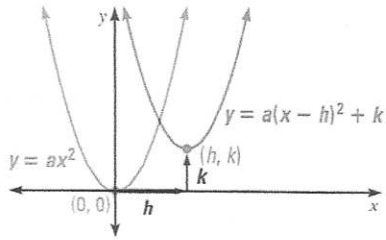
KEY CONCEPT *For Your Notebook*

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

The graph of $y = a(x-h)^2 + k$ is the parabola $y = ax^2$ translated horizontally h units and vertically k units.

Characteristics of the graph of $y = a(x-h)^2 + k$:

- The vertex is (h, k).
- The axis of symmetry is $x = h$.
- The graph opens up if $a > 0$ and down if $a < 0$.



Example 1 Graph $y = -\frac{1}{4}(x+2)^2 + 5$

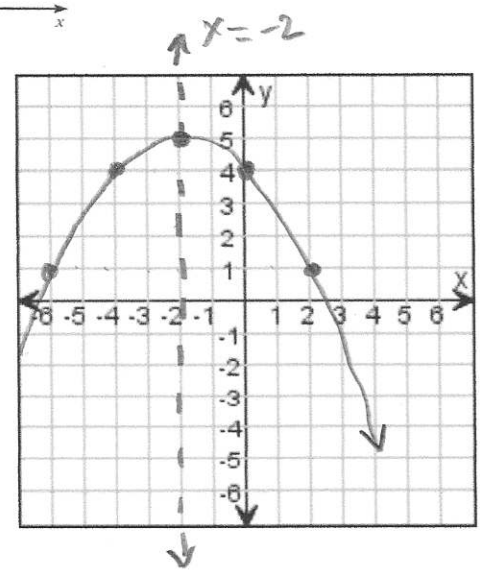
$\boxed{S1}$ $a = -\frac{1}{4}$ $h = -2$ $k = 5$

$\boxed{S2}$ $v(h,k)$; aos $x = h$ / $(-2, 5)$ $x = -2$

$\boxed{S3}$ $x = 0 \Rightarrow y = -\frac{1}{4}(0+2)^2 + 5 \Rightarrow y = 4$

$x = 2 \Rightarrow y = -\frac{1}{4}(2+2)^2 + 5 \Rightarrow y = 1$

$\boxed{S4}$ reflect



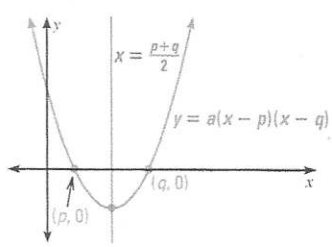
Intercept Form of a Quadratic Equation: $y = a(x-p)(x-q)$

KEY CONCEPT *For Your Notebook*

Graph of Intercept Form $y = a(x-p)(x-q)$

Characteristics of the graph of $y = a(x-p)(x-q)$:

- The x-intercepts are p and q.
- The axis of symmetry is halfway between $(p, 0)$ and $(q, 0)$. It has equation $x = \frac{p+q}{2}$.
- The graph opens up if $a > 0$ and opens down if $a < 0$.



Example 3 Graph $y = 2(x+3)(x-1)$

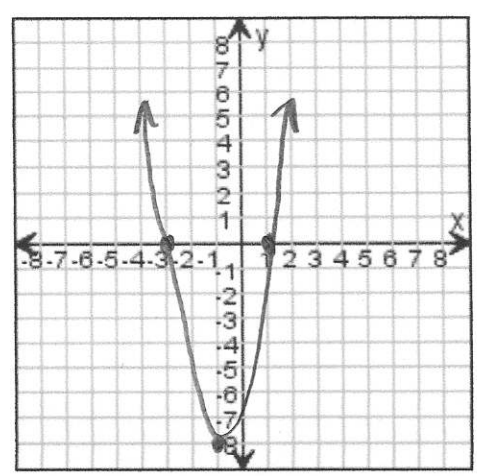
$\boxed{S1}$ $p = -3$ $q = 1$

$\boxed{S2}$ $x = \frac{p+q}{2} = \frac{-3+1}{2} = \frac{-2}{2} = -1$

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

$= 2(2)(-2) \Rightarrow y = -8$

$v(-1, -8)$



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

Example 5 Write $y = -2(x+5)(x-8)$ in Standard Form

$y = -2(x^2 - 8x + 5x - 40)$

$= -2(x^2 - 3x - 40)$

$y = -2x^2 + 6x + 80$

Example 6 Write $f(x) = 4(x-1)^2 + 9$ in Standard Form

$y = 4(x-1)(x-1) + 9$

$= 4(x^2 - x - x + 1) + 9$

$= 4(x^2 - 2x + 1) + 9$

$= (4x^2 - 8x + 4) + 9$

$y = 4x^2 - 8x + 13$

HW: (6-10 even), (15-19 odd), (24-30 even)

GRAPHING WITH VERTEX FORM **Graph the function. Label the vertex and axis of symmetry.**

3. $y = (x - 3)^2$
4. $y = (x + 4)^2$
5. $f(x) = -(x + 3)^2 + 5$
6. $y = 3(x - 7)^2 - 1$
7. $g(x) = -4(x - 2)^2 + 4$
8. $y = 2(x + 1)^2 - 3$
9. $f(x) = -2(x - 1)^2 - 5$
10. $y = -\frac{1}{4}(x + 2)^2 + 1$
11. $y = \frac{1}{2}(x - 3)^2 + 2$

12. ★ **MULTIPLE CHOICE** What is the vertex of the graph of the function $y = 3(x + 2)^2 - 5$?

Ⓐ $(2, -5)$ Ⓑ $(-2, -5)$ Ⓒ $(-5, 2)$ Ⓓ $(5, -2)$

GRAPHING WITH INTERCEPT FORM **Graph the function. Label the vertex, axis of symmetry, and x-intercepts.**

13. $y = (x + 3)(x - 3)$
14. $y = (x + 1)(x - 3)$
15. $y = 3(x + 2)(x + 6)$
16. $f(x) = 2(x - 5)(x - 1)$
17. $y = -(x - 4)(x + 6)$
18. $g(x) = -4(x + 3)(x + 7)$
19. $y = (x + 1)(x + 2)$
20. $f(x) = -2(x - 3)(x + 4)$
21. $y = 4(x - 7)(x + 2)$

22. ★ **MULTIPLE CHOICE** What is the vertex of the graph of the function $y = -(x - 6)(x + 4)$?

Ⓐ $(1, 25)$ Ⓑ $(-1, 21)$ Ⓒ $(-6, 4)$ Ⓓ $(6, -4)$

23. **ERROR ANALYSIS** *Describe* and correct the error in analyzing the graph of the function $y = 5(x - 2)(x + 3)$.

The x-intercepts of the graph are −2 and 3.

WRITING IN STANDARD FORM **Write the quadratic function in standard form.**

24. $y = (x + 4)(x + 3)$
25. $y = (x - 5)(x + 3)$
26. $h(x) = 4(x + 1)(x - 6)$
27. $y = -3(x - 2)(x - 4)$
28. $f(x) = (x + 5)^2 - 2$
29. $y = (x - 3)^2 + 6$
30. $g(x) = -(x + 6)^2 + 10$
31. $y = 5(x + 3)^2 - 4$
32. $f(x) = 12(x - 1)^2 + 4$