

1.9 Completing the Square

Use the technique we practiced to change from standard form to vertex form and identify the vertex of each parabola **WITHOUT** graphing.

1. $f(x) = x^2 + 2x - 48$

6. $f(x) = 7x^2 + 14x - 21$

2. $f(x) = x^2 - 10x - 56$

7. $f(x) = 2x^2 + 8x - 64$

3. $f(x) = x^2 + 2x - 57$

8. $f(x) = 10x^2 - 20x - 87$

4. $f(x) = x^2 + 8x + 12$

9. $f(x) = 9x^2 + 18x + 42$

5. $f(x) = x^2 + 12x - 6$

10. $f(x) = 3x^2 + 18x + 48$

1.10 Quadratic Forms Summary

If all key features (x-intercepts, y-intercept and vertex) are to be identified, it is sometimes necessary to express a function in an equivalent form. The forms and key features found include the following:

Form	Key Features Easily Identified
Vertex Form: $y = a(x - h)^2 + k$	vertex (h, k) y-intercept (replace x with 0, and simplify)
Factored Form: $y = (x + a)(x + b)$	x-intercepts from factors y-intercept by replacing x with 0, and simplifying
Standard Form: $y = ax^2 + bx + c$	y-intercept is c (replace x with 0, and simplify)

PART 1: Vertex Form to Standard Form (Identifying the y-intercept):

Use prior knowledge to simplify expression, and write terms in descending order.

Vertex Form

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

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

Multiply $(x - 1)(x - 1)$ and simplify.

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

Distribute 2.

Standard Form

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

Simplify.

TRY IT OUT: Write each quadratic function in standard form and identify the y-intercept of each function.

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

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

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

4. $y = -2(x - 4)^2 - 3$

PART 2: Factored Form to Standard Form:

Use prior knowledge to simplify expression, and write terms in descending order.

Factored Form	$y = 3(x - 2)(x - 1)$	
	$y = 3(x^2 - x - 2x + 2)$	Multiply $(x - 2)(x - 1)$ using Distributive Property.
	$y = 3(x^2 - 3x + 2)$	Simplify.
Standard Form	$y = 3x^2 - 9x + 6$	Distribute 3.

TRY IT OUT: Write quadratic function in standard form.

1. $y = -2(x + 2)(x - 1)$
2. $y = (x + 4)(x + 3)$
3. $y = 3(2x - 1)(x - 1)$
4. $y = (5x + 1)(x - 3)$

PART 3: Standard Form to Factored Form (Identifying the x-intercepts):

This will require new knowledge in factoring quadratic expressions.

Standard Form	$y = 2x^2 + 4x - 6$	
	$y = 2(x^2 + 2x - 3)$	Factor out common factor of 2.
Factored Form	$y = 2(x + 3)(x - 1)$	Factor quadratic expression.

TRY IT OUT: Write quadratic function in factored form.

1. $y = x^2 + 5x + 6$
2. $y = 2x^2 - x - 1$
3. $y = x^2 - 5x + 6$
4. $y = x^2 - 5x - 6$
5. $y = 3x^2 - 6x + 3$
6. $y = x^2 - 3x - 10$
7. $y = x^2 - 4x + 4$
8. $y = 2x^2 + 4x - 70$
9. $y = x^2 - 17x + 72$
10. $y = 5x^2 + 35x + 60$

PART 4: Standard Form to Vertex Form:

*Reason to change would be to identify vertex. This will require new knowledge in completing the square.

Standard Form	$y = x^2 + 4x - 6$	
	$y = (x^2 + 4x + 4) - 3 - 4$	Add 4 to complete the square. Subtract 4 to keep equation balanced.
Vertex Form	$y = (x + 2)^2 - 7$	Write in factored form, and simplify.
Standard Form	$y = 2x^2 + 4x - 10$	
	$y = 2(x^2 + 2x - 5)$	Factor out 2.
	$y = 2[(x^2 + 2x + 1) - 5 - 1]$	Add 1 to complete the square. Subtract 1 to keep equation balanced.
	$y = 2[(x + 1)^2 - 6]$	Write in factored form, and simplify.
Vertex Form	$y = 2(x + 1)^2 - 12$	Distribute 2.

TRY IT OUT: Write quadratic function in vertex form.

1. $y = x^2 + 6x - 2$
2. $y = x^2 + 8x - 1$
3. $y = 2x^2 + 4x + 6$
4. $y = 3x^2 + 12x - 6$
5. $y = x^2 + 12x + 2$
6. $y = x^2 + 5x + 1$