# Outcome 1 – Completing the square with non unitary $x^2$

## Bronze example

**Examples...** ** To complete the square you need positive 1 $x^2$ **

Write the following quadratic in the form...

$$y = a(x+b)^2 + c.$$

$y = 2x^2 + 12x + 10$ — 1. common factor first!

$= 2(x^2 + 6x) + 10$ — 2. Then complete the square as normal

$= 2(x+3)^2 + 10 - 18$

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

** Don't forget to multiply!**

## Bronze questions

Write the following quadratics in the form...

$$y = a(x+b)^2 + c.$$

1. $y = 3x^2 + 12x + 7$
2. $y = 2x^2 + 16x + 19$
3. $y = 5x^2 + 10x - 7$
4. $y = 4x^2 + 24x - 3$
5. $y = 2x^2 + 8x - 5$
6. $y = 3x^2 - 30x + 1$
7. $y = 9x^2 - 54x + 8$
8. $y = 2x^2 - 4x + 5$
9. $y = 8x^2 - 48x - 7$
10. $y = 2x^2 - 10x + 1$

# Outcome 2 - Completing the square with non unitary, negative $x^2$

## Silver example

**Example...** ** To complete the square you need positive 1 $x^2$ **

Write the following quadratic in the form...

$$y = a(x+b)^2 + c.$$

$y = -3x^2 - 18x + 7$ — 1. common factor first!**

$= -3(x^2 - 6x) + 7$ — 2. Then complete the square as normal**

$= -3(x-3)^2 + 7 + 27$

$= -3(x-3)^2 + 34$

** Don't forget to multiply!**

## Silver questions

Write the following quadratics in the form...

$$y = a(x+b)^2 + c.$$

1. $y = -2x^2 + 8x + 7$
2. $y = -3x^2 - 12x + 5$
3. $y = -4x^2 - 24x + 3$
4. $y = -5x^2 + 40x + 2$
5. $y = -7x^2 - 14x + 9$
6. $y = -9x^2 + 54x + 8$
7. $y = -8x^2 - 16x + 2$
8. $y = -6x^2 - 36x + 1$
9. $y = -2x^2 + 4x + 12$
10. $y = -10x^2 + 80x + 8$

# Outcome 3 – Maximum and minimum values

## Gold examples

**Examples...** $y = a(x+b)^2 + c$

By first completing the square, state the maximum or minimum values of the following and the corresponding values of x when they occur...

** To complete the square you need positive 1 $x^2$ **

$y = 2x^2 + 4x + 5$ — Min value = 3

$= 2(x^2 + 2x) + 5$ — when x = -1

$= 2(x+1)^2 + 5 - 2$ — (the coefficient of $x^2$ is positive)

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

$y = -2x^2 - 20x + 3$ — Max value = 53

$= -2(x^2 + 10x) + 3$ — when x = -5

$= -2(x+5)^2 + 3 + 50$

$= -2(x+5)^2 + 53$ — (the coefficient of $x^2$ is negative)

## Gold questions

By first completing the square, state the maximum or minimum values of the following and the corresponding values of x when they occur...

1. $3x^2 + 18x + 7$
2. $-4x^2 - 24x + 15$
3. $-2x^2 + 8x + 3$
4. $5x^2 + 10x - 6$
5. $8x^2 + 64x + 67$
6. $-9x^2 - 18x - 5$

For the following, state the maximum values and corresponding values of x...

7. $\dfrac{1}{2x^2 + 4x + 19}$
8. $\dfrac{10}{3x^2 - 30x - 5}$

## Bronze Answers

1. $y = 3(x + 2)^2 - 5$
2. $y = 2(x + 4)^2 - 13$
3. $y = 5(x + 1)^2 - 12$
4. $y = 4(x + 6)^2 - 147$
5. $y = 2(x + 2)^2 - 13$
6. $y = 3(x - 5)^2 - 74$
7. $y = 9(x - 3)^2 - 73$
8. $y = 2(x - 1)^2 + 3$
9. $y = 8(x - 3)^2 - 79$
10. $y = 2(x - 5/2)^2 - 23/2$

## Silver Answers

1. $y = -2(x - 2)^2 + 15$
2. $y = -3(x + 2)^2 + 17$
3. $y = -4(x + 3)^2 + 39$
4. $y = -5(x - 4)^2 + 82$
5. $y = -7(x + 1)^2 + 16$
6. $y = -9(x - 3)^2 + 89$
7. $y = -8(x + 1)^2 + 10$
8. $y = -6(x + 3)^2 + 55$
9. $y = -2(x - 1)^2 + 14$
10. $y = -10(x - 4)^2 + 168$

## Gold Answers

1. Min = -20 when $x = -3$
2. Max = -21 when $x = -3$
3. Max = 11 when $x = 2$
4. Min = -11 when $x = -1$
5. Min = -61 when $x = -4$
6. Max = 4 when $x = -1$
7. Max = $\frac{1}{17}$ when $x = -1$
8. Max = $-\frac{1}{8}$ when $x = 5$