Complete the Square:

We can change

$$\boldsymbol{y = ax^2 + bx + c} \qquad \textbf{into} \qquad \boldsymbol{y = a(x+h)^2 + c}$$

How? Look below

Example 1

$\boldsymbol{y = x^2 + 6x + 7}$

$\boldsymbol{Step\ 1}$: Add and subtract $(\frac{\boldsymbol{b}}{\boldsymbol{2}})^{\boldsymbol{2}}$

$\boldsymbol{Step\ 2}$: Group the perfect square trinomial

$\boldsymbol{Step\ 3}$: Factor the perfect square trinomial

$\boldsymbol{Step\ 4}$: Simplify

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Example 2

$\boldsymbol{y = 2x^2 - 4x + 5}$

$\boldsymbol{Step\ 1}$: Factor $\boldsymbol{a}$ from the first two terms only

$\boldsymbol{Step\ 2}$: Add and subtract $\boldsymbol{(\frac{b}{2})^2}$

$\boldsymbol{Step\ 3}$: Group the perfect square trinomial

$\boldsymbol{Step\ 4}$: Factor the perfect square trinomial

$\boldsymbol{Step\ 5}$: Expand the square brackets

$\boldsymbol{Step\ 6}$: Simplify

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Example 3

$\boldsymbol{y = -3x^2 + 2x - 1}$

$\boldsymbol{Step\ 1}$: Factor $\boldsymbol{a}$ from the first two terms only

$\boldsymbol{Step\ 2}$: Add and subtract $\boldsymbol{(\frac{b}{2})^2}$

$\boldsymbol{Step\ 3}$: Group the perfect square trinomial

$\boldsymbol{Step\ 4}$: Factor the perfect square trinomial

$\boldsymbol{Step\ 5}$: Expand the square brackets

$\boldsymbol{Step\ 6}$: Simplify

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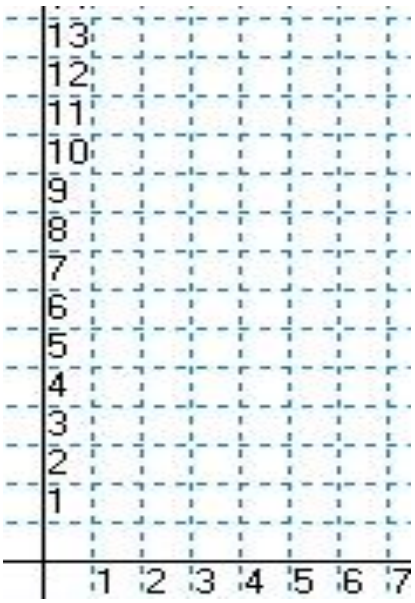
Example 4

The path of a volleyball hit from a height of 0.1m above the ground can be approximated by the quadratic function

$$\boldsymbol{h(x) = -2x^2 + 10x + 0.1}$$

, where *x* is the horizontal distance travelled, in metres, and *h(x)* is the height, in metres.

a) Sketch the graph



b) Find the maximum height of the volleyball by completing the square.

c) At what horizontal distance does the volleyball reach its maximum height?

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