

C2 Complete the square and explain how to transform the graph of $y = x^2$ to the graph of each function.

a) $f(x) = x^2 + 2x + 1$

b) $g(x) = x^2 - 4x + 3$

a) complete the square for

$$f(x) = x^2 + 2x + 1 = \boxed{x^2 + 2x + 1} + \boxed{0}$$

a perfect square an imperfection

this has the start of a perfect square:

$$x^2 + 2x + \dots = x^2 + 2 \cdot 1 \cdot x + 1^2 + \dots$$

it's not present, so we add it but then we must also remove it as follows.

give it to the perfect square

$$x^2 + 2x + \dots = x^2 + 2 \cdot 1 \cdot x + 1^2 - 1^2 + \dots = x^2 + 2x + 1 - 1 + \dots$$

overall zero so it makes no difference

give it to the imperfection

$$= (x+1)^2 - 1 + \dots \quad (*)$$

the original expression was

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

(*) $-1+1=0$

the question asked you to transform the "complete the square"

↓
the question asked you perform the "complete the square" method, but it was not really necessary to conclude

that $x^2 + 2x + 1 = (x+1)^2$ since this is based on the algebraic formula

$$(a+b)^2 = a^2 + 2ab + b^2$$

$$\text{and } (a+1)^2 = a^2 + 2a + 1$$

$$\therefore f(x) = (x+1)^2$$

and the base parent function (let's name it $p(x)$) is $p(x) = x^2$

Explanation: $p(x)$ transforms to $f(x)$ based on:

$$p(x) = \boxed{}^2$$

uses x

$$f(x) = \boxed{}^2$$

uses $x+1$

the difference:

other than the parameter $x \rightarrow x+1$
the rest of the pattern of the functions is the same

$\therefore$ our mapping is:

$$p(x) \rightarrow f(x)$$

$$x \rightarrow x+1$$

The answer

this is a horizontal shift to the left by 1 unit.

unit.

1 unit.

b)

$$g(x) = x^2 - 4x + 3$$

↓ "complete the square":

$$g(x) = x^2 - 4x + 3 \quad \swarrow \text{"imperfection"}$$

$$= x^2 - 2 \cdot 2x + 3$$

↳ would be a perfect square if a
added 2^2

like so:

$$x^2 - 2 \cdot 2x + \underbrace{2^2}_{\downarrow} = (x-2)^2$$

but u can't just add it,
so you must remove it as well

$$+ 2^2 - 2^2 = 0$$

$$g(x) = x^2 - 2 \cdot 2x + \underbrace{2^2 - 2^2}_{\text{zero}} + 3$$

forms a perfect square

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

$$= (x-2)^2 - 4 + 3$$

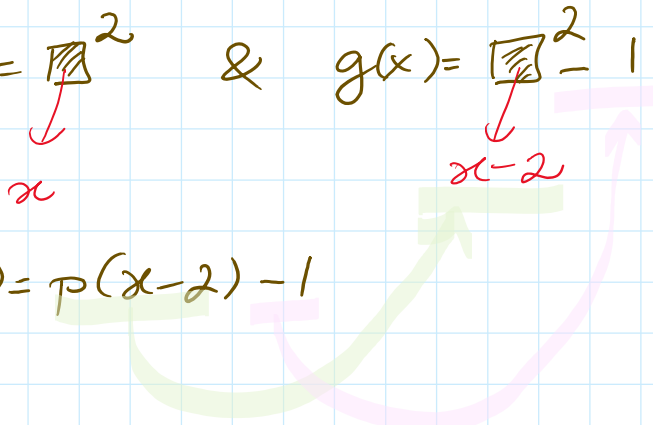
$$g(x) = (x-2)^2 - 1, \text{ done w/ "complete the square"}$$

from this form

we can conclude transformations of the base
parent $p(x) = x^2$

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patterns: $p(x) = \boxed{x}^2$ & $g(x) = \boxed{x-2}^2 - 1$



parameters:

$$\Rightarrow g(x) = p(x-2) - 1$$

This means a

The answer

1) Horizontal shift to the Right
by 2 units, and
2) a vertical shift down by 1 unit.