

Exercise walk-through

1.12

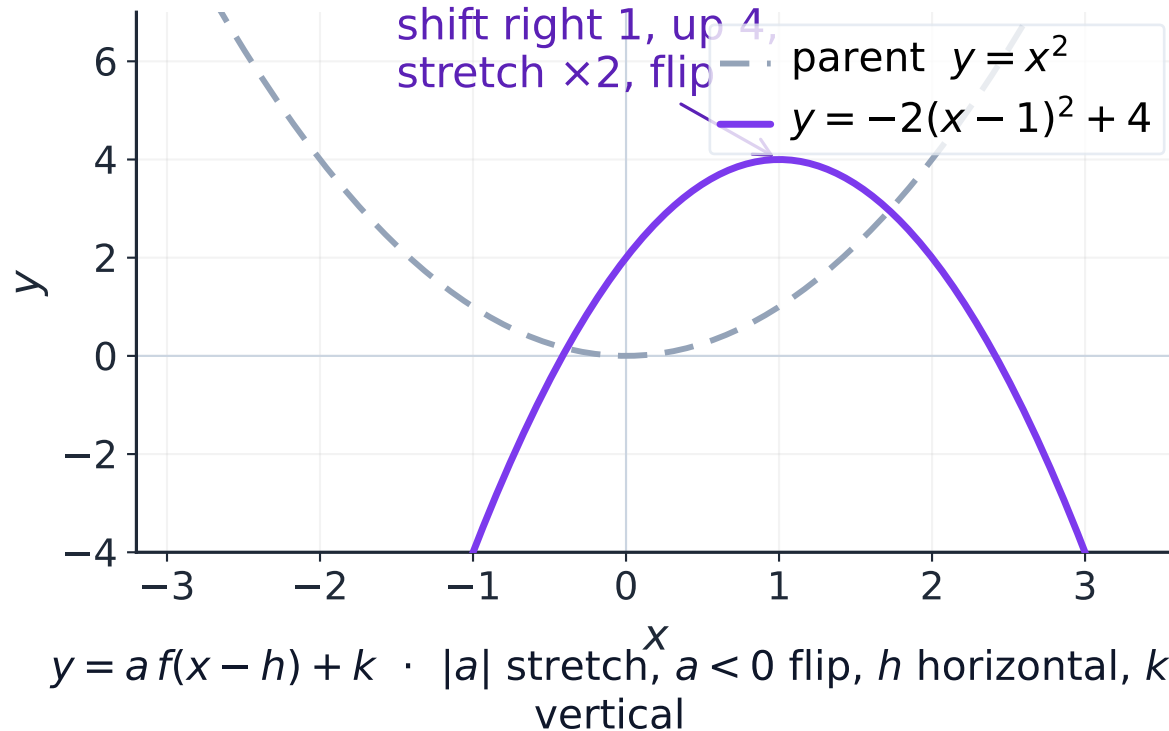
Transformations of Functions

AP Precalculus

Transformations of functions

- **Translations** : $f(x) + k$ up/down; $f(x - h)$ right/left
- **Dilations** : $a f(x)$ vertical; $f(bx)$ horizontal
- **Reflections** : $-f(x)$ over the x -axis; $f(-x)$ over the y -axis

Transformations of functions, in detail



Transforming the parent parabola: shift, stretch, and reflect

The four transformations, and the direction each moves

$f(x) + k$

vertical **shift** up by k – as expected

$f(x + k)$

horizontal shift **left** by k – the *opposite* of what the sign suggests

$a f(x)$

vertical **dilation** by a ; negative a also reflects in the x -axis

$f(bx)$

horizontal dilation by $\frac{1}{b}$ – again the reciprocal, not b

the reason

the inside of the function acts on the **input** before the rule runs, so its effects are inverted

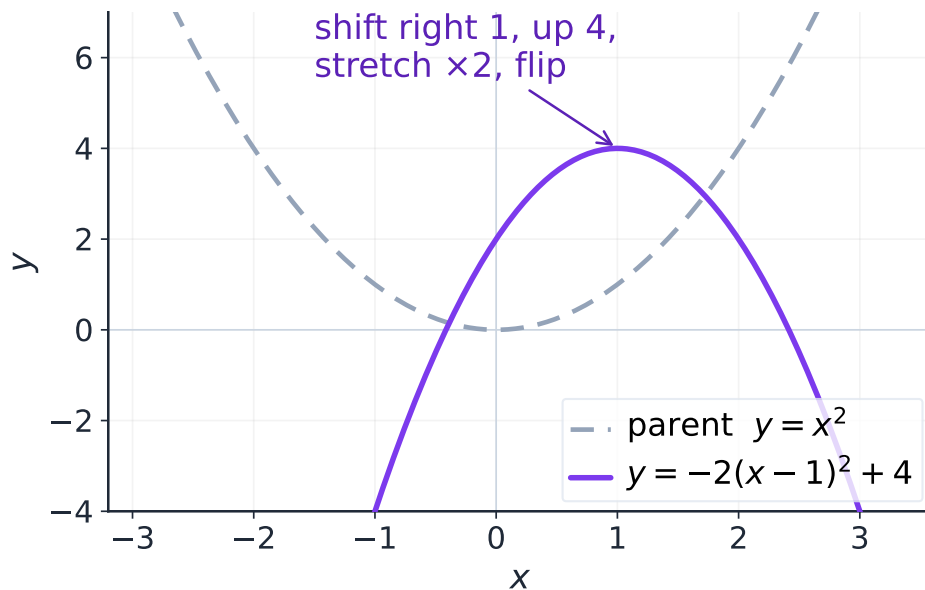
Inside the brackets, everything is backwards. Say that once and the four rules stop needing to be memorised separately.

Combining shift, stretch and reflect

Combine **additive** shifts and **multiplicative** stretches to model a shifted, scaled version of a known shape.

Read the general form $a f(b(x - h)) + k$ from the **inside out**.

Combining shift, stretch and reflect, in detail



Combine **additive** shifts and **multiplicative** stretches to model a shifted, scaled version of a known shape.

Exercises 2.1-2.3

2.1 State the transformation given by $f(x) + 3$. [1]

2.2 State the transformation given by $f(x - 2)$. [1]

2.3 Describe the graph of $g(x) = f(x) + 5$ compared with f . [1]

Exercises 2.1·2.3

2.1 State the transformation given by $f(x) + 3$. [1]

2.1

- a vertical shift up by 3
-

2.2 State the transformation given by $f(x - 2)$. [1]

2.2

- a horizontal shift right by 2
-

2.3 Describe the graph of $g(x) = f(x) + 5$ compared with f . [1]

2.3

- it is the graph of f shifted up 5 units

Exercises 3.1·3.2

3.1 $g(x) = f(x) + k$ is a

[1]

☐

A horizontal shift

B vertical shift by k

C reflection

D stretch

3.2 $g(x) = f(x - 4)$ shifts the graph of f

[1]

☐

A left 4

B right 4

C up 4

D down 4

Exercises 3.1·3.2

3.1 $g(x) = f(x) + k$ is a

[1]

☐

A horizontal shift

B vertical shift by k

C reflection

D stretch

3.1 B

- vertical shift by k .

3.2 $g(x) = f(x - 4)$ shifts the graph of f

[1]

☐

A left 4

B right 4

C up 4

D down 4

3.2 B

- right 4.

Exercise 3.3 (a)

3.3 Start from $f(x) = x^2$.

(a) Describe $g(x) = x^2 + 3$.

[1]

Exercise 3.3 (a)

3.3 Start from $f(x) = x^2$.

(a) Describe $g(x) = x^2 + 3$.

[1]

(a)

- shift f up 3

Exercise 3.3 (b)

3.3 Start from $f(x) = x^2$.

(b) Describe $h(x) = (x - 1)^2$.

[1]

Exercise 3.3 (b)

3.3 Start from $f(x) = x^2$.

(b) Describe $h(x) = (x - 1)^2$.

[1]

(b)

- shift f right 1

Exercise 3.3 (c)

3.3 Start from $f(x) = x^2$.

(c) State the vertex of h .

[1]

Exercise 3.3 (c)

3.3 Start from $f(x) = x^2$.

(c) State the vertex of h .

[1]

(c)

- $(1, 0)$