

New Functions from Old Functions

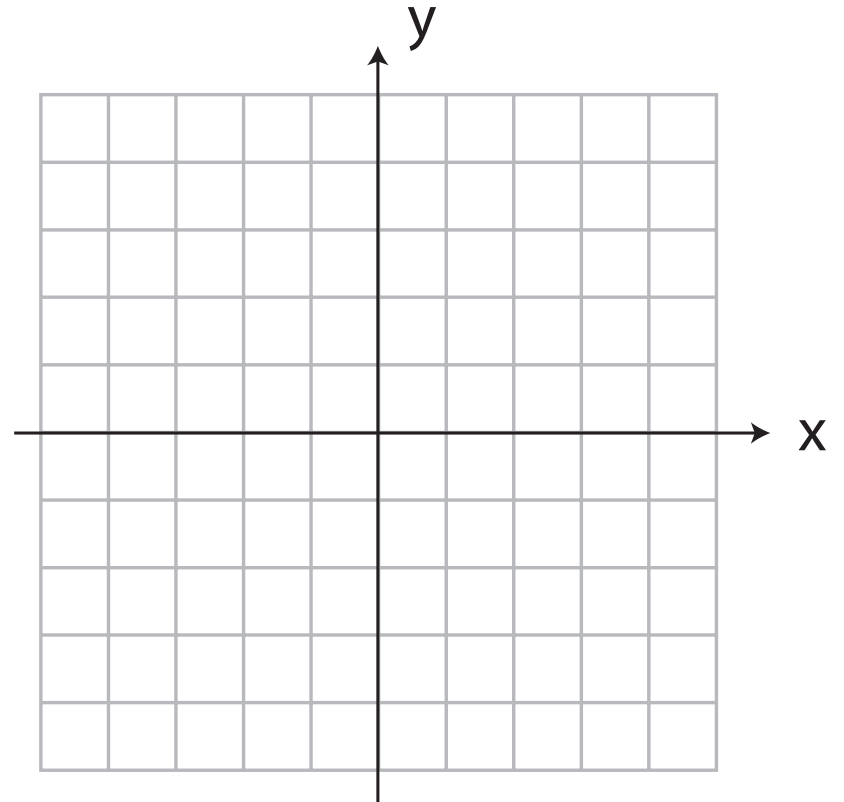
Section 1.3

Transformations: Stretching, Reflecting, Shifting

- By applying certain transformations to the graph of a given function (for example, the essential functions we studied in section 1.2), we can obtain the graphs of related functions.
- Use online graphing calculator to check your answers (try www.desmos.com/calculator)

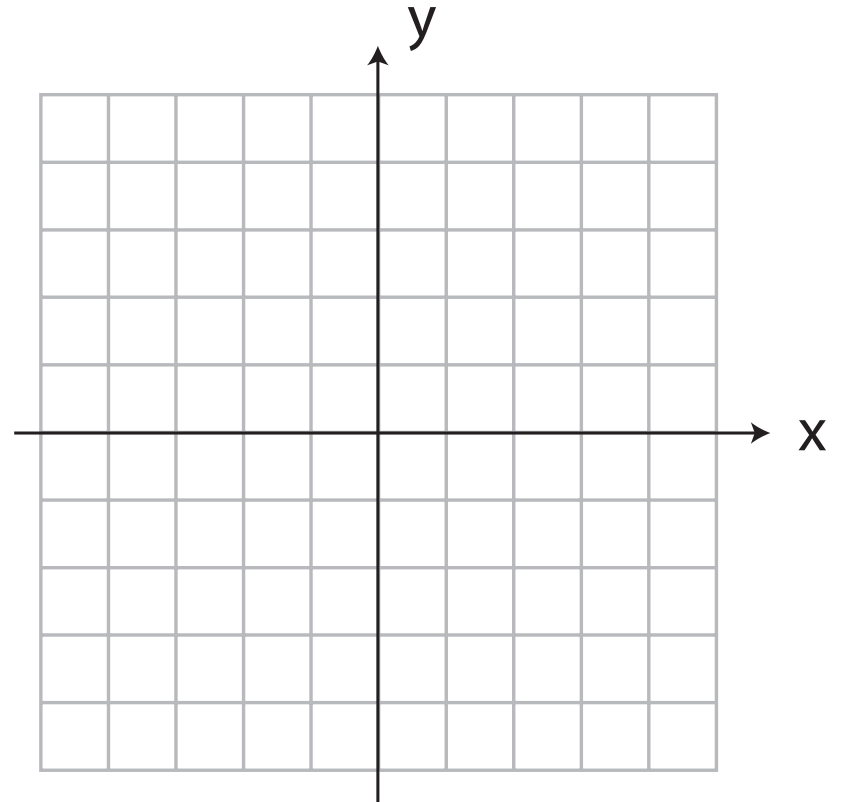
Exercise

Example 1: Graph $f(x) = -2x^3 + 1$



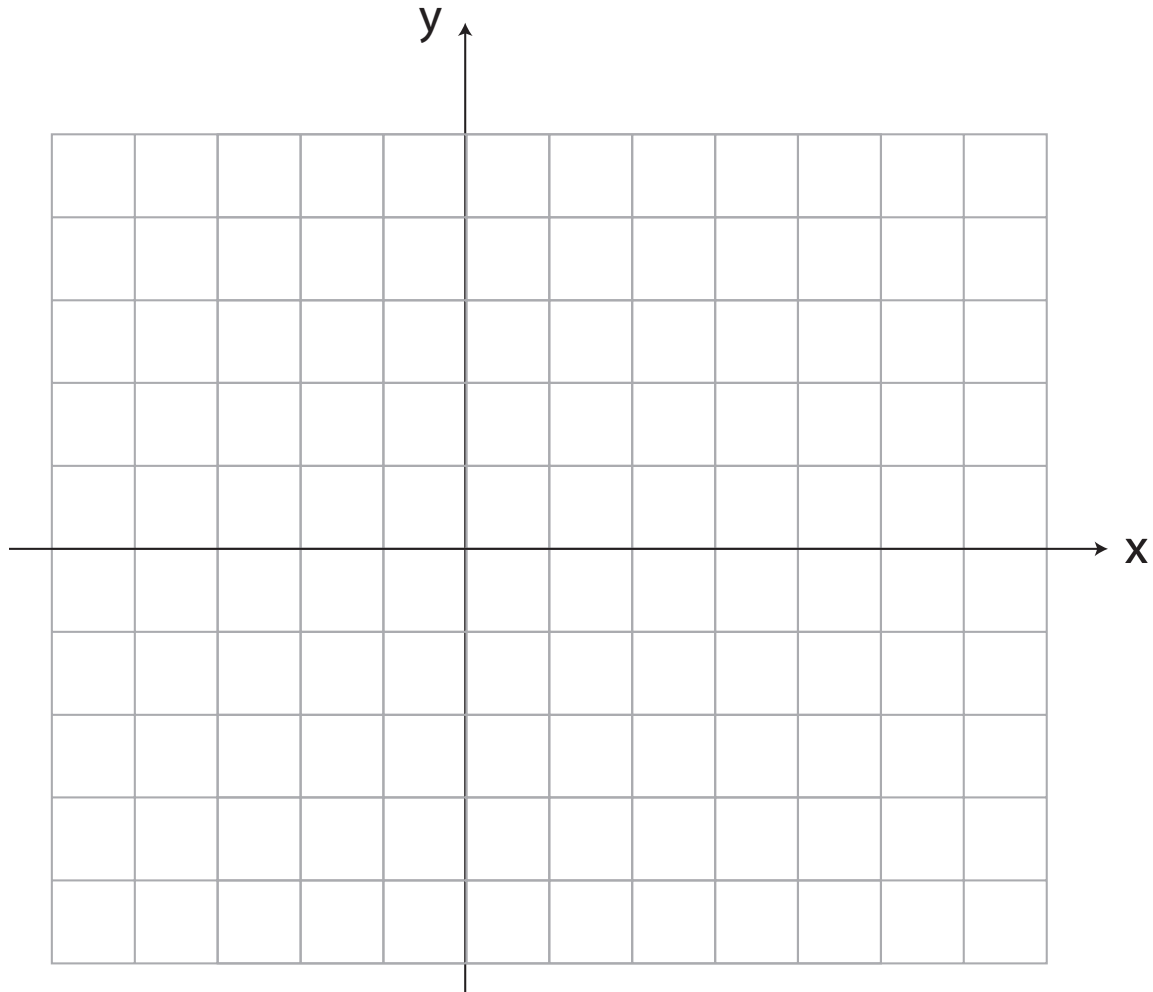
Exercise

Example 2: Graph $f(x) = \sqrt{4 - x}$



Exercise

Example 3: Graph $f(x) = -\cos 2x$



Combinations of Functions

Adding/Subtracting Functions

The sum $f + g$ of the functions f and g is the function defined by

$$(f + g)(x) = f(x) + g(x)$$

The difference $f - g$ of the functions f and g is the function defined by

$$(f - g)(x) = f(x) - g(x)$$

Combinations of Functions

Multiplying/Dividing Functions

The product $f \cdot g$ of the functions f and g is the function defined by

$$(f \cdot g)(x) = f(x) \cdot g(x)$$

The quotient f/g of the functions f and g is the function defined by

$$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$$

Combinations of Functions

Composition of Functions

The composition $f \circ g$ of the functions f and g is the function defined by

$$(f \circ g)(x) = f(g(x))$$

Note: f is called the **outer** function
 g is called the **inner** function

Combinations of Functions

Diagram:

Note: In general, $(f \circ g)(x) \neq (g \circ f)(x)$

Combinations of Functions

Example:

Use the table of values below to find the values of
of (a) $(f \circ g)(1)$ (b) $(g \circ f)(1)$ (c) $(f \circ f)(1)$

x	1	2	3	4	5	6
f(x)	3	1	4	2	2	5
g(x)	6	3	2	1	2	3