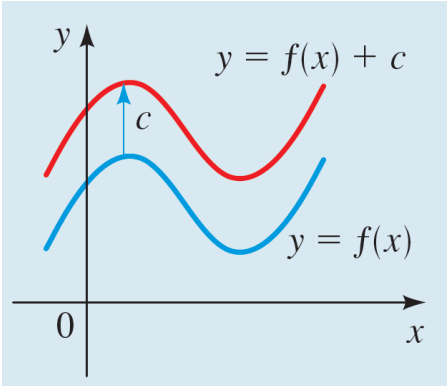
# Section 2.6 – Transformations of Functions

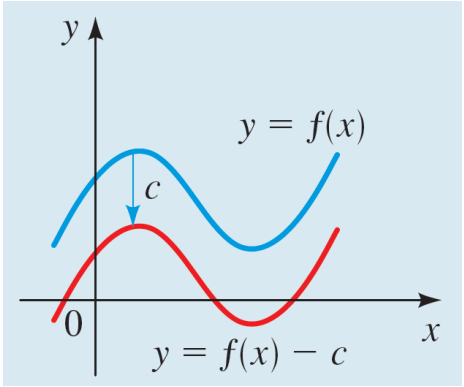
- Adding a constant to a function shifts its graph vertically

عند إضافة ثابت (رقم) للدالة يتسبب في تحرك رسم الدالة عموديا




إذا قمنا بإضافة رقم موجب:

تتحرك الرسمة لأعلى.



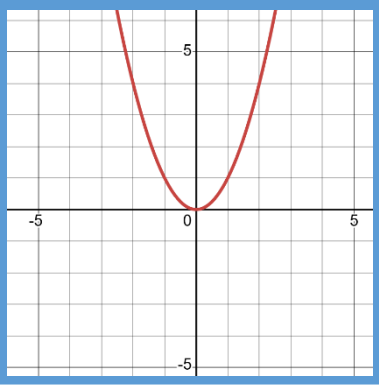

إذا قمنا بإضافة رقم سالب:

تتحرك الرسمة لأسفل.

## Example 1

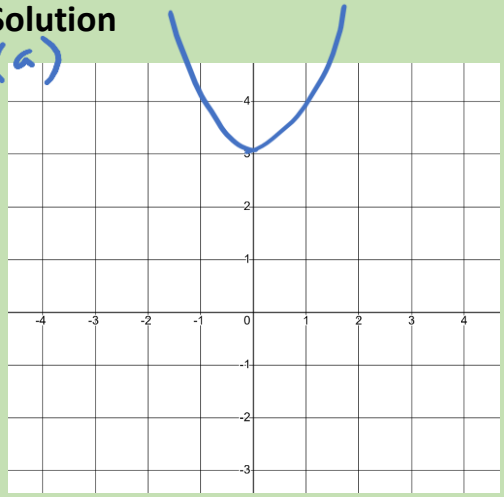
Use the graph of $f(x) = x^2$ to sketch the graph of each function.

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

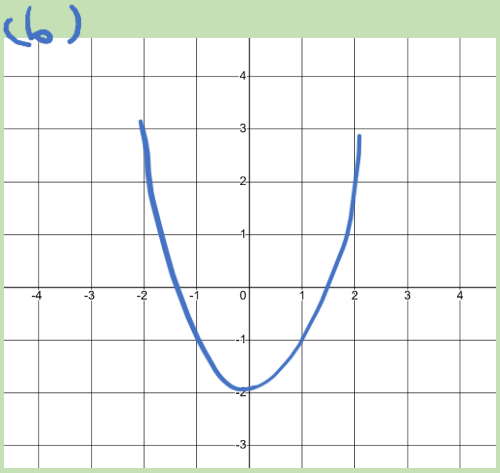



## Solution

(a)

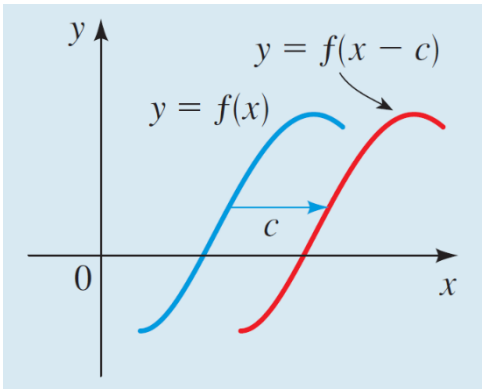


(b)



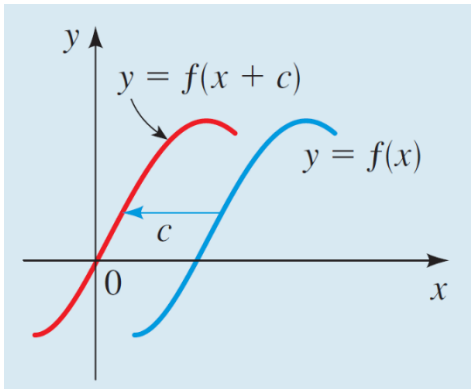
- Adding a constant to the variable of the function shifts its graph horizontally

عند إضافة ثابت إلى المتغير داخل الدالة يتحرك رسم الدالة أفقيا




إذا قمنا بإضافة رقم سالب:

تتحرك الرسمة لليمين.



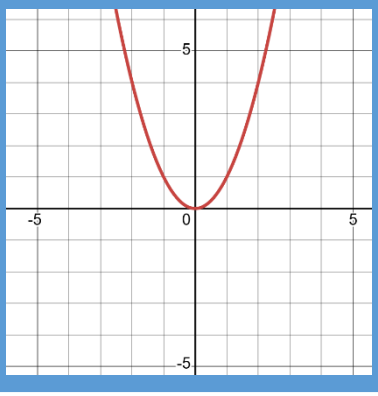

إذا قمنا بإضافة رقم موجب:

تتحرك الرسمة لليسار.

**Example 2**

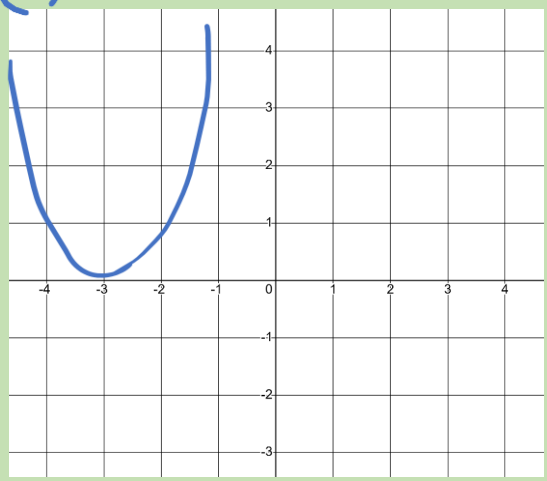
Use the graph of $f(x) = x^2$ to sketch the graph of each function.

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

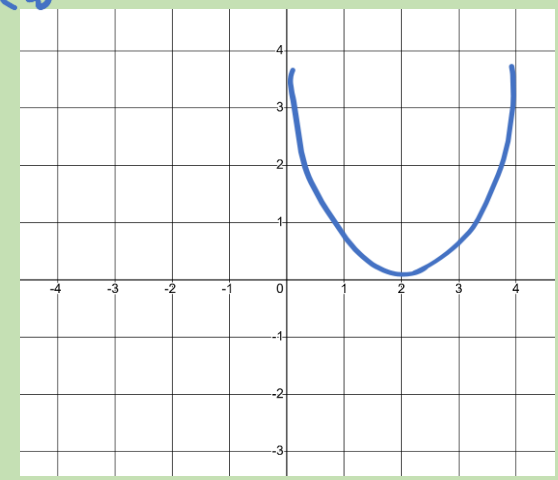



**Solution**

(a)



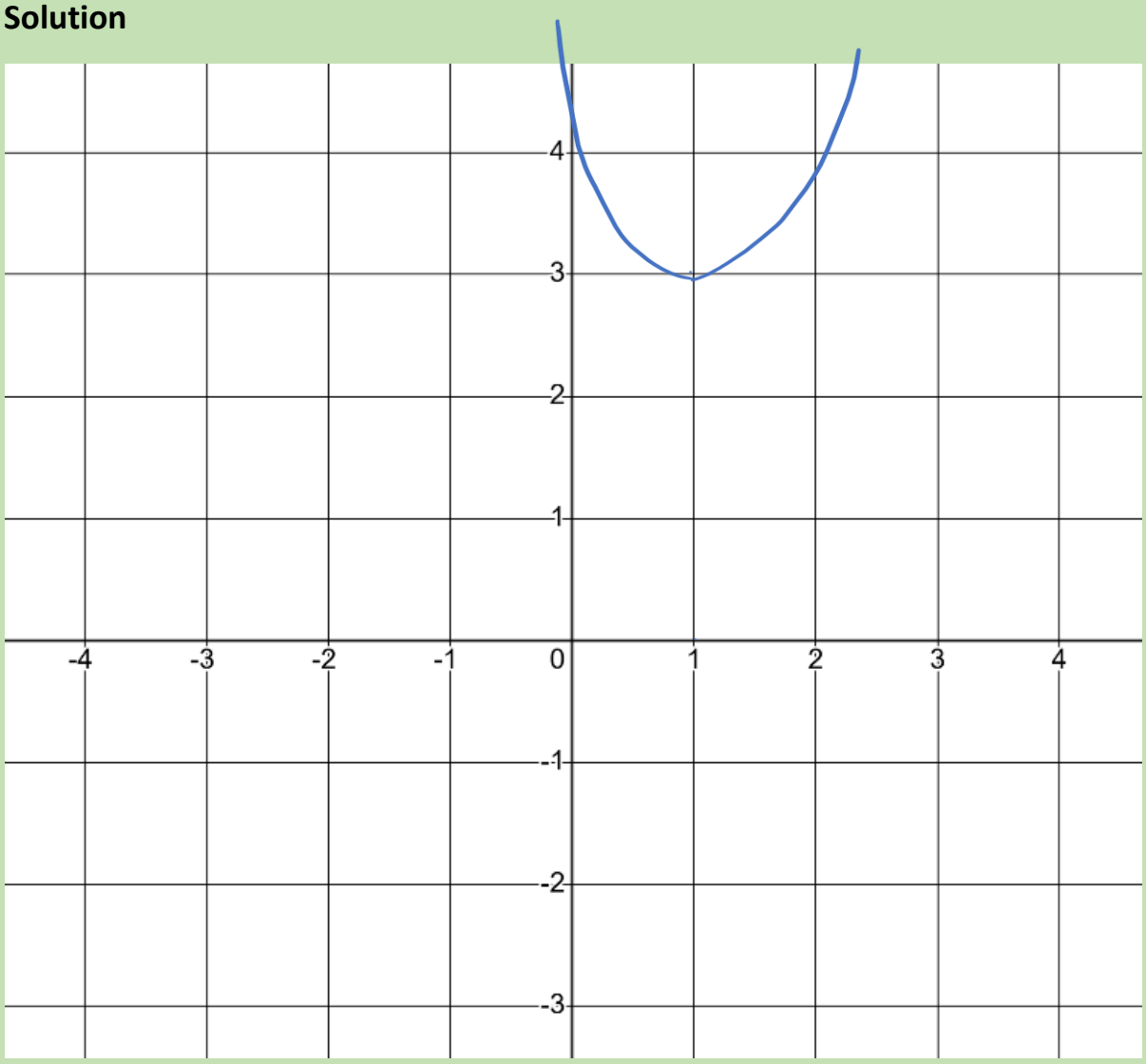
(b)



## Example 3

Sketch the graph of $f(x) = (x-1)^2 + 3$

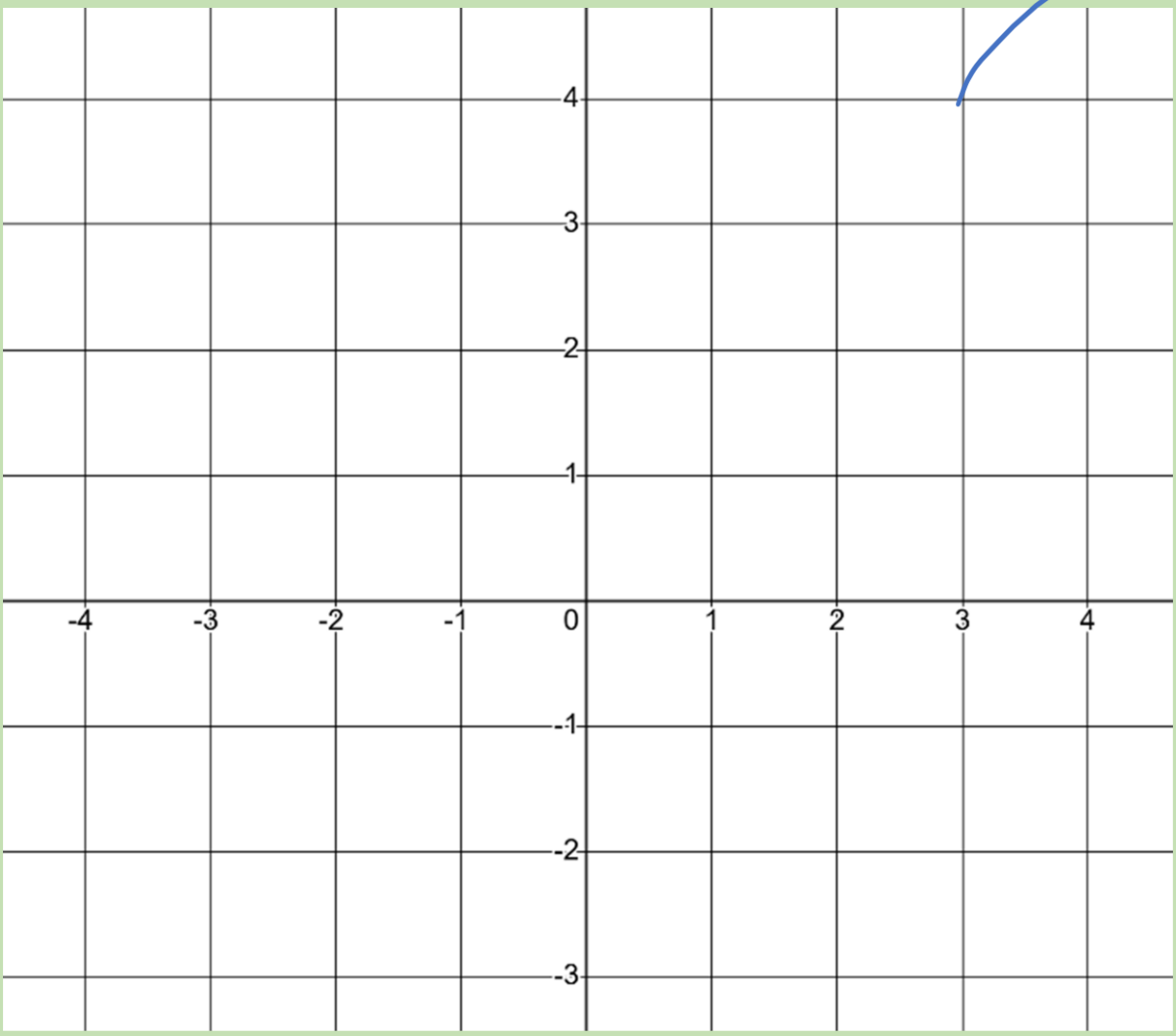
### Solution



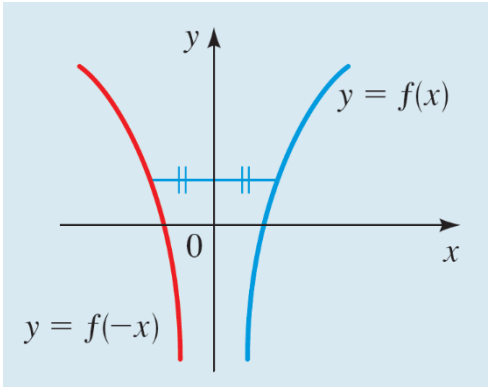
## Example 4

Sketch the graph of $f(x) = \sqrt{x-3} + 4$

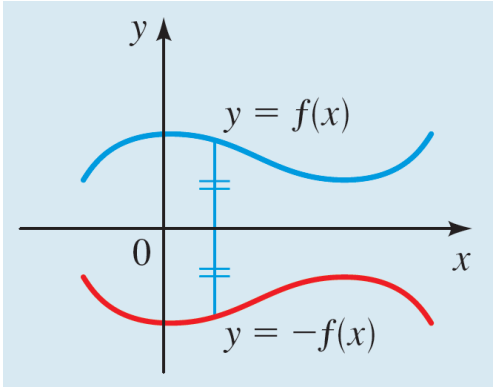
### Solution



- Changing the sign الإشارة of the whole function "$y = -f(x)$" results in graph reflection انعكاس about $x$-axis, and changing the sign of the variable of the function "$y = f(-x)$" reflects the graph about $y$-axis




تغير إشارة متغير الدالة يعكس الرسم حول $y$-axis



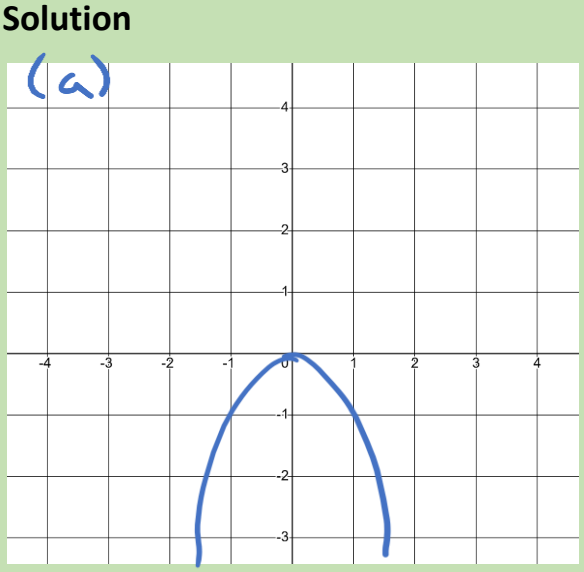

تغير إشارة الدالة يعكس الرسم حول $x$-axis

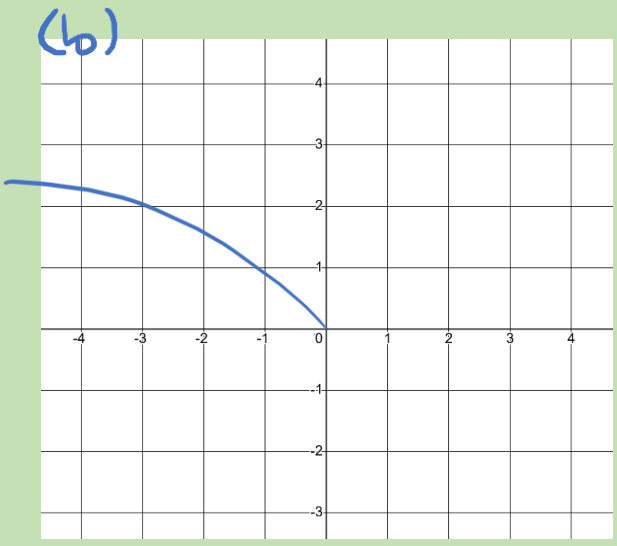
**Example 5**

Sketch the graph of each function.

(a) $f(x) = -x^2$ (b) $g(x) = \sqrt{-x}$

**Solution**



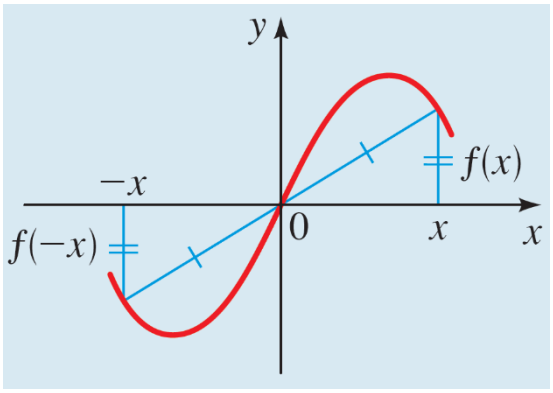



- A function is even زوجية if $f(-x) = f(x)$

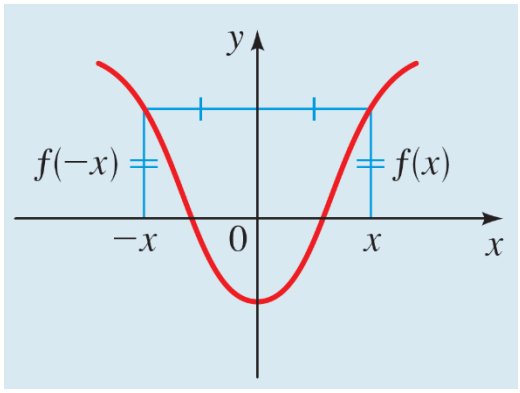
A function is odd فردية if $f(-x) = -f(x)$

الدالة الزوجية: دالة لا تتغير بتغير إشارة متغير الدالة

الدالة الفردية: تنعكس إشارة الدالة بالكامل بتغير إشارة متغير الدالة




الدالة الفردية: لاحظ تماثل الرسم حول origin (نقطة الأصل)




الدالة الزوجية: لاحظ تماثل الرسم حول $y$-axis

## Example 6

Determine whether the functions are even, odd, or neither even nor odd.

(a) $f(x) = x^5 + x$ (b) $g(x) = 1 - x^4$ (c) $h(x) = 2x - x^2$

**Solution**

(a) $f(-x) = (-x)^5 + (-x)$

$= -x^5 - x$

$= -(x^5 + x) = -f(x)$ ∴ odd

(b) $g(-x) = 1 - (-x)^4$

$= 1 - x^4 = g(x)$ ∴ even

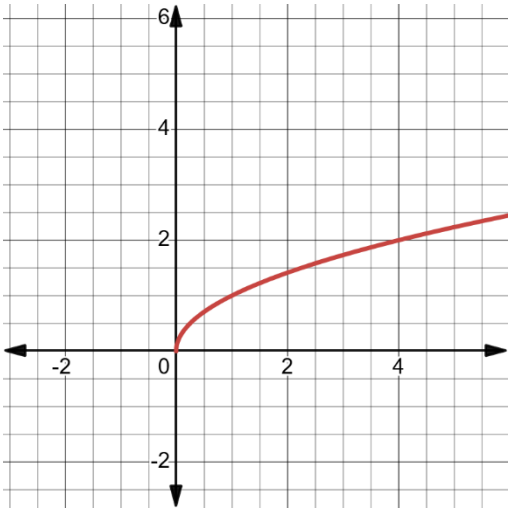
(c) $h(-x) = 2(-x) - (-x)^2$

$= -2x - x^2$

Neither even nor odd

## Problems

- Use the graph of $y = \sqrt{x}$ to graph the following.




(a) $g(x) = \sqrt{x-2}$

(b) $g(x) = \sqrt{x} + 1$

(c) $g(x) = \sqrt{x+2} + 2$

(d) $g(x) = -\sqrt{x} + 1$

**- Match the graph with the function.**

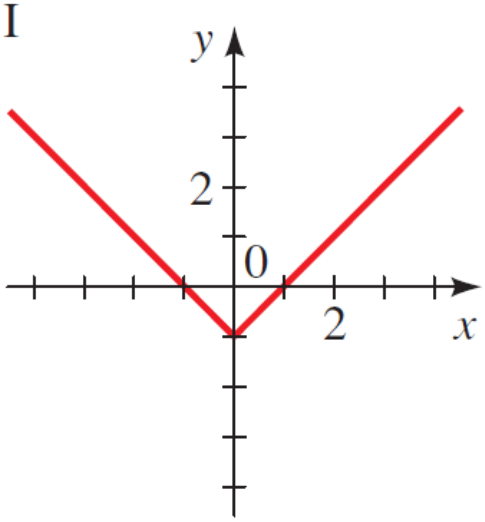
**(a)** $y = |x + 1|$

**(b)** $y = |x - 1|$

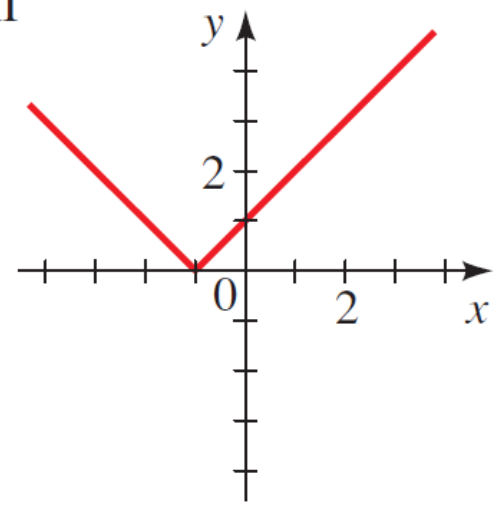
**(c)** $y = |x| - 1$

**(d)** $y = -|x|$

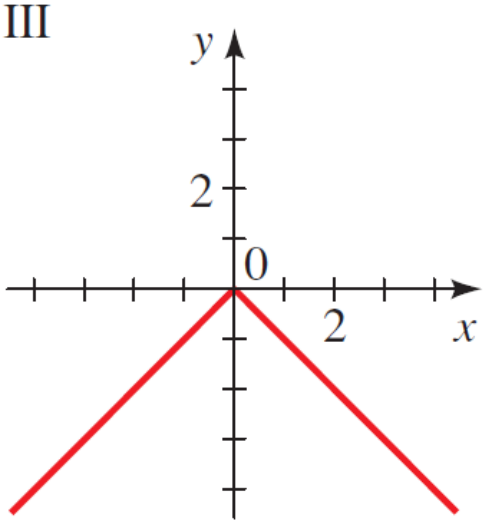
I



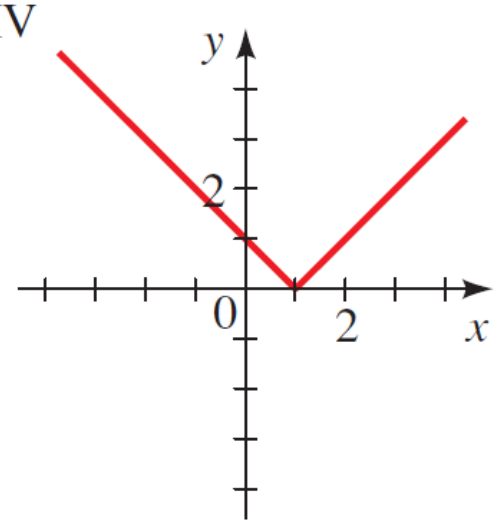

II




III




IV



**- Sketch the graph of the function by starting with the graph of a standard function and applying transformations.**

**(a)** $f(x) = x^2 + 3$

**(b)** $f(x) = (x - 5)^2$