

# Slope and Intercept of Absolute Value Functions

The absolute value of a real number  $x$  is defined by the following:

$$|x| = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{if } x \leq 0 \end{cases}$$

If  $n$  is a positive number, there are two solutions to the equation  $|f(x)| = n$  because there are exactly two numbers with the absolute value equal to  $n$ :  $n$  and  $-n$ . The existence of two distinct solutions is clear when the equation is solved graphically.

An absolute value function can be presented as  $y = a|x - h| + k$ . The graph moves as the changes of slope  $a$ ,  $x$ -intercept  $h$ , and  $y$ -intercept  $k$ .

### Example

Consider various absolute value functions and check the relation between the graphs and the values of coefficients.

1. Graph  $y = |x|$
2. Graph  $y = |x - 1|$  and  $y = |x| - 1$  using Rapid Graph feature.

**Before Starting** There may be differences in the results of calculations and graph plotting depending on the setting. Return all settings to the default value and delete all data.

Set the zoom to the decimal window: ZOOM A ( ENTER 2nd F ▼ ) 7

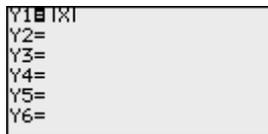
### Step & Key Operation

### Display

### Notes

- 1-1** Enter the function  $y = |x|$  for Y1.

Y= MATH B 1 X/θ/π/∞



- 1-2** View the graph.

GRAPH

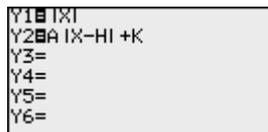


Notice that the domain of  $f(x) = |x|$  is the set of all real numbers and the range is the set of non-negative real numbers. Notice also that the slope of the graph is 1 in the range of  $X > 0$  and -1 in the range of  $X \leq 0$ .

- 2-1** Enter the standard form of an absolute value function for Y2 using the Rapid Graph feature.

Y= ▼ ALPHA A MATH B 1

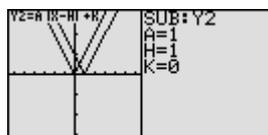
X/θ/π/∞ - ALPHA H ► + ALPHA K



- 2-2** Substitute the coefficients to graph  $y = |x - 1|$ .

2nd F SUB 1 ENTER 1 ENTER

0 ENTER



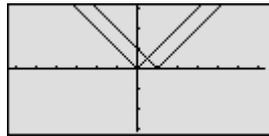
Step & Key Operation

Display

Notes

**2-3** View the graph.

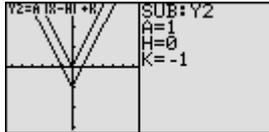
GRAPH



Notice that placing an  $h (>0)$  within the standard form  $y = a|x - h| + k$  will move the graph right  $h$  units on the  $x$ -axis.

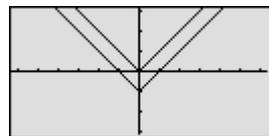
**2-4** Change the coefficients to graph  $y = |x| - 1$ .

Y= ▼ 2nd F SUB ENTER 1  
 ENTER 0 ENTER (-) 1 ENTER



**2-5** View the graph.

GRAPH



Notice that adding a  $k (>0)$  within the standard form  $y = a|x - h| + k$  will move the graph up  $k$  units on the  $y$ -axis.

The EL-9900 shows absolute values with  $| |$ , just as written on paper, by using the Equation editor. Use of the calculator allows various absolute value functions to be graphed quickly and shows their characteristics in an easy-to-understand manner.