# 1.2 Exploring Absolute Value

**YOU WILL NEED**

- graph paper
- graphing calculator

**GOAL**

Discover the properties of the absolute value function.

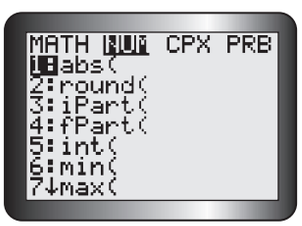
## *EXPLORE* the Math

An average person's blood pressure is dependent on their age and gender. For example, the average systolic blood pressure, $P_n$, for a 17-year-old girl is about 127 mm Hg. (The symbol mm Hg stands for millimetres of mercury, which is a unit of measure for blood pressure.) The average systolic blood pressure for a 17-year-old boy is about 134 mm Hg.

When doctors measure blood pressure, they compare the blood pressure to the average blood pressure for people in the same age and gender group. This comparison, $P_d$, is calculated using the formula $P_d = |P - P_n|$, where $P$ is the blood pressure reading and $P_n$ is the average reading for people in the same age and gender group.

**Tech Support**

To use the **absolute value** command on a graphing calculator, press MATH and scroll right to NUM. Then press ENTER.




? How can the blood pressure readings of a group of people be compared?

**A.** Jim is a 17-year-old boy whose most recent blood pressure reading was 142 mm Hg. Calculate $P_d$ for Jim.

**B.** Joe is a 17-year-old boy whose most recent blood pressure reading was 126 mm Hg. Calculate $P_d$ for Joe.

**C.** Compare the values of $P - P_n$ and $|P - P_n|$ that were used to determine $P_d$ for each boy. What do you notice?

**D.** Complete the following table by calculating the values of $P_d$ for the given blood pressure readings for 17-year-old boys.

| **Blood Pressure Reading, *P*** | 95 | 100 | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | 145 | 150 | 155 | 160 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_d$ | | | | | | | | | | | | | | |

**E.** Draw a **scatter plot** of $P_d$ as a function of blood pressure, $P$.

**F.** Describe these characteristics of your graph:

**i)** domain

**ii)** range

**iii)** zeros

**iv)** existence of any asymptotes

**v)** shape of the graph

**vi)** intervals of the domain in which the values of the function $P_d$ are increasing and decreasing.

**vii)** behaviour of the values of the function $P_d$ as $P$ becomes larger and smaller

## Reflecting

**G.** Why might you predict the range of your graph to be greater than or equal to zero?

**H.** What other function with domain greater than $P_n$ could you have used to plot the right side of your graph? Why does this make sense?

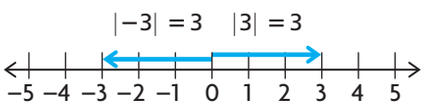
**I.** What other function with domain less than $P_n$ could you have used to plot the left side of your graph? Why does this make sense?

**J.** How will the graph of $y = |x|$ compare with the graph of $P_d = |P - P_n|$, if $P_d$ is the $y$-coordinate and $P$ is the $x$-coordinate? Use the characteristics you listed in part F to make your comparison.

## In Summary

### Key Idea

- $f(x) = |x|$ is the absolute value function. On a number line, this function describes the distance, $f(x)$, of any number $x$ from the origin.

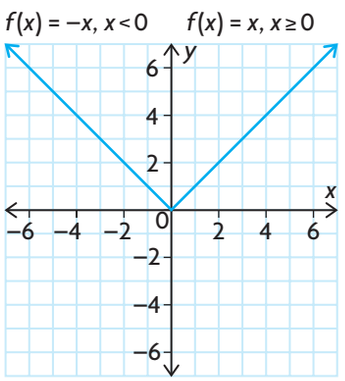



### Need to Know

- For the function $f(x) = |x|$,
  - there is one zero located at the origin
  - the graph is comprised of two linear functions and is defined as follows:

$$f(x) = \begin{cases} x, \text{ if } x \geq 0 \\ -x, \text{ if } x < 0 \end{cases}$$

  - the graph is symmetric about the $y$-axis
  - as $x$ approaches large positive values, $y$ approaches large positive values
  - as $x$ approaches large negative values, $y$ approaches large positive values
  - the absolute value function has domain $\{x \in \mathbf{R}\}$ and range $\{y \in \mathbf{R} | y \geq 0\}$
  - every input in an absolute value returns an output that is non-negative



## *FURTHER* Your Understanding

**1.** Arrange these values in order, from least to greatest:
$|-5|, |20|, |-15|, |12|, |-25|$

**2.** Evaluate.

**a)** $|-22|$ **c)** $|-5 - 13|$ **e)** $\dfrac{|-8|}{-4}$

**b)** $-|-35|$ **d)** $|4 - 7| + |-10 + 2|$ **f)** $\dfrac{|-22|}{|-11|} + \dfrac{-16}{|-4|}$

**3.** Express using absolute value notation.

**a)** $x < -3$ or $x > 3$ **c)** $x \leq -1$ or $x \geq 1$

**b)** $-8 \leq x \leq 8$ **d)** $x \neq \pm 5$

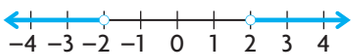
**4.** Graph on a number line.

**a)** $|x| < 8$ **b)** $|x| \geq 16$ **c)** $|x| \leq -4$ **d)** $|x| > -7$

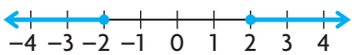
**5.** Rewrite using absolute value notation.

**a)**


**b)**




**c)**




**d)**


**6.** Graph $f(x) = |x - 8|$ and $g(x) = |-x + 8|$.

**a)** What do you notice?

**b)** How could you have predicted this?

**7.** Graph the following functions.

**a)** $f(x) = |x - 2|$

**b)** $f(x) = |x| + 2$

**c)** $f(x) = |x + 2|$

**d)** $f(x) = |x| - 2$

**8.** Compare the graphs you drew in question 7. How could you use transformations to describe the graph of $f(x) = |x + 3| - 4$?

**9.** Predict what the graph of $f(x) = |2x + 1|$ will look like. Verify your prediction using graphing technology.

**10.** Predict what the graph of $f(x) = 3 - |2x - 5|$ will look like. Verify your prediction using graphing technology.

**Communication *Tip***

To show that a number is not included in the solution set, use an open dot at this value. A solid dot shows that this value is included in the solution set.