Common Core State Standards:
6.NS.5, 6.NS.6.c, 6.NS.7.c

Rational Numbers

Getting the Idea

A **rational number** is a number that can be expressed as the ratio of two integers in the form $\frac{a}{b}$, where b is not equal to 0. A rational number can be positive or negative. The set of rational numbers includes integers, fractions, mixed numbers, percents, terminating decimals, and repeating decimals. Some examples of rational numbers are shown below.

8% $\quad \frac{4}{5}$ $\quad 0.35$ $\quad 1\frac{3}{8}$ $\quad -7$ $\quad 1.\overline{6}$

Fractions and decimals have opposites, just as integers do. For example, $\frac{5}{8}$ and $-\frac{5}{8}$ are opposites, and so are -3.25 and 3.25.

You can see rational numbers in many real-world situations, such as a sheet of paper that is $8\frac{1}{2}$ inches wide or a dog that weighs 29.51 kilograms.

Example 1

Explain why 4, $\frac{2}{3}$, and 0.9 are rational numbers.

Strategy **Express the numbers in the form $\frac{a}{b}$.**

Step 1 Show that 4 is a rational number.

$4 = \frac{4}{1}$, which is in the form $\frac{a}{b}$.

Step 2 Show that $\frac{2}{3}$ is a rational number.

$\frac{2}{3}$ is in the form $\frac{a}{b}$.

Step 3 Show that 0.9 is a rational number.

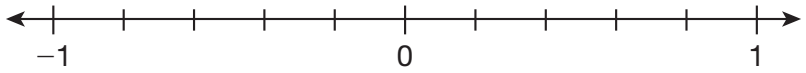
$0.9 = \frac{9}{10}$, which is in the form $\frac{a}{b}$.

Solution **The numbers 4, $\frac{2}{3}$, and 0.9 are rational numbers because each can be written in the form $\frac{a}{b}$.**

Remember that the absolute value of a number is the distance of that number from 0 on a number line. You can use absolute value to help you locate a rational number on a number line.

Example 2

Plot the rational numbers $\frac{3}{5}$ and $-\frac{2}{5}$ on the number line shown below.



Strategy **Identify what fractional units the number line is divided into. Then use absolute value to plot each point.**

Step 1 Determine what each mark on the number line stands for.

There are 5 spaces between 0 and 1.

The number line is divided into fifths. Each mark stands for $\frac{1}{5}$.

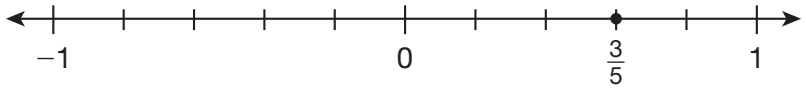
Step 2 Find the absolute value of $\frac{3}{5}$.

$\left|\frac{3}{5}\right| = \frac{3}{5}$ or 3 fifths

Step 3 Plot $\frac{3}{5}$ on the number line.

$\frac{3}{5}$ is three units away from 0 on this number line divided into fifths.

Since $\frac{3}{5}$ is positive, count 3 units to the right of 0. Plot the point.



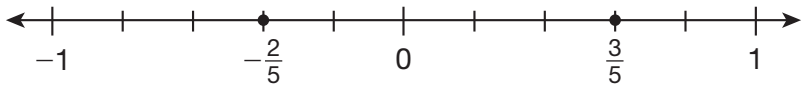
Step 4 Find the absolute value of $-\frac{2}{5}$.

$\left|-\frac{2}{5}\right| = \frac{2}{5}$ or 2 fifths

Step 5 Plot $-\frac{2}{5}$ on the number line.

$-\frac{2}{5}$ is two units away from 0 on this number line divided into fifths.

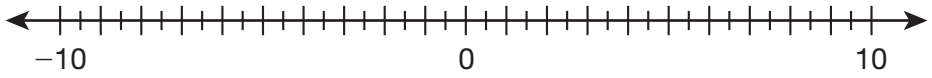
Since $-\frac{2}{5}$ is negative, count 2 units to the left of 0. Plot the point.



Solution **The rational numbers $\frac{3}{5}$ and $-\frac{2}{5}$ are shown on the number line in Step 5 above.**

Example 3

The floor of the valley in which Griffin lives is $7\frac{1}{2}$ feet below sea level. Write that elevation as a rational number. Then plot a point for it on the number line below.



Strategy **Write a rational number representing $7\frac{1}{2}$ feet below sea level. Then identify the value of each mark on the number line.**

Step 1 Determine whether the elevation is a positive or negative number.

In this case, the number 0 represents sea level.

The valley floor is below sea level, so the number will be less than 0, or negative.

The rational number $-7\frac{1}{2}$ represents the elevation.

Step 2 Determine what each mark on the number line stands for.

There are 20 spaces between 0 and 10 and 20 spaces between 0 and -10.

Each mark between integers stands for $\frac{1}{2}$.

Step 3 Find -7 on the number line.

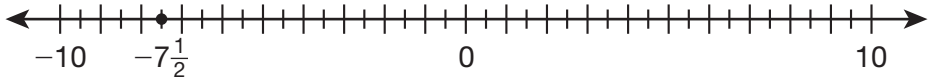
Since -7 is a negative number, it will be to the left of 0 on the number line.

Step 4 Plot $-7\frac{1}{2}$ on the number line.

$\left|-7\frac{1}{2}\right| = 7\frac{1}{2}$ $\qquad$ $|-7| = 7$

$7\frac{1}{2} > 7$, so $-7\frac{1}{2}$ will be farther from 0 than -7.

Plot a point for $-7\frac{1}{2}$ at the mark to the left of -7.

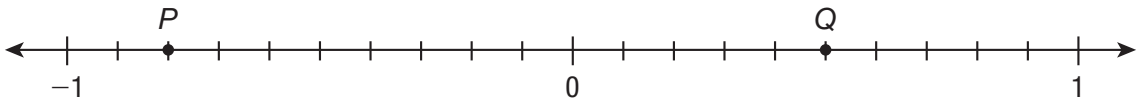


Solution **The rational number $-7\frac{1}{2}$ represents the elevation.**

The location of $-7\frac{1}{2}$ on a number line is shown in Step 4 above.

Example 4

What decimals do points *P* and *Q* represent on the number line shown?



Strategy **Identify what units the number line is divided into.**

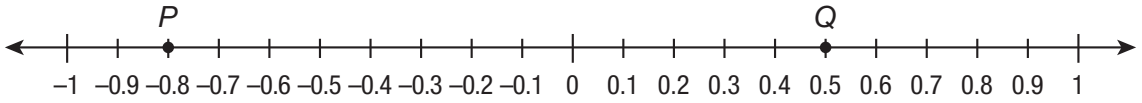
Step 1 Determine what each mark on the number line stands for.

There are 10 spaces between 0 and 1.

The number line is divided into tenths. Each mark stands for 0.1.

Step 2 Find the number of tenths that points *P* and *Q* represent.

Count from 0. It may help to label the marks as shown below.

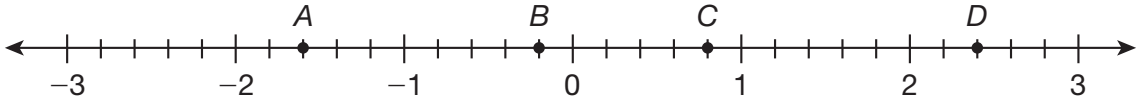


Point *P* is at −0.8 and point *Q* represents 0.5.

Solution **Point *P* represents −0.8 and point *Q* represents 0.5.**

Coached Example

The number line below shows points for several rational numbers. Which points represent $-\frac{1}{5}$, $\frac{4}{5}$, $2\frac{2}{5}$, and $-1\frac{3}{5}$?



There are ____ spaces between 0 and 1.

The number line is divided into _____. Each mark stands for _____.

$-\frac{1}{5}$ is between _____ and _____. It is located at point ____.

$\frac{4}{5}$ is between _____ and _____. It is located at point ____.

$2\frac{2}{5}$ is between _____ and _____. It is located at point ____.

$-1\frac{3}{5}$ is between _____ and _____. It is located at point ____.

Point ___ represents $-\frac{1}{5}$, point ___ represents $\frac{4}{5}$, point ___ represents $2\frac{2}{5}$, and point ___ represents $-1\frac{3}{5}$.