

Signed numbers and number lines

We can consider numbers (integers) to be of three types: positive, negative, and zero. Signed numbers generally denote a direction as well as an amount.

Positive numbers are the regular type you are used to. They may be referred to with a plus sign or without one. Positive numbers on a number line (as above) are distances from zero to the number. A number line is given meaning by its label. The label might be forward, up, east, x, y, z, etc. depending on what we want to measure.

Negative numbers are the opposite direction but the same amount as their opposite counterparts.

Addition

You can see how addition works on a number line, by placing the tip of one line segment at the end of another line segment.

Subtraction

Subtraction is defined as the addition of a negative number.

$$a - b \equiv a + (-b)$$

Look at the following examples:

Ex.

$$- \quad 5 + 7 = 2$$

$$7 - 5 = 7 + (-5) = 2$$

Multiplication

Notice the implication that multiplication on a number line is a summation (addition) of equal line lengths.

$$2 \times 5 = 10 \quad (\text{also } 10 \div 5 = 2)$$

Multiplication of signed numbers

The following are rules for multiplying signed numbers.

- | | |
|-----------------------------|------------------------------|
| 1.) $+$ \cdot $+$ $=$ $+$ | ex. $(+5) \times (+5) = +25$ |
| 2.) $-$ \cdot $-$ $=$ $+$ | ex. $(-5) \times (-5) = +25$ |
| 3.) $+$ \cdot $-$ $=$ $-$ | ex. $(+5) \times (-5) = -25$ |
| 4.) $-$ \cdot $+$ $=$ $-$ | ex. $(-5) \times (+5) = -25$ |

Division

Looking at the number line for the multiplication example, we can derive division as creating equal lengths of line from a larger line.

Division of signed numbers

Given a division problem, we can convert it into a fraction (if not already one).

$$\text{Ex. } 10 \div (-5) = \frac{10}{-5}$$

Now. Given a fraction with a negative sign, we can pull out (in front) the negative sign, or a negative one.

- Note: an odd number of negative signs can be pulled out of a negative number, and an even number of negative signs can be pulled out of a positive number.

$$\text{Ex. } \frac{10}{-5} = (-1)\frac{10}{5} = -\frac{10}{5}$$

Points on a line

Suppose we want to graph a point, such as $x = 5$. We would not graph (shade) the line up to 5, but rather we would place a noticeable dot and label it on the proper spot.

EX.

$$X = 2.5, 5$$

Sets of points on a line

Graph a set of points may be a graph of several dots or a line segment, or a line segment that goes to infinity (or negative infinity). If there are points in a line segment not to be graphed a hole is placed in that spot.

Ex.

Ex.

Ex.

Exercises: Do the following computations:

- 1.) $-2 + 9 = ?$
- 2.) $-2 - 9 = ?$
- 3.) $2 + x = -6$
- 4.) $2 - x = 7, x = ?$
- 5.) $-2(-5) = ?$
- 6.) $-3(4) = ?$
- 7.) $5 \div 1 = ?$
- 8.) $-4 \div -2 = ?$
- 9.) Draw a number line and graph $x = \{0, 1, 3, 5.5\}$
- 10.) Draw a number line and graph $x \geq -2$