

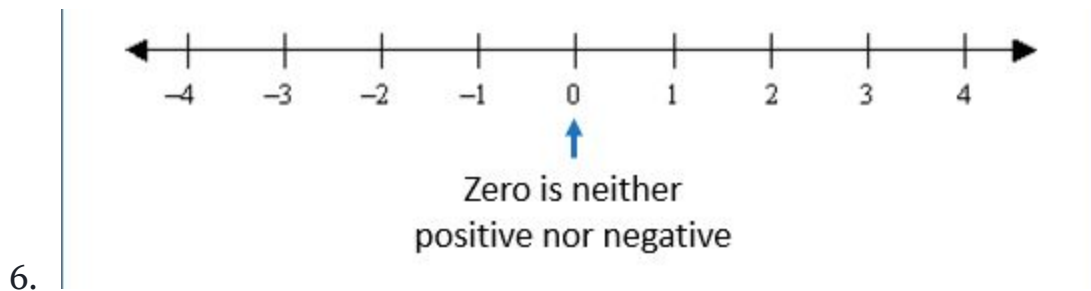
Negative Number Operations and Fractions

A Study Guide

Some basic rules we must agree upon first:

(We will use the * symbol for multiplication)

1. A negative number is just a number that has been multiplied by -1.
i.e. $-a = a * -1$ e.g. $-2 = 2 * (-1)$
2. Subtraction is just the *inverse* of addition. i.e. $a - b = a + (-b)$ e.g. $2 - 1 = 2 + (-1)$
3. Division is the *inverse* of multiplication. i.e. $a \div b = a * (1/b)$ e.g. $1 \div 2 = 1 * 1/2$
4. Converting division and subtraction equations to multiplication and addition is convenient because multiplication and addition are commutative, meaning the order of terms (numbers) does not matter.
5. Number lines continue in the positive direction to the right and negative numbers to the left



Adding Negative Numbers:

When adding negative numbers, move left on the number line toward the negative end. It is basically the same as subtracting.

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Subtracting Negative Numbers:

Remember that subtraction is the inverse of addition. Using the rule outlined in #2 we can see that when we want to subtract a negative number we first invert the operation (subtraction to addition) and the sign (negative or positive) of the following term.

When we add a negative number, we move toward the negative end of the number line, to the left.

i.e.. If we want to find $10 - (-5)$, first we invert the subtraction symbol to make it an addition problem, and we have to invert the sign of the following term (5).

E.g.

$$10 - (-5) = 10 + (+5) = 15$$

$$10 - 5 = 10 + (-5) = 5$$

Multiplying Negative Numbers

When multiplying negative numbers, use rule numbers 1 and 4 to rewrite the equation so that the only negative number is **(-1)**.

i.e. To find the product of the equation $19 * (-7)$, first convert the equation to $19 * 7 * (-1)$ and perform the multiplication problem normally.

e.g.

$$19 * (-7) = 19 * 7 * (-1) = 133 * (-1) = -133$$

$$\text{You could also think of this one as } = (20*7+(-7)) * (-1)$$

If an odd number of negative numbers is multiplied, the product is negative.

If an even number of negative numbers is multiplied, the product is positive.

e.g.

$$(-1) * (-1) = 1$$

Dividing Negative Numbers

Use rules 1 and 3 to work out these kinds of problems.

Convert division to multiplication and invert the term to be divided (rule 3), convert the negative number to $(-1) * (n)$. (rule 1)

$$\text{e.g. } 12 \div (-4) = 12 * (1/4) * (-1) = 3 * (-1) = -3$$

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Working with Mixed Numbers and Fractions

Basic rules:

1. Fractions are ratios that describe how many parts of a whole are represented.
2. All fractions are rational numbers
3. Fractions have been reduced completely when the numerator and denominator are coprimes
4. A whole number can be represented as the number of 1, or “the number of whole numbers”. e.g. $n = n/1$, or $2 = 2/1$
5. A common denominator is a multiple of both denominators in any math problem. (Including the number 1, see rule 4 above)
6. Fractions can be defined as a long division problem. e.g. $\frac{2}{3} = 3 \overline{)2}$

Adding/Subtracting: Find a common denominator, convert to addition problem as necessary, solve and reduce.

e.g. $\frac{2}{3} + \frac{3}{4} = \frac{(2*4)}{(3*4)} + \frac{(3*3)}{(4*3)} = \frac{8}{12} + \frac{7}{12} = \frac{15}{12} = \frac{5}{4} = 1 \frac{1}{4}$.

Why does this work?

In the above example, the number $\frac{2}{3}$ was multiplied by $\frac{4}{4}$ (or 1), and the second number was multiplied by $\frac{3}{3}$ (or 1). The denominator 12 is a common factor of both numbers. In each case, the term was only multiplied by 1 by determining the lowest common denominator with the other term.

Multiplying: Convert mixed number to improper fraction first. Multiply numerators to determine product numerator, and multiply denominators to determine product denominator. Reduce and convert to mixed number.

e.g. $3 \frac{3}{8} * 4 \frac{2}{3} = \frac{27}{8} * \frac{14}{3} = \frac{(27*14)}{(8*3)} = \frac{378}{24} = \frac{63}{4} = 15 \frac{3}{4}$

Division: First invert the divisor (2 becomes $\frac{1}{2}$, $\frac{1}{2}$ becomes 2) then multiply as above. $A \div B = A * \frac{1}{B}$

$2 \div 1 = 2 * \frac{1}{2} = \frac{2}{1} * \frac{1}{2} = \frac{(2*1)}{(1*2)} = \frac{2}{2} = 1$

The same rules for negative numbers apply to fractions. i.e. Convert the negative number to positive number * -1, then multiply as normal. Odd number of -1 = negative number, even number of -1 terms = positive.