

WONDERFUL WORLD OF MATHEMATICS

In all mathematics there are basic rules that apply. If you learn the rules you will be on your way to knowing how to solve any problem, however, the rules are different for each division of mathematics; such as simple addition, subtraction, multiplication and division. Some additional rules apply to fractions, decimals, powers of 10, Algebra, Geometry and Trigonometry.

We will examine the basic rules of all of the above.

Simple Mathematics:

The rules for simple mathematics are:

1. This sign (+) means plus or add.
2. This sign (-) means minus or subtract.
3. This sign (x) means product or multiply.
4. This sign (\div) means division or divide.

Examples:

Addition

$$244 + 124 = 368$$

Subtraction

$$244 - 124 = 120$$

Multiplication

$$244 \times 124 = 30,256$$

Division

$$244 \div 124 = 1.9677$$

It is obvious that simple mathematics is not all that is required.

Decimals are needed:

The rules for decimals are:

1. In addition all decimals must be aligned.
2. In subtraction all decimals must be aligned.
3. In multiplication decimals do not have to align, however the total number of decimals in the answer must equal the total number in the problem.
4. In division there will be no decimal in the divisor, but you must place enough zeros to transfer any decimal in the divisor into the dividend. Then the decimal in the answer will align with the decimal in the dividend.

Some examples are as follows:

Addition: $2.44 + 12.2 + 0.666 =$ would be written as follows:

$$\begin{array}{r} 2.440 \\ 12.200 \\ + \underline{0.666} \\ \hline 15.306 \end{array}$$

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Subtraction: $12.2 - 0.666 =$ would be written as follows:

$$\begin{array}{r} 12.200 \\ - \underline{0.666} \\ 11.534 \end{array}$$

Multiplication: $12.2 \times 0.666 =$ would be written as follows:

$$\begin{array}{r} 12.2 \\ \times \underline{0.666} \\ 8.1252 \end{array}$$

Division: $12.2 \div 0.666 =$ would be written as follows:

$$0.666 \overline{) 12.2} \quad \begin{array}{r} 18.318 \end{array}$$

Fractions are used in construction on a daily basis; they are the standard units of most architects and engineers.

Some of the rules for fractions are as follows:

1. All fractions should be aligned one under the other for addition.
2. All fractions should be aligned one under the other for subtraction.
3. All fractions should be placed in a horizontal row for multiplication.
4. All fractions should be placed in a horizontal row for division.
5. All fractions for addition and subtraction must be changed to have the same denominator.
6. All fractions for multiplication must be multiplied across the top and then across the bottom of the rows.
7. All fractions must be reduced to their lowest term.
8. All fractions being divided must have the second term, the one on the right side, inverted, never the one on the left side. Then proceed as in multiplication.

Examples follow:

Addition:

$$\begin{array}{r} \frac{1}{2} = \frac{2}{4} \\ + \frac{1}{4} = \frac{1}{4} \\ \hline \frac{3}{4} \end{array} \quad \begin{array}{r} 3 \frac{1}{2} = \frac{2}{4} \\ \underline{2 \frac{3}{4} = \frac{3}{4}} \\ 5 \frac{5}{4} = 1 \frac{1}{4} \\ \quad + 5 \\ \hline 6 \frac{1}{4} \end{array}$$

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Subtraction:

$$\begin{array}{r} \frac{1}{2} = \frac{2}{4} \\ - \frac{1}{4} = \frac{1}{4} \\ \hline \frac{1}{4} \end{array} \qquad \begin{array}{r} 3 \frac{3}{4} = \frac{3}{4} \\ - 2 \frac{1}{2} = \frac{2}{4} \\ \hline 1 \frac{1}{4} \end{array}$$

Multiplication:

$$\frac{1}{2} \times \frac{1}{4} = \frac{1}{8}$$

$$3 \frac{1}{2} \times 2 \frac{3}{4} =$$

$$\frac{7}{2} \times \frac{11}{4} = \frac{77}{8} = 9 \frac{5}{8}$$

Division:

$$\frac{1}{2} \div \frac{1}{4} =$$

$$\frac{1}{2} \times \frac{4}{1} = \frac{4}{2} = 2$$

$$3 \frac{1}{2} \div 2 \frac{3}{4} =$$

$$\frac{7}{2} \div \frac{11}{4} =$$

$$\frac{7}{2} \times \frac{4}{11} = \frac{28}{22} = \frac{14}{11} = 1 \frac{3}{11}$$

Note: invert the second term only.

Example: $\frac{1}{4}$ would be $\frac{4}{1}$

Powers of ten: (Exponents)

When the power is positive, the decimal is moved to the *right*. See examples below.

$$6 \times 10^3 = 6000$$

$$6 \times 10^2 = 600$$

$$6.66 \times 10^2 = 666$$

$$0.666 \times 10^3 = 666.$$

$$82.666 \times 10^2 = 8266.6$$

When the power is negative, the decimal is moved to the *left*.

For the following form, always have a maximum of one digit to the left of the decimal point.

$$0.0000246501 = 2.46501 \times 10^{-5}$$

$$0.822 = 8.22 \times 10^{-1}$$

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Algebra:

Important Things to Remember

- Order of Operations:
 1. The operation inside parentheses () and brackets [] are done first.
 2. Then any operations involving exponents is done next.
 3. Follow with multiplying and/or dividing from left to right.
 4. Finally, do all the addition and/or subtraction from left to right.
- *An easy way to remember the order of operations is:*
PEMDAS – Please Excuse My Dear Aunt Sally
Parenthesis, Exponents, Multiplication or Division, Addition or Subtraction

- Multiplication can be written three different ways:

$$7 \times n$$
$$7n$$
$$7(n)$$

- A fraction bar is also a division symbol.

$$\frac{7}{N} \text{ or } 7 / n$$

- Rules of exponents:

$$a^m \times a^n = a^{m+n}$$
$$a^m / a^n = a^{m-n}$$
$$(a^m)^n = a^{m \times n}$$

Geometry

Since we use only the right triangle we will only discuss Pythagorean Theorem.

In a right triangle the sides are noted as a, b, c and the angles are A, B, C.

Side a is opposite the angle A
Side b is opposite the angle B
Side c is opposite the angle C

Side c is always the hypotenuse.

Angle C is always the right angle.

Note: Pythagorean Theorem is $c^2 = a^2 + b^2$

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1. In a right triangle, if side “a” is 36 feet and side “b” is 27 feet, how long is the side “c”?

$$c^2 = 36^2 + 27^2$$

$$c^2 = 1296 + 729$$

$$c^2 = 2025$$

$$c = 45 \text{ feet}$$

The theorem is sometimes called the 3 – 4 – 5 rule because, if the side “a” is 3 feet and side “b” is 4 feet, side “c” is 5 feet.

Careful examination of the above problem will tell you that side “a” and side “b” were both multiplied by 9, thus the answer is 5 x 9 or 45. If two sides are multiplied by the same number the third side will be relative to the multiplier.

$$3 \times 9 = 27$$

$$4 \times 9 = 36$$

$$5 \times 9 = 45$$

2. If side “a” = 40 feet and side “c” is = 60 feet, how long is side “b”?

$$c^2 = a^2 + b^2$$

$$\text{or } b^2 = c^2 - a^2$$

$$b^2 = 60^2 - 40^2$$

$$b^2 = 3600 - 1600$$

b = the square root of 2000 which is 44.72 feet (approx).

Note: Remember, the side “c” is the hypotenuse of a right triangle.

Trigonometry:

The only two functions we will deal with here are the **sine**, which is pronounced as “sign”, and the **cos** which is pronounced as “cosign”.

The purpose of this study is to determine the angles of a right triangle. In a triangle, the three angles always add to 180°. $A+B+C = 180^\circ$

First, we know the angle “C” is 90°. This leaves angles “A” and “B”, and we know that the sum of these two angles is 90°.

To find the angle “A” we will need to know the length of the side “c” (hypotenuse) and one other side of the right triangle. Let us assume that we know side “a”. We may now solve with the equation:

$$\text{Sine} = \frac{\text{opposite}}{\text{Hypotenuse}}$$

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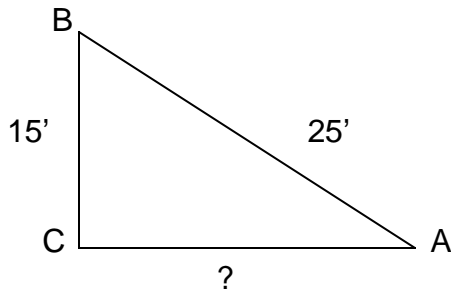
Sine of angle "a" is equal to the side opposite the angle "A" divided by the side "c" (hypotenuse).

To find the cosign of an angle, solve with the following equation:

$$\text{Cos} = \frac{\text{adjacent}}{\text{hypotenuse}}$$

Cosine of an angle is equal to the side adjacent of the angle "A" divided by the side "c". (hypotenuse).

Use the following right triangle to solve this problem.



If side "a" is 15 feet and side "c" is 25 feet, what is the formula for finding the angle "A"?

Sine angle "A" = $(o \div h) = 15 \div 25$, thus sine angle "A" is = 0.6.

Note: The actual angle of "A" can be found in a trigonometric table.

By table the above angle "A" would be approximately 37°