***Number Types***



Numbers are classified according to type. The first type of number is the first type you ever learned about: the counting, or "natural" numbers:

1, 2, 3, 4, 5, 6, ...

The next type is the "whole" numbers, which are the natural numbers together with zero:

0, 1, 2, 3, 4, 5, 6, ...

Then come the "integers", which are zero, the natural numbers, and the negatives of the naturals:

..., –6, –5, –4, –3, –2, –1, 0, 1, 2, 3, 4, 5, 6, ...

The next type is the "rational", or fractional, numbers, which are technically regarded as ratios (divisions) of integers. In other words, a fraction is formed by dividing one integer by another integer.

Note that each new type of number contained the previous type within it. The wholes are just the naturals with zero thrown in. The integers are just the wholes with the negatives thrown in. And the fractions are just the integers with all their divisions thrown in. (Remember that you can turn any integer into a fraction by putting it over the number 1. For example, the integer 4 is also the fraction 4/1.) Since you learned these number types in the same order as their hierarchy, it's easy to remember their order.

Once you're learned about fractions, there is another major classification of numbers: the ones that can't be written as fractions. Remember that fractions (also known as rational numbers) can be written as terminating (ending) or repeating decimals (such as 0.5, 0.76, or 0.333333....). On the other hand, all those numbers that can be written as non-repeating, non-terminating decimals are non-rational, so they are called the "irrationals". Examples would be *sqrt*(2) ("the square root of two") or the number *pi* ("3.14159...", from geometry). The rationals and the irrationals are two totally separate number types; there is no overlap.

Putting these two major classifications, the rationals and the irrationals, together in one set gives you the "real" numbers. Unless you have dealt with [complex numbers](http://www.purplemath.com/modules/complex.htm) (the numbers with an "*i*" in them, such as 4 – 3*i*), then every number you have ever seen has been a "real" number. "But why", you ask, "are they called 'real' numbers? Are there 'pretend' numbers?" Well, yes, actually there are, though they're actually called "imaginary" numbers; they are what is used to make the complex numbers, and is what the "*i*" stands for.

The commonest question I hear regarding number types is something along the lines of "Is a real number irrational, or is an irrational number real, or neither... or both?" Unless you know about complexes, everything you've *ever* done has used real numbers. Unless the number has an "*i*" in it, it's a real.

Here are some typical number-type questions (assuming that you haven't yet learned about imaginaries and complexes):   Copyright © Elizabeth Stapel 2000-2011 All Rights Reserved

* **True or False: An integer is a rational number.**

Since any integer can be formatted as a fraction by putting it over 1, then this is **true.**

* **True or False: A rational is an integer.**

Not necessarily; 4/1 is an integer, but 2/3 is not! So this is **false.**

* **True or False: A number is either a rational or an irrational, but not both.**

**True!**  In decimal form, a number is either non-terminating and non-repeating (so it's an irrational) or not (so it's a rational); there is no overlap between these two number types!

**Classify according to number type; some numbers may be of more than one type.**

* **0.45**

This is a terminating decimal, so it can be written as a fraction: 45/100 = 9/20. Since this fraction does not reduce to a whole number, then it's not an integer or a natural. And everything is a real, so the answer is: **rational, real**

* **3.14159265358979323846264338327950288419716939937510...**

You probably recognize this as being pi, though this may be more decimal places than you customarily use. The point, however, is that the decimal does not repeat, so pi is an irrational. And everything (that you know about so far) is a real, so the answer is: **irrational, real**

* **3.14159**

Don't let this fool you! Yes, you often use something like this as an *approximation* of pi, but it isn't pi! This is a rounded decimal approximation, and, since this approximation *terminates*, this is actually a rational, unlike pi which is irrational! The answer is: **rational, real**

* **10**

Obviously, this is a counting number. That means it is also a whole number and an integer. Depending on the text and teacher (there is some inconsistency), this may also be counted as a rational, which technically-speaking it is. And of course it's also a real. The answer is: **natural, whole, integer, rational** (possibly)**, real**

* **5/3**

This is a fraction, so it's a rational. It's also a real, so the answer is: **rational, real**

* **1 2/3**

This can also be written as 5/3, which is the same as the previous problem. The answer is: **rational, real**

* **–*sqrt*(81)**

Your first impulse may be to say that this is irrational, because it's a square root, but notice that this square root simplifies: –*sqrt*(81) = –9, which is just an integer. The answer is: **integer, rational, real**

* **– 9/3**

This is a fraction, but notice that it reduces to –3, so this may also count as an integer. The answer is: **integer** (possibly)**, rational, real**

Except for the section where you have to classify numbers according to type, you really won't need to be terribly familiar with this hierarchy. It's more important to know what the terms mean when you hear them. For instance, if your teacher talks about "integers", you should know that the term refers to the counting numbers, their negatives, and zero. [[1]](#endnote-1)

1. [↑](#endnote-ref-1)