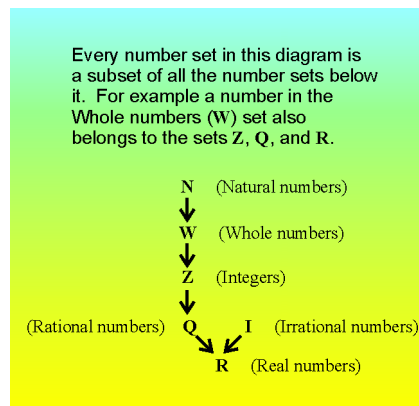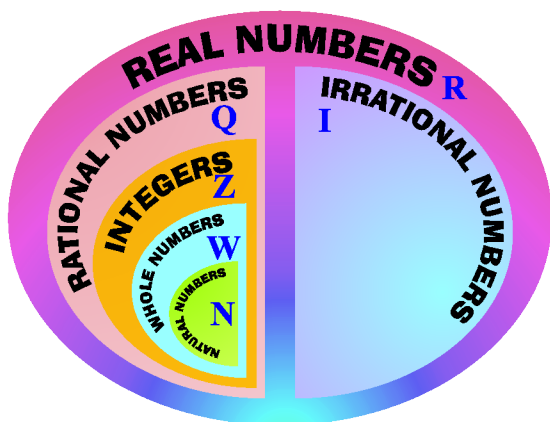# Number Sets

Real Numbers (symbol 'R'): All of the number sets below form the Real numbers.

Natural numbers (symbol 'N'): The numbers you count with. (The counting numbers, the positive integers.)
{ 1, 2, 3, 4, ... }

Whole numbers (symbol 'W'): Zero and the natural numbers. (The non-negative integers.)
{ 0, 1, 2, 3, 4, ...}

Integers (symbol 'Z'): The whole numbers and their opposites. (Zero does not have an opposite, it is the only number that is neither positive nor negative.)
{ ..., -3, -2, -1, 0, 1, 2, 3, ... }

Rational numbers (symbol 'Q'): Numbers that **CAN BE written as the ratio of two integers** where the integer on the bottom is not zero. These numbers can be **integers**, decimals that end (**terminating decimals**), decimals that have a pattern of digits that repeats (**repeating decimals**), or **square roots of perfect squares.** Examples of rational numbers are: 7, -6, .25, 4.98, $.\overline{5}$, 3/4, -10%, $\sqrt{16}$.
(It is important to realize that a number does not have to be written as a ratio of two integers to be a rational number, it just needs to be able to be written as a ratio of two integers.)

Irrational numbers (symbol 'I'): Numbers that **CAN NOT BE written as a ratio of two integers.** This is because the number never ends so you can't stop writing it. **Irrational numbers are non-repeating non-terminating decimals.** They are decimals that do not end (non-terminating) or decimals that do not have a repeating pattern of digits (non-repeating decimals). Although there may be a pattern to the way they are written there is no pattern of digits that repeats. Examples of irrational numbers that have patterns to the way they are written but do not have repeating patterns of the same digits are .101001000... and -.232332333... .
Square roots of non-perfect squares are also irrational because they are non-repeating non-terminating decimals. Examples are $\sqrt{2}$, and $\sqrt{5}$. One irrational number you may be familiar with is π. Sometimes π is represented as 3.14 or 22/7. These are both only approximations. The decimal 3.14 terminates (ends) and the fraction (ratio) 22/7 is a repeating decimal. If you divide 22 by 7 you get 3.142857**142857**142857**142857**142857..., which has a repeating pattern of digits **142857** so this is a repeating decimal. Since π does not terminate or have a repeating pattern of digits it is irrational.

REAL NUMBERS

IRRATIONAL NUMBERS

NONPERFECT SQUARE NUMBERS

$\sqrt{2}$ $\sqrt{3}$ $\sqrt{29}$
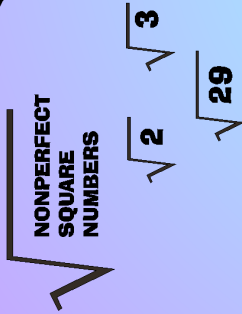
NONREPEATING, NONTERMINATING DECIMALS

.12233344445555566666...

.1011011011110...

.98765432109988776655544...

π

$\pi \approx 3.14159265358979...$

RATIONAL NUMBERS

PERFECT SQUARE NUMBERS

FRACTIONS OF THE FORM

NONZERO INTEGER

REPEATING DECIMALS .63 .458 .279

TERMINATING DECIMALS .25 .368 4.29

INTEGERS

..., -3, -2, -1, 0, 1, 2, 3, ...

WHOLE NUMBERS

0, 1, 2, 3, ...

NATURAL NUMBERS

1, 2, 3, ...