**Exponents (Powers of 2, 3, 4, ...)**

Exponential notation is useful in situations where the same number is multiplied repeatedly.

The number being multiplied is called the base, and the exponent tells how many times the base is multiplied by itself.

Example:

4 ×4 ×4 ×4 ×4 ×4 = 46

The base in this example is 4, the exponent is 6.

We refer to this as four to the sixth power, or four to the power of six.

Examples:

2 ×2 ×2 = 23 = 8

1.12 = 1.1 × 1.1 = 1.21

0.53 = 0.5 × 0.5 × 0.5 = 0.125

106 = 10 × 10 × 10 × 10 × 10 × 10 = 1000000

Observe that the base may be a decimal.

Special Cases:

A number with an exponent of two is referred to as the *square of a number*.

The square of a whole number is known as a *perfect square*. The numbers 1, 4, 9, 16, and 25 are all perfect squares.

A number with an exponent of three is referred to as the *cube of a number*.

The cube of a whole number is known as a *perfect cube*. The numbers 1, 8, 27, 64, and 125 are all perfect cubes.

Note:

A number written with an exponent of 1 is the same as the given number.

231 = 23.

**Place Value**

The position, or place, of a digit in a number written in standard form determines the actual value the digit represents. This table shows the place value for various positions:

|  |  |
| --- | --- |
| Place (underlined) | Name of Position |
| 1 000 | Ones (units) position |
| 1 000 | Tens |
| 1 000 | Hundreds |
| 1 000 | Thousands |
| 1 000 000 | Ten thousands |
| 1 000 000 | Hundred Thousands |
| 1 000 000 | Millions |
| 1 000 000 000 | Ten Millions |
| 1 000 000 000 | Hundred millions |
| 1 000 000 000 | Billions |

*E*xample:

The number 721040 has a 7 in the hundred thousands place, a 2 in the ten thousands place, a one in the thousands place, a 4 in the tens place, and a 0 in both the hundreds and ones place.

**Expanded Form**

The expanded form of a number is the sum of its various place values.

Example:

9836 = 9000 + 800 + 30 + 6.

**Ordering**

Symbols are used to show how the size of one number compares to another. These symbols are < (less than), > (greater than), and = (equals.) For example, since 2 is smaller than 4 and 4 is larger than 2, we can write: 2 < 4, which says the same as 4 > 2 and of course, 4 = 4.

To compare two whole numbers, first put them in standard form. The one with more digits is greater than the other. If they have the same number of digits, compare the most significant digits (the leftmost digit of each number). The one having the larger significant digit is greater than the other. If the most significant digits are the same, compare the next pair of digits from the left. Repeat this until the pair of digits is different. The number with the larger digit is greater than the other.

Example: 402 has more digits than 42, so 402 > 42.

Example: 402 and 412 have the same number of digits. We compare the leftmost digit of each number: 4 in each case. Moving to the right, we compare the next two numbers: 0 and 1. Since 0 < 1, 402 < 412.

**Rounding Whole Numbers**

To round to the nearest ten means to find the closest number having all zeros to the right of the tens place. Note: when the digit 5, 6, 7, 8, or 9 appears in the ones place, round up; when the digit 0, 1, 2, 3, or 4 appears in the ones place, round down.

Examples:

Rounding 119 to the nearest ten gives 120.

Rounding 155 to the nearest ten gives 160.

Rounding 102 to the nearest ten gives 100.

Similarly, to round a number to any place value, we find the number with zeros in all of the places to the right of the place value being rounded to that is closest in value to the original number.

Examples:

Rounding 180 to the nearest hundred gives 200.

Rounding 150090 to the nearest hundred thousand gives 200000.

Rounding 1234 to the nearest thousand gives 1000.

Rounding is useful in making estimates of sums, differences, etc.

Example:

To estimate the sum 119360 + 500 to the nearest thousand, first round each number in the sum, resulting in a new sum of 119000 + 1000.. Then add to get the estimate of 120000.