

# Math

## Common Core State Standards

# 8th Grade

The number system, exponents, radicals, functions, linear equations, transformations, geometry, statistics & more!

### THE NUMBER SYSTEM

#### Set of Rational Numbers

**Rational number:** The ratio of two integers; rational numbers include:

- **Fractions:**  $\frac{1}{2}$ ,  $1\frac{3}{4}$ ,  $-\frac{7}{8}$ ,  $-3\frac{1}{3}$ ,  $-\frac{12}{17}$
- **Decimals:**
  - Terminating decimals: 3.3, 0.6,  $-7.3$
  - Repeating decimals:  $0.\overline{3}$ ,  $1.\overline{513}$ ,  $-2.\overline{58}$
- **Integers:** All whole numbers and their opposites  
... -3, -2, -1, 0, 1, 2, 3, ...
- **Whole numbers:** All the counting numbers plus 0  
0, 1, 2, 3, 4, ...
- **Natural numbers:** All the counting numbers  
1, 2, 3, 4, 5, ...

**Tip!**

Numbers that are not rational are called **irrational**.

#### Set of Irrational Numbers

**Irrational numbers:** Nonterminating and nonrepeating decimals, such as  $\pi$ ; irrational numbers **cannot** be written as the ratio of two integers; **NOTE:** An ellipsis (...) indicates that the number does not terminate.

$$\sqrt{3} = 1.7320508...$$

$$56.7840375...$$

All non-perfect-square numbers have irrational square roots:  
 $\sqrt{5} = 2.23606...$

#### Common Irrational Numbers



$$\pi = 3.1415926...$$

$$e = 2.718281...$$

$$\phi = 1.618033...$$

$$\sqrt{2} = 1.4142135...$$

**Tip!**

**Real numbers** = Set of rational numbers + Set of irrational numbers

#### Decimal Expansion

Every number has a decimal expansion.

EX: Write .15 as a fraction.

$$.15 = \frac{15}{100} = \frac{3}{20}$$

$$\text{Write } \frac{11}{20} \text{ as a decimal.}$$

$$11 \div 20 = .55$$

$$\text{Write } -\frac{3}{25} \text{ as a decimal.}$$

$$-3 \div 25 = -.12$$

**Tip!**

To convert a decimal to a fraction, multiply the decimal by a power of 10 to get a whole number, divide that result by the same power of 10, and simplify.

### EXPONENTS & POWERS

**Exponents:** The number of times the base is multiplied by itself; the number of times the base is a factor.

EX:  $4^5 = 4 \times 4 \times 4 \times 4 \times 4$

$$\frac{1}{4^3} = \frac{1}{64}$$

**Degree of exponents:**  $x$  and  $x^2$  are the same; that is, they are both first degree;  $x^2$  = second degree, etc.

**Zero exponents:** Any base to the 0 power, always = 1

EX:  $4^0 = 1$

$$a^0 = 1$$

$$(3x^2y^3)^0 = 1$$

**Negative exponents:** Any base with a negative exponent; indicates a fraction value.

EX:

$$4^{-2} = \frac{1}{4^2} \quad x^{-3} = \frac{1}{x^3} \quad (x+y)^{-4} = \frac{1}{(x+y)^4}$$

**Adding and subtracting with exponents:** Add or subtract like terms with the same base and exponent.

EX:  $2a^2 + 3a^2 = 5a^2$

**Multiplying with exponents:** Add exponents if the bases are the same; simplify any coefficients.

EX:  $(2a^2)(3a^2) = 12a^4$

$$(x^2)(x^3) = x^5$$

$$\left(\frac{3}{4}\right)\left(\frac{2}{4}\right) = \left(\frac{3}{4}\right)^2$$

**Power of a power:** If the bases are the same, multiply the exponents.

EX:  $(x^2)^3 = x^6$

$$(x^2)^4 = x^8$$

$$(x^2y^3)^2 = x^4y^6$$

$$(3x^2)^3 = 9x^6$$

**Dividing with exponents:** Subtract exponents that have the same base.

EX:

$$\frac{12a^5}{3a^2} = 4a^3$$

$$\frac{-8a^4b^6}{-2a^2b^3} = 4a^2b^3$$

#### Properties of Powers

- **Product of powers:**  $a^m \cdot a^n = a^{m+n}$
- **Quotient of powers:**  $a^m \div a^n = a^{m-n}$
- **Power of a power:**  $(a^m)^n = a^{m \cdot n}$
- **Power of zero:**  $a^0 = 1$ , if  $a \neq 0$
- **Power of a product:**  $(ab)^n = a^n b^n$

- **Power of a quotient:**

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, \text{ if } b \neq 0$$

#### Scientific Notation & the Powers of 10

- Used to represent very large and very small numbers.
- Forms of writing numbers using powers of 10.

EX:  $1,000,000,000 = 10^9$

$$100,000 = 10^5$$

$$10,000 = 10^4$$

$$1,000 = 10^3$$

#### Scientific Notation for Large Numbers

$$2,890,000,000 = 2.890,000,000 \times 10^9$$

- Move the decimal point to the left to get 2.89 (a number between 1 and 10).
- Count the number of places the decimal point moved.
- Use the power of 10 to represent the number:  $2.89 \times 10^9$

**NOTE:** For very large numbers, the power is positive.

#### Scientific Notation for Small Numbers

$$0.0000073$$

- Move the decimal point to the right to get 7.3 (a number between 1 and 10).
- Count the number of places the decimal point moved.
- Use the power of 10 to represent the number:  $7.3 \times 10^{-6}$

**NOTE:** For very small numbers, the power is negative.

#### Operations with Scientific Notation

Use properties of exponents to solve problems involving scientific notation.

EX:

$$(2.5 \times 10^2)(3.7 \times 10^{-5}) = 21.75 \times 10^{-3} = 2.175 \times 10^{-2}$$

$$2.4 \div (5.2 \times 10^{-6}) = 2.46 \times 10^{-7} = 1.248 \times 10^{-6}$$

$$\frac{8.22 \times 10^5}{6.3 \times 10^7} = \frac{8.22}{6.3} \times \frac{10^5}{10^7} = 1.30 \times 10^{-2}$$

# Standard 8th Mathematics Self Study Guide

**David Baud**



## **Standard 8th Mathematics Self Study Guide:**

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