



# Algebra 1 Formulas

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# Operations

## Algebraic properties

|              |                                     |                      |
|--------------|-------------------------------------|----------------------|
| Reflexive    | $a = a$                             |                      |
| Commutative  | $a + b = b + a$                     | $ab = ba$            |
| Associative  | $(a + b) + c = a + (b + c)$         | $(ab)c = a(bc)$      |
| Distributive | $a(b + c) = ab + ac$                | $(b + c)a = ba + ca$ |
| Transitive   | If $a = b$ and $b = c$ then $a = c$ |                      |
| Symmetric    | If $a = b$ then $b = a$             |                      |

## Order of operations

- P     Parentheses
- E     Exponents
- M     Multiplication
- D     Division
- A     Addition
- S     Subtraction



# Equations

## Balancing

Whatever operation is performed on one side of an equation must also be performed on the other side of the equation in order to keep it balanced.

## Inverse operations

Addition and subtraction are inverse operations, because they undo each other.

Multiplication and division are inverse operations, because they undo each other.

## Addition-subtraction rules

The same number can be added to or subtracted from both sides of an equation without changing the solution to the equation.

$$\text{If } a = b, \quad \text{then } a + c = b + c$$

$$\text{If } a = b, \quad \text{then } a - c = b - c$$



## Multiplication-division rules

Both sides of an equation can be multiplied or divided by the same nonzero number without changing the solution to the equation.

$$\text{If } a = b, \quad \text{then } ac = bc$$

$$\text{If } a = b, \quad \text{then } \frac{a}{c} = \frac{b}{c} \quad (c \neq 0)$$

## Polynomials and factoring

### Polynomial multiplication

To multiply one polynomial by a second polynomial, each term of the first polynomial is multiplied by each term of the second polynomial and then the products are summed.

### Definition of a factor

A factor is one of two or more expressions that are multiplied to form a product.

### Greatest common factor (GCF)

The greatest common factor of two numbers is the largest number that divides evenly into both numbers.



## Difference of two squares theorem

If  $p$  and  $q$  are real numbers and  $p^2 = q^2$  then  $p = q$  or  $p = -q$

$$p^2 = q^2$$

## Quadratic formula

The solutions to a quadratic equation of the form

$$ax^2 + bx + c = 0$$

can be found using the formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

The value of  $b^2 - 4ac$  (called the discriminant) will determine the type(s) of solutions.

When  $b^2 - 4ac = 0$ , the solution is one real number

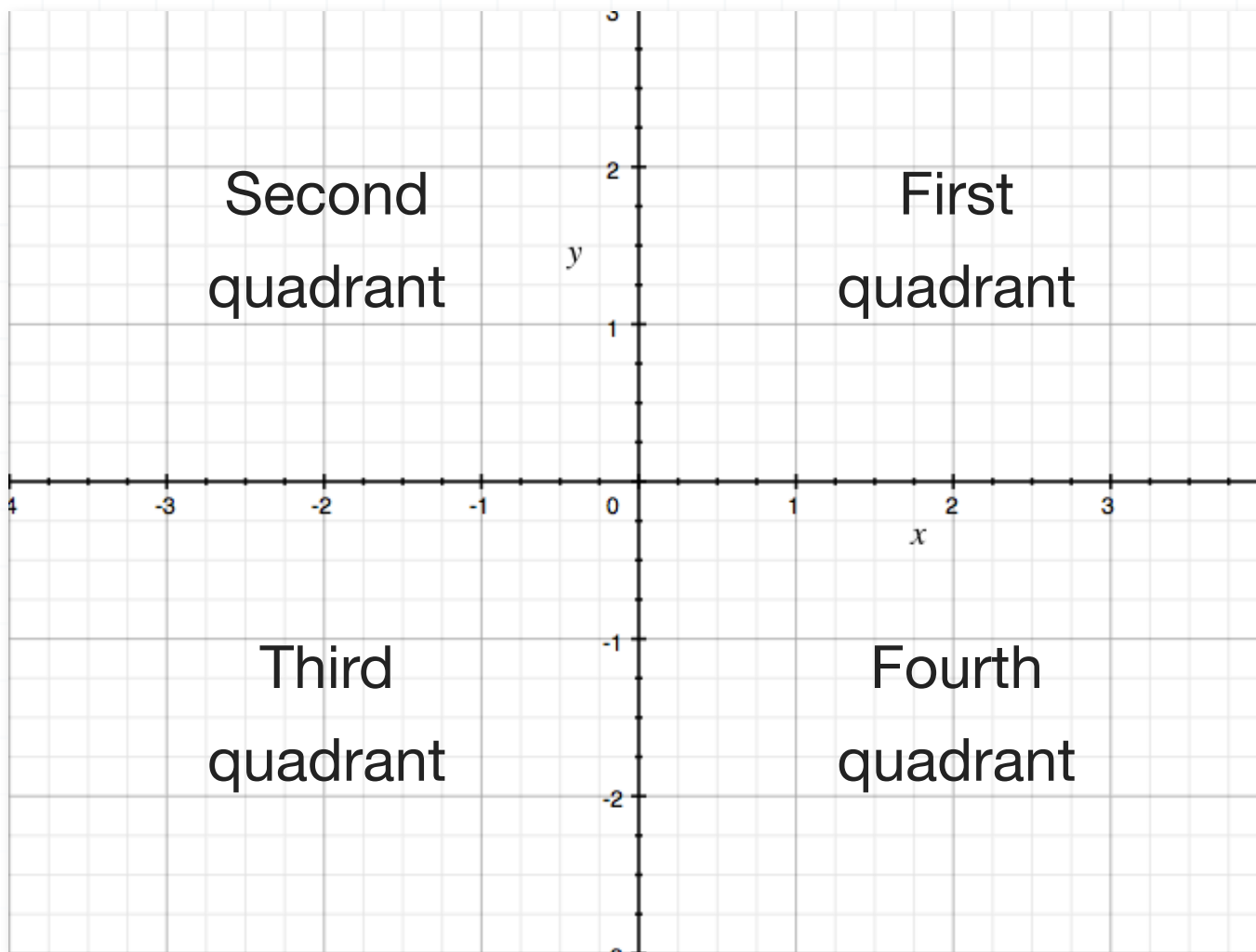
When  $b^2 - 4ac > 0$ , the solutions are two real numbers

When  $b^2 - 4ac < 0$ , the solutions are two real complex numbers



# Graphing

## Cartesian coordinate system



## Slope

The slope of any line can be defined by the formula

$$m = \frac{\text{change in the } y\text{-coordinate}}{\text{change in the } x\text{-coordinate}} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$



## Equation of a line, slope-intercept form

The slope-intercept form of the equation of a line is

$$y = mx + b$$

where  $m$  is the slope of the line, defined as

$$m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

and where  $b$  is the point at which the line crosses the  $y$ -axis.

## Inequalities

### Trichotomy axiom

For any real numbers  $a$  and  $b$ , exactly one of the following is true:

$$a < b \quad \text{or} \quad a = b \quad \text{or} \quad a > b$$

### Transitive axiom

For any real numbers  $a$ ,  $b$  and  $c$ ,

$$\text{If } a > b \text{ and } b > c, \quad \text{then } a > c$$

$$\text{If } a < b \text{ and } b < c, \quad \text{then } a < c$$

$$\text{If } a = b \text{ and } b = c, \quad \text{then } a = c$$



# Functions

## Three definitions of a function

1. A **function** is a **mapping** between two sets that associates with each element of the first set a **unique** (one and only one) element of the second set. The first set is called the **domain** of the function. For each element  $x$  of the domain, the corresponding element  $y$  of the second set is called the **image** of  $x$  under the function. The set of all images of the elements of the domain is called the **range** of the function.
2. A **function** is a **set of ordered pairs** in which no two pairs have the same first element and different second elements.
3. A function is something that has for every value of  $x$  exactly one answer.

## Vertical line test

A graph on the coordinate plane represents the graph of a function provided that any vertical line intersects the graph in at most one point.

## Even, odd, or neither

Even  $f(-x) = f(x)$

Odd  $f(-x) = -f(x)$





