GED Mathematical Reasoning Formulas

All Mathematics Formulas a GED Math Test Taker Must Know!

Created by: Effortless Math Education

www.EffortlessMath.com

Taking the GED with only a few weeks or even few days to study?

First and foremost, you should understand that the 2019 GED® Mathematical Reasoning test contains a formula sheet, which displays formulas relating to geometric measurement and certain algebra concepts. Formulas are provided to test-takers so that they may focus on *application*, rather than the *memorization*, of formulas. However, the test does not provide a list of all basic formulas that will be required to know for the test. This means that you will need to be able to recall many math formulas on the GED.

Below you will find the 2019 GED® Mathematics Formula Sheet followed by a complete list of all Math formulas you MUST have learned before test day, as well as some explanations for how to use them and what they mean. Keep this list around for a quick reminder when you forget one of the formulas.

Review them all, then take a look at the math topics to begin applying them!

Good luck!

GED Mathematical Reasoning Formula Sheet		
Area of a:		
Square	$A = s^2$	
Rectangle	$A = lw$	
Parallelogram	$A = bh$	
Triangle	$A = \frac{1}{2}bh$	
Trapezoid	$A = \frac{1}{2}h(b_1 + b_2)$	
Circle		
Surface Area and Volume of a:		
Rectangular	$SA = 2lw + 2lh + 2wh$	$V = lwh$
Right Prism	$SA = ph + 2B$	$V = Bh$
Cylinder	$SA = 2\pi rh + 2\pi r^2$	$V = \pi r^2 h$
Pyramid	$SA = \frac{1}{2}ps + B$	$V = \frac{1}{3}Bh$
Cone	$SA = \pi r + \pi r^2$	$V = \frac{1}{3}\pi r^2 h$
Sphere	$SA = 4\pi r^2$	$V = \frac{4}{3}\pi r^3$
	($p =$ perimeter of base B; $\pi = 3.14$)	
Algebra		
Slope of a line	$m = \frac{y_2 - y_1}{x_2 - x_1}$	
Slope-intercept form of the equation of a line	$y = mx + b$	
Point-slope form of the Equation of a line	$y - y_1 = m(x - x_1)$	
Standard form of a Quadratic equation	$y = ax^2 + bx + c$	
Quadratic formula	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	
Pythagorean theorem	$a^2 + b^2 = c^2$	
Simple interest	$I = prt$ (I = interest, p = principal, r = rate, t = time)	

A Quick Review and the List of all GED Mathematics Formulas

Place Value

The value of the place, or position, of a digit in a number.
Example: In 456, the 5 is in "tens" position.

Comparing Numbers Signs

Equal to $=$
Less than $<$
Greater than $>$
Greater than or equal $\geq$
Less than or equal $\leq$

Rounding

Putting a number up or down to the nearest whole number or the nearest hundred, etc.
Example: 64 rounded to the nearest ten is 60, because 64 is closer to 60 than to 70.

Whole Number

The numbers $\{0, 1, 2, 3, \ldots\}$

Estimates

Find a number close to the exact answer.

Decimals

Is a fraction written in a special form. For example, instead of writing $\frac{1}{2}$ you can write 0.5.

Factoring Numbers

Factor a number means to break it up into numbers that can be multiplied together to get the original number.
Example: $12 = 2 \times 2 \times 3$

Fractions

A number expressed in the form $\frac{a}{b}$
Adding and Subtracting with the same denominator:

$$\frac{a}{b} + \frac{c}{b} = \frac{a+c}{b}$$

$$\frac{a}{b} - \frac{c}{b} = \frac{a-c}{b}$$

Adding and Subtracting with the different denominator:

$$\frac{a}{b} + \frac{c}{d} = \frac{ad+cb}{bd}$$

$$\frac{a}{b} - \frac{c}{d} = \frac{ad-cb}{bd}$$

Multiplying and Dividing Fractions:

$$\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times \mathrm{d}}$$

$$\frac{a}{b} \div \frac{c}{d} = \frac{\frac{a}{b}}{\frac{c}{d}} = \frac{ad}{bc}$$

Mixed Numbers

A number composed of a whole number and fraction
Example: $2\frac{2}{3}$
Converting between improper fractions and mixed numbers:
$\mathrm{a}\frac{c}{b} = \mathrm{a} + \frac{c}{b} = \frac{ab+c}{b}$

Divisibility Rules

Divisibility means that you are able to divide a number evenly.
Example: 24 is divisible by 6, because $24 \div 6 = 4$

Greatest Common Factor
Multiply common prime factors
Example: $200 = 2 \times 2 \times 2 \times 5 \times 5$
$60 = 2 \times 2 \times 3 \times 5$
GCF $(200, 60) = 2 \times 2 \times 5 = 20$

Least Common Multiple
Check multiples of the largest number
Example: LCM $(200, 60)$: 200 (no), 400 (no), 600 (yes!)

Integers
$\{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$
Includes: zero, counting numbers, and the negative of the counting numbers

Real Numbers
All numbers that are on number line. Integers plus fractions, decimals, and irrationals ($\sqrt{2}, \sqrt{3}, \pi$, etc.)

Order of Operations
PEMDAS
(parentheses / exponents / multiply / divide / add / subtract)

Absolute Value
Refers to the distance of a number from 0, the distances are positive as absolute value of a number cannot be negative. $|-22| = 22$

$$|x| = \begin{cases} x & for\ x \geq 0 \\ -x & for\ x < 0 \end{cases}$$

$|x| < n \Rightarrow -n < x < n$
$|x| > n \Rightarrow x < -n$ or $x > n$

Ratios
A ratio is a comparison of two numbers by division.
Example: 3: 5, or $\frac{3}{5}$

Percentages
use the following formula to find part, whole, or percent

$$part = \frac{\text{percent}}{100} \times whole$$

Proportional Ratios
A proportion means that two ratios are equal. It can be written in two ways:
$\frac{a}{b} = \frac{c}{d}$, $a: b = c: d$

Percent of Change
$$\frac{New\ Value - Old\ Value}{Old\ Value} \times 100\%$$

Markup
Markup = selling price – cost
Markup rate = markup divided by the cost

Discount
Multiply the regular price by the rate of discount
Selling price = original price – discount

Expressions and Variables
A variable is a letter that represents unspecified numbers. One may use a variable in the same manner as all other numbers:

Tax
To find tax, multiply the tax rate to the taxable amount (income, property value, etc.)

Addition	$2 + a$	2 plus a
Subtraction	$y - 3$	y minus 3
Division	$\frac{4}{x}$	4 divided by x
Multiplication	$5a$	5 times a

Distributive Property
$a(b+c) = ab + ac$

Polynomial
$P(x) = a_0x^n + a_1x^{n-1} + \cdots + a_{n-2}x^2 + a_{n-1}x + an$

Systems of Equations
Two or more equations working together. example: $\begin{cases} -2x + 2y = 4 \\ -2x + y = 3 \end{cases}$

Inequalities
Says that two values are not equal

$a \neq b$ a not equal to b
$a < b$ a less than b
$a > b$ a greater than b
$a \geq b$ a greater than or equal b
$a \leq b$ a less than or equal b

Lines (Linear Functions)
Consider the line that goes through points $A(x_1, y_1)$ and $B(x_2, y_2)$.

Distance from $A(x_1, y_1)$ to $B(x_2, y_2)$:
$$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

Mid-point of the segment AB:
$$M\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

Slope of the line:
$$\frac{y_2 - y_1}{x_2 - x_1} = \frac{rise}{\text{run}}$$

Equations
The values of two mathematical expressions are equal.
$ax + b = c$

Solving Systems of Equations by Substitution
Consider the system of equations
$x - y = 1, -2x + y = 6$
Substitute $x = 1 - y$ in the second equation
$-2(1-y) + y = 5$ $y = 2$
Substitute $y = 2$ in $x = 1 + y$
$x = 1 + 2 = 3$

Solving Systems of Equations by Elimination
Example:
$$\begin{array}{r} x + 2y = 6 \\ + \; -x + y = \; 3 \\ \hline 3y = 9 \\ y = 3 \end{array}$$
$$x + 6 = 6$$
$$x = 0$$

Point-slope form:

Given the slope m and a point (x_1, y_1) on the line, the equation of the line is

$$(y - y_1) = m(x - x_1).$$

Slope-intercept form: given the slope m and the y-intercept b, then the equation of the line is:

$y = mx + b.$

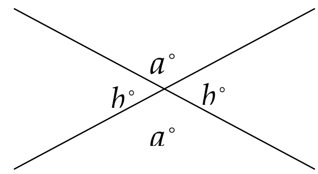
Scientific Notation

It is a way of expressing numbers that are too big or too small to be conveniently written in decimal form. In scientific notation all numbers are written in this form: $m \times 10^n$

Decimal notation	Scientific notation
5	5×10^0
$-25{,}000$	-2.5×10^4
0.5	5×10^{-1}
$2{,}122.456$	$2{,}122456 \times 10^3$

Parallel lines

Have equal slopes. Perpendicular lines (i.e., those that make a 90° angle where they intersect) have negative reciprocal slopes: $m_1 \,. m_2 = -1.$



Intersecting Lines
Parallel Lines ($l \,// m$)

Intersecting lines: opposite angles are equal. Also, each pair of angles along the same line add to 180°. In the figure above, $a + b = 180°$.

Parallel lines: eight angles are formed when a line crosses two parallel lines. The four big angles (a) are equal, and the four small angles (b) are equal.

Exponents

Refers to the number of times a number is multiplied by itself.
8 = 2 × 2 × 2 = 2^3

Factoring

"FOIL"
$(x + a)(x + b)$
$= x^2 + (b + a)x \; + ab$

Square

The number we get after multiplying an integer (not a fraction) by itself.
Example: $2 \times 2 = 4, 2^2 = 4$

Square Roots

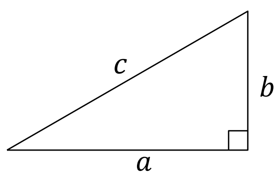
A square root of x is a number r whose square is x : $r^2 = x$
r is a square root of x

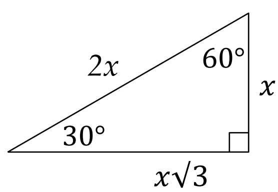
Pythagorean Theorem

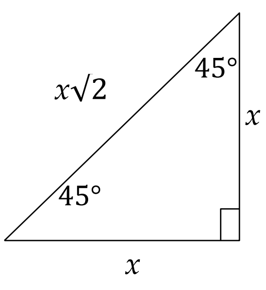
$$a^2 + b^2 = c^2$$

Triangles

Right triangles:







"Difference of Squares"

$a^2 - b^2 = (a + b)(a - b)$
$a^2 + 2ab + b^2 = (a + b)(a + b)$
$a^2 - 2ab + b^2 = (a - b)(a - b)$

"Reverse FOIL"

$x^2 + (b + a)x + ab =$
$(x + a)(x + b)$

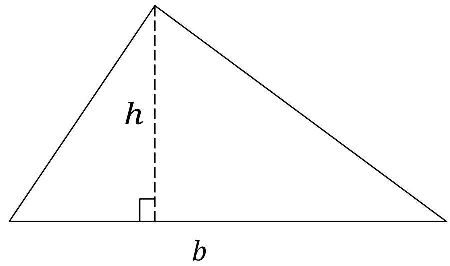
You can use Reverse FOIL to factor a polynomial by thinking about two numbers a and b which add to the number in front of the x, and which multiply to give the constant. For example, to factor $x^2 + 5x + 6$, the numbers add to 5 and multiply to 6, i.e.:
$a = 2$ and $b = 3$, so that
$x^2 + 5x + 6 = (x + 2)(x + 3)$.

To solve a quadratic such as $x^2 + bx + c = 0$, first factor the left side to get $(x + a)(x + b) = 0$, then set each part in parentheses equal to zero. For example, $x^2 + 4x + 3 = (x + 3)(x + 1) = 0$ so that $x = -3$ or $x = -1$.

To solve two linear equations in x and y: use the first equation to substitute for a variable in the second. E.g., suppose $x + y = 3$ and $4x - y = 2$. The first equation gives $y = 3 - x$, so the second equation becomes
$4x - (3 - x) = 2 \Rightarrow 5x - 3 = 2$
$\Rightarrow x = 1, y = 2$.

Triangles

A good example of a right triangle is one with $a = 3, b = 4$, and $c = 5$, also called a $3-4-5$ right triangle. Note that multiples of these numbers are also right triangles. For example, if you multiply these numbers by 2, you get $a = 6, b = 8$, and
$c = 10(6-8-10)$, which is also a right triangle.



$Area = \frac{1}{2} \mathrm{b} \cdot \mathrm{h}$

Angles on the inside of any triangle add up to $180°$.
The length of one side of any triangle is always less than the sum and more than the difference of the lengths of the other two sides.
An exterior angle of any triangle is equal to the sum of the two remote interior angles. Other important triangles:

Equilateral:

These triangles have three equal sides, and all three angles are $60°$.

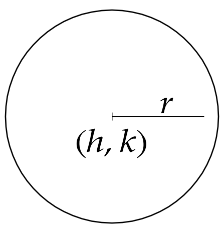
Isosceles:

An isosceles triangle has two equal sides. The “base” angles
(the ones opposite the two sides) are equal (see the $45°$ triangle above).

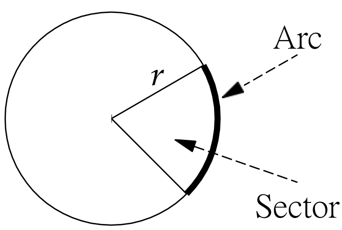
Similar:

Two or more triangles are similar if they have the same shape. The corresponding angles are equal, and the corresponding sides are in proportion. For example, the $3-4-5$ triangle and the $6-8-10$ triangle from before are similar since their sides are in a ratio of 2 to 1.

Circles



$Area = \pi r^2$
$Circumference = 2\pi r$
$Full\ circle = 360°$



Length Of $Arc = (n°/360°) \times 2\pi r$
$Area\ Of\ Sector$
$= (n°/360°) \times \pi r^2$

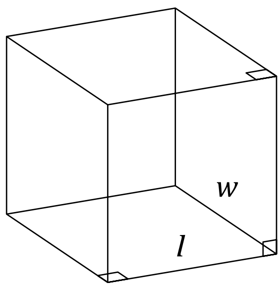
Area of a parallelogram:

$$A = bh$$

Area of a trapezoid:

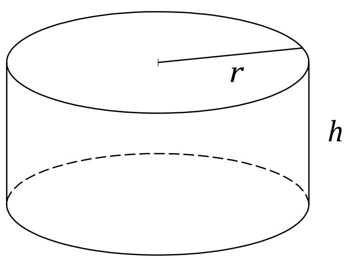
$$\mathbf{A} = \frac{1}{2}\mathrm{h}\ (b_1 + \mathrm{b}_2)$$

Solids



Rectangular Solid

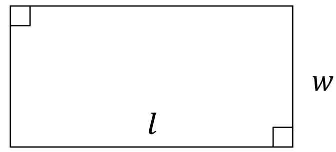
$$Volume = lwh$$
$$Area = 2(lw + wh + lh)$$



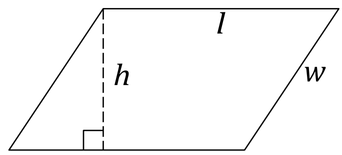
Right Cylinder

$$Volume = \pi r^2 h$$
$$Area = 2\pi r(r + h)$$

Rectangles



(Square if $l = w$)
$Area = lw$



Parallelogram

(Rhombus if $l = w$)
$Area = lh$

Regular polygons are n-sided figures with all sides equal and all angles equal.
The sum of the inside angles of an n-sided regular polygon is
$(n - 2)\ .\ 180°$.

Surface Area and Volume of a rectangular/right prism:

$$SA = ph + 2B$$
$$V = Bh$$

mean: $\frac{sum\ of\ the\ data}{\text{total number of entries}}$

mode: value in the list that appears most often

range: largest value - smallest value

Median

Middle value in the list (which must be sorted)

Example: median of

$$\{3, 10, 9, 27, 50\} = 10$$

Example: median of

$\{3, 9, 10, 27\} = \frac{(9+10)}{2} = 9.5$

Sum

$$average \times (number\ of\ terms)$$

Average

$\frac{\text{sum of terms}}{\text{number of terms}}$

Average speed

$average = \frac{\text{total distance}}{\text{total time}}$

Factorials

Factorial- the product of a number and all counting numbers below it.

8 factorial $= 8! =$

$8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

$= 40{,}320$

5 factorial $= 5! =$

$5 \times 4 \times 3 \times 2 \times 1 = 120$

2 factorial $= 2! = 2 \times 1 = 2$

Surface Area and Volume of a cylinder:

$$SA = 2\pi rh + 2\pi r^2$$
$$V = \pi r^2 h$$

Surface Area and Volume of a Pyramid

$$SA = \frac{1}{2}\,ps + b$$
$$V = \frac{1}{3}bh$$

Surface Area and Volume of a Cone

$$SA = \pi rs + \pi r^2$$
$$V = \frac{1}{3}\,\pi r^2 h$$

Surface Area and Volume of a Sphere

$$SA = 4\pi r^2$$
$$V = \frac{4}{3}\pi r^3$$

(*p* = perimeter of base B; $\pi \sim 3.14$)

Quadratic formula

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

Simple interest

$$I = prt$$

(*I* = interest, *p* = principal, *r* = rate, *t* = time)

Probability

$$Probability = \frac{number\ of\ desired\ outcomes}{\text{number of total outcomes}}$$

The probability of two different events A and B both happening is:

$$P(A\ and\ B) = p(A)\,.\,p(B)$$

as long as the events are independent (not mutually exclusive).

Exponents: Multiplying Two Powers of the SAME Base

When the bases are the same, you find the new power by just adding the exponents

$x^a\,.\,x^b = x^{a+b}$

Multiplying Two Powers of Different Bases Same Exponent

If the bases are different but the exponents are the same, then you can combine them

$$x^a.\,y^a = (xy)^a$$

Powers of Powers

For power of a power: you multiply the exponents.

$$(x^a)^b = x^{(ab)}$$

Powers, Exponents, Roots

$x^a\,.\,x^b = x^{a+b}$

$\frac{x^a}{x^b} = x^{a-b}$

$\frac{1}{x^b} = x^{-b}$

$(x^a)^b = x^{a.b}$

$(xy)^a = x^a\,.\,y^a$

$x^0 = 1$

$\sqrt{xy} = \sqrt{x}\,.\,\sqrt{y}$

$(-1)^n = -1$, if n is odd.

$(-1)^n = +1$, if n is even.

If $0 < x < 1$, then

$0 < x^3 < x^2 < x < \sqrt{x} < \sqrt{3x} < 1.$

Interest

Simple Interest

The charge for borrowing money or the return for lending it.

$Interest = principal \times rate \times time$

OR

$$I = prt$$

Compound Interest

Interest computed on the accumulated unpaid interest as well as on the original principal.

$$A = P(1+r)^t$$

$A =$ amount at end of time

$P =$ principal (starting amount)

$r =$ interest rate (change to a decimal i.e. $50\% = 0.50$)

$t =$ number of years invested

Positive Exponents

An exponent is simply shorthand for multiplying that number of identical factors. So 4^3 is the same as (4)(4)(4), three identical factors of 4. And x^3 is just three factors of x, $(x)(x)(x)$.

Negative Exponents

A negative exponent means to divide by that number of factors instead of multiplying.

So 4^{-3} is the same as $\frac{1}{4^3}$ and

$$x^{-3} = \frac{1}{x^3}$$

Dividing Powers

$$\frac{x^a}{x^b} = x^a x^{-b} = x^{a-b}$$

The Zero Exponent

Anything to the 0 power is 1.

$$x^0 = 1$$
$$4^0 = 1$$
$$(300)^0 = 1$$