

NUMBER SENSE

Math, made clearer.

Formulas, methods and worked examples for your next study session.

Know your numbers

Whole numbers: 0, 1, 2, 3, ...

Integers: ..., -2, -1, 0, 1, 2, ...

Rational numbers: fractions of integers with a nonzero denominator, such as $-\frac{3}{4}$ or 0.25.

Real numbers also include irrational values, such as $\sqrt{2}$ and π . Their decimals neither end nor repeat.

Read the signs

For addition, combine signed values. For subtraction, add the opposite.

$$-6 + 9 = 3$$

$$4 - (-2) = 6$$

Multiply or divide: matching signs give a positive result; different signs give a negative result. Never divide by zero.

Use order of operations

Grouping $\rightarrow$ exponents $\rightarrow$ multiply/divide from left to right $\rightarrow$ add/subtract from left to right.

$$18 - 2 \times (3 + 1) = 10$$

First $3 + 1 = 4$; then $2 \times 4 = 8$; finally $18 - 8 = 10$. Multiplication and division have equal priority.

Distance from zero

Absolute value is a nonnegative distance.

$$|-3| = 3 \text{ and } |0| = 0.$$



Factors and multiples

A factor divides a whole number evenly. A multiple is a whole-number product.

GCF of 18 and 24: 6.

LCM of 6 and 8: 24.

Use the greatest common factor to simplify fractions. Use a common multiple to find a common denominator.

Translate the situation

5 less than x: $x - 5$

3 times a number: $3x$

A fee of \$8 plus \$4 per hour: $8 + 4h$

Define the variable and its units. Word order matters: "5 less than x" means subtract 5 from x.

Coach's cue: Estimate first. Your estimate helps catch a misplaced decimal or an unreasonable sign.

FRACTIONS & PROPORTIONAL REASONING

Parts, rates and percents.

Keep the meaning of the whole visible as you calculate.

Equivalent fractions

$$3/4 = 6/8 = 0.75 = 75\%$$



6 of 8 parts = 3 of 4 parts

Multiply or divide the top and bottom by the same nonzero number. The value stays the same.

Add or subtract fractions

Use a common denominator, combine the numerators, then simplify.

$$2/3 + 1/4 = 8/12 + 3/12 = 11/12$$

Do not add denominators. For a mixed number: $2 \frac{1}{3} = (2 \times 3 + 1)/3 = 7/3$.

Multiply or divide fractions

$$(2/3) \times (9/10) = 3/5$$

$$(3/4) \div (2/5) = 15/8$$

Multiply numerators and denominators. To divide, multiply by the second fraction's reciprocal.

The divisor must be nonzero. Simplify common factors before multiplying when useful.

Ratios and unit rates

A recipe uses 2 cups of rice for 3 cups of water. Scaling both quantities by 3 gives 6 cups of rice and 9 cups of water.

$$\$7.50 \div 3 \text{ lb} = \$2.50/\text{lb}$$

A unit rate describes one unit. Keep the units attached when comparing costs or speeds.

Percent of an amount

$$\text{part} = \text{whole} \times \text{decimal rate}$$

$$18\% \text{ of } \$50 = 0.18 \times \$50 = \$9.$$

A 20% discount on \$45 gives

$$\$45 \times 0.80 = \$36.$$

Percent to decimal: divide by 100. Decimal to percent: multiply by 100.

Percent change

$$\text{change} \div \text{original} \times 100\%$$

A value rises from 80 to 100.

$$\text{Increase} = 20; 20/80 \times 100\% = 25\%.$$

Use the original amount as the base. From 100 back to 80 is a 20% decrease, not a 25% decrease. The usual formula needs a nonzero original value.

Coach's cue: A percentage needs a base. Ask "a percent of what?" before choosing your calculation.

EXPRESSIONS & POWERS

Make the structure visible.

Simplify carefully, and keep every restriction that makes an expression defined.

Combine like terms

$$5x + 2 + 3x - 7 = 8x - 5$$

Like terms have the same variable part and the same exponents.

$3x$ and $4x$ can combine. $3x$ and $4x^2$ cannot. When substituting a negative value, use parentheses.

Distribute and factor

$$3(x - 4) = 3x - 12$$

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

Distribute to every term inside the parentheses. Factoring reverses distribution.

A minus sign also distributes: $-(x - 5) = -x + 5$.

Exponent rules

$$a^m \times a^n = a^{m+n}$$

$$a^m \div a^n = a^{m-n}$$

$$(a^m)^n = a^{mn}$$

For integer exponents, use nonzero a when dividing or using zero/negative powers. Also: $a^0 = 1$ and $a^{-n} = 1/a^n$ for $a \neq 0$. These rules do not add unlike bases.

Square roots

$$\sqrt{49} = 7$$

$$\sqrt{72} = \sqrt{(36 \times 2)} = 6\sqrt{2}$$

The square-root symbol means the nonnegative root. But solving $x^2 = 49$ gives $x = 7$ or $x = -7$.

In the real-number system, $\sqrt{x}$ requires $x \geq 0$. Also $\sqrt{(x^2)} = |x|$.

Scientific notation

$$42,000 = 4.2 \times 10^4$$

$$0.0063 = 6.3 \times 10^{-3}$$

Write a nonzero number as $a \times 10^n$, with $1 \leq |a| < 10$ and integer n .

A positive exponent scales up; a negative exponent scales down. Keep the original sign.

Multiply two binomials

$$(x + 2)(x + 3)$$

$$= x^2 + 5x + 6$$

Multiply each term in the first factor by each term in the second, then combine like terms.

Check with $x = 1$: $(1 + 2)(1 + 3) = 12$, and $1^2 + 5(1) + 6 = 12$.

Coach's cue: Simplifying changes the form, not the value. Substitute a small number to check your work.

EQUATIONS & INEQUALITIES

Keep both sides balanced.

Write one justified step per line, then check the result in the original statement.

Solve a linear equation

$$4x - 7 = 13$$

$$4x = 20$$

$$x = 5$$

Add 7 to both sides, then divide both sides by 4.

Check: $4(5) - 7 = 13$.

Variables on both sides

$$5x + 2 = 2x + 14$$

$$3x + 2 = 14$$

$$x = 4$$

Subtract $2x$ from both sides, subtract 2, then divide by 3. If simplifying gives $0 = 0$, every allowed value works; if it gives $0 = 5$, none works.

Reverse an inequality

$$-2x \geq 8 \rightarrow x \leq -4$$

Reverse the inequality sign whenever you multiply or divide both sides by a negative number.

Adding or subtracting the same number on both sides does not reverse it.

Graph the solution

$$x < 3$$



Open circle: boundary excluded ($<$ or $>$). Filled circle: boundary included ($\leq$ or $\geq$). Shade the values that satisfy the inequality.

Rearrange a formula

$$d = rt \rightarrow t = d/r$$

If $d = 180$ miles and $r = 60$ miles/hour, then $t = 180/60 = 3$ hours.

Divide both sides by the same nonzero rate. Units help confirm that you solved for time.

Solve by factoring

$$x^2 - 5x + 6 = 0$$

$$(x - 2)(x - 3) = 0$$

$$x = 2 \text{ or } x = 3$$

If a product is zero, at least one factor is zero. Check both values in the original equation. The quadratic formula on page 8 also works.

Coach's cue: Write the relationship before substituting numbers. Keep the units and the question in view.

GRAPHS & FUNCTIONS

Read what changes.

A graph connects the algebra to a picture of the relationship.

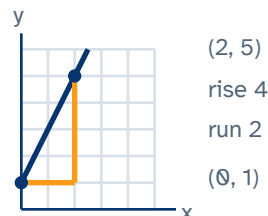
Coordinates and slope

$$m = (y_2 - y_1)/(x_2 - x_1)$$

A point (x, y) gives horizontal position first. Slope measures change in y per unit of x.

Use the same point order in the numerator and denominator. The denominator must be nonzero.

Rise over run



Between (0, 1) and (2, 5), $m = 4/2 = 2$.

Write a line

$$y = mx + b$$

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

In $y = 2x + 1$, slope $m = 2$ and y-intercept $b = 1$.

Positive slope rises left to right; negative slope falls. A horizontal line has slope 0. A vertical line has undefined slope.

Solve a system

$$x + y = 7$$

$$x - y = 1$$

Add the equations: $2x = 8$, so $x = 4$. Substitute: $y = 3$. The solution is **(4, 3)**.

Two distinct nonparallel lines meet once; parallel distinct lines never meet; the same line has infinitely many shared points.

Understand a function

$$f(x) = 3x - 2$$

$$f(4) = 3(4) - 2 = 10$$

A function assigns exactly one output to each allowed input. On a graph, a vertical line must not cross it more than once.

Different inputs may share an output. The same input cannot have two different outputs.

Graph an inequality

For $y > 2x + 1$, draw the boundary $y = 2x + 1$ dashed, then shade above it.

Use a solid boundary for $\geq$ or $\leq$. Test a point away from the line to confirm the correct side.

At (0, 0), $0 > 1$ is false, so the region containing that point is not the solution.

Coach's cue: Name both axes and read their scales. A slope is a rate, so explain it using the graph's units.

GEOMETRY & MEASUREMENT

Choose the right dimension.

Perimeter measures an edge. Area measures a surface. Volume measures space.

Perimeter and rectangles

$$P = 2l + 2w \cdot A = lw$$

A 9 ft by 4 ft room has perimeter **26 ft** and floor area **36 ft²**.

For a square of side s : $P = 4s$ and $A = s^2$. Perimeter is in linear units; area is in square units.

Base and height

$$\text{Parallelogram: } A = bh$$

$$\text{Triangle: } A = bh/2$$

$$\text{Trapezoid: } A = (b_1 + b_2)h/2$$

h is perpendicular height. Trapezoid bases b_1 and b_2 are parallel. With bases 6 and 10 and height 3: $A = (6 + 10) \times 3/2 = 24$ square units.

Circles

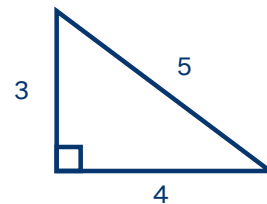
$$d = 2r$$

$$C = 2\pi r = \pi d$$

$$A = \pi r^2$$

r is radius; d is diameter. With $r = 3$, circumference is 6π and area is 9π . Use the requested approximation for π , and round at the end.

Right triangles



Right angle

$a^2 + b^2 = c^2$. The hypotenuse c is opposite the right angle: $3^2 + 4^2 = 5^2$.

Composite shapes

Split a complex shape into familiar pieces. Add their areas, or subtract a missing region.

$$10 \times 6 - 3 \times 2 = 54$$

A 10 by 6 rectangle with a 3 by 2 corner removed has area 54 square units. Do not count internal edges as outside perimeter.

Convert before calculating

$$1 \text{ ft} = 12 \text{ in}$$

$$1 \text{ ft}^2 = 144 \text{ in}^2$$

Square the conversion factor for area; cube it for volume. Keep all lengths in the same unit before using a formula.

1 m = 100 cm, so $1 \text{ m}^2 = 10,000 \text{ cm}^2$. A scale factor k changes area by k^2 and volume by k^3 .

Coach's cue: Draw a sketch and label known lengths. A slanted side is not usually the perpendicular height.

DATA & PROBABILITY

Read the evidence.

Describe the pattern, check the scale, and count the possible outcomes carefully.

Center and spread

mean = sum ÷ count

range = maximum – minimum

For 2, 4, 4, 6, 9: mean = **5**, median = **4**, mode = **4**, and range = **7**.

Sort values before finding the median. With an even count, average the two middle values.

Read tables and graphs

Bar graph: compare categories.

Line graph: follow change.

Histogram: group numeric values into intervals.

Scatter plot: compare paired values.

Check axis labels, units, intervals and whether the vertical scale begins at zero. Association alone does not establish a cause.

Quartiles and box plots

IQR = $Q_3 - Q_1$

A box plot displays minimum, lower quartile Q_1 , median, upper quartile Q_3 and maximum.

The interquartile range measures the spread of the middle half. Read the quartile values from the plot; follow a stated method when calculating them.

Simple probability

P(event) = favorable ÷ total

For one roll of a fair six-sided die, P(number above 4) = $2/6 = 1/3$.

This counting formula assumes equally likely outcomes. Probability ranges from 0 to 1. The complement has probability $1 - P(\text{event})$.

Repeated events

For independent events, multiply probabilities: two heads with a fair coin gives $(1/2) \times (1/2) = 1/4$.

Without replacement, update the counts. From 3 red and 2 blue beads, two reds have probability $(3/5) \times (2/4) = 3/10$.

Count and compare fairly

With 3 shirts and 2 pairs of pants, there are $3 \times 2 = 6$ outfits.

A survey of only your friends may not represent a whole city. Consider how the sample was selected.

For a weighted mean, add value $\times$ frequency, then divide by total frequency. A circle graph's shares should total 100%.

Coach's cue: An unusual value can pull the mean. Compare the mean and median before describing a typical value.

FORMULA DESK REFERENCE

Keep the method close.

Use these formulas with the explanations on the earlier pages.

Prisms and pyramids

Right prism: $V = Bh$

$SA = ph + 2B$

Pyramid: $V = Bh/3$

B = base area, p = base perimeter, h = perpendicular height.
For a regular pyramid with common slant height s , $SA = ps/2 + B$. A rectangular prism has $V = lwh$ and $SA = 2(lw + lh + wh)$.

Cylinders, cones and spheres

Cylinder: $V = \pi r^2 h$

$SA = 2\pi rh + 2\pi r^2$.

Right circular cone: $V = \pi r^2 h/3$

$SA = \pi rs + \pi r^2$.

Sphere: $V = 4\pi r^3/3$; $SA = 4\pi r^2$.

r = radius, h = perpendicular height, s = slant height.
Surface area includes the base(s). Volume uses cubic units.

The quadratic formula

$ax^2 + bx + c = 0, a \neq 0$

$x = [-b \pm \sqrt{(b^2 - 4ac)}]/(2a)$

For $x^2 - 5x + 6 = 0$:

$x = [5 \pm \sqrt{(25 - 24)}]/2$

= 3 or 2.

The entire numerator is divided by $2a$. A negative discriminant gives no real solution.

Rates, cost and interest

distance = rate $\times$ time

cost = quantity $\times$ unit price

simple interest: $I = Prt$

P = principal; r = rate as a decimal; t uses the same time period as the rate. For \$500 at 4% per year for 2 years: $I = \$40$. Total with simple interest = \$540. This is not compound interest.

A reliable study routine

1. Name the quantity you need.
2. List the known values and units.
3. Choose a relationship.
4. Substitute and calculate.
5. Check the units and reasonableness.

Use this reference during study. Consult the official GED.com classroom resources for the test-day formula sheet and calculator guidance.

Your next step



Scan for your free download, lessons and study tools.

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Paid plans include practice tests and Coach Me.

Coach's cue: Try a fresh problem without the sheet after practicing. Retrieval helps you see what still needs work.