Arithmetic & word problems

Translate the words before calculating. Use consistent units, and identify the original value in every percent problem.

Percent of a quantity	part = (p / 100) × whole	p is the percent number. A rate of 12% is 0.12 in a calculation.
Percent change	100 × (new - old) / old	The denominator is the original value, assumed positive. A negative result means a decrease.
Successive changes	final = initial × (1 + r) × (1 + s)	Use signed decimal rates. A 20% rise followed by a 20% fall gives 1.2 × 0.8 = 0.96.
Ratio shares	A = T × a / (a + b); B = T × b / (a + b)	For a total T split in the ratio a:b, with positive a and b.
Distance and rate	distance = rate × time	Convert minutes to hours when the rate is in miles per hour.
Average speed	average speed = total distance / total time	Do not average two speeds unless the time spent at each speed is equal.
Combined work	1 / T = 1 / a + 1 / b	Two workers finish alone in a and b time units. Assume constant independent rates; subtract an opposing rate.
Simple interest	A = P(1 + rt)	P is principal, r is the annual decimal interest rate, and t is years. Interest earned is Prt.
Compound interest	$A = P(1 + r / n)^{nt}$	n compounding periods per year; no deposits or withdrawals; r is the annual decimal rate.
Remainder	N = dq + r; 0 <= r < d	For integer N and positive integer divisor d; q is an integer quotient.
GCD and LCM	gcd(a, b) × lcm(a, b) = ab	For positive integers a and b. Prime factors help you find both quantities.

PUT IT TO WORK

A car travels 60 miles at 30 mph, then 60 miles at 60 mph. What is its average speed?

Total distance = 120 miles. Total time = 60/30 + 60/60 = 3 hours. Average speed = 120/3 = 40 mph.

Watch out: 45 mph is the mean of the speeds, but more time was spent traveling at 30 mph.

Reference: ETS GRE Math Review | Independent resource; not endorsed by ETS.

Algebra, exponents & sequences

Keep track of signs and restrictions. Check every candidate answer in the original equation when you square or clear denominators.

Exponent rules	$a^m \times a^n = a^{m+n}$; $(a^m)^n = a^{mn}$	Shown for integer exponents; any expression with a negative exponent requires a nonzero base.
Division and negatives	$a^m / a^n = a^{m-n}$; $a^{-n} = 1 / a^n$	a must be nonzero. Also, $a^0 = 1$ for a nonzero a.
Roots	$\sqrt{a^2} = \lvert a \rvert$; $\sqrt{ab} = \sqrt{a}\sqrt{b}$	The product rule shown requires a and b to be nonnegative real numbers.
Difference of squares	$a^2 - b^2 = (a - b)(a + b)$	The sign between the squared terms must be subtraction.
Perfect squares	$(a + b)^2 = a^2 + 2ab + b^2$	For $(a - b)^2$, the middle term is $-2ab$. Never omit the middle term.
Quadratic formula	$x = (-b \pm \sqrt{b^2 - 4ac}) / (2a)$	For $ax^2 + bx + c = 0$, $a \neq 0$. The discriminant $b^2 - 4ac$ determines the number of real roots.
Slope and line	$m = (y2 - y1) / (x2 - x1)$; $y = mx + b$	$x2 \neq x1$. A vertical line has undefined slope; a horizontal line has slope 0.
Parallel / perpendicular	parallel: $m1 = m2$; perpendicular: $m1 \times m2 = -1$	These slope formulas apply to nonvertical lines. A vertical line is perpendicular to a horizontal line.
Absolute value	$\lvert x - a \rvert = d$ means $x = a + d$ or $x = a - d$	For $d \geq 0$. Absolute value measures distance, so it cannot be negative.
Arithmetic sequence	$a_n = a_1 + (n - 1)d$; $S_n = n(a_1 + a_n) / 2$	d is the common difference and n is a positive integer. S_n sums the first n terms.
Geometric sequence	$a_n = a_1 \times r^{n-1}$	r is the common ratio and n is a positive integer.

PUT IT TO WORK

If $x < 0$ and $x^2 = 49$, what is $\sqrt{x^2} - x$?

$x = -7$, but $\sqrt{x^2} = \lvert x \rvert = 7$. Therefore $\sqrt{x^2} - x = 7 - (-7) = 14$.

Watch out: The principal square root is nonnegative. Also reverse an inequality sign when multiplying or dividing both sides by a negative number.

Reference: ETS GRE Math Review | Independent resource; not endorsed by ETS.

Geometry & coordinates

Do not infer lengths or angles from how a diagram looks. Use stated facts and mark radii, heights, and perpendicular lines explicitly.

Rectangle / parallelogram	rectangle: A = lw, P = 2(l + w); parallelogram: A = bh	h is the perpendicular height, not necessarily a slanted side.
Triangle / trapezoid	triangle: A = bh / 2; trapezoid: A = (b1 + b2)h / 2	b1 and b2 are the parallel bases of the trapezoid; h is perpendicular to them.
Triangle facts	angle sum = 180 degrees; $\|a - b\| < c < a + b$	The side inequality holds for a nondegenerate triangle with positive side lengths a, b, c.
Right triangle	$a^2 + b^2 = c^2$	c is the hypotenuse. Common triples: 3-4-5, 5-12-13, and their positive multiples.
Special right triangles	45-45-90: x, x, × sqrt(2); 30-60-90: x, × sqrt(3), 2x	Lengths appear opposite the angles in increasing order. The final length is the hypotenuse.
Circle	A = pi r^2; C = 2 pi r = pi d	d = 2r. Use the radius, not the diameter, in the area formula.
Arc / sector	arc = (theta / 360) × 2 pi r; sector = (theta / 360) × pi r^2	theta is the central angle in degrees; arc is a length and sector is an area.
Rectangular solid	V = lwh; surface area = 2(lw + lh + wh)	All three dimensions must use the same length unit.
Cylinder	V = pi r^2 h; total surface area = 2 pi rh + 2 pi r^2	Surface area shown includes both circular ends of a right circular cylinder.
Coordinate distance / midpoint	D = sqrt($(x2 - x1)^2 + (y2 - y1)^2$)	Midpoint = ((x1 + x2)/2, (y1 + y2)/2). Distance is always nonnegative.
Similarity / polygon angles	length factor k: area factor k^2; volume factor k^3	For similar figures/solids and k > 0. An n-sided simple polygon has interior angle sum (n - 2) × 180 degrees.

PUT IT TO WORK

A circle has radius 6. What is the area of a sector with a 60-degree central angle?

Sector area = (60/360) × pi × 6^2 = 6 pi square units.

Watch out: The corresponding arc length is 2 pi units. Arc length and sector area are different quantities.

Reference: ETS GRE Math Review | Independent resource; not endorsed by ETS.

Statistics & data interpretation

Check the sample size, axis scale, units, and whether a chart reports counts or percentages before calculating.

Arithmetic mean	mean = sum of values / n; sum = n × mean	n is the number of observations, including repeated values.
Weighted mean	weighted mean = sum(weight × value) / sum(weights)	Use nonnegative weights with a positive total. Group means must be weighted by group sizes.
Median	odd n: middle value; even n: mean of middle two	Sort the observations first. A median need not be one of the observed values when n is even.
Mode / range	mode = most frequent value; range = maximum - minimum	A data set can have more than one mode. Range uses only the two extreme observations.
Interquartile range	IQR = Q3 - Q1	Q1 and Q3 are the first and third quartiles. Use the question's quartile convention when one is specified.
Population standard deviation	SD = sqrt(sum((x - mean)^2) / n)	This is the population formula. Sample SD instead divides by n - 1; do not switch definitions silently.
Adding a constant	new mean = old mean + c; new SD = old SD	Adding c to every observation shifts the data but does not change the spread or range.
Multiplying by a constant	new mean = k × old mean; new SD = |k| × old SD	The range is also multiplied by |k|. Spread cannot become negative.
Normal distribution	about 68%, 95%, 99.7% within 1, 2, 3 SD of mean	Use only for a normal distribution. These are approximate proportions, not rules for arbitrary data.
Standardized distance	z = (x - mean) / SD	SD must be positive. z tells how many standard deviations a value lies above or below the mean.
Percentage points	point change = new percent - old percent	From 20% to 30% is +10 percentage points, but a 50% relative increase.

PUT IT TO WORK

A group of 10 students has mean score 70. A group of 30 students has mean score 90. What is the combined mean?

Total score = 10 × 70 + 30 × 90 = 3,400. Combined mean = 3,400 / 40 = 85.

Watch out: 80 gives both groups equal weight even though one group has three times as many students.

Reference: ETS GRE Math Review | Independent resource; not endorsed by ETS.

Counting, sets & probability

Decide whether order matters, whether repeats are allowed, and whether events are independent. Those choices determine the formula.

Multiplication principle	total outcomes = n1 × n2 × … × nk	Multiply the number of choices at each stage when each prior choice leaves those numbers of options.
Factorial	n! = n(n - 1)…1; 0! = 1	n is a nonnegative integer. n distinct objects can be arranged in n! orders.
Permutations	nPr = n! / (n - r)!	Order matters. Choose r distinct objects from n without replacement, with 0 <= r <= n.
Combinations	nCr = n! / (r!(n - r)!)	Order does not matter. Choose r distinct objects from n without replacement.
Repeated objects	arrangements = n! / (a! b! …)	a, b, … are counts of indistinguishable types and sum to n, such as repeated letters.
Equally likely outcomes	P(A) = favorable outcomes / total outcomes	Count this way only when the individual outcomes are equally likely.
Complement	P(not A) = 1 - P(A)	For 'at least one,' it is often easier to calculate 1 minus the probability of none.
Either event	P(A or B) = P(A) + P(B) - P(A and B)	'Or' includes both. If events are mutually exclusive, their overlap is zero.
Both events	P(A and B) = P(A) × P(B given A)	Only for independent events may you replace P(B given A) with P(B).
Two overlapping sets	|A union B| = |A| + |B| - |A intersection B|	Neither = total - |A union B|. Count the overlap once, not twice.
Expected value	E(X) = sum(value × probability)	Use all possible values and their probabilities, which must sum to 1.

PUT IT TO WORK

A bag holds 3 red and 2 blue balls. Two balls are drawn without replacement. What is the probability that both are red?

P(both red) = (3/5) × (2/4) = 3/10. After one red ball is drawn, 2 red balls remain among 4 total.

Watch out: The draws are not independent. Multiplying (3/5) × (3/5) would describe replacement instead.

Reference: ETS GRE Math Review | Independent resource; not endorsed by ETS.