ISEE Math Formula Sheets (Lower, Middle, Upper)

These ISEE math formula sheets were compiled by ISEEPrep's teaching team and are grouped by Lower, Middle and Upper Level. They list the formulas and rules used most often in number and operations, fractions and percents, ratios, algebra, geometry, and data and probability, and every row comes with a short worked example using real numbers. No calculator may be brought into the ISEE, and this sheet cannot be brought in either, so the formulas must be memorized ahead of time. The sheets are a free, printable PDF.

These sheets organize the formulas, conversions and rules used most often in math for the ISEE Lower, Middle and Upper Levels. The three levels build on one another: the Middle Level assumes students already know the Lower Level material, and the Upper Level assumes they know both earlier levels. Each row gives the topic, the formula or key point, and a short example with numbers.

> No calculator may be brought into the ISEE (except with an accommodation approved in advance), and this sheet cannot be brought into the test room either, so the formulas and conversions on it must be memorized and practiced by hand before the test. The sheet was compiled by ISEEPrep's teaching team for study; it is not an E3n (formerly ERB) publication.

Lower Level (applying to grades 5–6)

Number and Operations

Topic	Formula or key point	Example
Place value	From right to left: ones, tens, hundreds, thousands; after the decimal point: tenths, hundredths	In 3,482 the 4 is in the hundreds place and stands for 400
Rounding	Look at the digit just to the right of the place you are rounding to: 5 or more rounds up, 4 or less rounds down	3,482 rounded to the nearest hundred is 3,500
Factors and multiples	If a × b = c, then a and b are factors of c, and c is a multiple of a and of b	Factors of 12: 1, 2, 3, 4, 6, 12
Prime numbers	A prime has exactly two factors, 1 and itself; 1 is not prime, and 2 is the only even prime	Primes less than 20: 2, 3, 5, 7, 11, 13, 17, 19
Order of operations	Parentheses first, then multiplication and division (left to right), then addition and subtraction (left to right)	8 + 4 × (5 − 2) = 8 + 12 = 20

Fractions, Decimals and Percents

Topic	Formula or key point	Example
Common conversions (1)	1/2 = 0.5 = 50%; 1/4 = 0.25 = 25%; 3/4 = 0.75 = 75%	3/4 of 40 = 40 ÷ 4 × 3 = 30
Common conversions (2)	1/5 = 0.2 = 20%; 1/10 = 0.1 = 10%; 1/8 = 0.125 = 12.5%; 1/3 ≈ 0.333	3/8 = 3 × 0.125 = 0.375 = 37.5%
Adding and subtracting fractions	Rewrite with the least common denominator, add or subtract the numerators, then simplify	1/4 + 1/6 = 3/12 + 2/12 = 5/12
Multiplying fractions	Multiply numerator by numerator and denominator by denominator; simplify first when possible	2/3 × 3/5 = 6/15 = 2/5
Dividing fractions	Dividing by a fraction is the same as multiplying by its reciprocal	3/4 ÷ 1/2 = 3/4 × 2 = 3/2 = 1½

Geometry and Measurement

Topic	Formula or key point	Example
Rectangle	Perimeter = 2 × (length + width); area = length × width	Length 7, width 3: perimeter 20, area 21
Square	Perimeter = 4 × side; area = side × side	Side 5: perimeter 20, area 25
Area of a triangle	Area = base × height ÷ 2 (the height is perpendicular to the base)	Base 8, height 5: area = 8 × 5 ÷ 2 = 20
Time	1 hour = 60 minutes; 1 minute = 60 seconds; 1 day = 24 hours; 1 week = 7 days	2.5 hours = 2.5 × 60 = 150 minutes
US customary units	1 foot (ft) = 12 inches (in); 1 yard (yd) = 3 feet; 1 pound (lb) = 16 ounces (oz)	4 ft = 48 in; 3 lb = 48 oz
Metric prefixes	kilo = 1,000; centi = 1/100; milli = 1/1,000	2.5 km = 2,500 m; 150 cm = 1.5 m

Data and Probability

Topic	Formula or key point	Example
Mean (average)	Mean = sum of all the values ÷ number of values	4, 7, 10: (4 + 7 + 10) ÷ 3 = 7
Simple probability	Probability = number of favorable outcomes ÷ number of possible outcomes (all outcomes equally likely); always between 0 and 1	3 red balls and 5 blue balls: probability of drawing red = 3/8

Middle Level (applying to grades 7–8)

Number and Operations

Topic	Formula or key point	Example
Adding and subtracting negatives	Subtracting a number is the same as adding its opposite	$-3 - (-8) = -3 + 8 = 5$
Multiplying and dividing negatives	Same signs give a positive; different signs give a negative	$(-6) \times 4 = -24$; $(-20) \div (-5) = 4$
Absolute value	The distance of a number from 0; the result is never negative	$\lvert -7 \rvert = 7$; $\lvert 3 - 10 \rvert = \lvert -7 \rvert = 7$
Exponents	$a^3 = a \times a \times a$; any nonzero number to the power 0 equals 1	$2^5 = 32$; $(-3)^2 = 9$; $-3^2 = -9$
Square roots	$\sqrt{a}$ is the nonnegative number whose square is a; memorize the squares 1^2 through 15^2	$\sqrt{144} = 12$; $\sqrt{49} = 7$

Ratios, Percents and Rates

Topic	Formula or key point	Example
Ratios and proportions	$a : b = a/b$ and can be simplified; if $a/b = c/d$, then $a \times d = b \times c$ (cross-multiplication)	$3/4 = x/20 \rightarrow 4x = 60 \rightarrow x = 15$
Unit rate	Unit rate = total ÷ number of units	5 books for \$15 → \$3 per book
Percent of a number	Part = percent × whole; whole = part ÷ percent	15% of 30 = 0.15 × 30 = 4.5
Percent change	Percent change = (new value − original value) ÷ original value × 100%	40 → 50 is a 25% increase; 50 → 40 is a 20% decrease
Distance problems	Distance = rate × time; time = distance ÷ rate	60 miles per hour for 2.5 hours → 150 miles

Algebra and Geometry

Topic	Formula or key point	Example
One-step and two-step equations	Do the same inverse operation to both sides: undo addition and subtraction first, then multiplication and division	$3x - 4 = 11 \rightarrow 3x = 15 \rightarrow x = 5$
Angles	A straight angle = 180°; the angles of a triangle add up to 180°; vertical angles are equal	Two angles of 50° and 70° → the third angle is 60°
Parallelograms and trapezoids	Area of a parallelogram = base × height; area of a trapezoid = $(\text{base}_1 + \text{base}_2) \times \text{height} \div 2$	Trapezoid with bases 4 and 10, height 5: area 35
Circles	Circumference $C = 2\pi r = \pi d$; area $A = \pi r^2$; $\pi \approx 3.14$	$r = 3$: $C = 6\pi \approx 18.84$, $A = 9\pi \approx 28.26$
Volume of a rectangular prism	Volume = length × width × height	2 × 3 × 4 = 24 cubic units

Data and Probability

Topic	Formula or key point	Example
Median, mode, range	Median: the middle value when the data are in order (with an even count, the mean of the two middle values); mode: the value that appears most often; range = greatest − least	3, 5, 5, 8, 9: mean 6, median 5, mode 5, range 6
Independent events	P(A and B) = P(A) × P(B)	Two coin tosses both heads: 1/2 × 1/2 = 1/4
Complementary events	P(not happening) = 1 − P(happening)	Probability a die does not show 6 = 1 − 1/6 = 5/6

Upper Level (applying to grades 9–12)

Exponents, Radicals and Algebra

Topic	Formula or key point	Example
Multiplying and dividing powers with the same base	Same base multiplied: add the exponents; same base divided: subtract the exponents	$2^3 \times 2^4 = 2^7 = 128$; $5^6 \div 5^4 = 5^2 = 25$
Power of a power, zero and negative exponents	Power of a power: multiply the exponents; any nonzero number to the power 0 = 1; a negative exponent means the reciprocal	$(3^2)^3 = 3^6 = 729$; $2^{-3} = 1/2^3 = 1/8$
Simplifying radicals	$\sqrt{(a \times b)} = \sqrt{a} \times \sqrt{b}$; take any perfect-square factor outside the radical	$\sqrt{50} = \sqrt{25} \times \sqrt{2} = 5\sqrt{2}$
Inequalities	When multiplying or dividing both sides by a negative number, reverse the inequality sign	$-2x > 8 \rightarrow x < -4$
Slope	Slope $m = (y_2 - y_1) \div (x_2 - x_1)$	Through (1, 2) and (3, 8): $m = 6 \div 2 = 3$
Slope-intercept form	$y = mx + b$: m is the slope and b is the y-intercept	$y = 3x - 1$: slope 3, passes through (0, −1)
Systems of two linear equations	Use elimination or substitution to remove one variable	$x + y = 10$, $x - y = 4 \rightarrow 2x = 14 \rightarrow x = 7$, $y = 3$
Factoring	Difference of squares $a^2 - b^2 = (a + b)(a - b)$; for $x^2 + bx + c$, find two numbers with sum b and product c	$x^2 - 49 = (x + 7)(x - 7)$; $x^2 + 5x + 6 = (x + 2)(x + 3)$

Coordinates and Geometry

Topic	Formula or key point	Example
Distance formula	$d = \sqrt{((x_2 - x_1)^2 + (y_2 - y_1)^2)}$	(1, 2) to (4, 6): $\sqrt{(3^2 + 4^2)} = \sqrt{25} = 5$

Topic	Formula or key point	Example
Midpoint formula	Midpoint = $((x_1 + x_2) \div 2, (y_1 + y_2) \div 2)$	The midpoint of (1, 2) and (5, 8) is (3, 5)
Pythagorean theorem	$a^2 + b^2 = c^2$ (c is the hypotenuse); common Pythagorean triples 3-4-5, 5-12-13, 8-15-17 and their multiples	Legs 6 and 8 → hypotenuse $\sqrt{100} = 10$
Special right triangles	45-45-90 sides in the ratio 1 : 1 : $\sqrt{2}$; 30-60-90 sides in the ratio 1 : $\sqrt{3}$: 2 (short leg : long leg : hypotenuse)	30-60-90 with short leg 4 → long leg $4\sqrt{3}$, hypotenuse 8
Similar triangles	Corresponding angles are equal and corresponding sides are proportional; the ratio of areas = the square of the ratio of sides	Side ratio 2 : 3, a side of the smaller triangle is 4 → the corresponding side is 6
Arcs and sectors	Arc length = $2\pi r \times$ central angle $\div 360°$; sector area = $\pi r^2 \times$ central angle $\div 360°$	r = 6, central angle 90°: arc length 3π, sector area 9π
Volume of prisms and cylinders	Volume of a prism = area of base × height; volume of a cylinder = $\pi r^2 h$	Cylinder with r = 2, h = 5: volume = 20π

Counting and Probability

Topic	Formula or key point	Example
Counting principle	When a task is done in steps, the total number of ways = the product of the number of ways for each step	3 shirts and 4 pairs of pants: 3 × 4 = 12 outfits
With and without replacement	With replacement: the probability stays the same on each draw; without replacement: on the second draw, both the total and the number of target items go down by 1	3 red and 2 blue, both draws red: with replacement 3/5 × 3/5 = 9/25; without replacement 3/5 × 2/4 = 3/10

Common mistakes

- [ ] Units not matched: the problem gives minutes but asks for hours, or one length is in feet and another in inches.
- [ ] Using the diameter as the radius: the circle area and circumference formulas use the radius, r = diameter ÷ 2.
- [ ] Not reversing the inequality sign after multiplying or dividing by a negative number.
- [ ] Ignoring the order of operations: working straight from left to right instead of doing parentheses, multiplication and division first.
- [ ] Dividing by the wrong number in percent change: divide by the original value, not the new value.
- [ ] Mixing up -3^2 and $(-3)^2$: the first is −9, the second is 9.

- [ ] Forgetting to divide by 2 for the area of a triangle, or using a side that is not perpendicular to the base as the height.
- [ ] Choosing an answer as soon as an intermediate result appears, without going back to check what the question actually asks.

Formulas I tend to forget

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