



PRE-ALGEBRA I Learning Objectives



NUMBER SENSE

The learner will

- ☑ read, write and compare rational numbers in scientific notation (positive and negative powers of 10) with approximate numbers using scientific notation.
- ☑ add, subtract, multiply and divide rational numbers (integers, fractions and terminating decimals) and take positive rational numbers to whole-number powers.
- ☑ convert fractions to decimals and percents and use these representations in estimations, computations and applications.
- ☑ differentiate between rational and irrational numbers.
- ☑ know that every rational number is either a terminating or repeating decimal and be able to convert terminating decimals into reduced fractions.
- ☑ calculate the percentage of increases and decreases of a quantity.
- ☑ solve problems that involve discounts, markups, commissions and profit and compute simple and compound interest.
- ☑ understand negative whole-number exponents.
- ☑ multiply and divide expressions involving exponents with a common base.
- ☑ add and subtract fractions by using factoring to find common denominators.
- ☑ multiply, divide and simplify rational numbers by using exponent rules.
- ☑ use the inverse relationship between raising to a power and extracting the root of a perfect square integer; for an integer that is not square, determine without a calculator the two integers between which its square root lies and explain why.
- ☑ understand the meaning of the absolute value of a number; interpret the absolute value as the distance of the number from zero on a number line; and determine the absolute value of real numbers.

ALGEBRA AND FUNCTIONS

The learner will

- ☑ use variables and appropriate operations to write an expression, an equation, an inequality, or a system of equations or inequalities that represents a verbal description (e.g., three less than a number, half as large as area A).
- ☑ use the correct order of operations to evaluate algebraic expressions such as $3(2x + 5)^2$.
- ☑ simplify numerical expressions by applying properties of rational numbers (e.g., identity, inverse, distributive, associative, commutative) and justify the process used.
- ☑ use algebraic terminology (e.g., variable, equation, term, coefficient, inequality, expression, constant) correctly.
- ☑ represent quantitative relationships graphically and interpret the meaning of a specific part of a graph in the situation represented by the graph.
- ☑ interpret positive whole-number powers as repeated multiplication and negative whole-number powers as repeated division or multiplication by the multiplicative inverse.
- ☑ simplify and evaluate expressions that include exponents.
- ☑ multiply and divide monomials; extend the process of taking powers and extracting roots to monomials when the latter results in a monomial with an integer exponent.
- ☑ plot the values from the volumes of three-dimensional shapes for various values of the edge lengths (e.g., cubes with varying edge lengths or a triangle prism with a fixed height and an equilateral triangle base of varying lengths).
- ☑ graph linear functions, noting that the vertical change (change in y-value) per unit of horizontal change (change in x-value) is always the same.
- ☑ know that the ratio ("rise over run") is called the slope of a graph.
- ☑ plot the values of quantities whose ratios are always the same (e.g., cost to the number of an item, feet to inches, circumference to diameter of a circle).
- ☑ fit a line to the plot and understand that the slope of the line equals the quantities.
- ☑ solve two-step linear equations and inequalities in one variable over the rational numbers, interpret the solution or solutions in the context from which they arose and verify the reasonableness of the results.
- ☑ solve multi-step problems involving rate, average speed, distance and time or a direct variation.
- ☑ compare weights, capacities, geometric measures, times and temperatures within and between measurement systems (e.g., miles per hour and feet per second, cubic inches to cubic centimeters).
- ☑ construct and read drawings and models made to scale.
- ☑ use measures expressed as rates (e.g., speed, density) and measures expressed as products (e.g., person-days) to solve problems; check the units of the solutions; and use dimensional analysis to check the reasonableness of the answer.



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MEASUREMENT AND GEOMETRY

The learner will

- ☑ use formulas routinely for finding the perimeter and area of basic two-dimensional figures and the surface area and volume of basic three-dimensional figures, including rectangles, parallelograms, trapezoids, squares, triangles, circles, prisms and cylinders.
- ☑ estimate and compute the area of more complex or irregular two- and three-dimensional figures by breaking the figures down into more basic geometric objects.
- ☑ compute the length of the perimeter, the surface area of the faces and the volume of a three-dimensional object built from rectangular solids.
- ☑ understand that when the lengths of all dimensions are multiplied by a scale factor, the surface area is multiplied by the square of the scale factor and the volume is multiplied by the cube of the scale factor.
- ☑ relate the changes in measurement with a change of scale to the units used (e.g., square inches, cubic feet) and to conversions between units ($1 \text{ square foot} = 144 \text{ square inches}$ or $[1 \text{ ft}^2] = [144 \text{ in}^2]$, 1 cubic inch is approximately $16.38 \text{ cubic centimeters}$ or $[1 \text{ in}^3] = [16.38 \text{ cm}^3]$)
- ☑ identify and construct basic elements of geometric figures (e.g., altitudes, midpoints, diagonals, angle bisectors and perpendicular bisectors; central angles, radii, diameters and chords of circles) by using a compass and straightedge.
- ☑ understand and use coordinate graphs to plot simple figures, determine lengths and areas related to them and determine their image under translations and reflections.
- ☑ know and understand the Pythagorean theorem and its converse and use it to find the length of the missing side of a right triangle and the lengths of other line segments and, in some situations, empirically verify the Pythagorean theorem by direct measurement.
- ☑ demonstrate an understanding of conditions that indicate two geometrical figures are congruent and what congruence means about the relationships between the sides and angles of the two figures.
- ☑ construct two-dimensional patterns for three-dimensional models, such as cylinders, prisms and cones.
- ☑ identify elements of three-dimensional geometric objects (e.g., diagonals of rectangular solids) and describe how two or more objects are related in space (e.g., skew lines, the possible ways three planes might intersect).

STATISTICS, DATA ANALYSIS AND PROBABILITY

The learner will

- ☑ compute the range, mean, median and mode of data sets.
- ☑ understand how additional data added to data sets may affect these computations of measures of central tendency.
- ☑ understand how the inclusion or exclusion of outliers affects measures of central tendency.
- ☑ know why a specific measure of central tendency (mean, median, mode) provides the most useful information in a given context.
- ☑ compare different samples of a population with the data from the entire population and identify a situation in which it makes sense to use a sample.
- ☑ identify different ways of selecting a sample (e.g., convenience sampling, responses to a survey, random sampling) and which method makes a sample more representative for a population.
- ☑ analyze data displays and explain why the way in which the question was asked might have influenced the results obtained and why the way in which the results were displayed might have influenced the conclusions reached.
- ☑ identify data that represent sampling errors and explain why the sample (and the display) might be biased.
- ☑ identify claims based on statistical data and, in simple cases, evaluate the validity of the claims.
- ☑ represent all possible outcomes for compound events in an organized way (e.g., tables, grids, tree diagrams) and express the theoretical probability of each outcome.
- ☑ use data to estimate the probability of future events (e.g., batting averages or number of accidents per mile driven).
- ☑ represent probabilities as ratios, proportions, decimals between 0 and 1 and percentages between 0 and 100 and verify that the probabilities computed are reasonable; know that if P is the probability of an event, $1-P$ is the probability of an event not occurring.
- ☑ understand that the probability of either of two disjoint events occurring is the sum of the two individual probabilities and that the probability of one event following another, in independent trials, is the product of the two probabilities.
- ☑ understand the difference between independent and dependent events.



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MATHEMATICAL REASONING

The learner will

- ☑ analyze problems by identifying relationships, distinguishing relevant from irrelevant information, identifying missing information, sequencing and prioritizing information and observing patterns.
- ☑ formulate and justify mathematical conjectures based on a general description of the mathematical question or problem posed.
- ☑ determine when and how to break a problem into simpler parts.
- ☑ use estimation to verify the reasonableness of calculated results.
- ☑ apply strategies and results from simpler problems to more complex problems.
- ☑ estimate unknown quantities graphically and solve for them by using logical reasoning and arithmetic and algebraic techniques.
- ☑ make and test conjectures by using both inductive and deductive reasoning.
- ☑ use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams and models, to explain mathematical reasoning.
- ☑ express the solution clearly and logically by using the appropriate mathematical notation and terms and clear language; support solutions with evidence in both verbal and symbolic work.
- ☑ indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.
- ☑ make precise calculations and check the validity of the results from the context of the problem.
- ☑ evaluate the reasonableness of the solution in the context of the original situation.
- ☑ note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems
- ☑ develop generalizations of the results obtained and the strategies used and apply them to new problem situations.

RESOURCES

Prentice-Hall Mathematics Algebra I (2005 ed.)

Internet research, applications and modeling.

PASCO measurement devices, laboratory investigations and supplemental materials.