

Grade Nine

Number, Number Sense and Operations Standard

*Number and
Number
Systems*

1. Identify and justify whether properties (closure, identity, inverse, commutative and associative) hold for a given set and operations; e.g., even integers and multiplication.
2. Compare, order and determine equivalent forms for rational and irrational numbers.
3. Explain the effects of operations such as multiplication or division, and of computing powers and roots on the magnitude of quantities.

*Meaning of
Operations*

4. Demonstrate fluency in computations using real numbers.
5. Estimate the solutions for problem situations involving square and cube roots.

Computation
and Estimation

Measurement Standard

*Measurement
Units*

1. Convert rates within the same measurement system; e.g., miles per hour to feet per second; kilometers per hour to meters per second.

Use

*Measurement
Techniques
and Tools*

2. Use unit analysis to check computations involving measurement.
3. Use the ratio of lengths in similar two-dimensional figures or three-dimensional objects to calculate the ratio of their areas or volumes respectively.
4. Use scale drawings and right triangle trigonometry to solve problems that include unknown distances and angle measures.
5. Solve problems involving unit conversion for situations involving distances, areas, volumes and rates within the same measurement system.

Geometry and Spatial Sense Standard

*Characteristics
and Properties*

1. Define the basic trigonometric ratios in right triangles: sine, cosine and tangent.
2. Apply proportions and right triangle trigonometric ratios to solve problems involving missing lengths and angle measures in similar figures.

3. Analyze two-dimensional figures in a coordinate plane; e.g., use slope and distance formulas to show that a quadrilateral is a parallelogram.

*Visualization
and Geometric
Models*

Patterns, Functions and Algebra Standard

*Use Patterns,
Relations and
Functions*

1. Define function with ordered pairs in which each domain element is assigned exactly one range element.
2. Generalize patterns using functions or relationships (linear, quadratic and exponential), and freely translate among tabular, graphical and symbolic representations.
3. Describe problem situations (linear, quadratic and exponential) by using tabular, graphical and symbolic representations.
4. Demonstrate the relationship among zeros of a function, roots of equations, and solutions of equations graphically and in words.
5. Describe and compare characteristics of the following families of functions: linear, quadratic and exponential functions; e.g., general shape, number of roots, domain, range, rate of change, maximum or minimum.
6. Write and use equivalent forms of equations and inequalities in problem situations; e.g., changing a linear equation to the slope-intercept form.
7. Use formulas to solve problems involving exponential growth and decay.

**Use Algebraic
Representations**

8. Find linear equations that represent lines that pass through a given set of ordered pairs, and find linear equations that represent lines parallel or perpendicular to a given line through a specific point.
9. Solve and interpret the meaning of 2 by 2 systems of linear equations graphically, by substitution and by elimination, with and without technology.
10. Solve quadratic equations with real roots by factoring, graphing, using the quadratic formula and with technology.
11. Add, subtract, multiply and divide monomials and polynomials (division of polynomials by monomials only).
12. Simplify rational expressions by eliminating common factors and

applying properties of integer exponents.

13. Model and solve problems involving direct and inverse variation using proportional reasoning.

Analyze Change

14. Describe the relationship between slope and the graph of a direct variation and inverse variation.
15. Describe how a change in the value of a constant in a linear or quadratic equation affects the related graphs.

Data Analysis and Probability Standard

Data Collection

1. Classify data as univariate (single variable) or bivariate (two variables) and as quantitative (measurement) or qualitative (categorical) data.
2. Create a scatterplot for a set of bivariate data, sketch the line of best fit, and interpret the slope of the line of best fit.

**Statistical
Methods**

3. Analyze and interpret frequency distributions based on spread, symmetry, skewness, clusters and outliers.
4. Describe and compare various types of studies (survey, observation, experiment), and identify possible misuses of statistical data.
5. Describe characteristics and limitations of sampling methods, and analyze the effects of random versus biased sampling; e.g., determine and justify whether the sample is likely to be representative of the population.
6. Make inferences about relationships in bivariate data, and recognize the difference between evidence of relationship (correlation) and causation.
7. Use counting techniques and the Fundamental Counting principle to determine the total number of possible outcomes for mathematical situations.

Probability

8. Describe, create and analyze a sample space and use it to calculate probability.
9. Identify situations involving independent and dependent events, and explain differences between, and common misconceptions about, probabilities associated with those events.
10. Use theoretical and experimental probability, including simulations or random numbers, to estimate probabilities and to solve problems dealing with uncertainty; e.g., compound events, independent events, simple dependent events.

