Vermont Comprehensive Assessment Program (VTCAP)

VERMONT AGENCY OF EDUCATION

Practice Test Alignment Document

Mathematics | Grade 9

Sequence Number	Standard	Learning Target
Session 1		
1	HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	Use dimensional analysis to convert between units to determine density.
2	HSF-BF.B.3 Identify the effect on the graph of replacing *f(x)* by *f(x) + k*, k f(x), *f(kx)*, and *f(x + k)* for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.	Examine transformed functions and the characteristics of their graphs.

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3	HSS-ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). HSS-ID.A.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. HSS-ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). HSS-ID.A.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.	Compare the median and interquartile ranges of two box plots within the context they describe.
4	HSA-CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*	Use a system of inequalities to determine viable options in a real-world context.
5	HSA-CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*	Write a system of inequalities to represent a real-world context.
6	HSF-LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.	Identify an interval that represents the domain of a given function based on a real-world situation.

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7	HSG-GPE.B.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).	Graph a line given a point and the equation of a perpendicular line.
8	HSA-SSE.A.2 Use the structure of an expression to identify ways to rewrite it.	Identify quadratic expressions that can be written as *(ax + b)(ax - b).*
9	HSG-CO.B.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. HSG-GPE.B.4 Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).*	Find the side lengths of triangles graphed on a coordinate plane to prove congruency.
10	HSF-BF.A.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.	Identify a formula that defines a recursive sequence.
11	HSG.CO.A.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.	Identify statements that precisely define the points that make up a circle.
12	HSA.REI.B.4 Solve quadratic equations in one variable.	Find the solutions to a quadratic equation.
13	HSA.APR.A.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.	Perform operations to determine a missing coefficient of equivalent expressions.

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14	HSF.IF.C.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum*.	Compare the maximum heights of two functions expressed in two different ways within the context it describes.
15	HSS-ID.C.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. HSS-ID.C.8 Compute (using technology) and interpret the correlation coefficient of a linear fit. HSS-ID.C.9 Distinguish between correlation and causation.	Interpret the linear model and correlation coefficient given a real-world context.
16	HSG-CO.A.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.	Perform a series of transformations to determine the quadrant in which a point lies.
17	HSN-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define* $5^{(1/3)}$ *to be the cube root of 5 because we want* $(5^{1/3})^3 = 5^{((1/3)^3)}$ *to hold, so* $(5^{1/3})^3$ *must equal 5.* HSN-RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.	Rewrite an expression with a fractional exponent as a radical expression.

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18	HSA-REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). HSA-REI.D.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and y = g(x) intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.	Identify an inequality that describes the *x*-value of a point included on the graph of two different functions.
Session 2		
1	HSF-LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). HSF-LE.A.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.	Create a linear equation to model a real-world situation.
2	HSG-CO.D.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.): copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.	Determine the constructions needed to draw a square using a compass and straightedge.

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3	HSS-ID.B.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. HSS-ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.	Complete a two-way table to represent a real-world context.
4	HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.	Identify a linear equation that represents a real-world context.
5	HSF-LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.	Interpret the parameters of a linear function that models a real-world situation.
6	HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	Solve a linear equation that results in a fractional solution.
7	HSA-APR.A.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.	Write the polynomial resulting from the product of two binomials.
8	HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.	Graph the intercepts of a quadratic function on a coordinate plane.
9	HSA-SSE.A.1.a Interpret parts of an expression, such as terms, factors, and coefficients. HSA-SSE.A.1.b Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret P(1+r)n as the product of P and a factor not depending on P.*	Interpret parts of a function and its graph that represents the volume of an object.

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10	HSG-GPE.B.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).	Determine the *y*-intercept of a perpendicular line given a point and an equation of a line.
11	HSA-SSE.B.3.c Use the properties of exponents to transform expressions for exponential functions. *For example, the expression 1.15t can be rewritten as (1.151/12)12t ≅ 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*	Identify an exponential expression that models a real-world context.
12	HSF-LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). HSF-LE.A.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.	Find the parameters of an exponential function given solutions to the function.
13	HSF-BF.A.1.a Determine an explicit expression, a recursive process, or steps for calculation from a context. HSF-BF.A.1.b Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*	Build a function from a verbal description to interpret an interval of time.

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14	HSF-IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.	Graph line segments to model a real-world situation.
15	HSG-CO.B.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.	Identify a transformation that proves the congruency of two triangles.
16	HSF-IF.C.8.a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.	Create an equivalent quadratic function in vertex form.
17	HSG-CO.A.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.	Identify congruency statements based on a given transformation.
18	HSF-BF.B.4.a Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. *For example,* $f(x) = 2x^3$ *or* $f(x) = (x+1)/(x-1)$ *for* $x \neq 1$.	Identify an expression that represents the inverse of a given function.