Georgia Mathematics

Multivariable Calculus

Mathematical Practices

0 Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals. MVC.MP

- 0.1 Make sense of problems and persevere in solving them. MVC.MP.1
- 0.2 Reason abstractly and quantitatively. MVC.MP.2
- 0.3 Construct viable arguments and critique the reasoning of others. MVC.MP.3
- 0.4 Model with mathematics. MVC.MP.4
- 0.5 Use appropriate tools strategically. MVC.MP.5
- 0.6 Attend to precision. MVC.MP.6
- 0.7 Look for and make use of structure. MVC.MP.7
- 0.8 Look for and express regularity in repeated reasoning. MVC.MP.8

Mathematical Modeling

1 Apply mathematics to real-life situations; model real-life phenomena using mathematics. MVC.MM.1

- 1.1 Explain contextual, mathematical problems using a mathematical model. MVC.MM.1.1
- 1.2 Create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts. MVC.MM.1.2
- 1.3 Using abstract and quantitative reasoning, make decisions about information and data from a contextual situation. MVC.MM.1.3
- 1.4 Use various mathematical representations and structures with this information to represent and solve real-life problems. MVC.MM.1.4

Patterning & Algebraic Reasoning

2 Express spatial and functional relationships with vectors, functions, and analytic geometry in three dimensions, and use these relationships to solve contextual, mathematical problems. MVC.PAR.2

- 2.1 Represent equations of lines in space using vectors. MVC.PAR.2.1
- 2.2 Express the analytic geometry of three dimensions in terms of the dot product and cross product of vectors. MVC.PAR.2.2
- 2.3 Use a linear system of equations to determine whether two planes intersect in a single point or a line, or whether they do not intersect at all. MVC.PAR.2.3
- 2.4 Evaluate functions of two independent variables at a point in the plane. MVC.PAR.2.4
- 2.5 Graph the level curves of functions of two independent variables. MVC.PAR.2.5
- 2.6 Investigate the continuity of functions of two independent variables in terms of the limits of such functions as (x, y) approaches a given point in the plane. MVC.PAR.2.6
- 2.7 Determine points or regions of discontinuity of functions of two independent variables. MVC.PAR.2.7

Abstract & Quantitative Reasoning

3 Define, describe, and represent the differentiation of functions of two independent variables and differential vectors to solve contextual, mathematical problems and to explain real-life phenomena. MVC.AQR.3

- 3.1 Approximate the partial derivatives at a point of a function defined by a table of data. MVC.AQR.3.1
- 3.2 Find expressions for the first and second partial derivatives of a function. MVC.AQR.3.2
- 3.3 Use the total differential to approximate mathematical models. MVC.AQR.3.3
- 3.4 Represent the partial derivatives of a system of two functions in two variables using the Jacobian. MVC.AQR.3.4
- 3.5 Find the partial derivatives of the composition of functions using the general chain rule. MVC.AQR.3
- 3.6 Apply partial differentiation to problems of optimization, including problems requiring the use of the Lagrange multiplier. MVC.AQR.3.5
- 3.7 Find the family of solutions and the envelope of the family of solutions to differential equations, including Clairaut equations. MVC.AQR.3.6
- 3.8 Define and apply the gradient, the divergence, and the curl in terms of differential vector operations. MVC.AQR.3.7

4 Interpret integrals of functions of two independent variables and of vector functions to solve contextual, mathematical problems and to explain real-life phenomena. MVC.AQR.4

- 4.1 Integrate functions of the form z = f(x, y) or w = f(x, y, z) through various techniques. MVC.AQR.4.1
- 4.2 Use, evaluate, and interpret double and triple integrals in terms of volume and mass. MVC.AQR.4.2
- 4.3 Represent and evaluate integrals of vector functions as double and triple integrals. MVC.AQR.4.3
- 4.4 Apply line and surface integral to functions representing real-world phenomena. MVC.AQR.4.4
- 4.5 Solve first-order exact differential equations. MVC.AQR.4.5
- 4.6 Use Green's Theorem to evaluate line integrals in the plane; use Stokes' Theorem to evaluate line integrals in space. MVC.AQR.4.6
- 4.7 Determine whether a line integral is independent of path and use line integrals in context. MVC.AQR.4.7
- 4.8 Use Gauss' Divergence Theorem to evaluate surface integrals. MVC.AQR.4.8
- 4.9 Define and apply the gradient, the divergence, and the curl in terms of integrals of vector functions. MVC.AQR.4.9