Georgia Mathematics

Advanced Finite Mathematics

Adopted 2021

Mathematical Practices

MP. 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. AFM.MP

1. **Make sense of problems and persevere in solving them.** AFM.MP.1
2. **Reason abstractly and quantitatively.** AFM.MP.2
3. **Construct viable arguments and critique the reasoning of others.** AFM.MP.3
4. **Model with mathematics.** AFM.MP.4
5. **Use appropriate tools strategically.** AFM.MP.5
6. **Attend to precision.** AFM.MP.6
7. **Look for and make use of structure.** AFM.MP.7
8. **Look for and express regularity in repeated reasoning.** AFM.MP.8

Mathematical Modeling

1. **Apply mathematics to real-life situations; model real-life phenomena using mathematics.** AFM.MM.1
    1. Explain contextual, mathematical problems using a mathematical model. AFM.MM.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. AFM.MM.1.2
    3. Using abstract and quantitative reasoning, make decisions about information and data from a contextual situation. AFM.MM.1.3
    4. Use various mathematical representations and structures with this information to represent and solve real-life problems. AFM.MM.1.4

Logical Reasoning – Methods of Proof

2. **Apply methods of proof to prove or disprove mathematical statements; explain reasoning and justify thinking through mathematical induction when formulating mathematical arguments.** AFM.LR.2
    1. Use a counterexample to disprove a statement. AFM.LR.2.1

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2. Prove statements directly from definitions and previously proved statements. AFM.LR.2.2
3. Prove statements indirectly by proving the contrapositive of the statement. AFM.LR.2.3
4. Apply the method of reductio ad absurdum (proof by contradiction) to prove statements. AFM.LR.2.4
5. Use the method of mathematical induction to prove statements involving the positive integers. AFM.LR.2.5

Logical Reasoning – Logical Symbolism and Binary

3. **Interpret, represent, and communicate logical arguments to explain reasoning and justify thinking when solving problems and to explain real-life phenomena.** AFM.LR.3
    1. Construct truth tables that represent conditional, biconditional, and quantified statements; use truth tables to determine whether the statement is true or false and use Venn diagrams to illustrate the relationship represented by these truth tables. AFM.LR.3.1
    2. Represent logic operations such as AND, OR, NOT, NOR, and XOR (exclusive OR) using logical symbolism, determine whether statements involving these operations are true or false, and interpret such symbols into English. AFM.LR.3.2
    3. Apply modus ponens and modus tollens to analyze logical arguments to determine whether it is valid, invalid, a tautology, or a contradiction. AFM.LR.3.3
    4. Write the negation, converse, contrapositive, and inverse of a conditional statement and find the truth of each. AFM.LR.3.4
    5. Represent the dichotomy between "true" and "false" with 1s and 0s. Use 1s and 0s to calculate whether a statement is true or false by constructing Boolean logic circuits. AFM.LR.3.5
    6. Convert binary and hexadecimal numbers into decimal, and convert from binary to hexadecimal, and vice versa. Add binary integers and use 2's complement to subtract binary integers. AFM.LR.3.6

Numerical Reasoning – Number Theory

4. **Apply number theory and number-theoretic operations to solve contextual, mathematical problems and to explain real-life phenomena.** AFM.NR.4
    1. Apply the divides relation to positive integers and calculate one integer modulo another integer. AFM.NR.4.1
    2. Find the inverse of an integer for a certain modulus. AFM.NR.4.2
    3. Calculate the floor and the ceiling of a real number. AFM.NR.4.3
    4. Prove statements involving properties of numbers. AFM.NR.4.4
    5. Prove statements involving the floor and ceiling functions. AFM.NR.4.5
    6. Prove the Fundamental Theorem of Arithmetic, the Euclidean algorithm, and Fermat's Little Theorem. AFM.NR.4.6

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Abstract & Quantitative Reasoning – Set Theory

5. **Use set theory to describe relationships and equivalence when solving contextual, mathematical problems used to explain real-life phenomena.** AFM.AQR.5
    1. Find the union, intersection, difference, complement, and Cartesian product of sets, and classify sets as equal, subsets, and power sets. AFM.AQR.5.1
    2. Justify whether the union of subsets of a set is a partition of that set. AFM.AQR.5.2
    3. Given a relation on two sets, determine whether the relation is a function and find its inverse relation, if it exists. AFM.AQR.5.3
    4. Determine the equivalence classes given an equivalence relation on a set; determine whether the union of equivalence classes of a set is a partition of that set. AFM.AQR.5.4
    5. Prove set relations, including DeMorgan's Laws and equivalence relations. AFM.AQR.5.5
    6. Prove statements in Boolean algebra. AFM.AQR.5.6
    7. Simplify Boolean algebra expressions using Karnaugh maps (K-maps). AFM.AQR.5.7

Abstract & Quantitative Reasoning – Probabilities and Combinatorics

6. **Calculate and solve combinatorics problems to make sense of a real-life, contextual problem.** AFM.AQR.6
    1. Use the addition rule to count the number of outcomes in a disjoint set of sample spaces. Use the principle of inclusion-exclusion to count the number of outcomes in the union of sample spaces. AFM.AQR.6.1
    2. Apply the axioms of probability to determine the probability of dependent and independent events, including use of the multiplication rule for independent events. AFM.AQR.6.2
    3. Find expected value. AFM.AQR.6.3
    4. Apply Bayes' Theorem to determine conditional probability. AFM.AQR.6.4
    5. Calculate the number of permutations of a set with n elements. Calculate the number of permutations of r elements taken from a set of n elements. AFM.AQR.6.5
    6. Calculate the number of subsets of size r that can be chosen from a set of n elements. AFM.AQR.6.6
    7. Calculate the number of combinations with repetitions of r elements from a set of n elements AFM.AQR.6.7
    8. Prove combinatorial identities. AFM.AQR.6.8
    9. Apply a combinatorial argument to prove the binomial theorem. AFM.AQR.6.9
    10. Use the pigeonhole principle to prove statements about counting. AFM.AQR.6.10

Abstract & Quantitative Reasoning – Graph Th

7. **Apply graph theory to solve contextual, mathematical problems and to explain real-life phenomena.** AFM.AQR.7
    1. Identify simple graphs, complete graphs, complete bipartite graphs, and trees. Identify graphs that have Euler and Hamiltonian cycles. AFM.AQR.7.1

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2. Construct the complement and the line graph of a graph. AFM.AQR.7.2
3. Use the adjacency matrix of a graph to determine the number of walks of length n in a graph. AFM.AQR.7.3
4. Prove statements about graph properties. AFM.AQR.7.4
5. Prove that every connected graph has a minimal spanning tree. AFM.AQR.7.5
6. Use Kruskal's algorithm and Prim's algorithm to determine the minimal spanning tree of a weighted graph. AFM.AQR.7.6