CSET mathematics preparation

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Contents

1 number and quantity (page 13)

1.1 the real and complex number system

1.1.1 demonstrate knowledge of the properties of the real number system and its subsets

1. properties of the real number system
   - closure
     - the sum or product of two real numbers is a real number:
     - $\forall a, b \in R, a + b \in R$
     - $\forall a, b \in R, a \times b \in R$
   - associative

- the grouping in the sum or product of real numbers does not matter
- $\forall a, b, c \in R, (a + b) + c = a + (b + c)$
- $\forall a, b, c \in R, (ab)c = a(bc)$

- commutative
  - the order in sum or product does not matter (does not hold for subtraction or division).
- identity
- inverse
- distributive

2. subsets of the real numbers
   (a) rational numbers $\mathbb{Q}$
   (b) irrational numbers
   (c) integers
   (d) whole numbers
3. division involving zero
4. completeness of the real numbers
5. **REVIEW PROBLEMS**
   (a) name the property:
      i. $\frac{1}{2} + \frac{2}{7} \in \mathbb{R}$ ::answer:: closure property of addition for $\mathbb{R}$

1.1.2 perform opertations and recognize equivalent expressions using various representations of real numbers(e.g. fractions, decimals, exponenents) (page 18)

1. converting a fraction to a decimal
2. converting from decimal to fraction
3. percents
4. scientific notation
5. operation with fractions

6. operations witht decimals

7. exponents

8. REVIEW PROBLEMS

1.1.3 solve real-world and mathematical problems using numerical and algebraic expressions and equations

1.1.4 apply proportional relationships to model and solve real-world and mathematical problems

1. ratio and proportion

1.1.5 reason quantitatively and use units to solve problems (i.e. dimensional analysis)

1.1.6 perform operations on complex numbers and represent complex numbers and their operations in the complex plain

1. the complex numbers

1.2 number theory (page 44)

1.2.1 prove and use basic properties of natural numbers (e.g, properties of divisibility)

1. divisibility

2. theorems involving divisibility

Definition 1. *this is my def...*

1.2.2 use the principle of Mathematical Induction to prove results in number theory

1. mathematical induction

1.2.3 be able to apply the Euclidean Algorithm

1. the division and Euclidian algorithm

1.2.4 apply the Fundamental Theorem of Arithmetic(e.g., find the GCF and the LCM; show that every fraction is equivalent to a unique fraction where the numerator and denominator are relatively prime; prove that the square root of any number that is not a perfect square is irrational)

2 algebra (page 61)

2.1 algebraic structures

2.1.1 demonstrate knowledge of why the real numbers and complex numbers are each a field, and that particular rings are not fields(e.g., integers, polynomial rings, matrix rings).

1. binary operations
2. groups

2.1.2 apply basic properties of real and complex numbers in constructing mathematical arguments (e.g., $a < b \wedge c < 0 \implies ac > bc$)

1. using properties of the real numbers
2. mathematical arguments involving the reals
3. properties of the complex numbers
4. mathematical arguments involving complex numbers

2.1.3 demonstrate knowledge that the rational numbers and real numbers can be ordered and the complex numbers cannot be ordered, but that any polynomial equation with real coefficients can be solved in the complex field

1. ordering
2. solvability of polynomials over complex numbers

2.1.4 identify and translate between equivalent forms of algebraic expressions and equations using a variety of techniques(e.g., factoring, applying properties of operations).

1. addition, subtraction, and multiplication of polynomials

2. factoring polynomials
    (a) factoring binomials
    (b) factoring trinomials
    (c) non-perfect square trinomials
3. division of polynomials
4. operations with rational expressions
    (a) adding and subtracting rational expressions
    (b) multiplying and dividing rational expressions
5. rational expressions and radicals

2.1.5 justify the steps in manipulating algebraic expressions and solving algebraic equations and inequalities.

2.1.6 represent situations and solve problems using algebraic equations and inequalities.

2.2 polynomial equations and inequalities (page 116)

2.2.1 analyze and solve polynomial equations with real coefficients using: the Fundamental Theorem of Algebra, the Rational Root Theorem for polynomials with integer coefficients, the Conjugate Root Theorem for polynomial equations with real coefficients, and the Binomial Theorem.

2.2.2 Prove and use the Factor Theorem and the quadratic formula for real and complex quadratic polynomials

2.2.3 Solve polynomial inequalities

2.3 functions (page 130)

2.3.1 Analyze general properties of functions (i.e., domain and range, one-to-one, onto, inverses, composition, and differences between relations and functions) and apply arithmetic operations on functions

2.3.2 Analyze properties of linear functions (e.g., slope, intercepts) using a variety of representations

2.3.3 Demonstrate knowledge of why graphs of linear inequalities are half planes and be able to apply this fact

2.3.4 Analyze properties of polynomial, rational, radical, and absolute value functions in a variety of ways (e.g., graphing, solving problems)

2.3.5 Analyze properties of exponential and logarithmic functions in a variety of ways (e.g., graphing, solving problems)

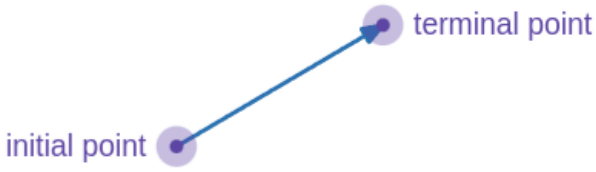
2.3.6 Model and solve problems using nonlinear functions

2.4 linear algebra (page 187)

2.4.1 Understand and apply the geometric interpretation and basic operations of vectors in two and three dimensions, including their scalar multiples.

1. introduction to vectors

- **scalar quantities**:: physical quantities that can be represented by a single real number.
- **vector quantities**:: concepts that require two or more numbers for their representations.



- **vector addition**::

2. rectanular coordinate system in R^2 and R^3

2.4.2 Prove the basic properties of vectors (e.g., perpendicular vectors have zero dot product)

2.4.3 Understand and apply the basic properties and operations of matrices and determinants (e.g., to determine the solvability of linear systems of equations) (page 202)

1. systems of linear equations

2.4.4 Analyze the properties of proportional relationships, lines, linear equations, and their graphs, and the connections between them

2.4.5 Model and solve problems using linear equations, pairs of simultaneous linear equations, and their graphs

3 geometry (page 237)

3.1 plane Euclidean geometry [1]

3.1.1 Apply the Parallel Postulate and its implications and justify its equivalents (e.g., the Alternate Interior Angle Theorem, the angle sum of every triangle is 180 degrees)

3.1.2 Demonstrate knowledge of complementary, supplementary, and vertical angles

3.1.3 Prove theorems, justify steps, and solve problems involving similarity and congruence

3.1.4 Apply and justify properties of triangles (e.g., the Exterior Angle Theorem, concurrence theorems, trigonometric ratios, triangle inequality, Law of Sines, Law of Cosines, the Pythagorean Theorem and its converse)

3.1.5 Apply and justify properties of polygons and circles from an advanced standpoint (e.g., derive the area formulas for regular polygons and circles from the area of a triangle)

3.1.6 Identify and justify the classical constructions (e.g., angle bisector, perpendicular bisector, replicating shapes, regular polygons with 3, 4, 5, 6, and 8 sides)

3.2 coordinate geometry

3.2.1 Use techniques in coordinate geometry to prove geometric theorems

3.2.2 Model and solve mathematical and real-world problems by applying geometric concepts to two-dimensional figures

3.2.3 Translate between the geometric description and the equation for a conic section

3.2.4 Translate between rectangular and polar coordinates and apply polar coordinates and vectors in the plane

3.3 three-dimensional geometry

3.3.1 Demonstrate knowledge of the relationships between lines and planes in three dimensions (e.g., parallel, perpendicular, skew, coplanar lines)

3.3.2 Apply and justify properties of three-dimensional objects (e.g., the volume and surface area formulas for prisms, pyra-