

Updated 09/15/04

Integrated Mathematics 4

Integrated Mathematics 4 provides students an advanced study of trigonometry, functions, analytic geometry, and data analysis with a problem-centered, connected approach in preparation for college-level mathematics. Applications and modeling should be included throughout the course of study. Appropriate technology, from manipulatives to calculators and application software, should be used regularly for instruction and assessment.

Prerequisites

- *Describe graphically, algebraically and verbally phenomena as functions; identify independent and dependent quantities, domain, and range, and input/output.*
- *Translate among graphic, algebraic, numeric, tabular, and verbal representations of relations.*
- *Define and use linear, quadratic, cubic, exponential, rational, absolute value, and radical functions to model and solve problems.*
- *Use systems of two or more equations or inequalities to solve problems.*
- *Use the trigonometric ratios to model and solve problems.*
- *Use logic and deductive reasoning to draw conclusions and solve problems.*

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GOAL 1: The learner will operate with complex numbers and vectors to solve problems.

- 1.01 Operate with vectors in two dimensions to model and solve problems.
- 1.02 Define and compute with complex numbers.

GOAL 2: The learner will describe geometric figures in the coordinate plane algebraically.

- 2.01 Use the quadratic relations (parabola, circle, ellipse, hyperbola) to model and solve problems; justify results.
 - a) Solve using tables, graphs, and algebraic properties.
 - b) Interpret the constants and coefficients in the context of the problem.
- 2.02 Estimate the area and volume of continuously varying quantities.

GOAL 3: The learner will analyze data to solve problems.

- 3.01 Analyze univariate data to solve problems.
 - a) Apply and compare methods of data collection.
 - b) Apply statistical principles and methods in sample surveys.
 - c) Determine measures of central tendency and spread.
 - d) Recognize, define, and use the normal distribution curve.
 - e) Interpret graphical displays of distributions of univariate data.
 - f) Compare distributions of univariate data.
- 3.02 Create and use calculator-generated models of linear, polynomial, exponential, trigonometric, power, logistic, and logarithmic functions of bivariate data to solve problems.
 - a) Interpret the constants, coefficients, and bases in the context of the data.
 - b) Check models for goodness-of-fit; use the most appropriate model to draw conclusions or make predictions.

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Goal 4: The learner will use relations and functions to solve problems.

- 4.01 Use functions (polynomial, power, rational, exponential, logarithmic, logistic, piecewise-defined, and greatest integer) to model and solve problems; justify results.
 - a) Solve using graphs and algebraic properties.
 - b) Interpret the constants, coefficients, and bases in the context of the problem.
- 4.02 Use recursively-defined functions to model and solve problems.
 - a) Find the sum of a finite sequence.
 - b) Find the sum of an infinite sequence.
 - c) Determine whether a given series converges or diverges.
 - d) Translate between recursive and explicit representations.
- 4.03 Use the composition and inverse of functions to model and solve problems.
- 4.04 Use trigonometric and inverse trigonometric functions to model and solve problems.
 - a) Solve using graphs and algebraic properties.
 - b) Create and identify transformations with respect to period, amplitude, and vertical and horizontal shifts.
- 4.05 Use polar equations to model and solve problems.
 - a) Solve using graphs and algebraic properties.
 - b) Interpret the constants and coefficients in the context of the problem.
- 4.06 Use parametric equations to model and solve problems.
- 4.07 Find the rate of change at any point of a function.

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Vocabulary
Concepts
Skills

1.01 Operate with vectors in two dimensions to model and solve problems.

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Vocabulary
Concepts
Skills

1.02 Define and compute with complex numbers.

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Vocabulary
Concepts
Skills

Parabola

Circle

Ellipse

Hyperbola

Conic Sections

Standard Form

Center

Focus

Axes

Vertices

Lines of Symmetry

Directrix

Asymptotes

Transformations

Parametric Forms

Solve Equations and
Inequalities
Justifying
Steps Used

2.01 Use the quadratic relations (parabola, circle, ellipse, hyperbola) to model and solve problems; justify results.

A. According to Kepler's first law of planetary motion, each planet moves in an ellipse with the sun at one focus. Assume that one focus (the Sun) has coordinates $(0,0)$ and the major axis of each planetary ellipse is the x-axis on a cosmic coordinate system (one unit = one billion kilometers). The minimum and maximum distances for Neptune are 4.456 and 4.537 billion kilometers. The minimum and maximum distances for Pluto are 4.425 and 7.375 billion kilometers. For each planet determine the coordinates of the center and second focus; write an equation which represents the orbit; and determine the eccentricity. Graph and describe the orbits.

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Vocabulary
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2.02 Estimate area and volume of continuously varying quantities.

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Vocabulary
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3.01 Analyze univariate data to solve problems.

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3.02 Create and use calculator-generated models of linear, polynomial, exponential, trigonometric, power, logistic, and logarithmic functions of bivariate data to solve problems.

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Vocabulary
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4.01 Use functions (polynomial, power, rational, exponential, logarithmic, logistic, piecewise-defined, and greatest integer) to model and solve problems; justify results.

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4.02 Use recursively-defined functions to model and solve problems.

A. $A_0 = \begin{bmatrix} 3 & 4 & 5 \end{bmatrix}$ and, for $n \geq 1$, $A_{n+1} = A_n \cdot \begin{bmatrix} 1 & 2 & 2 \\ -2 & -1 & -2 \\ 2 & 2 & 3 \end{bmatrix}$. Use the definition

of A_n to generate a sequence of matrices ($1 \leq n \leq 6$). For the matrices, $A_n = \begin{bmatrix} a_n & b_n & c_n \end{bmatrix}$, generate a recursive definition for each set of first elements (a_n), second elements (b_n), and third elements (c_n). Write an explicit definition for each set of elements. Explain the relationship between the sets of definitions.

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Vocabulary
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4.03 Use the composition and inverse of functions to model and solve problems.

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Vocabulary
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4.04 Use trigonometric and inverse trigonometric functions to model and solve problems.

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4.05 Use polar equations to model and solve problems.

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4.06 Use parametric equations to model and solve problems.

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4.07 Find the rate of change at any point of a function.

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