

## Galway Math Curriculum Guide Algebra 2 and Trigonometry

### Problem Solving Strand

**Students will build new mathematical knowledge through problem solving.**

- A2.PS.1 Use a variety of problem solving strategies to understand new mathematical content
- A2.PS.2 Recognize and understand equivalent representations of a problem situation or a mathematical concept

**Students will solve problems that arise in mathematics and in other contexts.**

- A2.PS.3 Observe and explain patterns to formulate generalizations and conjectures
- A2.PS.4 Use multiple representations to represent and explain problem situations (e.g., verbally, numerically, algebraically, graphically)

**Students will apply and adapt a variety of appropriate strategies to solve problems.**

- A2.PS.5 Choose an effective approach to solve a problem from a variety of strategies (numeric, graphic, algebraic)
- A2.PS.6 Use a variety of strategies to extend solution methods to other problems
- A2.PS.7 Work in collaboration with others to propose, critique, evaluate, and value alternative approaches to problem solving

**Students will monitor and reflect on the process of mathematical problem solving.**

- A2.PS.8 Determine information required to solve the problem, choose methods for obtaining the information, and define parameters for acceptable solutions
- A2.PS.9 Interpret solutions within the given constraints of a problem
- A2.PS.10 Evaluate the relative efficiency of different representations and solution methods of a problem

### Reasoning and Proof Strand

**Students will recognize reasoning and proof as fundamental aspects of mathematics.**

- A2.RP.1 Support mathematical ideas using a variety of strategies

**Students will make and investigate mathematical conjectures.**

- A2.RP.2 Investigate and evaluate conjectures in mathematical terms, using mathematical strategies to reach a conclusion
- A2.RP.3 Evaluate conjectures and recognize when an estimate or approximation is more appropriate than an exact answer
- A2.RP.4 Recognize when an approximation is more appropriate than an exact answer

**Students will develop and evaluate mathematical arguments and proofs.**

- A2.RP.5 Develop, verify, and explain an argument, using appropriate mathematical ideas and language
- A2.RP.6 Construct logical arguments that verify claims or counterexamples that refute claims
- A2.RP.7 Present correct mathematical arguments in a variety of forms
- A2.RP.8 Evaluate written arguments for validity

**Students will select and use various types of reasoning and methods of proof.**

- A2.RP.9 Support an argument by using a systematic approach to test more than one case
- A2.RP.10 Devise ways to verify results, using counterexamples and informal indirect proof
- A2.RP.11 Extend specific results to more general cases
- A2.RP.12 Apply inductive reasoning in making and supporting mathematical conjectures

### Communication Strand

**Students will organize and consolidate their mathematical thinking through communication.**

- A2.CM.1 Communicate verbally and in writing a correct, complete, coherent, and clear design (outline) and explanation for the steps used in solving a problem
- A2.CM.2 Use mathematical representations to communicate with appropriate accuracy, including numerical tables, formulas, functions, equations, charts, graphs, and diagrams

**Students will communicate their mathematical thinking coherently and clearly to peers, teachers, and others.**

- A2.CM.3 Present organized mathematical ideas with the use of appropriate standard notations, including the use of symbols and other representations when sharing an idea in verbal and written form
- A2.CM.4 Explain relationships among different representations of a problem
- A2.CM.5 Communicate logical arguments clearly, showing why a result makes sense and why the reasoning is valid
- A2.CM.6 Support or reject arguments or questions raised by others about the correctness of mathematical work

**Students will analyze and evaluate the mathematical thinking and strategies of others.**

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- A2.CM.7 Read and listen for logical understanding of mathematical thinking shared by other students
- A2.CM.8 Reflect on strategies of others in relation to one's own strategy
- A2.CM.9 Formulate mathematical questions that elicit, extend, or challenge strategies, solutions, and/or conjectures of others

**Students will use the language of mathematics to express mathematical ideas precisely.**

- A2.CM.10 Use correct mathematical language in developing mathematical questions that elicit, extend, or challenge other students' conjectures
- A2.CM.11 Represent word problems using standard mathematical notation
- A2.CM.12 Understand and use appropriate language, representations, and terminology when describing objects, relationships, mathematical solutions, and rationale
- A2.CM.13 Draw conclusions about mathematical ideas through decoding, comprehension, and interpretation of mathematical visuals, symbols, and technical writing

**Connections Strand**

**Students will recognize and use connections among mathematical ideas.**

- A2.CN.1 Understand and make connections among multiple representations of the same mathematical idea
- A2.CN.2 Understand the corresponding procedures for similar problems or mathematical concepts

**Students will understand how mathematical ideas interconnect and build on one another to produce a coherent whole.**

- A2.CN.3 Model situations mathematically, using representations to draw conclusions and formulate new situations
- A2.CN.4 Understand how concepts, procedures, and mathematical results in one area of mathematics can be used to solve problems in other areas of mathematics
- A2.CN.5 Understand how quantitative models connect to various physical models and representations

**Students will recognize and apply mathematics in contexts outside of mathematics.**

- A2.CN.6 Recognize and apply mathematics to situations in the outside world
- A2.CN.7 Recognize and apply mathematical ideas to problem situations that develop outside of mathematics
- A2.CN.8 Develop an appreciation for the historical development of mathematics

**Representation Strand**

**Students will create and use representations to organize, record, and communicate mathematical ideas.**

- A2.R.1 Use physical objects, diagrams, charts, tables, graphs, symbols, equations, or objects created using technology as representations of mathematical concepts
- A2.R.2 Recognize, compare, and use an array of representational forms
- A2.R.3 Use representation as a tool for exploring and understanding mathematical ideas

**Students will select, apply, and translate among mathematical representations to solve problems.**

- A2.R.4 Select appropriate representations to solve problem situations
- A2.R.5 Investigate relationships among different representations and their impact on a given problem

**Students will use representations to model and interpret physical, social, and mathematical phenomena.**

- A2.R.6 Use mathematics to show and understand physical phenomena (e.g., investigate sound waves using the sine and cosine functions)
- A2.R.7 Use mathematics to show and understand social phenomena (e.g., interpret the results of an opinion poll)
- A2.R.8 Use mathematics to show and understand mathematical phenomena (e.g., use random number generator to simulate a coin toss)

**Number Sense and Operations Strand**

**Students will understand meanings of operations and procedures, and how they relate to one another.**

- A2.N.1 Evaluate numerical expressions with negative and/or fractional exponents, without the aid of a calculator (when the answers are rational numbers)
- A2.N.2 Perform arithmetic operations (addition, subtraction, multiplication, division) with expressions containing irrational numbers in radical form
- A2.N.3 Perform arithmetic operations with polynomial expressions containing rational coefficients
- A2.N.4 Perform arithmetic operations on irrational expressions
- A2.N.5 Rationalize a denominator containing a radical expression
- A2.N.6 Write square roots of negative numbers in terms of  $i$
- A2.N.7 Simplify powers of  $i$
- A2.N.8 Determine the conjugate of a complex number

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- A2.N.9 Perform arithmetic operations on complex numbers and write the answer in the form  $a + bi$  *Note: This includes simplifying expressions with complex denominators.*
- A2.N.10 Know and apply sigma notation

### Algebra Strand

#### **Students will represent and analyze algebraically a wide variety of problem solving situations.**

- A2.A.1 Solve absolute value equations and inequalities involving *Inequalities* linear expressions in one variable
- A2.A.2 Use the discriminant to determine the nature of the roots of a quadratic equation
- A2.A.3 Solve systems of equations involving one linear equation and one quadratic equation algebraically *Note: This includes rational equations that result in linear equations with extraneous roots.*
- A2.A.4 Solve quadratic inequalities in one and two variables, algebraically and graphically
- A2.A.5 Use direct and inverse variation to solve for unknown values
- A2.A.6 Solve an application which results in an exponential function

#### **Students will perform algebraic procedures accurately.**

- A2.A.7 Factor polynomial expressions completely, using any combination of the following techniques: common factor extraction, difference of two perfect squares, quadratic trinomials
- A2.A.8 Apply the rules of exponents to simplify expressions involving negative and/or fractional exponents
- A2.A.9 Rewrite algebraic expressions that contain negative exponents using only positive exponents
- A2.A.10 Rewrite algebraic expressions with fractional exponents as radical expressions
- A2.A.11 Rewrite algebraic expressions in radical form as expressions with fractional exponents
- A2.A.12 Evaluate exponential expressions, including those with base  $e$
- A2.A.13 Simplify radical expressions
- A2.A.14 Perform addition, subtraction, multiplication, and division of radical expressions
- A2.A.15 Rationalize denominators involving algebraic radical expressions
- A2.A.16 Perform arithmetic operations with rational expressions and rename to lowest terms
- A2.A.17 Simplify complex fractional expressions
- A2.A.18 Evaluate logarithmic expressions in any base
- A2.A.19 Apply the properties of logarithms to rewrite logarithmic expressions in equivalent forms
- A2.A.20 Determine the sum and product of the roots of a quadratic equation by examining its coefficients
- A2.A.21 Determine the quadratic equation, given the sum and product of its roots
- A2.A.22 Solve radical equations
- A2.A.23 Solve rational equations and inequalities
- A2.A.24 Know and apply the technique of completing the square
- A2.A.25 Solve quadratic equations, using the quadratic formula
- A2.A.26 Find the solution to polynomial equations of higher degree that can be solved using factoring and/or the quadratic formula
- A2.A.27 Solve exponential equations with and without common bases
- A2.A.28 Solve a logarithmic equation by rewriting as an exponential equation

#### **Students will recognize, use, and represent algebraically patterns, relations, and functions.**

- A2.A.29 Identify an arithmetic or geometric sequence and find the formula for its  $n$ th term
- A2.A.30 Determine the common difference in an arithmetic sequence
- A2.A.31 Determine the common ratio in a geometric sequence
- A2.A.32 Determine a specified term of an arithmetic or geometric sequence
- A2.A.33 Specify terms of a sequence, given its recursive definition
- A2.A.34 Represent the sum of a series, using sigma notation
- A2.A.35 Determine the sum of the first  $n$  terms of an arithmetic or geometric series
- A2.A.36 Apply the binomial theorem to expand a binomial and determine a specific term of a binomial expansion
- A2.A.37 Define a relation and function
- A2.A.38 Determine when a relation is a function
- A2.A.39 Determine the domain and range of a function from its equation
- A2.A.40 Write functions in functional notation
- A2.A.41 Use functional notation to evaluate functions for given values in the domain
- A2.A.42 Find the composition of functions
- A2.A.43 Determine if a function is one-to-one, onto, or both
- A2.A.44 Define the inverse of a function

- A2.A.45 Determine the inverse of a function and use composition to justify the result
- A2.A.46 Perform transformations with functions and relations:  $f(x+a)$ ,  $f(x)+a$ ,  $f(-x)$ ,  $-f(x)$ ,  $af(x)$
- A2.A.47 Determine the center-radius form for the equation of a circle in standard form
- A2.A.48 Write the equation of a circle, given its center and a point on the circle
- A2.A.49 Write the equation of a circle from its graph
- A2.A.50 Approximate the solution to polynomial equations of higher degree by inspecting the graph
- A2.A.51 Determine the domain and range of a function from its graph
- A2.A.52 Identify relations and functions, using graphs
- A2.A.53 Graph exponential functions of the form  $y = b^x$  for positive values of  $b$ , including  $b = e$
- A2.A.54 Graph logarithmic functions, using the inverse of the related exponential function
- A2.A.55 Express and apply the six trigonometric functions as ratios of the sides of a right triangle
- A2.A.56 Know the exact and approximate values of the sine, cosine, and tangent of  $0^\circ$ ,  $30^\circ$ ,  $45^\circ$ ,  $60^\circ$ ,  $90^\circ$ ,  $180^\circ$ , and  $270^\circ$  angles
- A2.A.57 Sketch and use the reference angle for angles in standard position
- A2.A.58 Know and apply the co-function and reciprocal relationships between trigonometric ratios
- A2.A.59 Use the reciprocal and co-function relationships to find the value of the secant, cosecant, and cotangent of  $0^\circ$ ,  $30^\circ$ ,  $45^\circ$ ,  $60^\circ$ ,  $90^\circ$ ,  $180^\circ$ , and  $270^\circ$  angles
- A2.A.60 Sketch the unit circle and represent angles in standard position
- A2.A.61 Determine the length of an arc of a circle, given its radius and the measure of its central angle
- A2.A.62 Find the value of trigonometric functions, if given a point on the terminal side of angle  $\theta$
- A2.A.63 Restrict the domain of the sine, cosine, and tangent functions to ensure the existence of an inverse function
- A2.A.64 Use inverse functions to find the measure of an angle, given its sine, cosine, or tangent
- A2.A.65 Sketch the graph of the inverses of the sine, cosine, and tangent functions
- A2.A.66 Determine the trigonometric functions of any angle, using technology
- A2.A.67 Justify the Pythagorean identities
- A2.A.68 Solve trigonometric equations for all values of the variable from  $0^\circ$  to  $360^\circ$
- A2.A.69 Determine amplitude, period, frequency, and phase shift, given the graph or equation of a periodic function
- A2.A.70 Sketch and recognize one cycle of a function of the form  $y = A \sin Bx$  or  $y = A \cos Bx$
- A2.A.71 Sketch and recognize the graphs of the functions  $y = \sec(x)$ ,  $y = \csc(x)$ ,  $y = \tan(x)$ , and  $y = \cot(x)$
- A2.A.72 Write the trigonometric function that is represented by a given periodic graph
- A2.A.73 Solve for an unknown side or angle, using the Law of Sines or the Law of Cosines
- A2.A.74 Determine the area of a triangle or a parallelogram, given the measure of two sides and the included angle
- A2.A.75 Determine the solution(s) from the SSA situation (ambiguous case)
- A2.A.76 Apply the angle sum and difference formulas for trigonometric functions
- A2.A.77 Apply the double-angle and half-angle formulas for trigonometric functions

#### Measurement Strand

**Students will determine what can be measured and how, using appropriate methods and formulas.**

- A2.M.1 Define radian measure
- A2.M.2 Convert between radian and degree measures

#### Statistics and Probability Strand

**Students will collect, organize, display, and analyze data.**

- A2.S.1 Understand the differences among various kinds of studies (e.g., survey, observation, controlled experiment)
- A2.S.2 Determine factors which may affect the outcome of a survey
- A2.S.3 Calculate measures of central tendency with group frequency distributions
- A2.S.4 Calculate measures of dispersion (range, quartiles, interquartile range, standard deviation, variance) for both samples and populations
- A2.S.5 Know and apply the characteristics of the normal distribution

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**Students will make predictions that are based upon data analysis.**

- A2.S.6 Determine from a scatter plot whether a linear, logarithmic, exponential, or power regression model is most appropriate
- A2.S.7 Determine the function for the regression model, using appropriate technology, and use the regression function to interpolate and extrapolate from the data
- A2.S.8 Interpret within the linear regression model the value of the correlation coefficient as a measure of the strength of the relationship

**Students will understand and apply concepts of probability.**

- A2.S.9 Differentiate between situations requiring permutations and those requiring combinations
- A2.S.10 Calculate the number of possible permutations ( ${}_n P_r$ ) of  $n$  items taken  $r$  at a time
- A2.S.11 Calculate the number of possible combinations ( ${}_n C_r$ ) of  $n$  items taken  $r$  at a time
- A2.S.12 Use permutations, combinations, and the Fundamental Principle of Counting to determine the number of elements in a sample space and a specific subset (event)
- A2.S.13 Calculate theoretical probabilities, including geometric applications
- A2.S.14 Calculate empirical probabilities
- A2.S.15 Know and apply the binomial probability formula to events involving the terms *exactly*, *at least*, and *at most*
- A2.S.16 Use the normal distribution as an approximation for binomial probabilities