

# Mathematics High School Curriculum

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## WNCP Curriculum Status

- The documents are posted on-line for public consultation.
- WNCP Mathematics Consultants will meet to make adjustments as part of finalizing the WNCP.
  - adjustments will be done for September 2007.
  - the final sign off will be in January 2008.

*There is an underlying feeling among college/university instructors that overall the secondary mathematics curriculum. . . contains the content and topics with which a mathematics/statistics student would need familiarity in order to succeed in most post-secondary environments. However, the success rates, especially in Calculus, are evidence that to judge student preparedness solely on curricular content of a prerequisite course is unwise<sup>1</sup>.*

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<sup>1</sup> *Mathematics Proficiencies Report*, page 12.

*The [Steering] Committee seemed agreed that . . . the single most important mathematical shortcoming of students entering post-secondary is their lack of general skills<sup>2</sup>.*

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<sup>2</sup>Mathematics Proficiencies Report, page 14.

*There is a feeling that action should be taken to assist students in raising their level of general mathematical proficiency<sup>3</sup>.*

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<sup>3</sup>Mathematics Proficiencies Report, page 13.

## General Proficiencies

- positive attitude
- critical and logical thinking skills
- language skills, word problems
- (multi-step) problem solving
- model building
- combining concepts
- abstraction, analysis, synthesis, and integration skills
- generalizing
- symbolic manipulation

## Specific Proficiencies (by rank, importance ratings $\geq 2$ ) Understand and use:

- function concept
- polynomial expressions
- exponential expressions
- straight lines and linear functions
- solve equations and inequalities
- circular trigonometric functions
- rational expressions
- triangle trigonometry
- quadratic functions
- logarithmic functions
- radical expressions
- geometry of points and lines
- polynomial functions
- quadratic relations



### A. Understand and use polynomial expressions

Simplify polynomial expressions	3.96	Model, record, explain multiplication of polynomial expressions	10N4
Add and subtract polynomial expressions	3.96	Understand sum, difference, product, quotient of linear, quadratic functions	12F1
Multiply and simplify polynomial expressions	3.96		

### A. Understand and use polynomial expressions

Factor binomials and trinomials	3.83	Factor $ax^2 + bx + c$ , $a \neq 0$ , $a^2x^2 - b^2y^2$ , $a \neq 0 \neq b$	11R3
Factor polynomial expressions of more than 3 terms	3.15	Factor polynomials, degree $\leq 5$	12P1
Divide polynomials by binomials of degree 1	3.31	Divide a polynomial by a binomial of the form $x - a$ , $a \in \mathbb{Z}$	12P1.1

## B. Understand and Use Rational Expressions

Simplify rational expressions	3.79	Determine equivalent forms of rational expressions (up to trinomials)	12/1
Simplify complex fractions	3.54		
Add and subtract rational expressions	3.83	Perform operations on rational expressions (up to trinomials)	12/2
Multiply and divide rational expressions	3.83		

## C. Understand and Use Exponential Expressions

Use the laws of exponents to simplify expressions	3.96	Understand operations with powers by applying the exponent laws	10N3.1
Write radical expressions in exponential form	3.92	Express powers with rational exponents as radicals and vice versa	10N3.4

### C. Understand and Use Exponential Expressions

Apply the laws of exponents to expressions with rational exponents	3.88	Apply the laws of exponents to rational exponents	10N3.3
Apply the laws of exponents to expressions with real exponents	3.75		

### D. Understand and use radical expressions

Simplify radical expressions, index 2	3.71	Solve radical equations algebraically, graphically	$12\sqrt{1}$
Apply four basic operations to radical expressions, index 2	3.71	Use four basic operations to solve problems involving radicals	11N2
Simplify radical expressions, index $n \in \mathbb{Z}$	3.21		

## D. Understand and use radical expressions

Apply four basic operations to radical expressions, index $n \in \mathbb{Z}$	3.17		
Rationalize numerator or denominator with radical expression, index 2	3.42	Rationalize when the denominator is a monomial or binomial	11N2.6
Rationalize numerator or denominator with radical expressions, index $n \in \mathbb{Z}$	2.58		

## E. Solve Equations and Inequalities

Linear equations	3.96	Solve problems using function notation to represent linear functions	10R8
Linear inequalities	3.85	Solve problems that involve linear inequalities in 2 variables over $\mathbb{Q}$	10R9
Equations containing absolute values	3.31	Solve absolute value equation graphically, algebraically	11R2



## E. Solve Equations and Inequalities

Quadratic equations by completing the square	3.25	Solve $ax^2 + bx + c = 0$ by factoring, completing the square, quadratic formula	11R8.4
Quadratic equations by quadratic formula	3.81		
Quadratic inequalities	3.27	Quadratic inequalities	11R10
Equations containing radicals with index 2	3.50	Solve radical equations	$12\sqrt{1}$

## E. Solve Equations and Inequalities

Systems of linear equations in two variables	3.71	Solve systems of equations: linear-linear	11AO
Graph solutions for systems of linear inequalities	2.67		
Systems of linear equations in three variables	2.56		

## E. Solve Equations and Inequalities

Equations containing rational expressions	3.67	Rational equations	11AO
Inequalities containing rational expressions	2.79		
Polynomial equations of degree $> 2$	2.90	Solve polynomial equations graphically	12P3
Polynomial inequalities of degree $> 2$	2.31	Solve polynomial inequalities	12AO

## E. Solve Equations and Inequalities

Logarithmic and exponential equations	3.67	Solve exponential and logarithmic equations	12E3
Tailored systems of quadratic equations	2.08	Systems of equations: linear-quadratic, quadratic-quadratic	11AO
Trigonometric equations	3.54	Solve 1st, 2nd degree trigonometric equations	12E4

## F. Understand and Use the Geometry of Lines and Points

Angle relations: two intersecting lines and parallel lines cut by a transversal	3.25		
Conditions sufficient for congruence of two triangles	2.92		
Pythagorean theorem	3.92	Distance formula developed from the Pythagorean theorem	10G3.6
Prove simple geometric results	2.65		

## G. Understand and Use the Geometry of Circles

Apply basic properties of a chord of a circle	2.13		
Apply basic properties for angles of figures inscribed in a circle	2.08		
Apply basic properties of tangents to a circle	2.56		

## H. Understand and Use Triangle Trigonometry

Primary trigonometric ratios as related to triangles	3.83	Use primary trigonometric ratios to solve problems	10T1
Trigonometric ratios for special angles	3.46	Exact value for trig functions for $\frac{\pi}{6}$ , $\frac{\pi}{4}$ , $\frac{\pi}{3}$ , $\frac{\pi}{2}$	12T2.2
Formulæ for area of triangles using trigonometric ratios	2.40		
Laws of sines and cosines	3.10	Solve problems using laws of sines, cosines (includes ambiguous case)	11T5

## K. Understand and Use Sequences and Series

Arithmetic sequences and series	2.75	Analyze arithmetic sequences and series	11R12
Geometric sequences and series	2.71	Analyze geometric sequences and series	11R13
Sigma notation	2.92	Express a series in sigma notation or expanded form	11R11.6
Sum of geometric series	2.63	Derive a rule for the sum of a finite/infinite geometric series	11R12



## L. Understand and Use the Function Concept

Function notation	4.00	Use function notation to represent linear functions	10R8
Relations which are not functions	3.73	Understand relations and functions	10R10.2
Graph basic $\mathbb{R} \rightarrow \mathbb{R}$ functions	3.83	Graph and analyze absolute value	11R2
Inverse of a function	3.67	Determine the graph of the inverse of a relation	11R1

## L. Understand and Use the Function Concept

Functional transformations	3.29	Sketch $y = ax^2 + bx + c$ using transformations and identify vertex, symmetry etc.	11R5
		Apply translations and stretches to linear, quadratic, absolute value graphs.	12F5

## M. Understand and Use Straight Line and Linear Functions

Equations for linear functions	4.00	Write equation of a line given graph, point-slope, two points	10R5
Slope of a line	4.00	Understand slope (rise/run, slope of line segment, slope of line, rate of change)	10G1
Direct variations as equations	3.48	Solve problems involving partial or direct variation	10R7

## N. Understand and Use Quadratic Functions

Graph and write equations	3.75	Analyze the graph of a quadratic function	11R7.2
Determine extrema of quadratic functions (no calculus)	2.98	Determine characteristics of $y = a(x - p)^2 + q$ including vertex, symmetry, intercepts	11R4

## P. Understand and Use Quadratic Relations

Circles	3.31	Circles	12RO
Parabolas	3.17	(quadratic functions)	
Ellipses and Hyperbolas centred the origin	2.85		
Ellipses and Hyperbolas not centred the origin	2.58		
Analytic geometry (midpoints, distances, etc.)	3.38	Use the midpoint and length of a line segment to solve problems	10G3

### Q. Understand and Use Polynomial Functions

Graph and analyze (degree $\geq 2$ )	3.31	Graph and analyze (degree $\leq 5$ )	12P2
Factor and Remainder Theorems	2.48	Factor and Remainder Theorems	12P3
Nature of roots	2.52	Explain relationship between zeros and linear factors	12P1.3

## R. Understand and Use the Logarithmic Function

Exponential expressions in logarithmic form	3.79	Convert a logarithmic to an exponential expression and vice versa	12E1.1
Values of exponential and logarithmic functions	3.79	Determine the value of eg. $\log_2 8$ ; estimate $\log_2 9$ using referents	12E1.2,3
Logarithmic functions base $a \in \mathbb{Z}$	3.42	Characteristics of $y = \log_b x$	12E2.10

## R. Understand and Use the Logarithmic Function

Properties of logarithms	3.67	Laws of logarithms from numerical examples and exponent laws	12E1.4,7
Common and natural logarithms to evaluate expressions	3.63	Natural logarithms	11NO
Calculations from practical settings	3.23	Exponential growth, decay, loans, mortgages, logarithmic scales	12E3



## S. Understand and Use Circular Trigonometric Functions

Primary trigonometric ratios	3.79	Primary trigonometric ratios	10T1
Identify reference angles	3.54	Determine reference angles	11T3.2
Radian measure	3.79	Express the measure of an angle in radians given its measure in degrees and vice versa	12T1.3,4

## S. Understand and Use Circular Trigonometric Functions

Reciprocal trigonometric functions	3.17	The six trigonometric ratios	11TO
Graph and analyze sine, cosine, tangent	3.21	Graph and analyze primary trigonometric functions	12T3
Period and amplitude	3.21	Determine amplitude and period of the graph of a given primary trigonometric function	12T3
Phase-shift	2.83		

## S. Understand and Use Circular Trigonometric Functions

Basic trigonometric identities	3.46	Trigonometric identities including quotient,	12T5
Sum, difference, double angle identities	3.38	Pythagorean, sum, difference, double-angle	
Prove identities	3.00	Proving trigonometric identities	12TO
Simplify trigonometric expressions	3.38		

## U. General, Higher Level, or Specialized Proficiencies

Word Problems	3.54	“real life problems”	
Writing simple proofs	2.50	Explain steps in proofs of laws of logarithms	12E1.5
		Inductive and deductive reasoning, counter example, number property proofs	11NO
Concept of set, subset, complement	2.00		
Union, intersection	2.06	Union, intersection	11NO
Scientific calculator	3.58	“using technology”	
Graphing calculator	2.21	“using technology”	

## Topics Missing from the WNCP Curriculum

- C real exponents
- D radicals with indices  $> 2$
- E systems of linear equations in three variables, systems of linear inequalities, rational inequalities
- F, G geometry of lines and points, congruence, circles, areas of triangles using trigonometry
- P conics

## Topics Missing from the Proficiencies Report

- Grade 10:
  - measurement in SI and imperial units
  - prime factorization (greatest common divisor, least common multiple)
  - continuous, discrete data
- Grade 12:
  - volumes and surface areas of cones, spheres, pyramids, cylinders, solids of revolution

## Abbreviations (WNCP Curriculum)

- A Algebra (“Calculus Based” Overview in red)
- E Exponential and Logarithmic Functions
- F Functions and Transformations
- G Geometry
- M Measurement
- N, N Number and Logic
- P, P Polynomial Functions and Equations
- R, R Relations and Functions
- T, T Trigonometry
- √. Radical Functions and Equations
- / Rational Expressions, Functions, and Equations