



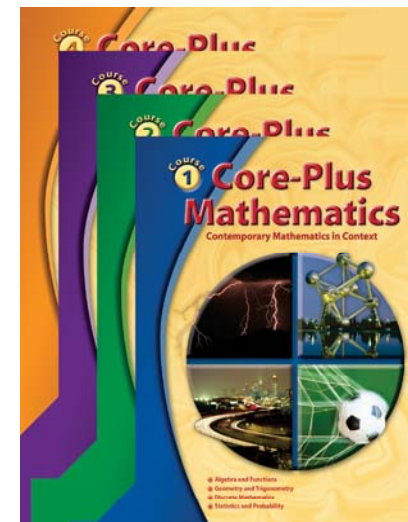
Michigan High School Mathematics Content Expectations (HSCE)

Alignment with Second Edition *Core-Plus Mathematics*

Interpreting this document

By design, the *Core-Plus Mathematics* curriculum introduces topics in a developmentally-appropriate manner. Thus, some of the content expectations are introduced in Course 1 and treated at increasing depth in later courses. This document indicates both the pages where a topic is first introduced and where it is extended in later courses.

When correlating state content expectations with textbooks, it is frequently the case that a benchmark may include more than one topic. These topics may not be treated in the same course level. For example, A1.2.7 refers to solving exponential and logarithmic equations. The expectation of solving exponential equations, similar to the example given by the Michigan Department of Education (MDE) in companion documents, is taught in Course 1. Solving logarithmic equations is developed in Course 3 and in Course 4.



The HSCEs identifies some expectations as recommended extensions. “These extensions represent content that is desirable and valuable for all students, but attention to these items should not displace or dilute curricular emphasis of any of the core expectations.” (*High School Mathematics Content Expectations*, p. 3, MDE 2007) In this document, these expectations begin with the word “Recommended” to help you identify them.

Additional recommendations by the MDE:

... educators must...develop in students the cognitive skills and habits of mind that will result in mathematical proficiency and successful post-secondary engagement. An integrated approach to high school mathematics can help develop these “habits of mind.” These programs allow students to develop and extend their mathematical content knowledge by seeing mathematical ideas connected to each other and to the real world. MDE Integrated Mathematics

The following paragraph related to the Algebra I, Geometry, Algebra II sequence of courses developed by the MDE can be found at:
<http://mi-math-companion.wikispaces.com/message/view/home/1498133>

“Please remember that these course/credit descriptions serve to show just one arrangement of the required HSCE. The legislation required that MDE develop course descriptions for Algebra I, Algebra II and Geometry but it doesn't require that you teach these courses. The required HSCE are 3 credits no matter how or in what order they are taught. The 4th credit is at the discretion of the district. Use this flexibility to your advantage! This is why the clarification document is arranged by topics and not by units of instruction. The purpose of clarification document is articulate a common understanding of the meaning of the expectations themselves and does not imply any order of instruction.” (See web reference above.)

Strand 1: Quantitative Literacy and Logic

Standard L1: Reasoning about Numbers, Systems, and Quantitative Situations: Based on their knowledge of the properties of arithmetic, students understand and reason about numbers, number systems, and the relationships between them. They represent quantitative relationships using mathematical symbols, and interpret relationships from those representations.

	COURSE 1	COURSE 2	COURSE 3
<i>L1.1 Number Systems and Number Sense</i>			
1. Know the different properties that hold in different number systems and recognize that the applicable properties change in the transition from the positive integers to all integers, to the rational numbers, and to the real numbers.	351 #36, 475-476, 482 #8, 492	336-340, 343, 348 #11-13, 351 #22, 356	345 #20, 361 #21, 369-371, 372-375, 376-379, 382-383 (Review examples 124 #26, 155#35, 258 #27)
2. Explain why the multiplicative inverse of a number has the same sign as the number, while the additive inverse of a number has the opposite sign.		Opportunity to address: 132-138	Opportunity to address: 122 #5
3. Explain how the properties of associativity, commutativity, and distributivity, as well as identity and inverse elements, are used in arithmetic and algebraic calculations.	220-223, 229 #20	132-138, 147, 148, 355	58-61, 64 #10-12, 67#15, 68 #20 (Used often in Course 3 – see 478 #19, 567 #11)
4. Describe the reasons for the different effects of multiplication by, or exponentiation of, a positive number by a number less than 0, a number between 0 and 1, and a number greater than 1.	284 #20, 298-300, 322-325	19 #7, 206-208, 214, 215	122 #15, 459-468, 471 #6, 485-489, 508 #21
5. Justify numerical relationships			10, 12-13, 15, 17 #3, 19 #8, 20 #10, 23 #21, 25 #24, 53-57, 62-63, 70-72, 122 #15
6. Explain the importance of the irrational numbers $\sqrt{2}$ and $\sqrt{3}$ in basic right triangle trigonometry and the importance of π because of its role in circle relationships.	46 #28, 62, 175 #14, 344 #18, 392 #21, 413, 415	230 #42, 478, 479	(Review examples 315 #31, 444 #17)

L1.2 Representations and Relationships

1. Use mathematical symbols to represent quantitative relationships and situations.	Throughout – See for examples 32, 50, 116, 118, 119 #4, 121 #8, 140 #26, 187-200, 248-249	Throughout – See for examples 261, 263, 276, 291-297, 316, 318, 319, 324, 326-358, 378-381	Throughout – See for examples 67 #18, 116-117, 120-121, 127-157, 158, 160, 253 #11, 254 #14, 316 #19, 504 #13
2. Interpret representations that reflect absolute value relationships in such contexts as error tolerance.	140-141	314 #12, 316 #18 and #19, 283 #2 and #3	
3. Use vectors to represent quantities that have magnitude and direction; interpret direction and magnitude of a vector numerically, and calculate the sum and difference of two vectors.			Course 4
4. Organize and summarize a data set in a table, plot, chart, or spreadsheet; find patterns in a display of data; understand and critique data displays in the media.	3-23, 32-36, 67, 291-292, 301-303, 307-311, 312 #17-18, 317 #30-31, 319 #34, 329-331, 338 #1, 348-350, 500-502	3-5, 21, 75-82, 94, 95, 96, 97 #19, 99	75, 237, 259-262, 273
5. Recommended: Read and interpret representations from various technological sources, such as contour or isobar diagrams.	67 #34	434-451	Course 4

L1.3 Counting and Probabilistic Reasoning

1. Describe, explain, and apply various counting techniques; relate combinations to Pascal’s triangle; know when to use each technique.	291, 581 #22		Course 4
2. Define and interpret commonly used expressions of probability.	552-557	523-542, 545-558	(Review examples 73 #37, 258 #31)
3. Recognize and explain common probability misconceptions such as “hot streaks” and “being due.”	533 TATS(d), 551-554, See T554f Possible Misconception		

Standard L2: Calculation, Algorithms, and Estimation: Students calculate fluently, estimate proficiently, and describe and use algorithms in appropriate situations (e.g., approximating solutions to equations). They understand the basic ideas of iteration and algorithms.

L2.1 Calculation Using Real and Complex Numbers

1. Explain the meaning and uses of weighted averages.	87-89, 93 #7, 96 #17, 99 #21, 100 #23-24, 101 #25		
2. Calculate fluently with numerical expressions involving exponents; use the rules of exponents; evaluate numerical expressions involving rational and negative exponents; transition easily between roots and exponents.	25 #25-28, 45 #26, 46 #29, 67 #31, 143 #35, 285 #24, 304-306, 311-312, 316#28, 319 #35-36, 332-337, 346 #23, 352 #37, 353 #42, 523, 525	24 #22&25, C248#36, 68 #31, 102 #30, 155 #25, 193 #33, U7 URM p48, 321 #32, 451 #24, 485 #23, U6 URM p57, 585 #30, C2376 #29 (Review examples 24 #22, 357 #47, 559 #21)	(Review examples 51 #31, 72 #32)
3. Explain the exponential relationship between a number and its base 10 logarithm, and use it to relate rules of logarithms to those of exponents in expressions involving numbers.		377-390, 397	559-567, 568-574
4. Know that the complex number i is one of two solutions to $x^2 = -1$.		Opportunity to address: 340-344	354-356
5. Add, subtract, and multiply complex numbers; use conjugates to simplify quotients of complex numbers.			Course 4
6. Recommended: Understand the mathematical bases for the differences among voting procedures.			Course 4

L2.2 Sequences and Iteration

1. Find the n th term in arithmetic, geometric, or other simple sequences.	26-45, 71 #2, 151-161, 290-300, 303, 322-329, 335-359	95 #11, 570-572	481-489, 499-500, 535 #3, 536 #5
2. Compute sums of finite arithmetic and geometric sequences.			23 #21, 478 #19, 489-494, 501 #6, 503 #11, 506 #16, 535 #3, 536 #5
3. Use iterative processes in such examples as computing compound interest or applying approximation procedures.	26-46, 289-297, 298-300, 309 #7, 315 #23, 318 #32-33, 322-329, 348-349, 356		458-467, 468-478, 514-522, 524 #7
4. Recommended: Compute sums of infinite geometric sequences.		582 #22, 583 #23	508 #21

L2.3 Measurement Units, Calculations, and Scales

1. Convert units of measurement within and between systems; explain how arithmetic operations on measurements affect units, and carry units through calculations correctly.	121 #7(d), 124-125, 176 #18, 323-326, 397 #40, 447 #12, 452-453	131, 467-476	427-431, 438-440, 448 #28, 450 #32, 451 #34
2. Describe and interpret logarithmic relationships in such contexts as the Richter scale, the pH scale, or decibel measurements; solve applied problems.		C2 377-392	570 #4, 562 CYU (c), 563 #4, 564, 568 #4 and #5

L2.4 Understanding Error

1. Determine what degree of accuracy is reasonable for measurements in a given situation; express accuracy through use of significant digits, error tolerance, or percent of error; describe how errors in measurements are magnified by computation; recognize accumulated error in applied situations.	3-5, 49-50 67 #33, 143 #31 and 37, 130 #4, 180 #30, 371 #4,	462-521	237, 448 #28
2. Describe and explain round-off error, rounding, and truncating.	Opportunity to address: 26-46, 562-563	Opportunity to address: 234-236, 246 #10, 462-521	237, 444 #15, 448 #28, 553 #15

3. Know the meaning of and interpret statistical significance, margin of error, and confidence level.			74-80, 81-88, 91, 94-95, 97 #10, 98, 99, 104 #4
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Standard L3: Mathematical Reasoning, Logic, and Proof: Students understand mathematical reasoning as being grounded in logic and proof and can distinguish mathematical arguments from other types of arguments. They can interpret arguments made about quantitative situations in the popular media. Students know the language and laws of logic and can apply them in both mathematical and everyday settings. They write proofs using direct and indirect methods and use counterexamples appropriately to show that statements are false.

L3.1 Mathematical Reasoning

1. Distinguish between inductive and deductive reasoning, identifying and providing examples of each.	374 #1, 375-376 #4, 386 #8, 387 #10, 420 #22	Opportunity to address: 223 #15&16, 224 #17-#20, 210-216, 227 #29, 489-491, 511 #22, 512 #25	10-15, 23 # 18 and #19, 25 #24
2. Differentiate between statistical arguments (statements verified empirically using examples or data) and logical arguments based on the rules of logic.			75-92, 96 #7 and #9, 97 #12
3. Define and explain the roles of axioms (postulates), definitions, theorems, counterexamples, and proofs in the logical structure of mathematics. Identify and give examples of each.	365 #4, 373 STM (d), 377 STM, 382 STM, 412 #2, 451 #19, 457 #3, Teacher’s Guide T220	Opportunity to address: 170-174, 179, 182 #6, 184 #9
, 187 #16	30-34, 35-39, 43 #10, 45 #13, 48 #22, 46 #14, 205 #2

L3.2 Language and Laws of Logic

1. Know and use the terms of basic logic.		191 #30	12 #3, 25 #23
2. Use the connectives “NOT,” “AND,” “OR,” and “IF...,THEN,” in mathematical and everyday settings. Know the truth table of each connective and how to logically negate statements involving these connectives.	377 #5, 378-382	523-542	22 #17

3. Use the quantifiers “THERE EXISTS” and “ALL” in mathematical and everyday settings and know how to logically negate statements involving them.			49 #24-25
4. Write the converse, inverse, and contrapositive of an “If..., then...” statement; use the fact, in mathematical and everyday settings, that the contrapositive is logically equivalent to the original while the inverse and converse are not.	377 Check Your Understanding, 378-382, 388 #12(c),		10-15, 20 #11, 21 #12-13, 27 #29

L3.3 Proof

1. Know the basic structure for the proof of an “If..., then...” statement (assuming the hypothesis and ending with the conclusion) and know that proving the contrapositive is equivalent.			2-15, 22 #13 d.
2. Construct proofs by contradiction. Use counterexamples, when appropriate, to disprove a statement.	391 #18, 451 #19		49 #24-25, 96 #9, 12 #5, 103 #2
3. Explain the difference between a necessary and a sufficient condition within the statement of a theorem. Determine the correct conclusions based on interpreting a theorem in which necessary or sufficient conditions in the theorem or hypothesis are satisfied.			36-39, 168-172, 182 #7, 196-199, 219 #14, 206-207

Strand 2: Algebra and Functions

Standard A1: Expressions, Equations, and Inequalities: Students recognize, construct, interpret, and evaluate expressions. They fluently transform symbolic expressions into equivalent forms. They determine appropriate techniques for solving each type of equation, inequality, or system of equations, apply the techniques correctly to solve, justify the steps in the solutions, and draw conclusions from the solutions. They know and apply common formulas.

	Course 1	COURSE 2	COURSE 3
<i>A1.1 Construction, Interpretation, and Manipulation of Expressions</i>			
1. Give a verbal description of an expression that is presented in symbolic form, write an algebraic expression from a verbal description, and evaluate expressions given values of the variables.	2-46, 73, 150-213, 232-236, 290-360, 462-490	50-72, 155 #25, 327-355, 359-361, 368-369, 374, 486 #37	53-54, 109-112, 110 #1, 118-119, 324-328, 339, 357, 361 #21-22 380, 385, 459-479, 481-501, 544-545, 560-562
2. Know the definitions and properties of exponents and roots, transition fluently between them, and apply them in algebraic expressions.	304-321, 332-354, 358-359, 413 #3, 415 #7, 423 #32, 512 #3	321 #32, 356, 357, 376 #29, 378-391	(Review examples 51 #31, 72, #32)
3. Factor algebraic expressions using, for example, greatest common factor, grouping, and the special product identities.	220-223, 225 #7, 228 #19, 229 #23, 496, 498, 519 #4	321 #30, 336-358, 362-367, 369-370	112-114, 118-120 (Review examples 51 #29, 72 #31, 125 #26)
4. Add, subtract, multiply, and simplify polynomials and rational expressions.			327-335, 337-345, 372- 379, 380-388

5. Divide a polynomial by a monomial.			378-379, 382 #7, 383 #11, 386 #25, 417 #30 and Course 4
6. Transform exponential and logarithmic expressions into equivalent forms using the properties of exponents and logarithms, including the inverse relationship between exponents and logarithms.		378-390, 397	559-567, 568-574 and Course 4
7. Recommended: Transform trigonometric expressions into equivalent forms using basic identities such as $\sin^2 \theta + \cos^2 \theta = 1$ and $\tan^2 \theta + 1 = \sec^2 \theta$			Course 4

A1.2 Solutions of Equations and Inequalities

1. Write equations and inequalities with one or two variables to represent mathematical or applied situations, and solve.	186-211, 230 #27, 234, 264 #35	30-33, 35-38, 346 #7, 347 #8, 349 #15, 352 #29, 489-497, 503-505	112-114, 118-120, 327-328, 432-442, 455, 459-471, 481-484
2. Associate a given equation with a function whose zeros are the solutions of the equation.	207 #19, 510-514, 513 #5, 517(c)	336-339, 340-344	112-114, 118-120, 329-445
3. Solve linear and quadratic equations and inequalities, including systems of up to three linear equations with three unknowns. Justify steps in the solution, and apply the quadratic formula appropriately.	65 #27, 185-211, 197-200, 232-236, 510-517, 519 #8, 549 #25	30-33, 49-68, 133-154, 340-344, 357 #47, 359-375,	101 #22, 112-114, 115-120, 127-155, 440 #13
4. Solve absolute value equations and inequalities, and justify steps in the solution.			100, 116, 117, 120, 418, 599, Unit Resource Masters Unit 3: 91-92, Unit 4: 73, Unit 5: 58, Unit 8: 61
5. Solve polynomial equations and equations involving rational expressions, and justify steps in the solution.		359-363, 3264-367, 368-374, 340-344, 395	353-356, 358, 361 #18, 19, 21, 22 and Course 4

6. Solve power equations and equations including radical expressions, justify steps in the solution, and explain how extraneous solutions may arise.		352 #24	115-120
7. Solve exponential and logarithmic equations and justify steps in the solution.	304-306, 332-334, 343 #12, 423 #35, 520 #13	377-392	559-574 and Course 4
8. Solve an equation involving several variables (with numerical or letter coefficients) for a designated variable. Justify steps in the solution.		25-48, 355 #41, 489-497, 503-506	452 #37
9. Know common formulas and apply appropriately in contextual situations.	24 #3	16 #2, 17 #3, 18 #5, 64 #15, 155 #23, 164-169, 189, 340-344, 433 #31	Review examples 26 #25, 418 #32, 419 #38, 513 #35 and Course 4
10. Use special values of the inverse trigonometric functions to solve trigonometric equations over specific intervals.			578-583, 584-589, 590-599

Standard A2: Functions: Students understand functions, their representations, and their attributes. They perform transformations, combine and compose functions, and find inverses. Students classify functions and know the characteristics of each family. They work with functions with real coefficients fluently. Students construct or select a function to model a real-world situation in order to solve applied problems. They draw on their knowledge of families of functions to do so.

A2.1 Definitions, Representations, and Attributes of Functions

1. Recognize whether a relationship (given in contextual, symbolic, tabular, or graphical form) is a function; and identify its domain and range.		326-322, 345-346	320-389, 425-453
2. Read, interpret, and use function notation and evaluate a function at a value in its domain.		327-354	109-126, 320-389, 425-453
3. Represent functions in symbols, graphs, tables, diagrams, or words, and translate among representations.	70-72, 290-360, 396 #35, 423 #34, 462-490, 483 #12, 484 #13,	327-354	109-126, 320-389, 425-453

4. Recognize that functions may be defined by different expressions over different intervals of their domains; such functions are piecewise-defined.	16 #5, 348	345-346	553
5. Recognize that functions may be defined recursively. Compute values of and graph simple recursively defined functions.	26-46, 290-360, 352 #39		457-479, 481-489
6. Identify the zeros of a function and the intervals where the values of a function are positive or negative, and describe the behavior of a function as x approaches positive or negative infinity, given the symbolic and graphical representations.	293 STM, 323, 345 #20, 352 #39, 488, 513	326-332, 332-352	109-126, 329-335, 343, 341 #13, 365-369, 383 #15
7. Identify and interpret the key features of a function from its graph or its formula(e).	153 #3, 155-157, 158-161, 175 #16, 177 #22, 178 #24-25, 294-297, 303, 314 #21, 345 #20-21, 417 #11, 463-479, 482 #7-8, 483 #11-12, 485 #15-18, 513	332-335, 347 #7, 348 #9
, 352 #28	109-126, 322-326, 329-331, 365-369, 386-387, 432-437

A2.2 Operations and Transformation

1. Combine functions by addition, subtraction, multiplication, and division.	473-477, 494 #4, 504 #12		327-331, 336-337, 372-379, 380-388 and Course 4
2. Apply given transformations to basic functions, and represent symbolically.	473-479	449 #31, 450 #33	432-437, 441 #10-11, 442 #12, 449 #31, 450 #33, and Course 4
3. Recognize whether a function (given in tabular or graphical form) has an inverse and recognize simple inverse pairs.			538-554, 549, 550, 552, #11-14, 579-583, 584-589, 590-599
4. Recommended: If a function has an inverse, find the expression(s) for the inverse.			545-548, 550 #7, 551 #8, 553-557

5. Recommended: Write an expression for the composition of one function with another; recognize component functions when a function is a composition of other functions.			Course 4
6. Recommended: Know and interpret the function notation for inverses and verify that two functions are inverses using composition.			545-547 and Course 4

A2.3 Representations of Functions

1. Identify a function as a member of a family of functions based on its symbolic or graphical representation; recognize that different families of functions have different asymptotic behavior.	23, 40 #14, 56-66, 176 #20, 177 #21-23, 345 # 20-21, 485 # 18, 488 #24	2-23, 332-335, 346-348, 354 #35, 355 #38	447 #25, 565 #1-2 and Course 4
2. Describe the tabular pattern associated with functions having constant rate of change (linear); or variable rates of change.	3-7, 11-24, 27-42, 61 #11, 151-161, 290-303, 312 #17-18, 323-331, 338-343, 345 #21, 349	2-23, 332-335, 346-348	321-327, 365-369, 432-437, 565, 570 #17, 573 #25-26
3. Write the general symbolic forms that characterize each family of functions.	157-160, 178 #24, 228 #17, 298-303, 322-328, 359, 462-472, 485 #18	7, 9, 12, 14	324-326, 330 #6, 366, 433 and Course 4

A2.4 Models of Real-world Situations Using Families of Functions

1. Identify the family of function best suited for modeling a given real-world situation.	150-183, 176 #20, 291-303, 307-311, 322-331, 338-344, 348-350, 355-359, 462-472, 480 #1-2, 482 #9, 527 #2	3-21, 23 #19	146-150, 320-324, 364-366, 368, 459-461, 464-471, 481-489, 524 and Course 4
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2. Adapt the general symbolic form of a function to one that fits the specifications of a given situation by using the information to replace arbitrary constants with numbers.	150-167, 170-171, 174, 294-303, 307-311, 312 #18, 314 #20-23, 317, 329-331, 338-342, 344 #19, 348-350, 355-358, 464-468, 474, 480, 482 #9	16-17, 332-335, 346 #7	28 #33, 73 #36, 321-326, 371 #6, 433-437, 441 #11, 447 #25, 449 #31 and Course 4
3. Using the adapted general symbolic form, draw reasonable conclusions about the situation being modeled.	159 #3-4, 162 #2, 165 #5d, 166-171, 294-303, 307-311, 312 #18, 314 #20-23, 317, 338-340, 344 #19, 348-350, 355-358, 464-468, 480	3-21, 23 #20, 333. 347 #8, 353-354 #34, 382-386	365-376, 393 #6-7, 432-437, 442, 449, 455, 561 #4, 563 #4, 569 #10 and Course 4
4. Recommended: Use methods of linear programming to represent and solve simple real-life problems.			132-143, 146-155

Standard A3: Families of Functions: Students study the symbolic and graphical forms of each function family. By recognizing the unique characteristics of each family, they can use them as tools for solving problems of for modeling real-world situations.

A3.1 Lines and Linear Functions

1. Write the symbolic forms of linear functions (standard, point-slope, and slope-intercept) given appropriate information, and convert between forms.	153-161, 171 #9, 179 #28, 230 #25, 235 #6, 284 #19, 354 #45, 395 #31, 524 #30	30-40, 49-53, 139-141, 145-146	(Review examples 26 #27, 346 #27)
2. Graph lines (including those of the form $x = h$ and $y = k$) given appropriate information.	150-157, 168 #2, 171 #8, 178 #24, 199 #4, 203-205 #13, 285 #23, 352, #39, 514 #d, 519 #7	56 #3, 154 #24, 165-166, 187 #16, 320 #28, 360-372	(Review example 100 #18)
3. Relate the coefficients in a linear function to the slope and x - and y -intercepts of its graph.	153-161, 168 #2, 171 #8, 175 #16, 178 #24-25, 265 #36, 285 #23, 485 #18	154 #24, 170-175, 281-290, 305-308, 360-372	

4. Find an equation of the line parallel or perpendicular to given line, through a given point; understand and use the facts that non-vertical parallel lines have equal slopes, and that non-vertical perpendicular lines have slopes that multiply to give -1 .	153 #3, 155 #5, 168 #2, 177 #22, 178 #25, 180 #30	URM Unit 4 p.53 #7 172-175	186 #15, 187 #16, 190 #27, 220 #18, 221 #24 (Review example 346 #27)
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A3.2 Exponential and Logarithmic Functions

1. Write the symbolic form and sketch the graph of an exponential function given appropriate information.	290-320, 322-359, 524 #30		459-471, 560-562, 563 #4, 564, 573 # 25-26 (Review example 558 #34)
2. Interpret the symbolic forms and recognize the graphs of exponential and logarithmic functions; recognize the logarithmic function as the inverse of the exponential function.	294-303, 316 #27	390 #27, 374 #21	565-567 and Course 4
3. Apply properties of exponential and logarithmic functions.	304-321, 332-354, 358-359, 423 #32	382-383, 390 #24&25	559-567, 568-574
4. Understand and use the fact that the base of an exponential function determines whether the function increases or decreases and understand how the base affects the rate of growth or decay.	41 #15, 294-303, 316 #27, 322-328, 342 #9-10, 345 #20, 259	15, 18 #5, 382-383, 385, 386	459-462, 465-467, 468-471 (Review example 558 #34)
5. Relate exponential and logarithmic functions to real phenomena, including half-life and doubling time.	26-46, 36 #1, 38 #7, 327, 328 (d), 341 #8	377-383, 386, 390 #27	459-469, 482-489, 559-564, 568-570 and Course 4

A3.3 Quadratic Functions

1. Write the symbolic form and sketch the graph of a quadratic function given appropriate information.	464-472, 482 #7, 516 #3, 527 #3, 528	332-335, 346 #7, 347 #8	(Review examples 347 #24, 358 #7)
2. Identify the elements of a parabola (vertex, axis of symmetry, direction of opening) given its symbolic form or its graph, and relate these elements to the coefficient(s) of the symbolic form of the function.	417 #11, 463-488, 515-517, 529	332-335, 348 #9
, 352 #28	(Review examples 101 #24, 113 #3, 125 #25, #47 #24, 348-350)

3. Convert quadratic functions from standard to vertex form by completing the square.			347-352, 358 #4
4. Relate the number of real solutions of a quadratic equation to the graph of the associated quadratic function.	515-517, 519 #7, 521 #13, 529	336-344, 348 #9	353-356, 358 #8, 359 #11 (Review example 101 #24)
5. Express quadratic functions in vertex form to identify their maxima or minima, and in factored form to identify their zeros.		332-335, 348 #10	347-352, 358 #4, 360 #16

A3.4 Power Functions

1. Write the symbolic form and sketch the graph of power functions.		12-15, 19 #7, 21, #11	(Review example 363 #30)
2. Express direct and inverse relationships as functions and recognize their characteristics.	23	12-15, 19 #7, 21, #11	
3. Analyze the graphs of power functions, noting reflectional or rotational symmetry.		12-15, 19 #7, 21, #11	(Review example 363 #30)

A3.5 Polynomial Functions

1. Write the symbolic form and sketch the graph of simple polynomial functions.			321-326, 332-335, 336-344
2. Understand the effects of degree, leading coefficient, and number of real zeros on the graphs of polynomial functions of degree greater than 2.			321-326, 336-344
3. Determine the maximum possible number of zeros of a polynomial function, and understand the relationship between the x -intercepts of the graph and the factored form of the function.			329-331, 332-335, 336-344

A3.6 Rational Functions

1. Write the symbolic form and sketch the graph of simple rational functions.			364-379, 380-388 and Course 4
2. Analyze graphs of simple rational functions and understand the relationship between the zeros of the numerator and denominator and the function's intercepts, asymptotes, and domain.			364-379, 380-388 and Course 4

A3.7 Trigonometric Functions

1. Use the unit circle to define sine and cosine; approximate values of sine and cosine; use sine and cosine to define the remaining trigonometric functions; explain why the trigonometric functions are periodic.			425-436, 437-451, 455-456 and Course 4
2. Use the relationship between degree and radian measures to solve problems.			427-431 and Course 4
3. Use the unit circle to determine the exact values of sine and cosine, for integer multiples of $\pi/6$ and $\pi/4$.		461-466, 477-479 (in degrees)	427-431 (in degrees and radians)
4. Graph the sine and cosine functions; analyze graphs by noting domain, range, period, amplitude, and location of maxima and minima.			577-589, 590-599 and Course 4
5. Graph transformations of basic trigonometric functions (involving changes in period, amplitude, and midline) and understand the relationship between constants in the formula and the transformed graph.			577-589, 590-599 and Course 4

Strand 3: Geometry and Trigonometry

Standard G1: Figures and Their Properties: Students represent basic geometric figures, polygons, and conic sections and apply their definitions and properties in solving problems and justifying arguments, including constructions and representations in the coordinate plane. Students represent three-dimensional figures, understand the concepts of volume and surface area, and use them to solve problems. They know and apply properties of common three-dimensional figures.

	Course 1	Course 2	Course 3
<i>G1.1 Lines and Angles; Basic Euclidean and Coordinate Geometry</i>			
1. Solve multistep problems and construct proofs involving vertical angles, linear pairs of angles supplementary angles, complementary angles, and right angles.	376 #4, 389 #13, 396 #34, 509 #28		29-34, 40-49
2. Solve multistep problems and construct proofs involving corresponding angles, alternate interior angles, alternate exterior angles, and same-side (consecutive) interior angles.			35-39, 40-49
3. Perform and justify constructions, including midpoint of a line segment and bisector of an angle, using straightedge and compass.	386 #8		28, 33, 190, 399, 402 #3, 414 #18, 416 #27
4. Given a line and a point, construct a line through the point that is parallel to the original line using straightedge and compass. Given a line and a point, construct a line through the point that is perpendicular to the original line. Justify the steps of the constructions.	386 #8 (d)		33-34, 39, 190, 402 #3, 414 #18, 416
5. Given a line segment in terms of its endpoints in the coordinate plane, determine its length and midpoint.		164-175	
6. Recognize Euclidean geometry as an axiom system. Know the key axioms and understand the meaning of and distinguish between undefined terms, axioms, definitions, and theorems.			30-34, 35-39, 43 #10, 45 #13, 48 #22, 46 #14, 205 #2

G1.2 Triangles and Their Properties

1. Prove that the angle sum of a triangle is 180° and that an exterior angle of a triangle is the sum of the two remote interior angles.			45#13, 46 #15
2. Construct and justify arguments and solve multistep problems involving angle measure, side length, perimeter, and area of all types of triangles.	212 #37, 370-378, 384-385, 388, 392 #21-22	452 #25, 467-465, 488-513, 544 #29, Unit 6 URM p56-57	
3. Know a proof of the Pythagorean Theorem and use the Pythagorean Theorem and its converse to solve multistep problems.	46, 50, 230 #26, 231, 263 #30, 353 #41, 378-382, 391 #19, 413 #3, 422 #28, 447 #12, 451 #21, 521 #20	497-471, Unit 6 URM p56-57	400 CYU, 402 #4, 403 CYU, 419 #38
4. Prove and use the relationships among the side lengths and the angles of 30° - 60° - 90° triangles and 45° - 45° - 90° triangles.	392 #21, 415 #7, 447 #12, 452 #23	191 #27c, 230 #42, 478, 479	418 #33 428-429, 432 CYU, 444 #17
5. Solve multistep problems and construct proofs about the properties of medians, altitudes, and perpendicular bisectors to the sides of a triangle, and the angle bisectors of a triangle. Using a straightedge and compass, construct these lines.		192 #32	200-203, 231 #5, 418 #36

G1.3 Triangles and Trigonometry

1. Define the sine, cosine, and tangent of acute angles in a right triangle as ratios of sides. Solve problems about angles, side lengths, or areas using trigonometric ratios in right triangles.		467-470, 471-473, 474-478	(Review examples 28 #3, 73 #34, 418 #19)
2. Know and use the Law of Sines and the Law of Cosines and use them to solve problems. Find the area of a triangle with sides a and b and included angle θ using the formula $\text{Area} = (1/2) a b \sin \theta$.		483 #27, 488-492, 493-497, 503-505, 506 #9	27 #31, 60-61, 123 #16, 125 #30, 157 #40, 168-172, 314 #29, 389 #41, 594 #18
3. Determine the exact values of sine, cosine, and tangent for 0° , 30° , 45° , 60° and their integer multiples and apply in various contexts.		478, 479	427-429, 432 CYU, 439 #5, 441 #9, 444 #17

G1.4 *Quadrilaterals and Their Properties*

1. Solve multistep problems and construct proofs involving angle measure, side length, diagonal length, perimeter, and area of squares, rectangles, parallelograms, kites, and trapezoids.	25 #26, 46 #30, 65 #25, 70 #1, 212 #37, 393 #25, 394 #28-29, 444 #6, 490 #32	170-175, 181 #1, 184 #10, 187 #16	27 #25, 204-208, 216 #8, 221 #24, 480 #25
2. Solve multistep problems and construct proofs involving quadrilaterals using Euclidean methods or coordinate geometry.	375-377, 387, 388, 393 #25,	170-175, 181 #1, 184 #10, 187 #16, 252, 253	42 #7, 102 #1-2, 156 #36, 204-208, 216 #8, 220 #18-19, 221 #24, 223 #32
3. Describe and justify hierarchical relationships among quadrilaterals,	230 #28, 366 #4 ciii, 368 STM(c), Unit 6 Summary Resource Masters p. 421		204-206, 388 #34
4. Prove theorems about the interior and exterior angle sums of a quadrilateral.	404-405		410 #10
5. Recommended: Understand the definition of a cyclic quadrilateral, and know and use the basic properties of cyclic quadrilaterals.			410 #10 T410 #10

G1.5 *Other Polygons and Their Properties*

1. Know and use subdivision or circumscription methods to find areas of polygons.	212 #37(d), 415 #7, 452 #23, 584 #27		
2. Know, justify, and use formulas for the perimeter and area of a regular n -gon and formulas to find interior and exterior angles of a regular n -gon and their sums.	375 #3(d), 404-411, 418, 418 #13-14, 420 #24, 458 #5, 459 #9, 522 #28		

G1.6 *Circles and Their Properties*

1. Solve multistep problems involving circumference and area of circles.	51 #8, 62 #13, 175 #14, 315 #24, 390 #16, 483 #11, 506 #20	URM Unit1 p67, URM Unit 2 p68, URM Unit 3 p38, 11, 18 #5, 554 #8	
2. Solve problems and justify arguments about chords.			401-403, 408-417, 454 #1-2

3. Solve problems and justify arguments about central angles, inscribed angles and triangles in circles.		178-179	403-407, 408-417, 454 #1-2, 575 #35
4. Know and use properties of arcs and sectors and find lengths of arcs and areas of sectors.		Unit 8 URM p58 #10	413 #15, 415 #21-22

G1.7 Conic Sections and Their Properties

1. Find an equation of a circle given its center and radius; given the equation of a circle, find its center and radius.		175-180, 184 #11, 187 #17, 188 #19, 189 #26, 253 #1, 351 #22, 356 #42	315 #31, 359 #10, 411 #12
2. Identify and distinguish among geometric representations of parabolas, circles, ellipses, and hyperbolas; describe their symmetries, and explain how they are related to cones.	417 #11, 474 #1, 478 STM(c), 484 #14		Course 4
3. Graph ellipses and hyperbolas with axes parallel to the x- and y-axes, given equations.			Course 4
4. Recommended: Know and use the relationship between the vertices and foci in an ellipse, the vertices and foci in a hyperbola, and the directrix and focus in a parabola; interpret these relationships in applied contexts.			Course 4

G1.8 Three-Dimensional Figures

1. Solve multistep problems involving surface area and volume of pyramids, prisms, cones, cylinders, hemispheres, and spheres.	320 #41 and 43, 447-448, 448 #13-14, 453 #26, 490 #32-35	18 #5, 39 #13, 130 #26, 391 #29, 481 #4	
2. Identify symmetries of pyramids, prisms, cones, cylinders, hemispheres, and spheres.	435-436, 438, 441, 445-446, 451 #19		

Standard G2: Relationships Between Figures: Students use and justify relationships between lines, angles, area and volume formulas, and 2- and 3-dimensional representations. They solve problems and provide proofs about congruence and similarity.

G2.1 Relationships Between Area and Volume Formulas

1. Know and demonstrate the relationships between the area formula of a triangle, the area formula of a parallelogram, and the area formula of a trapezoid.	227 #12, 389 # 15		7-8
2. Know and demonstrate the relationships between the area formulas of various quadrilaterals.	227 #12, 389 # 15		
3. Know and use the relationship between the volumes of pyramids and prisms (of equal base and height) and cones and cylinders (of equal base and height).	448 #13, 490 #32(d)		

G2.2 Relationships Between Two-dimensional and Three-dimensional Representations

1. Identify or sketch a possible three-dimensional figure, given two-dimensional views. Create a two-dimensional representation of a three-dimensional figure.	424-430, 434 STM(b), 435, 459 #7		Course 4
2. Identify or sketch cross-sections of three-dimensional figures. Identify or sketch solids formed by revolving two-dimensional figures around lines.	446 #11, 453 #25, 484 #14		Course 4

G2.3 Congruence and Similarity

1. Prove that triangles are congruent using the SSS, SAS, ASA, and AAS criteria, and that right triangles are congruent using the hypotenuse-leg criterion.	369-371, 381 #4		195-199, 215-216, 389 #38
2. Use theorems about congruent triangles to prove additional theorems and solve problems, with and without use of coordinates.	374-377, 384-385, 387-389, 390 #17, 394 #28, 524 #31, 549 #22		200-203, 204-207, 215-216, 219 #14-16, 532 #23
3. Prove that triangles are similar by using SSS, SAS, and AA conditions for similarity.			162-167, 168-172, 180-191, 557 #31, 599 #37
4. Use theorems about similar triangles to solve problems with and without use of coordinates.	285 #26		173-178, 179-180, 180-191

5. Know and apply the theorem stating that the effect of a scale factor of k relating one two dimensional figure to another or one three dimensional figure to another, on the length, area, and volume of the figures is to multiply each by k , k^2 , and k^3 , respectively.	68 #36, 183 #36, 452 #22, 460 #8, 490 #32 and 35	208 #5-#7, 209, 210 CYU	187 #17, 189 #22-23
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Standard G3: Transformations of Figures in the Plane: Students will solve problems about distance-preserving transformations and shape-preserving transformations. The transformations will be described synthetically and, in simple cases, by analytic expressions in coordinates.

G3.1 Distance-preserving Transformations: Isometries

1. Define reflection, rotation, translation, and glide reflection and find the image of a figure under a given isometry.	408-422, 419 #16	195-205, 224 #19, 225 #21	208-214
2. Given two figures that are images of each other under an isometry, find the isometry and describe it completely.		216 CYU, 220 #7, 221 #17, 222 #14, 227 #28, 228 #33, 254 #3	211 #4-5, 218 #13, 224 #33
3. Find the image of a figure under the composition of two or more isometries, and determine whether the resulting figure is a reflection, rotation, translation, or glide reflection image of the original figure.		210-216, 218, 221 #11, 222 #12&13, 223 #16, 233-237, 243-248, 254, 256	210 #3, 214 CYU

G3.2 Shape-preserving Transformations: Dilations and Isometries

1. Know the definition of dilation, and find the image of a figure under a given dilation.		205-210, 222 #12, 228 #33, 229 #34,	
2. Given two figures that are images of each other under some dilation, identify the center and magnitude of the dilation.		216 CYU, 221 #11, 222 #14, 248 #18	
3. Recommended: Find the image of a figure under the composition of a dilation and an isometry.		214-216, 225 #20, 227 #28, 237-242, 256	

Strand 4: Statistics and Probability

Standard S1: Univariate Data – Examining Distributions: Students plot and analyze univariate data by considering the shape of distributions and analyzing outliers; they find and interpret commonly-used measures of center and variation; and they explain and use properties of the normal distribution.

	Course 1	Course 2	Course 3
<i>S1.1 Producing and Interpreting Plots</i>			
1. Construct and interpret dot plots, histograms, relative frequency histograms, bar graphs, basic control charts, and box plots with appropriate labels and scales; determine which kinds of plots are appropriate for different types of data; compare data sets and interpret differences based on graphs and summary statistics.	74-142	277 #18	75-101, 104-105, 283-307
2. Given a distribution of a variable in a data set, describe its shape, including symmetry or skewness, and state how the shape is related to measures of center (mean and median) and measures of variation (range and standard deviation) with particular attention to the effects of outliers on these measures.	74-142	277 #18	
<i>S1.2 Measures of Center and Variation</i>			
1. Calculate and interpret measures of center including: mean, median, and mode; explain uses, advantages and disadvantages of each measure given a particular set of data and its context.	83-101, 96 #16, 185 #43	277 #18	
2. Estimate the position of the mean, median, and mode in both symmetrical and skewed distributions, and from a frequency distribution or histogram.	83-94, 95 #14	277 #18	
3. Compute and interpret measures of variation, including percentiles, quartiles, interquartile range, variance, and standard deviation.	103-143, 147, 397 #39, 544 #7	277 #18	260-265, 266-270

S1.3 The Normal Distribution

1. Explain the concept of distribution and the relationship between summary statistics for a data set and parameters of a distribution.	103-147		236-242
2. Describe characteristics of the normal distribution, including its shape and the relationships among its mean, median, and mode.	116-123		236-242
3. Know and use the fact that about 68%, 95%, and 99.7% of the data lie within one, two, and three standard deviations of the mean, respectively in a normal distribution.	116-122, 132 #7		236-242, 248-257
4. Calculate z-scores, use z-scores to recognize outliers, and use z-scores to make informed decisions.			242-247, 248-257

Standard S2: Bivariate Data – Examining Relationships: Students plot and interpret bivariate data by constructing scatterplots, recognizing linear and nonlinear patterns, and interpreting correlation coefficients; they fit and interpret regression models, using technology as appropriate.

S2.1 Scatterplots and Correlation

1. Construct a scatterplot for a bivariate data set with appropriate labels and scales.	Throughout. See for examples: 3-7, 14, 165, 169-171, 301-303, 310, 311, 329-331	4-5, 13, 19, 21, 23, 28, 279, 282, 296	
2. Given a scatterplot, identify patterns, clusters, and outliers. Recognize no correlation, weak correlation, and strong correlation.		264-279, 291-299, 316 #20	
3. Estimate and interpret Pearson’s correlation coefficient for a scatterplot of a bivariate data set. Recognize that correlation measures the strength of linear association.		258-279, 280-299, 313 #13, 315 #16, 316 #20, 317 #21	

4. Differentiate between correlation and causation. Know that a strong correlation does not imply a cause-and-effect relationship. Recognize the role of lurking variables in correlation.		299-320, 323 #2	
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S2.2 Linear Regression

1. For bivariate data which appear to form a linear pattern, find the least squares regression line by estimating visually and by calculating the equation of the regression line. Interpret the slope of the equation for a regression line.	161-182, 392 #20	280-290, 305-310, 313 #11, 315 #18, 316 #20, 317, 319 #26	
2. Use the equation of the least squares regression line to make appropriate predictions.	165-167, 172 #10, 173 #12, 174, 176 #19, 178 #27, 182 #35	T280, 281-283, 286, 305-308	

Standard S3: Samples, Surveys, and Experiments: Students understand and apply sampling and various sampling methods, examine surveys and experiments, identify bias in methods of conducting surveys, and learn strategies to minimize bias. They understand basic principles of good experimental design.

S3.1 Data Collection and Analysis

1. Know the meanings of a sample from a population and a census of a population, and distinguish between sample statistics and population parameters.			259-270
2. Identify possible sources of bias in data collection and sampling methods and simple experiments; describe how such bias can be reduced and controlled by random sampling; explain the impact of such bias on conclusions made from analysis of the data; and know the effect of replication on the precision of estimates.			75-80, 89-91, 92 #1-2, 95 #5-6, 97 #10-11, 98 #14-15, 104 #4, 279 #17-18, 74-80, 92-99, 280 #20, 313 #24, and Course 4
3. Distinguish between an observational study and an experimental study, and identify, in context, the conclusions that can be drawn from each.			74-80, 92-99

4. Recommended: Design simple experiments or investigations to collect data to answer questions of interest; interpret and present results.			89-91, 92-99
5. Recommended: Understand methods of sampling, including random sampling, stratified sampling, and convenience samples, and be able to determine, in context, the advantages and disadvantages of each.			89-91, 280 #19
6. Recommended: Explain the importance of randomization, double-blind protocols, replication, and the placebo effect in designing experiments and interpreting the results of studies.			74-80, 92-99
<i>S 3.2 Statistical Process Control</i>			
S3.2.1 Recommended: Explain the basic ideas of statistical process control, including recording data from a process over time.			283-307
S3.2.2 Recommended: Read and interpret basic control charts; detect patterns and departures from patterns.			283-307

Standard S4: Probability Models and Probability Calculation: Students understand probability and find probabilities in various situations, including those involving compound events, using diagrams, tables, geometric models and counting strategies; they apply the concepts of probability to make decisions.

S4.1 Probability

1. Understand and construct sample spaces in simple situations.	8-10, 212 #38, 396 #32, 532-536, 545 #10, 547 #17-18, 586	522-528	
2. Define mutually exclusive events, independent events, dependent events, compound events, complementary events and conditional probabilities; and use the definitions to compute probabilities.	24 #21, 528-544, 546 #11, 548 #20, 589	522-542, 561-583	

3. Recommended: Design and carry out an appropriate simulation using random digits to estimate answers to questions about probability; estimate probabilities using results of a simulation; compare results of simulations to theoretical probabilities.	8-10, 551-583	560-565, 588	
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S4.2 Application and Representation

1. Compute probabilities of events using tree diagrams, formulas for combinations and permutations, Venn diagrams, or other counting techniques.	355 #1, 540, 581 #22, 584 #29	539	Course 4
2. Apply probability concepts to practical situations, in such settings as finance, health, ecology, or epidemiology, to make informed decisions.	543 #5, 544 #6, 546, 557-558, 571-577, 582, 587	546-554, 586-588, 573-573, URM Unit 5 p57, URM Unit 2 p68	285-302, 303-307