Grade 10 Principles of Mathematics (MPM2D): Course Map

MPM2D, Academic (also used for de-streamed Grade 10 math). Seven units (74 lessons, plus a test class for each unit), a culminating task and a final evaluation: 88 classes of 75 minutes, or about 110 hours.

Course at a glance

This course follows The Ontario Curriculum, Grades 9 and 10: Mathematics (2005, revised), Principles of Mathematics, Grade 10, Academic (MPM2D), including the 2022 addendum for students who completed the de-streamed Grade 9 course (MTH1W). Students solve and apply linear systems, use analytic geometry to verify properties of figures, explore quadratic relations and their applications, and investigate the trigonometry of right and acute triangles. Every lesson mixes investigation, practice, real-world problems and discussion, and every problem comes with a worked solution for the teacher.

Evaluation: 65% classroom work (a summative task and a unit test in each unit, plus the culminating modelling task), 20% final exam (written, in the exam period) and 15% attendance and participation, following Ontario's requirements for Grades 9 and 10 from September 2026.

Strands and overall expectations

Code	Overall expectation	Students will…
QR1	**Basic properties of quadratic relations** QR. Quadratic Relations of the Form $y = ax^2 + bx + c$	determine the basic properties of quadratic relations;
QR2	**Transformations of $y = x^2$**	relate transformations of the graph of $y = x^2$ to the algebraic representation $y = a(x – h)^2 + k$;
QR3	**Solving quadratic equations**	solve quadratic equations and interpret the solutions with respect to the corresponding relations;
QR4	**Solving problems with quadratic relations**	solve problems involving quadratic relations.
AG1	**Linear systems and lines** AG. Analytic Geometry	model and solve problems involving the intersection of two straight lines;
AG2	**Lines and line segments**	solve problems using analytic geometry involving properties of lines and line segments;
AG3	**Verifying geometric properties**	verify geometric properties of triangles and quadrilaterals, using analytic geometry.
T1	**Similar triangles** T. Trigonometry	use their knowledge of ratio and proportion to investigate similar triangles and solve problems related to similarity;
T2	**Right triangles**	solve problems involving right triangles, using the primary trigonometric ratios and the Pythagorean theorem;

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Code	Overall expectation	Students will…
T3	**Acute triangles**	solve problems involving acute triangles, using the sine law and the cosine law.

The 2005 curriculum does not number its expectations; codes here follow the document's order (strand, overall expectation, specific expectation). AG1.3 to AG1.5 are the 2022 addendum expectations. The mathematical process expectations are built into every lesson.

Units

#	Unit	Classes	Big question	Summative task
1	**Lines and Linear Systems** Analytic Geometry	11	How can two straight lines model a decision, and how do we find where they meet?	Event Planner: plan a school concert using linear systems: the ticket mix that meets a revenue goal, when two bus companies cost the same, and a two-variable budget, with every intersection found two ways and interpreted.
2	**Analytic Geometry** Analytic Geometry	10	How can coordinates prove what a shape looks like it is?	Town Planner: place a new library equidistant from three neighbourhoods, model cell-tower coverage with circles, find the shortest path from a home to a road, and prove a proposed park is a rectangle.
3	**Quadratic Relations** Quadratic Relations	11	What makes a parabola, and how does each number in its equation change its shape and position?	Parabola Hunt: find parabolas in the built and natural world (photos students take or public-domain images), fit an equation in vertex form with Desmos, describe each transformation, and compare to an exponential curve.
4	**Quadratic Expressions** Quadratic Relations	10	How are multiplying and factoring two sides of the same idea, and what do factors tell us about a graph?	Frame It: design a picture frame, garden border or poster with areas written as expressions, expand and factor to find dimensions, and connect the factored form of a relation to the graph's zeros.
5	**Quadratic Equations** Quadratic Relations	13	How many ways can we solve a quadratic equation, and what do the answers mean in real situations?	Launch It: use launch data (a class water-bottle launch, video of a thrown ball, or a provided data set) to build a quadratic model, then find the maximum height, the landing time and the interval when the object is above a given height, solving three ways.

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#	Unit	Classes	Big question	Summative task
6	**Similar and Right Triangles** Trigonometry	11	How can a small triangle help us measure something we can't reach?	Measure the Unreachable: use similar triangles and a homemade clinometer to measure the height of something tall around the school (flagpole, tree, gym wall) two ways, compare results and explain sources of error.
7	**Acute Triangles** Trigonometry	8	How do we solve triangles that don't have a right angle?	Trail Mapper: plan a triangular hiking or paddling route between three landmarks on a map, using the sine law and the cosine law to find every distance and angle, and justify the choice of law at each step.
	Culminating Task: Design the Splash Pad	4	QR4.2, AG1.2, AG2.5, AG3.3, T2.3, T3.4, plus the mathematical processes	Students design a community splash pad on a coordinate grid: water jets modelled by parabolas (maximum height, landing point), paths modelled by lines and their intersections, shade and spray zones as circles, a layout verified with analytic geometry, and ramps and shade sails measured with trigonometry. Includes a planning package, two check-in conferences, a worked exemplar and a rubric.
	Final Evaluation: Written Exam	3	QR, AG and T (all strands)	Two review classes with review packages and worked solutions, then a two-hour written exam in the exam period covering every strand, with full solutions and a marking guide. Ships with a second version for make-ups.

Evaluation plan (Ontario, 2026)

Evaluation	Weight	Notes
Unit 1: Lines and Linear Systems	8%	Summative task 4%, unit test 4%
Unit 2: Analytic Geometry	7%	Summative task 3.5%, unit test 3.5%
Unit 3: Quadratic Relations	8%	Summative task 4%, unit test 4%
Unit 4: Quadratic Expressions	7%	Summative task 3.5%, unit test 3.5%
Unit 5: Quadratic Equations	10%	Summative task 5%, unit test 5%
Unit 6: Similar and Right Triangles	9%	Summative task 4.5%, unit test 4.5%

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Evaluation	Weight	Notes
Unit 7: Acute Triangles	6%	Summative task 3%, unit test 3%
Culminating Task: Design the Splash Pad	10%	Last week of classes
Classroom work total	**65%**	Evaluated throughout the course
Final Evaluation: Written Exam	**20%**	Exam period
Attendance and participation	**15%**	Whole course, on the Ministry's scale below

Weights within classroom work are suggestions: use professional judgement, giving special weight to the most consistent and more recent evidence. Assessment for and as learning (warm-ups, quick checks, exit tickets, self-checks and handout practice) gives feedback and is not counted in the grade. Each rubric uses the four achievement chart categories (Knowledge and Understanding, Thinking, Communication and Application) at four levels.

This plan follows Ontario's mandatory assessment and evaluation requirements for Grades 9 and 10, in effect from September 2026: 65% classroom work, 20% final evaluation and 15% attendance and participation. In mathematics, the 20% final evaluation is a written exam held in the school's designated exam period. Classroom work is based on the most consistent, more recent evidence of achievement; assessment for and as learning (exit tickets, quick checks, conferences and self-checks) gives feedback but is not counted in the grade.

Attendance and participation (15%)

Level	Unexcused absences	About (per semester)	Participation
Level 4 (80–100%)	0 to 2.5% of classes	2 or fewer	Consistently participates: comes prepared, asks relevant questions, respects others and contributes to a positive classroom
Level 3 (70–79%)	2.5 to 5%	2.5 to 4.5	Generally meets these criteria
Level 2 (60–69%)	5 to 7.5%	5 to 7	Occasionally meets these criteria
Level 1 (50–59%)	7.5 to 10%	7.5 to 9	Infrequently meets these criteria
Below Level 1 (under 50%)	More than 10%	More than 9	Does not meet these criteria

A summary of the Ministry's scale. Excused absences (illness, unavoidable circumstances such as bad weather, and approved absences such as cultural and holy days) do not lower the mark. Record attendance and participation the way your board requires.

Source: Ontario Ministry of Education, Growing Success, mandatory assessment and evaluation requirements for Grades 9 to 12 (September 2026). Check ontario.ca and your board's procedures before the semester starts.

Threads that run through every unit

- **Mathematical processes:** problem solving, reasoning and proving, reflecting, selecting tools, connecting, representing and communicating, built into every lesson's tasks and look-fors.
- **Making connections:** the history of quadratics (Babylonian tablets, al-Khwarizmi), real-life contexts in every lesson, and a careers link in each unit (surveying, engineering, design, finance, sport).

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- **Technology and coding:** Desmos and GeoGebra for investigation, and two short optional Python programs (Units 1 and 5) that continue the coding students learned in MTH1W.
- **Bridging from MTH1W:** Unit 1 starts with slope, equations and forms of lines (the 2022 addendum), so students coming from the de-streamed Grade 9 course start on firm ground.
- **Free tools only:** Desmos, GeoGebra, free spreadsheets and any free Python editor approved by your board. Hands-on investigations use rulers, metre sticks, string, paper, a board-and-can ramp, mirrors and a homemade clinometer (protractor, straw, string and a washer).

What's in each unit

- Unit overview, summative task with a Growing Success rubric, and a unit test with full solutions
- A teacher plan, student handouts and a 15 to 18 slide deck (with speaker notes) for every 75-minute lesson
- A hook, the big idea, direct teaching, a worked example, guided practice, an independent handout task, a quick check and an exit ticket in every lesson
- Worked solutions for every problem; editable Word and PowerPoint files, plus PDFs

Unit 1: Lines and Linear Systems

Big question: How can two straight lines model a decision, and how do we find where they meet?

#	Lesson	Expectations	Focus
1	**Slope Revisited**	AG1.4	Bridging from MTH1W: rise over run, the slope formula from two points, slope as a rate of change.
2	**Equations of Lines**	AG1.4	Equations from a graph, a table of values, a point and a slope, or two points.
3	**Forms of a Line**	AG1.5	y = mx + b, Ax + By + C = 0 and Ax + By = D: when each form helps, and translating between them.
4	**Parallel and Perpendicular Lines**	AG1.3	Equal slopes and negative reciprocal slopes; writing parallel and perpendicular lines through a point.
5	**Solving Systems by Graphing**	AG1.2	Points of intersection by hand and in Desmos; one, none or infinitely many solutions.
6	**Substitution**	AG1.1	Solving systems algebraically by substitution, and verifying algebraically and graphically.
7	**Elimination**	AG1.1	Solving systems by elimination, including multiplying an equation first.
8	**Choosing a Method**	AG1.1, AG1.2	When to graph, substitute or eliminate; efficiency and checking.
9	**Systems at Work: Money and Mixtures**	AG1.2	Ticket sales, investments at two simple-interest rates, mixtures and blends.

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#	Lesson	Expectations	Focus
10	**Systems at Work: Rates and Distance**	AG1.2	Two travellers, catch-up problems, wind and current, and phone and rental plans.
11	**Coding Systems and Review**	AG1.1–AG1.5	A short Python program that solves any system by elimination (extension from MTH1W coding); mixed review.

Summative task: Event Planner: plan a school concert using linear systems: the ticket mix that meets a revenue goal, when two bus companies cost the same, and a two-variable budget, with every intersection found two ways and interpreted. Plus a unit test with full solutions.

Unit 2: Analytic Geometry

Big question: How can coordinates prove what a shape looks like it is?

#	Lesson	Expectations	Focus
1	**Midpoints**	AG2.1	Developing the midpoint formula; midpoints of the sides of a triangle, checked in GeoGebra.
2	**Length of a Line Segment**	AG2.2	From the Pythagorean relationship to the distance formula; perimeters on the grid.
3	**Circles Centred at the Origin**	AG2.3, AG2.4	Developing $x^2 + y^2 = r^2$; radius from the equation; sketching; points inside, on or outside.
4	**Right Bisectors and Medians**	AG2.5, AG3.1	Equations of right bisectors and medians; where they meet.
5	**Shortest Distance to a Line**	AG2.5	The perpendicular from a point to a line: a three-step strategy.
6	**Investigating Properties of Figures**	AG3.1	GeoGebra and paper folding: medians, midsegments and diagonals; making conjectures.
7	**Classifying Triangles and Quadrilaterals**	AG3.2	Using lengths and slopes to classify and to verify perpendicular and parallel sides.
8	**Verifying Properties: Multi-Step Proofs**	AG3.3	Planning and carrying out a coordinate proof (midsegments, bisecting diagonals).
9	**Analytic Geometry in Design**	AG2.5, AG3.3	Maps, playgrounds and coverage zones: choosing the right formula.
10	**Analytic Geometry Review**	AG2.1–AG3.3	Mixed review and a proof-planning workshop with worked solutions.

Summative task: Town Planner: place a new library equidistant from three neighbourhoods, model cell-tower coverage with circles, find the shortest path from a home to a road, and prove a proposed park is a rectangle. Plus a unit test with full solutions.

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Unit 3: Quadratic Relations

Big question: What makes a parabola, and how does each number in its equation change its shape and position?

#	Lesson	Expectations	Focus
1	**Collecting Quadratic Data**	QR1.1	A rolling-can ramp experiment (and secondary data); scatter plots and curves of best fit.
2	**Second Differences**	QR1.2	Tables of values for $y = ax^2 + bx + c$; constant second differences mean a parabola.
3	**Key Features of a Parabola**	QR1.3	Vertex, axis of symmetry, zeros, y-intercept, maximum or minimum, and how to describe them.
4	**Comparing $y = x^2$ and $y = 2^x$**	QR1.4	Quadratic versus exponential growth in tables and graphs; which wins, and when.
5	**Zero and Negative Exponents**	QR1.4	What 2^0 and 2^{-3} mean, from patterns in tables and the exponent rules.
6	**Translations of $y = x^2$**	QR2.1	The effect of k and h in $y = x^2 + k$ and $y = (x – h)^2$, in Desmos and by hand.
7	**Stretches, Compressions and Reflections**	QR2.1	The effect of a in $y = ax^2$: wider, narrower, opening down.
8	**Vertex Form**	QR2.2	Putting it together: the roles of a, h and k in $y = a(x – h)^2 + k$; vertex and axis of symmetry.
9	**Sketching from Vertex Form**	QR2.3	Sketching by hand with transformations and a step pattern, then checking in Desmos.
10	**Finding the Equation of a Parabola**	QR2.4	From a graph or a vertex and one point to $y = a(x – h)^2 + k$.
11	**Parabolas in Our World and Review**	QR1.1–QR2.4	Bridges, fountains and jumps; fitting models to photos in Desmos; mixed review.

Summative task: Parabola Hunt: find parabolas in the built and natural world (photos students take or public-domain images), fit an equation in vertex form with Desmos, describe each transformation, and compare to an exponential curve. Plus a unit test with full solutions.

Unit 4: Quadratic Expressions

Big question: How are multiplying and factoring two sides of the same idea, and what do factors tell us about a graph?

#	Lesson	Expectations	Focus
1	**Multiplying Binomials**	QR3.1	Area models and algebra tiles to the distributive property; (x + a)(x + b).

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#	Lesson	Expectations	Focus
2	**Special Products**	QR3.1	Squares of binomials and (a + b)(a – b); two-variable products like (2x – y)(x + 3y).
3	**Common Factoring**	QR3.2	Greatest common factors, including binomial common factors and grouping.
4	**Factoring $x^2 + bx + c$**	QR3.2	Sum and product patterns, with algebra tiles and a table.
5	**Factoring $ax^2 + bx + c$**	QR3.2	Decomposition (splitting the middle term) and checking by expanding.
6	**Special Factoring Patterns**	QR3.2	Differences of squares and perfect square trinomials.
7	**Choosing a Factoring Strategy**	QR3.2	A decision flowchart and mixed practice.
8	**Factored Form and Zeros**	QR3.3	$y = a(x – r)(x – s)$: the factors give the x-intercepts; the axis of symmetry is halfway between.
9	**From Factored Form to Graph**	QR3.3, QR1.3	Sketching from factored form; writing an equation from the zeros and one point.
10	**Expressions Review**	QR3.1–QR3.3	Mixed review, error analysis and a factoring relay with worked solutions.

Summative task: Frame It: design a picture frame, garden border or poster with areas written as expressions, expand and factor to find dimensions, and connect the factored form of a relation to the graph's zeros. Plus a unit test with full solutions.

Unit 5: Quadratic Equations

Big question: How many ways can we solve a quadratic equation, and what do the answers mean in real situations?

#	Lesson	Expectations	Focus
1	**Solving by Factoring**	QR3.8	Zero product property; rearranging to = 0 first; checking solutions.
2	**Solving by Graphing**	QR3.8, QR3.4	Zeros in Desmos; equations that have two, one or no real roots.
3	**Completing the Square**	QR3.5	Building perfect squares with algebra tiles and diagrams (no fractions).
4	**From Standard Form to Vertex Form**	QR3.5, QR3.6	Completing the square to find the vertex and sketch $y = ax^2 + bx + c$.
5	**Sketching $y = ax^2 + bx + c$**	QR3.6	Three methods: intercepts and symmetry, completing the square, technology.

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#	Lesson	Expectations	Focus
6	**The Story of the Quadratic Formula**	QR3.7	From Babylonian tablets and al-Khwarizmi's completed squares to the formula; following the algebra with a numerical example.
7	**Using the Quadratic Formula**	QR3.8	Exact and approximate roots; checking with technology.
8	**Real and Non-Real Roots**	QR3.4	The discriminant: how many x-intercepts, and what “no real roots” looks like.
9	**Maximum and Minimum Problems**	QR4.1	Zeros, vertex and optimal values from equations and graphs.
10	**Projectile Problems**	QR4.2	Height over time: maximum height, landing time, and intervals above a height.
11	**Area and Revenue Problems**	QR4.2	Fencing, frames and ticket prices: modelling and solving.
12	**Coding Quadratics**	QR3.8, QR4.1	A short Python program that uses the quadratic formula and the discriminant (extension from MTH1W coding).
13	**Quadratics Review**	QR3.4–QR4.2	Choosing the best method; mixed review with worked solutions.

Summative task: Launch It: use launch data (a class water-bottle launch, video of a thrown ball, or a provided data set) to build a quadratic model, then find the maximum height, the landing time and the interval when the object is above a given height, solving three ways. Plus a unit test with full solutions.

Unit 6: Similar and Right Triangles

Big question: How can a small triangle help us measure something we can't reach?

#	Lesson	Expectations	Focus
1	**Similar or Congruent?**	T1.2	Same shape versus same shape and size; similarity and congruence compared.
2	**Properties of Similar Triangles**	T1.1	Equal corresponding angles and proportional sides, verified in GeoGebra and with paper.
3	**Similar Triangles in the Real World**	T1.3	Shadows, mirrors, scale models and surveying.
4	**Indirect Measurement Lab**	T1.3	Shadow and mirror methods outside: measuring a tree or flagpole.
5	**The Primary Trigonometric Ratios**	T2.1	Similar right triangles have equal side ratios: defining sine, cosine and tangent.

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#	Lesson	Expectations	Focus
6	**Finding Side Lengths**	T2.2	Choosing a ratio, setting up and solving; the Pythagorean theorem to check.
7	**Finding Angles**	T2.2	Inverse ratios on a calculator; solving a right triangle completely.
8	**Angles of Elevation and Depression**	T2.3	Building and using a clinometer; heights and distances.
9	**Two-Triangle Problems**	T2.3	Problems with two right triangles: towers, cliffs and ramps.
10	**Trigonometry at Work**	T2.3	Surveying, navigation, roofing and accessibility ramps.
11	**Right Triangle Review**	T1.1–T2.3	Mixed review with worked solutions.

Summative task: Measure the Unreachable: use similar triangles and a homemade clinometer to measure the height of something tall around the school (flagpole, tree, gym wall) two ways, compare results and explain sources of error. Plus a unit test with full solutions.

Unit 7: Acute Triangles

Big question: How do we solve triangles that don't have a right angle?

#	Lesson	Expectations	Focus
1	**Beyond Right Triangles**	T3.1	Why primary ratios aren't enough; an investigation of side–angle ratios in GeoGebra.
2	**The Sine Law**	T3.1, T3.3	Following the development with two right triangles; finding a side.
3	**Using the Sine Law**	T3.3	Finding angles; labelling carefully; checking reasonableness.
4	**The Cosine Law**	T3.2	Following the development; its link to the Pythagorean theorem.
5	**Using the Cosine Law**	T3.3	Two sides and the angle between them; three sides.
6	**Choosing the Right Tool**	T3.3, T3.4	Primary ratios, sine law or cosine law: a decision chart.
7	**Acute Triangle Problems**	T3.4	Navigation, surveying, roof trusses and sports.
8	**Trigonometry Review**	T1.1–T3.4	Mixed review across Units 6 and 7 with worked solutions.

Summative task: Trail Mapper: plan a triangular hiking or paddling route between three landmarks on a map, using the sine law and the cosine law to find every distance and angle, and justify the choice of law at each step. Plus a unit test with full solutions.

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Culminating task and final exam

Culminating Task: Design the Splash Pad (classroom work, 10%, 4 classes)

Students design a community splash pad on a coordinate grid: water jets modelled by parabolas (maximum height, landing point), paths modelled by lines and their intersections, shade and spray zones as circles, a layout verified with analytic geometry, and ramps and shade sails measured with trigonometry. Includes a planning package, two check-in conferences, a worked exemplar and a rubric.

Expectations: QR4.2, AG1.2, AG2.5, AG3.3, T2.3, T3.4, plus the mathematical processes

Final Evaluation: Written Exam (20%, 3 classes)

Two review classes with review packages and worked solutions, then a two-hour written exam in the exam period covering every strand, with full solutions and a marking guide. Ships with a second version for make-ups.

Expectations: QR, AG and T (all strands)

Expectation coverage

Every specific expectation and where it is taught. Expectations are evaluated in the unit summative tasks and tests, and again in the final evaluation.

Code	Specific expectation	Lessons
QR1.1	collect data that can be represented as a quadratic relation, from experiments using appropriate equipment and technology (e.g., concrete materials, scientific probes, graphing calculators), or from secondary sources (e.g., the Internet, Statistics Canada); graph the data and draw a curve of best fit, if appropriate, with or without the use of technology (Sample problem: Make a 1 m ramp that makes a 15° angle with the floor. Place a can 30 cm up the ramp. Record the time it takes for the can to roll to the bottom. Repeat by placing the can 40 cm, 50 cm, and 60 cm up the ramp, and so on. Graph the data and draw the curve of best fit.);	U3 L1, U3 L11
QR1.2	determine, through investigation with and without the use of technology, that a quadratic relation of the form $y = ax^2 + bx + c$ ($a \neq 0$) can be graphically represented as a parabola, and that the table of values yields a constant second difference (Sample problem: Graph the relation $y = x^2 – 4x$ by developing a table of values and plotting points. Observe the shape of the graph. Calculate first and second differences. Repeat for different quadratic relations. Describe your observations and make conclusions, using the appropriate terminology.);	U3 L2, U3 L11
QR1.3	identify the key features of a graph of a parabola (i.e., the equation of the axis of symmetry, the coordinates of the vertex, the y-intercept, the zeros, and the maximum or minimum value), and use the appropriate terminology to describe them;	U3 L3, U3 L11, U4 L9
QR1.4	compare, through investigation using technology, the features of the graph of $y = x^2$ and the graph of $y = 2^x$, and determine the meaning of a negative exponent and of zero as an exponent (e.g., by examining patterns in a table of values for $y = 2^x$; by applying the exponent rules for multiplication and division).	U3 L4, U3 L5, U3 L11

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Code	Specific expectation	Lessons
QR2.1	identify, through investigation using technology, the effect on the graph of $y = x^2$ of transformations (i.e., translations, reflections in the x-axis, vertical stretches or compressions) by considering separately each parameter a, h, and k [i.e., investigate the effect on the graph of $y = x^2$ of a, h, and k in $y = x^2 + k$, $y = (x – h)^2$, and $y = ax^2$];	U3 L6, U3 L7, U3 L11
QR2.2	explain the roles of a, h, and k in $y = a(x – h)^2 + k$, using the appropriate terminology to describe the transformations, and identify the vertex and the equation of the axis of symmetry;	U3 L8, U3 L11
QR2.3	sketch, by hand, the graph of $y = a(x – h)^2 + k$ by applying transformations to the graph of $y = x^2$ [Sample problem: Sketch the graph of $y = –½(x – 3)^2 + 4$, and verify using technology.];	U3 L9, U3 L11
QR2.4	determine the equation, in the form $y = a(x – h)^2 + k$, of a given graph of a parabola.	U3 L10, U3 L11
QR3.1	expand and simplify second-degree polynomial expressions [e.g., $(2x + 5)^2$, $(2x – y)(x + 3y)$], using a variety of tools (e.g., algebra tiles, diagrams, computer algebra systems, paper and pencil) and strategies (e.g., patterning);	U4 L1, U4 L2, U4 L10
QR3.2	factor polynomial expressions involving common factors, trinomials, and differences of squares [e.g., $2x^2 + 4x$, $2x – 2y + ax – ay$, $x^2 – x – 6$, $2a^2 + 11a + 5$, $4x^2 – 25$], using a variety of tools (e.g., concrete materials, computer algebra systems, paper and pencil) and strategies (e.g., patterning);	U4 L3, U4 L4, U4 L5, U4 L6, U4 L7, U4 L10
QR3.3	determine, through investigation, and describe the connection between the factors of a quadratic expression and the x-intercepts (i.e., the zeros) of the graph of the corresponding quadratic relation, expressed in the form $y = a(x – r)(x – s)$;	U4 L8, U4 L9, U4 L10
QR3.4	interpret real and non-real roots of quadratic equations, through investigation using graphing technology, and relate the roots to the x-intercepts of the corresponding relations;	U5 L2, U5 L8, U5 L13
QR3.5	express $y = ax^2 + bx + c$ in the form $y = a(x – h)^2 + k$ by completing the square in situations involving no fractions, using a variety of tools (e.g. concrete materials, diagrams, paper and pencil);	U5 L3, U5 L4, U5 L13
QR3.6	sketch or graph a quadratic relation whose equation is given in the form $y = ax^2 + bx + c$, using a variety of methods (e.g., sketching $y = x^2 – 2x – 8$ using intercepts and symmetry; sketching $y = 3x^2 – 12x + 1$ by completing the square and applying transformations; graphing $h = –4.9t^2 + 50t + 1.5$ using technology);	U5 L4, U5 L5, U5 L13
QR3.7	explore the algebraic development of the quadratic formula (e.g., given the algebraic development, connect the steps to a numerical example; follow a demonstration of the algebraic development [student reproduction of the development of the general case is not required]);	U5 L6, U5 L13

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Code	Specific expectation	Lessons
QR3.8	solve quadratic equations that have real roots, using a variety of methods (i.e., factoring, using the quadratic formula, graphing) (Sample problem: Solve $x^2 + 10x + 16 = 0$ by factoring, and verify algebraically. Solve $x^2 + x – 4 = 0$ using the quadratic formula, and verify graphically using technology. Solve $–4.9t^2 + 50t + 1.5 = 0$ by graphing $h = –4.9t^2 + 50t + 1.5$ using technology.).	U5 L1, U5 L2, U5 L7, U5 L12, U5 L13
QR4.1	determine the zeros and the maximum or minimum value of a quadratic relation from its graph (i.e., using graphing calculators or graphing software) or from its defining equation (i.e., by applying algebraic techniques);	U5 L9, U5 L12, U5 L13
QR4.2	solve problems arising from a realistic situation represented by a graph or an equation of a quadratic relation, with and without the use of technology (e.g., given the graph or the equation of a quadratic relation representing the height of a ball over elapsed time, answer questions such as the following: What is the maximum height of the ball? After what length of time will the ball hit the ground? Over what time interval is the height of the ball greater than 3 m?).	U5 L10, U5 L11, U5 L13
AG1.1	solve systems of two linear equations involving two variables, using the algebraic method of substitution or elimination (Sample problem: Solve $y = ½x – 5$, $3x + 2y = –2$ for x and y algebraically, and verify algebraically and graphically);	U1 L6, U1 L7, U1 L8, U1 L11
AG1.2	solve problems that arise from realistic situations described in words or represented by linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method (Sample problem: The Robotics Club raised $5000 to build a robot for a future competition. The club invested part of the money in an account that paid 4% annual interest, and the rest in a government bond that paid 3.5% simple interest per year. After one year, the club earned a total of $190 in interest. How much was invested at each rate? Verify your result.).	U1 L5, U1 L8, U1 L9, U1 L10, U1 L11
AG1.3	identify the relationship between the slopes of parallel and perpendicular lines, and use this relationship to solve related problems; [Addendum, 2022]	U1 L4, U1 L11
AG1.4	develop the formula for the slope of a line (i.e., $m = (y_2 – y_1) / (x_2 – x_1)$), and use this formula to determine the equations of lines, given information about the lines (e.g., a graph of a line, a table of values, the coordinates of two points); [Addendum, 2022]	U1 L1, U1 L2, U1 L11
AG1.5	represent the equations of lines in different forms (e.g., $y = mx + b$, $Ax + By + C = 0$, $Ax + By = D$) and translate between these forms, as appropriate for the context. [Addendum, 2022]	U1 L3, U1 L11
AG2.1	develop the formula for the midpoint of a line segment, and use this formula to solve problems (e.g., determine the coordinates of the midpoints of the sides of a triangle, given the coordinates of the vertices, and verify concretely or by using dynamic geometry software);	U2 L1, U2 L10

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Code	Specific expectation	Lessons
AG2.2	develop the formula for the length of a line segment, and use this formula to solve problems (e.g., determine the lengths of the line segments joining the midpoints of the sides of a triangle, given the coordinates of the vertices of the triangle, and verify using dynamic geometry software);	U2 L2, U2 L10
AG2.3	develop the equation for a circle with centre (0, 0) and radius r, by applying the formula for the length of a line segment;	U2 L3, U2 L10
AG2.4	determine the radius of a circle with centre (0, 0), given its equation; write the equation of a circle with centre (0, 0), given the radius; and sketch the circle, given the equation in the form $x^2 + y^2 = r^2$;	U2 L3, U2 L10
AG2.5	solve problems involving the slope, length, and midpoint of a line segment (e.g., determine the equation of the right bisector of a line segment, given the coordinates of the endpoints; determine the distance from a given point to a line whose equation is given, and verify using dynamic geometry software).	U2 L4, U2 L5, U2 L9, U2 L10
AG3.1	determine, through investigation (e.g., using dynamic geometry software, by paper folding), some characteristics and properties of geometric figures (e.g., medians in a triangle, similar figures constructed on the sides of a right triangle);	U2 L4, U2 L6, U2 L10
AG3.2	verify, using algebraic techniques and analytic geometry, some characteristics of geometric figures (e.g., verify that two lines are perpendicular, given the coordinates of two points on each line; verify, by determining side length, that a triangle is equilateral, given the coordinates of the vertices);	U2 L7, U2 L10
AG3.3	plan and implement a multi-step strategy that uses analytic geometry and algebraic techniques to verify a geometric property (e.g., given the coordinates of the vertices of a triangle, verify that the line segment joining the midpoints of two sides of the triangle is parallel to the third side and half its length, and check using dynamic geometry software; given the coordinates of the vertices of a rectangle, verify that the diagonals of the rectangle bisect each other).	U2 L8, U2 L9, U2 L10
T1.1	verify, through investigation (e.g., using dynamic geometry software, concrete materials), the properties of similar triangles (e.g., given similar triangles, verify the equality of corresponding angles and the proportionality of corresponding sides);	U6 L2, U6 L11, U7 L8
T1.2	describe and compare the concepts of similarity and congruence;	U6 L1, U6 L11, U7 L8
T1.3	solve problems involving similar triangles in realistic situations (e.g., shadows, reflections, scale models, surveying) (Sample problem: Use a metre stick to determine the height of a tree, by means of the similar triangles formed by the tree, the metre stick, and their shadows.).	U6 L3, U6 L4, U6 L11, U7 L8
T2.1	determine, through investigation (e.g., using dynamic geometry software, concrete materials), the relationship between the ratio of two sides in a right triangle and the ratio of the two corresponding sides in a similar right triangle, and define the sine, cosine, and tangent ratios (e.g., sin A = opposite/hypotenuse);	U6 L5, U6 L11, U7 L8

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Code	Specific expectation	Lessons
T2.2	determine the measures of the sides and angles in right triangles, using the primary trigonometric ratios and the Pythagorean theorem;	U6 L6, U6 L7, U6 L11, U7 L8
T2.3	solve problems involving the measures of sides and angles in right triangles in real-life applications (e.g., in surveying, in navigating, in determining the height of an inaccessible object around the school), using the primary trigonometric ratios and the Pythagorean theorem.	U6 L8, U6 L9, U6 L10, U6 L11, U7 L8
T3.1	explore the development of the sine law within acute triangles (e.g., use dynamic geometry software to determine that the ratio of the side lengths equals the ratio of the sines of the opposite angles; follow the algebraic development of the sine law and identify the application of solving systems of equations [student reproduction of the development of the formula is not required]);	U7 L1, U7 L2, U7 L8
T3.2	explore the development of the cosine law within acute triangles (e.g., use dynamic geometry software to verify the cosine law; follow the algebraic development of the cosine law and identify its relationship to the Pythagorean theorem and the cosine ratio [student reproduction of the development of the formula is not required]);	U7 L4, U7 L8
T3.3	determine the measures of sides and angles in acute triangles, using the sine law and the cosine law (Sample problem: In triangle ABC, ∠A = 35°, ∠B = 65°, and AC = 18 cm. Determine BC. Check your result using dynamic geometry software.);	U7 L2, U7 L3, U7 L5, U7 L6, U7 L8
T3.4	solve problems involving the measures of sides and angles in acute triangles.	U7 L6, U7 L7, U7 L8

From The Ontario Curriculum, Grades 9 and 10: Mathematics (2005, revised), MPM2D, and the MPM2D Addendum (2022).

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