MATHEMATICS

MTH-5082-2 — Geometry V

DEFINITION OF THE DOMAIN FOR SUMMATIVE EVALUATION

SEPTEMBER 1997

Québec

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Direction de la formation générale des adultes
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1. Introduction

This definition of the domain for summative evaluation describes and classifies the essential and representative elements of the *Mathematics* program—specifically, for module *Geometry V*. It presents an overview of the program, but should by no means replace the program itself. The purpose of defining the domain is to ensure that all summative evaluation instruments are consistent with the overall program.

The organization of this definition of the domain is the same as that of those of other modules. The content of each section is, however, specific to this module.

The goal of the definition of the domain for summative evaluation is to permit the preparation of examinations that are valid from one version to another, from year to year and from one school board to another, taking into account the responsibilities shared by the ministère de l'Éducation and the school boards.

2. Program Orientations and Consequences for Summative Evaluation

Orientations	Consequences
The main purpose of the adult education secondary level *Mathematics* program is to help adults understand the mathematical concepts needed to solve problems related to everyday situations, expand their knowledge of mathematics and, ultimately, facilitate access to a future occupation. Consequently, in the program, mathematics is presented as a practical tool for solving common, real-life problems.	Evaluation items should deal with either original and practical situations taken from everyday life or those associated with an occupation.
Another area of development emphasized in the program involves mastering the mathematical operations used in science and technology for processing the kind of information students encounter in their daily lives, and which enables them to understand various everyday phenomena in terms of quantities and relations. In developing these skills, the *Mathematics* program can also prepare interested adults for studies leading to a career in science.	Evaluation items should also pertain to situations in the fields of science and mathematics. For example, problems could deal with such things as the calculation of interest rates or the use of mathematical formulas used in science.
Whether the aim is to enable students to solve practical problems or to orient them toward a career in science, all the learning activities in the program emphasize the acquisition of a systematic work method.	Evaluation should measure the adult's ability to follow the steps involved in solving a problem. It should also verify whether or not the student has mastered a work method.
The program places equal emphasis on mastering the use of a calculator or a microcomputer in the classroom. This particular area is addressed throughout the different learning activities.	The use of a calculator is permitted.

3. Content of the Program for Purposes of Summative Evaluation

Concepts

- **Relationships governing measures in a circle**
  - Measures of length, angles, arcs and area
  - Related theorems and corollaries
  - Problem-solving
- **Relationships governing measures in a right triangle**
  - Measures of length, angles and area
  - Related theorems and corollaries
  - Problem-solving
- **Congruent polygons**
  - Properties of congruent figures
  - Related theorems and corollaries
  - Problem-solving
- **Similar polygons**
  - Properties of similar figures
  - Related theorems and corollaries
  - Problem-solving
- **Construction of regular polygons**

Skills

Each skill is defined within the context of a mathematics program. Given that the adult education *Mathematics* program corresponds to the mathematics programs in the youth sector, the skills involved are the same for students in both sectors.

- **Structuring**: Being familiar with the fundamentals of mathematics, understanding some mathematical concepts, establishing cognitive relations.
  Possible actions: associating, classifying, comparing, completing, describing, defining, contrasting, stating, enumerating, grouping, naming, ranking, organizing, recognizing, arranging, and so on

- **Operating**: Performing a given operation or transformation.
  Possible actions: calculating, constructing, breaking down, performing, estimating, evaluating, isolating, measuring, reconstructing, solving, drawing, transforming, verifying, and so on

- **Analyzing or Synthesizing**: Establishing a link between a problem and a given solution or solving a given problem.
  Possible actions: concluding, deducing, deriving, explaining, extrapolating, inferring, justifying, proving, solving, transferring, and so on

4. Table of Dimensions

CONCEPTS / SKILLS	RELATIONS GOVERNING MEASURES IN A CIRCLE 25%	RELATIONS GOVERNING MEASURES IN A RIGHT TRIANGLE 25%	CONGRUENT POLYGONS 20%	SIMILAR POLYGONS 20%	REGULAR POLYGONS 10%
STRUCTURING 18%	1 Choice of theorem or corollary 3%	4 Choice of theorem or corollary 3%	7 Choice of theorem or corollary 3%	10 Choice of theorem or corollary 3%	
			8 Congruent or not? 3%	11 Similar or not? 3%	
OPERATING 30%	2 Measures of length, angles, arcs and area 10%	5 Measures of length, angles and area 10%			13 Construction of regular polygons 10%
ANALYZING OR SYNTHESIZING 52%	3 Problem-solving 12%	6 Problem-solving 12%	9 Problem-solving 14%	12 Problem-solving 14%	

5. Observable Behaviours

Examination items should be formulated on the basis of the observable behaviours listed below. A list of theorems and corollaries related to the relationships governing measures in a circle and in a right triangle, as well as congruent and similar polygons, will be provided with the examination (see appendix). Furthermore, each problem will require a maximum of three theorems or corollaries to solve. The requirements and restrictions specified in the objectives of the program must be observed.

Dimension 1

Given a diagram of a circle in which several elements are represented, selecting the theorem or corollary to support a given relationship governing measures.

Dimension 2

Given a diagram of one or two circles with the measures required to solve a particular problem, determining the measure of a radius, a diameter, a circumference, an area, a chord, an arc or a segment tangent, using the appropriate theorems or corollaries. Given a diagram of a circle with the measures required to solve a particular problem, determining the measure of an arc, a central angle, an inscribed angle, an interior angle or an exterior angle, using the appropriate theorems or corollaries.

Dimension 3

Solving problems related to a variety of human activities and based on relationships governing measures in a circle.

Dimension 4

Given a diagram of a right triangle in which several elements are represented, selecting the theorem or corollary to support a given relationship governing measures.

Dimension 5

Given a diagram of one or more right triangles with the measures required to solve a particular problem, determining the measure of an angle, a side, a segment, a median, an altitude, the hypotenuse, the perimeter or the area, using the appropriate theorems or corollaries.

Dimension 6

Solving problems related to a variety of human activities and based on relationships governing measures in a right triangle.

Dimension 7

Given a diagram of two congruent polygons with the measures required to solve a particular problem, selecting the theorem or corollary used to support a given relationship governing measures. The polygons can be triangles, quadrilaterals, pentagons, hexagons or octagons.

Dimension 8

Given measures of angles and sides of two polygons, determining if these polygons are congruent on the basis of the properties of congruent figures. The polygons can be triangles, quadrilaterals, pentagons, hexagons or octagons.

Dimension 9

Solving problems related to a variety of human activities and based on congruent polygons.

Dimension 10

Given a diagram of two similar polygons with the measures required to solve a particular problem, selecting the theorem or corollary used to support a given relationship governing measures. The polygons can be triangles, quadrilaterals, pentagons, hexagons or octagons.

Dimension 11

Given measures of angles and sides of two polygons, determining if these polygons are similar on the basis of the properties of similar figures. The polygons can be triangles, quadrilaterals, pentagons, hexagons or octagons.

Dimension 12

Solving problems related to a variety of human activities and based on similar polygons.

Dimension 13

Given sufficient data, constructing a five-, six- or eight-sided regular polygon and indicating its apothem.

6. Explanation of Content and Weighting

Given that the program focuses on helping the students learn how to use various mathematical tools to solve concrete real-life problems, emphasis has been placed on the skills of operating and analyzing. Emphasis should also be placed on the steps involved in solving written problems.

The weighting of the skills listed below is based on the program itself and on the time normally required to master these skills.

STRUCTURING	18%
OPERATING	30%
ANALYZING OR SYNTHESIZING	52%

On the basis of the program, the concepts have been weighted relatively equally:

RELATIONSHIPS GOVERNING MEASURES IN A CIRCLE	25%
RELATIONSHIPS GOVERNING MEASURES IN A RIGHT TRIANGLE	25%
CONGRUENT POLYGONS	20%
SIMILAR POLYGONS	20%
REGULAR POLYGONS	10%

7. Description of the Examination

7.1 Type of Examination

There will be a written examination consisting of items that will be scored subjectively (free-response or extended-response items). Some items may be scored objectively.

7.2 Characteristics of the Examination

- The examination must be taken in a single session lasting no more than two hours.
- The distribution of marks should be consistent with the percentages indicated in the table of dimensions.
- Students are permitted to use a calculator, as well as a ruler, square, protractor and compass.
- A list of theorems and corollaries related to relationships governing measures in a circle and in a right triangle and to congruent and similar polygons will be provided (see appendix).

7.3 Pass Mark

To pass the module, students must obtain 60 out of 100 on the examination.

APPENDIX

LIST OF THEOREMS AND COROLLARIES USED

IN GEOMETRY V

LIST 1

RELATIONSHIPS GOVERNING MEASURES IN A CIRCLE

A. Relationships within a circle

1. Any perpendicular bisector of a chord is a diameter of a circle.
2. The longest chord of a circle is a diameter.
3. In a circle, any radius perpendicular to a chord divides that chord into two congruent segments.
4. In a circle, any radius perpendicular to a chord divides the subtended arc into two congruent arcs.
5. In a circle, arcs located between two parallel chords are congruent.
6. Two chords are congruent if they are equidistant from the centre of the circle.
7. In a circle, congruent chords subtend congruent arcs and, conversely, congruent arcs are subtended by congruent chords.
8. Any line tangent to a circle is perpendicular to the radius that shares the point of tangency.
9. For any circle, two tangent segments originating from the same exterior point are congruent.
10. Two parallel lines, be they tangents or secants, intercept congruent arcs of a circle.

B. Relationships involving two circles

11. The circumferences of two circles have the same ratio as their radii.

12. The areas of two circles have the same ratio as the squares of their radii.

13. The measures of similar arcs of two circles have the same ratio as their radii.

C. Relationships governing angular measures in a circle

14. In a circle, the measure of a central angle is equal to the measure of its intercepted arc.

15. In a circle, the measure of an inscribed angle is one half the measure of its intercepted arc.

16. The measure of an angle formed by two chords intersecting in the interior of a circle is one half the sum of the measures of the arcs intercepted by the angle and its vertical angle.

17. The measure of an angle formed by two tangents, a tangent and a secant, or two secants is one half the difference of the measures of the intercepted arcs.

LIST 2

RELATIONSHIPS GOVERNING MEASURES IN A RIGHT TRIANGLE

18. The hypotenuse of a right triangle inscribed in a circle is always a diameter of that circle.

19. In a right triangle, the length of the median to the hypotenuse is one half the length of the hypotenuse.

20. In a right triangle with a 30^{o} angle, the length of the side opposite this angle is one half the length of the hypotenuse.

21. A right triangle and the altitude to its hypotenuse form two right triangles that are similar to the given triangle and to each other.

22. The length of the altitude to the hypotenuse of a right triangle is the geometric mean between the lengths of the segments of the hypotenuse.

23. The length of a leg of a right triangle is the geometric mean between the length of the hypotenuse and the length of the adjacent segment of the hypotenuse formed by the altitude to the hypotenuse.

24. The product of the lengths of the legs of a right triangle is equal to the product of the length of the hypotenuse and the length of the altitude to the hypotenuse.

LIST 3

CONGRUENT POLYGONS

25. If two lines are perpendicular to a third line, then they are parallel to each other.

26. Any point on the perpendicular bisector of a segment is equidistant from the endpoints of that segment.

27. Any point on the bisector of an angle is equidistant from the sides of that angle.

28. The angles of a linear pair are supplementary.

29. Vertical angles are congruent.

30. If two parallel lines are intersected by a transversal:
    a) alternate interior angles are congruent;
    b) alternate exterior angles are congruent;
    c) corresponding angles are congruent;
    d) interior angles on the same side of the transversal are supplementary;
    e) exterior angles on the same side of the transversal are supplementary.

31. In any isosceles triangle, the angles opposite the congruent sides are congruent.

32. In any isosceles triangle, the perpendicular bisector of the side adjacent to the congruent angles is also the bisector, median and altitude to that side.

33. The line segment having the midpoints of two sides of a triangle as its endpoints is parallel to the third side and its length is one half the length of the third side.

34. The sum of the measures of the interior angles of a triangle is 180^{o}.

35. The sum of the measures of the interior angles of a polygon is equal to 180^{o} times the number of sides minus two (i.e. $180^{o}(n - 2)$, where n is the number of sides in the polygon).

36. The sum of the measures of the exterior angles of a convex polygon is 360^{o}.

37. The opposite (or non-consecutive) angles of a parallelogram are congruent.

38. The opposite (or non-consecutive) sides of a parallelogram are congruent.

39. The diagonals of a parallelogram bisect each other.

40. The diagonals of a rectangle are congruent.

41. The diagonals of a rhombus are perpendicular to each other.

42. The diagonals of a square are perpendicular bisectors of each other.

LIST 4

SIMILAR POLYGONS

43. Transversals intersected by parallel lines are divided into proportional segments.

44. A line parallel to one side of a triangle and passing through an interior point of that triangle determines a second triangle similar to the first.

45. The lengths of the corresponding segments of two similar triangles are proportional.

46. Two polygons are similar if their corresponding angles are congruent and if the measures of their corresponding sides are proportional.

47. The perimeters of similar polygons have the same ratio as the lengths of the corresponding diagonals or the lengths of the corresponding sides.

48. The perimeters of regular similar polygons have the same ratio as their apothems or as the radii of their circumscribed circles.

49. The areas of regular similar polygons have the same ratio as the squares of their apothems or as squares of the radii of their circumscribed circles.

50. The areas of similar polygons have the same ratio as the square of their ratio of similitude (i.e. the same ratio as the squares of the lengths of any two corresponding segments).

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