

# Adult Basic Education (ABE)

## Level III Mathematics

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### Mathematics 2101C

## Quadratic Equations/Proportional Reasoning Curriculum Guide

**Student Resource:** *Principles of Mathematics 11. Nelson. 2011. ISBN-13: 978-0-17-650412-0.*

**Level III Degree and Technical/Business-Related College Profiles Mathematics Courses (Academic)**

Mathematics 1101A: Measurement/Trigonometry/Factors and Products

Mathematics 1101B: Roots and Powers/Relations and Functions

Mathematics 1101C: Linear Functions/Systems of Linear Equations

Mathematics 2101A: Reasoning/Angles and Triangles/Trigonometry

Mathematics 2101B: Radicals/Statistics/Quadratic Functions

**Mathematics 2101C: Quadratic Equations/Proportional Reasoning**

Mathematics 3101A: Set Theory/Counting Methods/Probability

Mathematics 3101B: Rational Expressions and Equations/Polynomial Functions/Exponential Functions

Mathematics 3101C: Logarithmic Functions/Sinusoidal Functions/ Borrowing Money



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## General Information

### *Introduction*

**Mathematics 2101C** when completed with **Mathematics 2101A** and **B** is equivalent to the Newfoundland and Labrador senior high school **Mathematics 2201 (Academic)** course.

### *Pre-requisite*

Students must have passed **Mathematics 2101B**.

### *Resources*

The student resource for this course is:

- *Principles of Mathematics 11. Nelson. 2011. ISBN-13: 978-0-17-650412-0.*

The instructor resources for this course are:

- *Principles of Mathematics 11. Nelson. 2011. ISBN-13: 978-0-17-651402-0.*
- *Principles of Mathematics 11 Teacher's Resource CD-ROM.*

Instructors may also supplement with other resources at their discretion.

### *Study Guide*

The Study Guide provides the student with Required Work for the course. It guides the student through the course by assigning relevant reading and exercises from the student resource. Sometimes the Study Guide provides important points for students to think about, to remember or to note. The Study Guide is designed to give students some degree of independence in their work. There is information in the Curriculum Guide applicable to teaching, learning and assessment that is not included in the Study Guide. Instructors should review this information and decide how to use it when teaching students.

Instructors can also exercise professional judgment and make minor alterations to the Required Work in the Study Guide. For example, an instructor may decide that it is unnecessary to assign students all the exercises to complete within each lesson.

### ***Curriculum Guide***

The Curriculum Guide includes the specific curriculum outcomes and achievement indicators for the course. The specific curriculum outcomes are listed numerically, and the achievement indicators are listed alphabetically. Suggestions for teaching, learning and assessment are also provided to support student achievement of the outcomes. Some of these suggestions will also be repeated in the curriculum guides for other mathematics courses as appropriate. The curriculum guide also states the pre-requisite for each Level III mathematics course.

## **Mathematics 2101C Outcomes/Achievement Indicators**

### ***Unit 1: Quadratic Equations***

1. Solve problems that involve quadratic equations
  - a) Determine, with or without technology, the intercepts of the graph of a quadratic function.
  - b) Explain the relationships among the roots of an equation, the zeroes of the corresponding function, and the x-intercepts of the graph of the function.
  - c) Explain, using examples, why the graph of a quadratic function may have zero, one or two x-intercepts.
  - d) Determine, by factoring, the roots of a quadratic equation, verify by substitution.
  - e) Express a quadratic equation in factored form, given the zeroes of the corresponding quadratic function or the x-intercepts of the graph of the function.
  - f) Determine, using the quadratic formula, the roots of a quadratic equation.
  - g) Solve a contextual problem by modelling a situation with a quadratic equation and solving the equation.

## ***Unit 2: Proportional Reasoning***

1. Solve problems that involve the application of rates.
  - a) Interpret rates in a given context, such as the arts, commerce, the environment, medicine or recreation.
  - b) Determine and compare rates and unit rates.
  - c) Make and justify a decision, using rates.
  - d) Draw a graph to represent a rate.
  - e) Explain, using examples, the relationship between the slope of a graph and a rate.
  - f) Describe a context for a given rate or unit rate.
  - g) Identify and explain factors that influence a rate in a given context.
  - h) Solve a contextual problem that involves rates or unit rates.
  - i) Solve a rate problem that requires the isolation of a variable.
2. Solve problems that involve scale diagrams, using proportional reasoning.
  - a) Explain, using examples, how scale diagrams are used to model a 2-D shape.
  - b) Determine, using proportional reasoning, an unknown dimension of a 2-D shape, given a scale diagram or model.
  - a) Determine, using proportional reasoning, the scale factor, given one dimension of a 2-D shape, and its representation.
  - b) Draw, with or without technology, a scale diagram of a given 2-D shape, according to a specified scale factor (enlargement or reduction).
  - c) Solve a contextual problem that involves a scale diagram.
3. Demonstrate an understanding of the relationships among scale factors, areas, surface areas and volumes of similar 2-D shapes and 3-D objects.
  - a) Explain, using examples, the effect of a change in the scale factor on the area of a 2-D shape.
  - b) Determine the area of a 2-D shape, given the scale diagram, and justify the reasonableness of the result.
  - c) Solve a spatial problem that requires the manipulation of formulas.
  - d) Solve a contextual problem that involves the relationships among scale factors, areas and volumes.

- e) Explain, using examples, how scale diagrams are used to model a 3-D object.
- f) Determine, using proportional reasoning, the scale factor, given one dimension of a 3-D object, and its representation.
- g) Determine, using proportional reasoning, an unknown dimension of a 3-D object, given a scale diagram or model.
- h) Explain, using examples, the effect of a change in the scale factor on the surface area and volume of a 3-D object.
- i) Determine the surface area and volume of a 3-D object, given the scale diagram, and justify the reasonableness.

## **Recommended Evaluation**

Written Notes (Including all the Required Work)	10%
Assignments	20%
Tests	20%
Final Exam (entire course)	50%
<b>Total</b>	<b>100%</b>

Instructors have the discretion to make minor changes to this evaluation scheme.



## Unit 1: Quadratic Equations—Suggestions for Teaching and Learning

- In this unit, students will solve quadratic equations by graphing, factoring and using the quadratic formula.
- Discuss with students that technology such as FX Draw, a graphing calculator, or graphing software can be used to graph a quadratic function.
- Ensure that students are able to identify the intercepts of a graph using visual representation.
- Ensure that students understand what the x-intercept(s) and y-intercepts mean on a quadratic graph of a real-life solution.
- Discuss with students that not all x-intercepts are integers. Sometimes students will have to approximate the x-intercepts when drawing a graph of a quadratic equation by hand or with technology.
- Ensure that students understand that x-intercepts of the graph, or zeroes of the quadratic function, correspond to the roots of the quadratic equation.
- Ensure that students understand that the graph of a quadratic function may have zero, one or two x-intercepts depending on the location of the vertex and possibly the direction of opening.
- Ensure students understand that once a quadratic equation has been factored, the zero product property will be used to determine the roots.
- Discuss with students the importance of checking solutions by substituting the value of each root into the original equation and verifying that the value makes the equation true.

## **Unit 1: Quadratic Equations—Suggestions for Teaching and Learning**

- Ensure that students understand that a quadratic equation may be given in a format which requires students to simplify before they are able to determine the roots.
- Discuss with students that the quadratic formula allows them to work with situation where the quadratic equation is not factorable.
- Discuss with students that quadratic equations can be solved using different methods. Factoring can only be used when the equation itself is factorable, but the quadratic formula can be used for all quadratic equations.
- Discuss with students the difference between exact and approximate solutions.
- Discuss with students that quadratic equations can be used to model a variety of situations such as projectile motion and geometry-based word problems.

## **Unit 1: Quadratic Equations—Suggestions for Assessment**

- Instructors can use the BLM's on the CD-ROM to further reinforce the unit concepts.
- The BLM's on the CD-ROM can be useful for developing unit tests and the final exam.
- Instructors have discretion to combine the last unit test with the final exam if beneficial to the student.
- Students must pass the final exam with a minimum grade of 50% to receive credit for this course.
- Instructors should encourage students to reflect on the math concepts in this unit to relate to everyday life.
- Instructors should engage students in discussions to verbalize student thinking on the math concepts.
- Instructors should require students to always show complete calculations with correct units when relevant.
- Instructors can use their own professional judgment to design assessment tools (additional exercises, word problems, assignments, reflections, math journals, etc.) to meet individual student needs.

## **Unit 2: Proportional Reasoning—Suggestions for Teaching and Learning**

- In this unit, students will represent a rate in different ways, determine a unit rate, and will then use unit rates to solve problems and make decisions.
- Discuss with students that a rate is a comparison between two things with different units. Common rates are fuel consumption, speed, supermarket prices, and monthly gym fees.
- Discuss with students the difference between rate and unit rate.
- Ensure students understand how to compare rates expressed in different units.
- Discuss with students problems involving rates that are compared using proportional reasoning and unit rates.
- Discuss with students that some stores, especially grocery stores, provide a special shelf tag below the product. These shelf tags provide information on unit pricing.
- Discuss with students how to draw and interpret graphs which illustrate various rates, such as gas rates, speed, etc.
- Discuss with students rates in real-life scenarios in order to reinforce the understanding of rates, their usefulness, and their reasonableness.

## Unit 2: Proportional Reasoning—Suggestions for Teaching and Learning

- Review the concepts of scale factors and scale diagrams of 2-D shapes.
- Ensure students understand that a variable  $k$  will be used to represent the scale factor,  $k = \text{diagram measurement} / \text{actual measurement}$ .
- Ensure that students understand how to determine scale factors from a variety of sources: models and scale diagrams and by using corresponding lengths.
- Ensure that students understand the scale factor for an enlargement is greater than 1 and the scale factor of a reduction is between 0 and 1.
- Discuss with students real-life applications such as maps, sewing patterns, car models, and construction blueprints.
- Discuss with students how area is affected when the lengths of shapes are enlarged or reduced by a specific scale factor.
- Discuss with students how to apply scale factors to a 3-D object.
- Discuss with students the relationship between scale factor and the surface area of two similar 3-D objects and the scale factor and the volume of two similar 3-D objects.

## **Unit 2: Statistics—Suggestions for Assessment**

- Instructors can use the BLM's on the CD-ROM to further reinforce the unit concepts.
- The BLM's on the CD-ROM can be useful for developing unit tests and the final exam.
- Instructors have discretion to combine the last unit test with the final exam if beneficial to the student.
- Students must pass the final exam with a minimum grade of 50% to receive credit for this course.
- Instructors should encourage students to reflect on the math concepts in this unit to relate to everyday life.
- Instructors should engage students in discussions to verbalize student thinking on the math concepts.
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