Adult Basic Education
# Mathematics

# Mathematics 2105C

## Geometry

# Study Guide

**Prerequisites:**     Mathematics 2105A, 2105B

**Credit Value**:     1

**Text:**     *Essentials of Mathematics 10*,  Baron, Celia;  Pacific
Educational Press, 2003.

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Mathematics Courses [General College Profile]

Mathematics 2105A
Mathematics 2105B
**Mathematics 2105C**
Mathematics 3107A
Mathematics 3107B
Mathematics 3107C
Mathematics 3109A
Mathematics 3109B
Mathematics 3109C

# Table of Contents

## To the Student

## I.    Introduction to Mathematics to 2105C

In this course you will measure lengths and estimate the measurement of objects using both metric and imperial units.  You will work with and create scale drawings as well as sketch 3-D designs using isometric dot paper.  You will use ratio and proportion to solve similar triangle problems. The primary trigonometric ratios sine, cosine, and tangent will help you when solving problems involving right triangles.

The study of trigonometry, starting with similar triangles, allows you to solve many ratio, proportion, and distance problems as well as problems that look for the lengths of sides of triangles and measures of unknown angles.  These skills are particularly useful for construction trades such as carpentry.

## II.    Resources

You will require the following:

- *Essentials of Mathematics 10*
- scientific calculator
- isometric dot paper (see instructor)
- protractor

**Notes concerning the textbook**:

**Glossary**: Knowledge of mathematical terms is essential to understand concepts and correctly interpret questions. Written explanations will be part of the work you submit for evaluation, and appropriate use of vocabulary will be required.

Your text for this course includes a Glossary where definitions for mathematical terms are found. Be sure you understand such definitions and can explain them in your own words.  Where appropriate, you should include examples or sketches to support your definitions.

**Examples**: You should study the **Examples** in each section carefully and see your instructor if you have any questions.  These **Examples** have full solutions to problems that will be a great help when answering assigned questions from **Notebook Assignment**.

**Chapter Project:**  Unless your instructor directs you differently, you should omit all **Chapter Projects** and **Project Activity**.

## To the Student

**Notes concerning technology**:

You should have a scientific calculator (the word "scientific" should be written on it) and the instruction booklet that belongs with it. Scientific calculators are fairly inexpensive. Even though your calculator will be a  useful tool, you should be able to solve most exercises by using paper and pencil.

## III.    Study Guide

**This Study Guide is required at all times.** It will lead you through the course and you should take care to complete each unit of study in the order given in this Guide.

To be successful, you should read the **References and Notes** first and then, when indicated by the ▶▶ symbols, complete the **Work to Submit** problems. Many times you will be directed to see your instructor, and this is vital, especially in a Mathematics course. If you have only a hazy idea about what you just completed, nothing will be gained by continuing on to the next set of problems.

## To the Student

The Study Guide has the following format:

> **Reading for this Unit:**     In this box, you will find the name of the text, and the chapters, sections and pages used to cover the material for this unit.  As a preliminary step, skim the referenced section, looking at the name of the section, and noting each category.  Once you have completed this overview, you are ready to begin.

| **References and Notes** | **Work to Submit** |
|---|---|
| This left hand column guides you through the material to read from the text. | There are two basic categories included in this column that correspond to the same categories in the sections of the text. They are **Mental Math** and **Notebook Assignment**. |
| It will also refer to specific **Examples** found in each Exploration.  You are directed to carefully study these **Examples** with solutions and see your instructor if you have any questions.  The **Examples** are important in that they not only explain and demonstrate a concept, but also provide techniques or strategies that can be used in the assigned questions. | **Mental Math:** These problems should be completed using pencil and paper.  If you have difficulty, you should see your instructor for extra practice problems.  Usually the skills that are applied in **Mental Math** are those required to successfully complete **Notebook Assignment**. Your instructor will provide the answers to **Mental Math** exercises. |
| You should read and understand the **Hints** and **New Terms** that are at the bottom of selected pages in the textbook. | **Notebook Assignment:**  This section provides a series of problems similar to those in the **Exploration**. You should attempt these problems only after the **Exploration** problems have been understood and all assigned **Mental Math** and practice worksheets have been completed. |
| The symbols  ▶▶ direct you to the column on the right which contains the work to complete and submit to your instructor.  You will be evaluated on this material. | The textbook contains answers to **Notebook Assignment**.  Your instructor will provide more detailed solutions with workings and some explanations. |
| This column will also contain general **Notes** which are intended to give extra information and are not usually specific to any one question. | This column will also contain **Notes** which give information about specific questions. |

## IV.   Recommended Evaluation

| | |
|---|---|
| Written Notes | 10% |
| Assignments | 10% |
| Test(s) | 30% |
| Final Exam *(entire course)* | <u>50%</u> |
| | 100% |

| Geometry |
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**To meet the objectives of this unit, students should complete the following:**

| |
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| **Reading for this unit**:    *Essentials of Mathematics 10* |

Chapter 5:

| **References and Notes** | **Work to Submit** |
| --- | --- |
| Omit **Chapter Project** and **Project Activity**.<br><br>Read pages 247, 250 - 253. These pages demonstrate how the creation of a scale model is used in the design and construction of a building.<br><br>You will <u>not</u> be required to do the activities on these pages.<br><br>Read **Exploration 2**. Study each of the **Examples** and the given solutions. See your instructor if you do not understand all of the calculations. | |

**Geometry**

| **References and Notes** | **Work to Submit** |
|---|---|
| Study the prefixes used in the metric system on page 255.  In particular; you should become very familiar with kilo, deci, centi and milli.<br><br>You do <u>not</u> have to memorize the formulas in the green boxes on page 258 and 259, but you must know how to substitute values for the variables. You should also be able to name the figures and objects shown.<br><br>Answer the following questions.<br>▶▶<br>Ask your instructor for a copy of **Practice Exercise 1**, *Area and Perimeter*<br><br>The Appendix in the back of this Study Guide contains a Formula Sheet. | 1.1     **Practice Exercise 1**, *Area and Perimeter*<br>         Answer questions 1 - 17.<br><br>1.2     **Notebook Assignment**, pages 261 - 264<br>         Answer questions 1, 2 and 3.<br>         (*See note below on question 3*.)<br><br>         Answer questions 4 - 13.<br>         (*See note below on questions 10 - 13*.)<br><br>**Question 3:** When converting between metric measures, you should set up a ratio which is equal to 1. On page 254, in the **Hint** box, you will see that  1 m = 100 cm.<br>Divide both sides by 1 m, to get  $1 = \dfrac{100\,cm}{1m}$.<br><br>Divide both sides by 100 cm, to get $\dfrac{1m}{100\,cm} = 1$.<br><br>Look at 3a) on page 262.  2.57 m  =  _____ cm.<br>To do this problem, you should multiply the left side by one of the 2 ratios given above. |

**Geometry**

| **References and Notes** | **Work to Submit** |
|---|---|
| | Since we want the answer in cm, we would like for the m unit to cancel, therefore multiply by $\dfrac{100\,cm}{1m}$. |
| | $$2.57 \text{ m} \times \dfrac{100\,cm}{1m} = 257 \text{ cm}.$$ |
| | ( The *m's* in the numerator and denominator cancelled.) |
| | Similarly, for 3b), 1000 mm = 1 m. |
| | Therefore, $1 = \dfrac{1m}{1000\,mm}$ and $1 = \dfrac{1000\,mm}{1m}$. |
| | **Questions 10 - 13:** Draw a sketch and put in the given dimensions before you attempt to solve each of these questions. |
| | 1.3 **Mental Math**, page 262<br>Answer questions 1 - 3. |
| Study **Exploration 3**. | |
| You will notice on the ruler on page 265, that 1 inch has 16 divisions. The midway point between inches has 8 divisions or $\dfrac{8}{16}$ or $\dfrac{1}{2}$ inch. If you look at 2 divisions, the length is $\dfrac{2}{16}$ or $\dfrac{1}{8}$ inch. | |

**Geometry**

| **References and Notes** | **Work to Submit** |
|---|---|
| You do not have to memorize the conversions between the metric and imperial systems which are given on page 268.  You should have an idea how some of these measures compare. | |
| Answer the following questions. ▶▶ | 1.4     **Practice Exercise 2**, *Area, Perimeter and Volume* <br> Answer questions 1 - 4. |
| Ask your instructor for a copy of **Practice Exercise 2**, *Area, Perimeter and Volume* | 1.5     **Notebook Assignment**, pages 269 - 273 <br> Answer questions 1 - 5, 7 - 12. <br> (*See notes below on questions 11 and 12*.) <br><br> Answer questions 13 - 16. <br> (*See note below on question 14*.) |
| | **Question 11:** The symbol for inch is ″ and the symbol for foot is ′. |
| | **Question 12:** Refer to the formulas on pages 258 and 259. |
| | **Question 14:** Calculate the total area, and then subtract the triangular area occupied by the fireplace. |
| Read **Exploration 4**, carefully studying **Examples 1** and **2** and their solutions. | |
| Answer the following questions. ▶▶ | 1.6     **Notebook Assignment**, pages 279 and 280 <br> Answer questions 1 - 5. <br> (*See note below on questions 4 and 5*.) |
| | **Questions 4 and 5**: If necessary, refer to the formulas on pages 258 and 259. |

**Geometry**

| References and Notes | Work to Submit |
|---|---|
| | 1.7 **Mental Math**, page 280 |
| You will need graph paper for **Exploration 5**. | |
| Read **Exploration 5**. Study **Examples 1** - **5**. | |
| A scale factor presented as $\frac{1}{4}$ or 1:4 means that 1 unit on the model represents 4 of the <u>same</u> units on the actual object. This is demonstrated in **Example 1b**). | |
| Answer the following questions. ▶▶ | 1.8 Define the following terms: *scale drawing* and *floor plan*. |
| Ask your instructor for a copy of **Practice Exercise 3**, *Word Problems* and **Practice Exercise 4**, *Scale Drawings*. | 1.9 **Practice Exercise 3**, *Word Problems* Answer questions 1 - 15. |
| | 1.10 **Practice Exercise 4**, *Scale Drawings* Answer questions 1 - 11. |
| | 1.11 **Notebook Assignment**, pages 285 - 288 Answer questions 1 - 9. (*See note below on question 9.*) |
| | Answer questions 10 - 12. (*See note below on questions 11 and 12*.) |
| | Answer questions 13 and 14. |

| **Geometry** |
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| **References and Notes** | **Work to Submit** |
| :--- | :--- |
| | **Question 9**: A rectangular prism is a rectangular solid. See pages 258 and 259 for formulas. |
| | **Question 11**: You should rewrite the scale. <br>       1 cm = 0.25 m, therefore 1 cm = 25 cm <br><br> Next, change all dimensions (bedroom, bed and night table) from m to cm. <br> $$3.6 \text{ m} \times \frac{100\,cm}{1\,m} \ = \ 360 \text{ cm}$$ |
| | **Question 12**: When you write the scale factor, the first number is larger than the second number, because the model (photograph) is larger than the actual object. |
| [Omit **Exploration 6**.] <br><br> Ask your instructor for isometric dot paper before you begin. <br><br> Read **Exploration 7** and study **Examples 1** and **2**. Try to reproduce the drawings given in the solutions. <br><br> Answer the following questions. ▶▶ | |
| | 1.12    Define the term *isometric dot paper*. <br><br> 1.13    **Mental Math**, page 298 <br><br> 1.14    **Notebook Assignment**, pages 301 and 302 <br>          Answer questions 1 and 5. |

**Geometry**

| References and Notes | Work to Submit |
|---|---|
| Read **Exploration 8**.<br><br>Study **Examples 1** and **2**.<br><br>Read the **Hint** on page 304. It is important that you label triangles as shown in this **Hint**.<br><br>Answer the following questions. ▶▶ | <br><br><br><br><br><br>1.15  Using a sketch, define each of the following terms: *similar triangles* and *corresponding sides*.<br><br>1.16  **Notebook Assignment**, pages 305 - 310<br>  Answer question 1.<br>  (*See note below on question 1.*)<br><br>  Answer questions 2 - 7.<br>  (*See note below on questions 3 - 7.*)<br><br>**Question 1:** A copy of the Data Table is in the Appendix.<br><br>**Questions 3 - 7**: Draw a sketch for each problem before you try to solve it! |
| Read **Exploration 9.**<br><br>Make sure that your calculator is in degree mode.<br><br>Answer the following questions. ▶▶<br>See your instructor to ensure that you are properly labeling the sides of a right triangle.<br><br>Study the **Hint** on page 313.  See your instructor to make sure that you are using the calculator properly. | <br><br><br><br>1.17  **Pairs Activity**, pages 311 - 313<br>  You can complete this activity in pairs or individually.  If you have a partner, each of you should work though the calculations and write out your own solutions.<br><br>  Answer questions 1 - 8.<br><br>  Draw and <u>neatly</u> label your triangle. |

**Geometry**

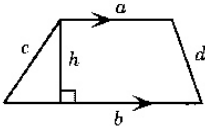| References and Notes | Work to Submit |
|---|---|
| Read **Exploration 10.**<br><br>Omit **Pairs Activity**.<br><br>Study **Examples 1** and **2.** Work through all calculations in the solutions. In particular, notice the steps taken to isolate the variable. Note also, that you should check that your answer is reasonable.<br><br>Answer the following questions. ▶▶<br><br>Ask your instructor for a copy of **Practice Exercise 5**, *Trigonometry*. | 1.18 **Notebook Assignment**, pages 314 - 316<br>Answer questions 1 - 7.<br><br><br><br><br><br><br><br>1.19 **Mental Math**, page 320<br><br>1.20 **Practice Exercise 5**, *Trigonometry*<br>Answer questions 1 - 4.<br><br><br>1.21 **Notebook Assignment**, pages 324 and 325<br>Answer questions 1 - 8.<br><br>Draw and label a sketch for each of these problems.<br><br>1.22 **Chapter Review**, pages 327 - 332.<br>Answer questions 4, 5, 6, 8, 10, 11, 14, and 16 - 31. |

# Appendix

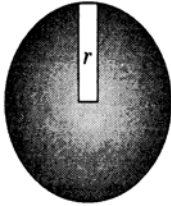# Formulas for Area, Perimeter, Surface Area and Volume
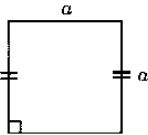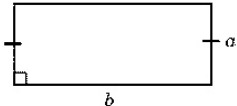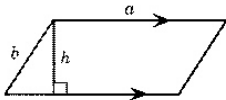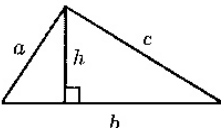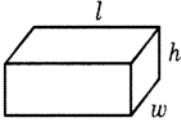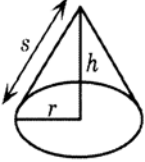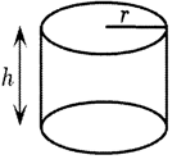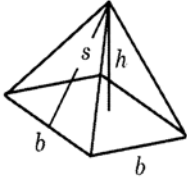
| Figure | Diagram | Area (in square units) | Perimeter (in units of length) |
|---|---|---|---|
| square |  | $A = a^2$ | $p = 4a$ |
| rectangle |  | $A = ab$ | $p = 2(a + b)$ <br> or <br> $p = 2a + 2b$ |
| parallelogram |  | $A = ah$ | $p = 2a + 2b$ |
| trapezoid |  | $A = \dfrac{1}{2}(a + b)h$ | $p = a + b + c + d$ |
| triangle |  | $A = \dfrac{1}{2}bh$ | $p = a + b + c$ |
| circle |  | $A = \pi r^2$ | $C = 2\pi r$ |

| Figure | Diagram | Surface Area (in square units) | Volume (in cubic units) |
|---|---|---|---|
| rectangular solid |  | $SA = 2wh + 2lw + 2lh$ | $V = lwh$ |
| sphere |  | $SA = 4\pi r^2$ | $V = \dfrac{4}{3}\pi r^3$ |
| cone |  | $SA = \pi rs$ (slanted side only) | $V = \dfrac{1}{3}\pi r^2 h$ |
| cylinder |  | $SA = 2\pi rh + 2\pi r^2$ | $V = \pi r^2 h$ |
| pyramid |  | $SA = 2sb$ (all four sides — not the bottom) | $V = \dfrac{1}{3}b^2 h$ |

| | | | |
|---|---|---|---|
| Data Table for #1 of the **Notebook Assignment** on pages 306 and 307 of Student Text | | | |
| $\angle$A | | $\dfrac{a}{d}$ | |
| $\angle$B | | $\dfrac{b}{e}$ | |
| $\angle$C | | $\dfrac{c}{f}$ | |
| $\angle$D | | $\dfrac{a}{b}$ | |
| $\angle$E | | $\dfrac{d}{e}$ | |
| $\angle$F | | $\dfrac{a}{c}$ | |
| $\dfrac{\angle A}{\angle D}$ | | $\dfrac{d}{f}$ | |
| $\dfrac{\angle B}{\angle E}$ | | $\dfrac{b}{c}$ | |
| $\dfrac{\angle C}{\angle F}$ | | $\dfrac{e}{f}$ | |
| length of side a | | length of AM (cm) | |
| length of side b | | length of DN (cm) | |
| length of side c | | area of $\triangle$ABC | |
| length of side d | | area of $\triangle$DEF | |
| length of side e | | $\dfrac{area\ of\ \triangle\ ABC}{area\ of\ \triangle\ DEF}$ | |
| length of side f | | | |