Adult Basic Education

Mathematics

Mathematics 3107B

Relations and Formulas

Study Guide

Prerequisites: Mathematics 2105A, 2105B, 2105C
Mathematics 3107A

Credit Value: 1

Text: *Essentials of Mathematics 11*, Baron, Celia; Pacific Educational Press, 2002.

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 3107B

The main goal of Relations and Formulas is to investigate the characteristics of linear relations. Linear relations whose graphs pass through the origin, as well as linear relations whose graphs have a fixed value, will be examined. You will learn to express a linear relation in words, as a table of values, as a graph, and as a formula. You will also learn to calculate the slope of a line and explain what the slope means in the context of a specific problem. Applications of linear relations to real-world situations will also be explored. Finally, you will be required to examine graphs of non-linear relations and evaluate formulas.

To be successful in this course, you should know how to apply the order of operations correctly in calculations. You should also know how to change percents to their decimal equivalents. At various points throughout this guide you will be asked to see your instructor for review worksheets on these topics to ensure you fully understand these concepts.

II. Resources

You will require the following:

- *Essentials of Mathematics 11*
- scientific calculator
- graph paper

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 calculators 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. It will also refer to specific **Examples** found in each section. You are directed to study these **Examples** carefully 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. You should read and understand the **Hints** and **New Terms** that are at the bottom of selected pages in the textbook. 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. This column will also contain general notes which are intended to give extra information and are not usually specific to any one question.	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**. **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**. **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 textbook contains answers to **Notebook Assignment**. Your instructor will provide more detailed solutions with workings and some explanations. 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)*	50%
	100%

Relations and Formulas

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

Reading for this unit: *Essentials of Mathematics 11*

Chapter 5:	Exploration 1:	pages 245, 247 - 255
	Exploration 2:	pages 256 - 264
	Exploration 3:	pages 265 - 275
	Exploration 4:	pages 278 - 284
	Exploration 5:	pages 285 - 291
	Exploration 6:	pages 293 - 304
	Exploration 7:	pages 305 - 310
	Case Study:	pages 317 and 318

References and Notes

Omit **Chapter Project** and all references to **Project Activity**.

Read **Exploration 1**. Study and work through the calculations given in **Examples 1** to **3** on pages 247 - 251.

Note: In **Example 2a** on page 248, the formula $P = 8h$ comes from Emma's gross pay formula in **Example 1** on page 247. In **Example 2b** on page 249, since Emma's hours worked is the independent variable, it is plotted on the horizontal axis. Since her gross pay "depends" on her hours worked, it is the dependent variable; so it is plotted on the vertical axis.

Read **Hints** and **New Terms** on the bottom of the pages.

Work to Submit

Relations and Formulas

References and Notes

Answer the following questions. ▶▶

You should understand the terms **interpolation** (determining values between known points) and **extrapolation** (determining values beyond known points). You should know how to apply their meanings when answering questions.

See your instructor for solutions to **Mental Math**.

Remember: Make sure that when you graph an ordered pair (x, y), the first coordinate, x, is graphed along the horizontal axis and the second coordinate, y, is graphed along the vertical axis. Be sure to give your graph a title, label the axes and include units of measure.

Answers to **Notebook Assignment** are in the back of your textbook. Your instructor will have detailed solutions to these problems.

Read **Exploration 2**. Study and work through the calculations given in **Examples 1** to **3** on pages 256 - 261.

Work to Submit

1.1 Briefly define the following terms:
- i) dependent variable
- ii) independent variable
- iii) origin

1.2 **Mental Math**, page 251

1.3 **Notebook Assignment**, pages 254 and 255
Answer questions 1 - 4.
(*See notes below on questions 1 and 4.*)

Answer questions 5 - 7.

Question 1: The **vs.** in this question stands for **versus** meaning "compared to".

Question 4: To determine the independent and dependent variables, ask yourself which variable is the fixed variable? Litres of gasoline or distance travelled? The fixed variable is the independent variable.

Relations and Formulas

References and Notes	Work to Submit
Answer the following questions. ▶▶	1.4 Briefly define the following terms: i) slope ii) rise iii) run
	1.5 **Mental Math**, page 261
	1.6 **Notebook Assignment**, pages 262 - 264 Answer questions 1 - 5. (*See note below on question 1c*.)
The value of the slope of a line can be written as a decimal, as a fraction, or as an integer.	**Question 1c:** To answer this question ask yourself if the value of the slope calculated in question 1a changed after choosing a different set of points in question 1b.
Note: Slope expressed as an integer can still be written in the form $\frac{rise}{run}$ as follows: $slope = 15 = \frac{15}{1}$.	**Note:** If you are going to compare two graphs, make sure that the scales on the axes are the same. For example, if the horizontal axis of one graph increases by ten, then the horizontal axis of the other graph must also increase by ten.
Read **Exploration 3**. Study and work through the calculations given in **Examples 1** and **2** on pages 265 - 268.	
Answer the following questions. ▶▶	1.7 **Mental Math**, page 271
	1.8 **Bouncing Balls Activity**, page 269 (optional)
The **Bouncing Balls Activity** is optional since it must be completed in a group of two or three. You can complete this activity with your instructor or another student who is also completing this section of the course.	**Note:** Omit Step 11 of this activity.

Relations and Formulas

References and Notes

You should understand the term **line of best fit** (a straight line that best fits a set of data on a graph).

Remember: For a linear relation, the independent variable is on the horizontal axis of the graph and the dependent variable is on the vertical axis of the graph.

You are not required to complete **Problem Analysis** and **Games** on pages 276 and 277.

Read **Exploration 4**. Study and work through the calculations given in **Examples 1** to **3** on pages 278 - 281.

Answer the following questions.

Work to Submit

1.9 **Notebook Assignment**, pages 273 - 275
Answer questions 1 - 3a.
(*See note below on question 3a*.)

Answer questions 4 - 6.
(*See notes below on questions 4b and 6b*.)

Question 3a: Complete the table of values by substituting the given values from the table into the equation of the line from question 2e, and then solve for the desired variable.

Question 4b: The term **increment** means "increasing by". In the table of values, the independent variable should begin with \$0, increase by \$20,000 and end with \$100,000.

Question 6b: Draw a third line through the origin that is not as steep as the first line. Choose the same letter for the independent and dependent variables. Express the linear relation represented by the line as a formula.

1.10 **Mental Math**, page 279
Answer questions 1 - 3.

Relations and Formulas

References and Notes	Work to Submit
	1.11 **Notebook Assignment**, pages 282 - 284 Answer questions 1 - 3. (*See note below on question 3c*.) Answer questions 4 - 7a. (*See note below on question 6*.) **Question 3c:** To answer this question, determine whether or not the steeper line has the larger slope. **Question 6:** The **fixed value** in this question refers to the value where the line crosses the vertical axis or *y*-axis.
See your instructor for **Practice Exercise 1**, *Slope Activity*. Read **Exploration 5**. Study and work through the calculations given in **Examples 1** and **2** on pages 286 - 289. **Remember:** The point where two line graphs cross is the point where the two linear relations are equal. **Note:** In **Example 1d** on page 287, the point where the two lines cross shows that if a car drives 200 km then it costs $50 to rent the car from both Company A and Company B. On the left side of this point it is cheaper to rent from Company A. On the right side of this point it is cheaper to rent from Company B.	1.12 **Practice Exercise 1**, *Slope Activity*

Relations and Formulas

References and Notes	Work to Submit
Answer the following questions. ▶▶	1.13 **Notebook Assignment**, pages 290 and 291 Answer questions 1 - 3. (*See note below on question 3*.)
	Question 3: Create two tables of values, one for Travel Agency A and one for Travel Agency B. Use these tables to draw the graphs and answer questions 3b, 3c, and 3d.
Read **Exploration 6**. Study and work through the calculations given in **Examples 1** to **4** on pages 293 - 297.	
Answer the following questions. ▶▶	1.14 **Notebook Assignment**, pages 299 - 304 Answer questions 1 - 2d. (*See note below on question 2d*.) Answer questions 3 and 4. (*See note below on question 4c*.) Answer questions 5 and 7.
	Question 2d: The highest point on the graph on page 300 shows the amount of gas the tank might hold.
	Questions 4c: Even though the child is running downhill, he or she will still pick up speed as they travel down the hill.

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See your instructor for **Practice Exercise 2**, *Hot Air Balloon*.

See your instructor for **Practice Exercise 3**, *Marathon Runner Problem*.

Read **Exploration 7**. Study and work through the calculations given in **Examples 1** and **2** on page 306.

If necessary, see your instructor for a review on order of operations and changing a percent to a decimal.

You should know the term **irrational number**. Two examples of irrational numbers are π or any decimal number that continues without repeating.

Note: There is a π button on your calculator. If you use this button in your calculations your answers will be slightly different from the answers you will get if you use $\pi = 3.14$.

Answer the following questions.

Work to Submit

1.15 **Practice Exercise 2**, *Hot Air Balloon*

1.16 **Practice Exercise 3**, *Marathon Runner Problem*

1.17 **Mental Math**, page 305

Relations and Formulas

References and Notes	Work to Submit
	1.18 **Notebook Assignment**, pages 307 - 310 Answer questions 1, 2, 3a, 3c, and 4. (*See note below on question 4c*.) Answer questions 5, 6, 8, and 9. (*See note below on question 8*.) **Question 4c:** The world population in 2002 was 6,233,821,945. **Question 8:** Solve for the hypotenuse, *c*, by taking the square root of the value obtained for c^2. $c = \sqrt{c^2}$
See your instructor for **Practice Exercise 4**, *Rearranging Formulas*. If you are having difficulty with the **Practice Exercise 4**, *Rearranging Formulas*, see your instructor for further explanation and practice before moving on.	1.19 **Practice Exercise 4**, *Rearranging Formulas*

Relations and Formulas

References and Notes

Note: Sometimes solving formulas may require you to rearrange the formula so that the variable you want to solve for is on one side of the equation and all other variables are on the other.

Example: Solve the formula $I = prt$ for t.

$$\frac{I}{pr} = \frac{prt}{pr}$$

$$\frac{I}{pr} = t$$

Now find the value of t when $I = 300$, $p = 1500$, and $r = 0.04$.

$$t = \frac{300}{(1500)(0.04)}$$

$$t = 5$$

See your instructor for **Practice Exercise 5**, *Perimeter and Area*.

See your instructor for **Practice Exercise 6**, *The Pythagorean Theorem*.

Work to Submit

1.20 **Practice Exercise 5**, *Perimeter and Area*

1.21 **Practice Exercise 6**, *The Pythagorean Theorem*

1.22 **Case Study**, pages 317 and 318
Answer questions 1 - 4.
(*See note below on question 1b*.)

Question 1b: With Aura Publishing, the royalties are 10% of $15.00 or $1.50 per book. With McCreary Publishing, the royalties are 5% of $15.00 or $0.75 per book. In the table of values, the number of books should begin at 0, increase by 1000, and end with 5000.