STUDENT WORKBOOK

7th Grade / Jr. High  1 Credit – Math


BOOK 1

# PRINCIPLES OF MATHEMATICS

BIBLICAL WORLDVIEW CURRICULUM

[Katherine A. Loop]

First printing: May 2015



Master Books®, P.O. Box 726, Green Forest, AR 72638
Master Books® is a division of the New Leaf Publishing Group, Inc.

ISBN: 978-0-89051-876-2

Cover by Diana Bogardus

Unless otherwise noted, Scripture quotations are from the King James Version of the Bible.

Some problems are used/adapted from the following resources:

Katherine Loop, *Revealing Arithmetic: Math Concepts from a Biblical Worldview* (Fairfax, VA: Christian Perspective, 2010).

Eugene Henry Barker, *Applied Mathematics for Junior High Schools and High Schools* (Boston: Allyn and Bacon, 1920). Available on Google Books, http://books.google.com/books?id=-t5EAAAAIAAJ&vq=3427&pg=PR2#v=onepage&q&f=false

John C. Stone and James F. Millis, *A Secondary Arithmetic: Commercial and Industrial for High, Industrial, Commercial, Normal Schools, and Academies* (Boston: Benj. H. Sanborn & Co., 1908). Available on Google Books, http://books.google.com/books?id=RtYGAAAAYAAJ&pg=PP1#v=onepage&q&f=false

Joseph Victor Collins, *Practical Algebra: First Year Course* (New York: American Book Co., 1910). Available on Google Books, http://google.com/books?id=hNdHAAAAIAAJ&pg=PP1#v=onepage&q&f=false

We have attempted to mark all the problems adapted from early 1900s textbooks for easy reference; however, they inspired other problems as well.

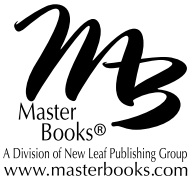
For the most part, units are based on the official standards given in Tina Butcher, Linda Crown, Rick Harshman, and Juana Williams, eds. *NIST Handbook 44: 97th National Conference on Weights and Measures 2012,* 2013 ed. (Washington: U. S. Department of Commerce, 2012), Appendix C. Found on http://www.nist.gov/pml/wmd/pubs/h44-13.cfm (Accessed 10/6/2014)

Please consider requesting that a copy of this volume be purchased by your local library system.

**Printed in the United States of America**

Please visit our website for other great titles:
www.masterbooks.com

For information regarding author interviews,
please contact the publicity department at (870) 438-5288.



# How to Use This Course

Get ready to discover math from a biblical worldview! Designed for use alongside the *Principles of Mathematics Student Textbook*, this *Student Workbook*, contains worksheets, quizzes, and tests to help build both a biblical worldview of math and mathematical skills. The problems incorporate a lot of history, science, and real-life examples, helping students master the skills, build problem-solving skills, and learn to use math as a real-life tool to both explore God's creation and serve Him.

- **Suggested Schedule** — Check out the Suggested Daily Schedule (page 6–13) or the Accelerated Daily Schedule (page 14–18) for an easy-to-follow daily plan. Most days, students will be instructed to read a lesson in the Student Textbook and then work a worksheet in this Student Workbook. Quizzes, tests, study days, and days off are also built into the schedule. Feel free to adapt as needed.
- **Tear-Out Worksheets, Quizzes, and Tests** — The worksheets, quizzes, and tests are all perforated, so you can easily tear them out for use. Students may solve problems directly on the sheets, using additional notebook paper if needed.
- **Answer Key** — Answers to all the problems given are included in the back of this book. Grading suggestions are given on pages 391-392.

**Note to Parent/Teacher: God has created each person individually, so please modify and adapt this curriculum as needed.**

## *Supplies Needed*

- *Principles of Mathematics Student Textbook Book 1*
- Binder with Notebook Paper — Students will need to tear out the reference section from this book and put it in the binder, as well as add notes to it during the course.
- Abacus — You can either make your own (instructions are given on Worksheet 1.3), use a premade one, or use an online abacus (see www.christianperspective.net/math/pom1).
- Blank Index Cards to use in making flashcards.
- Calculator
- Graph Paper
- Compass
- Measuring Tape with both Metric and U.S. Customary markings
- Ruler with Metric and U.S. Customary markings
- Protractor

## *Additional Ideas and Support*

For additional math ideas and resources, please check out www.ChristianPerspective.net. You'll find links to helpful supplemental resources there (including links to online fact sheets for students needing more drill), as well as ways to stay connected and ask questions.

## *Problems from the Early 1900s*

History…in math? Why not! Throughout the text, we've sprinkled in some math problems from history, often with significant adaptation. The sources are listed here for your reference. Feel free to look up the books and have fun with additional problems!

The following problems were adapted from Eugene Henry Barker, *Applied Mathematics for Junior High Schools and High Schools* (Boston: Allyn and Bacon, 1920). Available on Google Books, http://books.google.com/books?id=-t5EAAAAIAAJ&vq=3427&pg=PR2#v=onepage&q&f=false

Worksheet 2.6, problem 5; Worksheet 4.1, problems 3, 4, and 5; Worksheet 4.5, problem 1; Worksheet 5.2, problem 6; Worksheet 5.7, problem 8; Worksheet 6.5, problem 3; Worksheet 8.2, problem 2b and 3; Worksheet 8.3, problems 5 and 6; Worksheet 8.6, problems 3a and 3b; Worksheet 9.1, problem 8; Worksheet 14.3, problem 5; Worksheet 18.1B, problem 4a; Worksheet 18.4, problems 1e, 3a, and 3b; Worksheet 18.6, problem 3; Worksheet 21.1, problem 2a and 7; Worksheet 21.4B, problem 14; Quiz 3, problem 1; Quiz 6, problem 3a; Test 5; extra credit problems

The following problems were adapted from John C. Stone and James F. Millis, *A Secondary Arithmetic: Commercial and Industrial for High, Industrial, Commercial, Normal Schools, and Academies* (Boston: Benj. H. Sanborn & Co., 1908). Available on Google Books, http://books.google.com/books?id=RtYGAAAAYAAJ&pg=PP1#v=onepage&q&f=false

Worksheet 12.3, problem 3; Worksheet 12.6, problem 1; Worksheet 12.7, problem 4; Worksheet 12.8, problem 7; Worksheet 15.4, problem 4; Worksheet 16.4, problem 8; Worksheet 18.1B, problem 4b; Worksheet 18.2B, problems 2a and 2b; Worksheet 18.3, problem 2a; Worksheet 18.5, problem 3; Worksheet 18.6, problem 4; Worksheet 21.2, problem 6

This problem was adapted from Joseph Victor Collins, *Practical Algebra: First Year Course* (New York: American Book Co., 1910). Available on Google Books, http://google.com/books?id=hNdHAAAAIAAJ&pg=PP1#v=onepage&q&f=false

Worksheet 10.7, problem 2b

## *General Instructions for Worksheets, Quizzes, and Tests*

- **Review** — If at any point you hit a concept that does not make sense, back up and review the preceding concepts. Be sure to take advantage of the reference notebook you'll be instructed to start in Worksheet 1.2.
- **Calculator** — Anytime you see a  , you are permitted to use a calculator to solve the problem (instructions on using a calculator can be found in Lesson 4.5). Unless instructed otherwise by your parent/teacher, all other problems should be solved without the use of a calculator, as you won't always have a calculator with you when you need to solve a problem in real life.

- **Word Problems** — Except for when told to solve mentally, you should show your work on all word problems — meaning, write down enough steps of what you did that someone can see how you solved the problem (what you added, subtracted, etc.). Unless otherwise specified, it does not matter how you show your work (it doesn't have to be as in-depth as the answer key)—the important thing is that you can see how you obtained your answer.

  While showing your work may seem like busy work on simple problems, forming the habit of organizing your steps on paper from the beginning will greatly help you when you come to in-depth problems involving numerous steps.

- **Units** — If a unit is given in the problem (dollars, feet, etc.), you should always include it in your answer. From Worksheet 16.1 on, you should always list square units using exponents.

- **Decimals** — From Worksheet 7.4 on, decimal answers should be rounded to the hundredth digit unless otherwise specified.

- **Fractions** — From Worksheet 5.3 on, fractional answers should be in simplest terms unless otherwise specified. This includes rewriting mixed numbers as improper fractions. If a question is asked using only fractions, your answer should be listed as a fraction. If a question includes both decimals and fractions, you can pick which notation to use, unless otherwise specified.

## *General Instructions for Study Days*

The study days built into the schedule are designed to give you a chance to study on your own! While you can study different ways, here are a few suggestions:

- Look at the "Chapter Synopsis" for each chapter you need to study. Read the text, and review any aspects you may have forgotten. Look at the problems too, especially at concepts with which you frequently struggled. Do you know how to solve them now?

- Go back over the quizzes for the chapters you're studying. Again, look at what you got wrong—do you know how to solve it now? How about the ones you got right?

- Review any concepts you know were hard for you.

- Go through your math notebook and look at the notes you've taken and review any flashcards.

## Suggested Daily Schedule

(to complete Year 1 in a school year)

| Date | Day | Assignment | Due Date | ✓ | Grade |
|---|---|---|---|---|---|
| First Semester—First Quarter | | | | | |
| Week 1 | Day 1 | Lesson 1.1 (*Student Textbook*, pages 13–14)<br>Worksheet 1.1 (*Student Workbook*, page 21) | | | |
| | Day 2 | Lesson 1.2 (*Student Textbook*, pages 15–17)<br>Worksheet 1.2 (*Student Workbook*, page 23) | | | |
| | Day 3 | Lesson 1.3 (*Student Textbook*, pages 18–22)<br>Worksheet 1.3 (*Student Workbook*, pages 25–26)* | | | |
| | Day 4 | Lesson 1.4 (*Student Textbook*, pages 22–27)<br>Worksheet 1.4 (*Student Workbook*, page 27) | | | |
| | Day 5 | Lesson 1.5 (*Student Textbook*, pages 27–30;<br>Worksheet 1.5 (*Student Workbook*, pages 29–31) | | | |
| Week 2 | Day 6 | Lesson 1.6 (*Student Textbook*, pages 31–35)<br>Worksheet 1.6 (*Student Workbook*, pages 33–36) | | | |
| | Day 7 | Lesson 2.1 (*Student Textbook*, pages 37–42)<br>Worksheet 2.1 (*Student Workbook*, page 37) | | | |
| | Day 8 | Lesson 2.2 (*Student Textbook*, pages 42–45)<br>Worksheet 2.2 (*Student Workbook*, pages 39–40)* | | | |
| | Day 9 | Lesson 2.3 (*Student Textbook*, pages 46–51)<br>Worksheet 2.3 (*Student Workbook*, pages 41–42) | | | |
| | Day 10 | Lesson 2.4 (*Student Textbook*, pages 52–56)<br>Worksheet 2.4 (*Student Workbook*, pages 43–44) | | | |
| Week 3 | Day 11 | Lesson 2.5 (*Student Textbook*, pages 56–58)<br>Worksheet 2.5 (*Student Workbook*, pages 45–46) | | | |
| | Day 12 | Lesson 2.6 (*Student Textbook*, pages 58–63)<br>Worksheet 2.6 (*Student Workbook*, pages 47–50) | | | |
| | Day 13 | Lesson 2.7 (*Student Textbook*, pages 63–64)<br>Quiz 1 (*Student Workbook*, pages 335) | | | |
| | Day 14 | Lesson 3.1 (*Student Textbook*, pages 65–66)<br>Worksheet 3.1 (*Student Workbook*, page 51) | | | |
| | Day 15 | Lesson 3.2 (*Student Textbook*, pages 67–68)<br>Worksheet 3.2 (*Student Workbook*, pages 53–54) | | | |
| Week 4 | Day 16 | Lesson 3.3 (*Student Textbook*, pages 68–73)<br>Worksheet 3.3 (*Student Workbook*, pages 55–56) | | | |
| | Day 17 | Lesson 3.4 (*Student Textbook*, pages 73–76)<br>Worksheet 3.4 (*Student Workbook*, page 57–58) | | | |
| | Day 18 | Lesson 3.5 (*Student Textbook*, pages 76–81)<br>Worksheet 3.5 (*Student Workbook*, pages 59–60) | | | |
| | Day 19 | Lesson 3.6 (*Student Textbook*, pages 81–83)<br>Worksheet 3.6 (*Student Workbook*, pages 61–62) | | | |
| | Day 20 | Lesson 3.7 (*Student Textbook*, pages 83–84)<br>Study Day | | | |

* Worksheet 1.3 includes instructions on building an abacus. To build an abacus, students will need an 8 x 10 or larger picture frame, multi-color pony beads, wire, needle-nose pliers, and carpet tacks/small nails. Alternately, students can use an online or premade abacus.
* Worksheet 2.2 includes extra-credit assignment to research the history of time zones.

## Suggested Daily Schedule

(to complete Year 1 in a school year)

| Date | Day | Assignment | Due Date | ✓ | Grade |
|---|---|---|---|---|---|
| Week 5 | Day 21 | Quiz 2 (*Student Workbook*, pages 337–338) | | | |
| | Day 22 | Lesson 4.1 (*Student Textbook*, pages 85–91)<br>Worksheet 4.1 (*Student Workbook*, pages 63–64) | | | |
| | Day 23 | Lesson 4.2 (*Student Textbook*, pages 92–94)<br>Worksheet 4.2 (*Student Workbook*, pages 65–66) | | | |
| | Day 24 | Lesson 4.3 (*Student Textbook*, pages 95–99)<br>Worksheet 4.3 (*Student Workbook*, pages 67–68) | | | |
| | Day 25 | Lesson 4.4 (*Student Textbook*, pages 99–102)<br>Worksheet 4.4 (*Student Workbook*, pages 69–70) | | | |
| Week 6 | Day 26 | Lesson 4.5 (*Student Textbook*, pages 102–105)<br>Worksheet 4.5 (*Student Workbook*, pages 71–72) | | | |
| | Day 27 | Lesson 4.6 (*Student Textbook*, pages 105–107)<br>Worksheet 4.6 (*Student Workbook*, pages 73–75)* | | | |
| | Day 28 | Quiz 3 (*Student Workbook*, pages 339–340) | | | |
| | Day 29 | Lesson 5.1 (*Student Textbook*, pages 109–114)<br>Worksheet 5.1 (*Student Workbook*, pages 77–78) | | | |
| | Day 30 | Lesson 5.2 (*Student Textbook*, pages 114–117)<br>Worksheet 5.2 (*Student Workbook*, pages 79–80) | | | |
| Week 7 | Day 31 | Lesson 5.3 (*Student Textbook*, pages 117–120)<br>Worksheet 5.3 (*Student Workbook*, pages 81–82) | | | |
| | Day 32 | Lesson 5.4 (*Student Textbook*, pages 121–123)<br>Worksheet 5.4 (*Student Workbook*, pages 83–84) | | | |
| | Day 33 | Lesson 5.5 (*Student Textbook*, page 124–125)<br>Worksheet 5.5 (*Student Workbook*, pages 85–86) | | | |
| | Day 34 | Lesson 5.6 (*Student Textbook*, pages 125–129)<br>Worksheet 5.6 (*Student Workbook*, pages 87–88) | | | |
| | Day 35 | Lesson 5.7 (*Student Textbook*, pages 130–131)<br>Worksheet 5.7 (*Student Workbook*, pages 89–92) | | | |
| Week 8 | Day 36 | Lesson 5.8 (*Student Textbook*, pages 131–133)<br>Quiz 4 (*Student Workbook*, pages 341–343) | | | |
| | Day 37 | Lesson 6.1 (*Student Textbook*, pages 135–138)<br>Worksheet 6.1 (*Student Workbook*, pages 93–94) | | | |
| | Day 38 | Lesson 6.2 (*Student Textbook*, pages 138–141)<br>Worksheet 6.2 (*Student Workbook*, pages 95–96) | | | |
| | Day 39 | Lesson 6.3 (*Student Textbook*, pages 142–145)<br>Worksheet 6.3 (*Student Workbook*, pages 97–98) | | | |
| | Day 40 | Lesson 6.4 (*Student Textbook*, pages 146–147)<br>Worksheet 6.4 (*Student Workbook*, page 99) | | | |
| Week 9 | Day 41 | Lesson 6.5 (*Student Textbook*, pages 148–152)<br>Worksheet 6.5 (*Student Workbook*, pages 101–102) | | | |
| | Day 42 | Lesson 6.6 (*Student Textbook*, page 152)<br>Worksheet 6.6 (*Student Workbook*, pages 103–104)* | | | |
| | Day 43 | Worksheet 6.7 (*Student Workbook*, pages 105–108) | | | |
| | Day 44 | Study Day | | | |
| | Day 45 | Test 1 (*Student Workbook*, pages 373–374) | | | |

* Worksheet 4.6 includes hands-on activity with gas prices and extra-credit assignment to make Napier's rods.
* Worksheet 6.6 includes an assignment to half or double a recipe.

# Worksheets

1. **Numbers Everywhere —** Take a piece of paper and write down every different use for math you encounter today. Try to find at least 10 different ways math (including numbers) is used outside a textbook. Ask your parents how they use math if you get stumped. (*Hint*: Look for numbers on phones, exit signs, at stores, etc.)

   a.

   b.

   c.

   d.

   e.

   f.

   g.

   h.

   i.

   j.

2. **Definition —** Look up the word "worldview" in a dictionary and write out the definition you find.

3. **Misconceptions —** List the three common misconceptions about math covered in Lesson 1.1.

   a.

   b.

   c.

4. **Question —** When are you allowed to use a calculator in this course? (See the "How to Use This Curriculum" section at the beginning of this *Student Workbook*—be sure to read it if you haven't yet!)

1. **Math in Action —** Give 5 examples of how math is used outside a textbook that are different than the uses you listed in Worsheet 1.1.

   a.

   b.

   c.

   d.

   e.

2. **Notebook Preparation —** Tear out the Reference Sheet Section from this *Student Workbook* and place it inside a binder, along with some lined paper you can use to add additional notes as you study. Taking notes of key information as you go will help you both remember the information and find it easily when you forget.

3. **Math Defined —** What is math and why does math work outside of a textbook?

1. **Question —** How would you define the spiritual battle in math?

2. **Definition —** Look up the words "naturalism" and "humanism" in a dictionary and write out the definitions you find.

3. **Preparing Your Abacus —** Some of the problems in the upcoming lessons will require the use of an abacus. You can either make your own, use a premade one if you have one, or use an online abacus (see www.christianperspective.net/math/pom1). Today's the day to decide and either find or make one! The instructions for making one are below if you choose to assemble your own.

   *WARNING: These abacuses contain small parts (beads) that can be a choking hazard as well as wires/nails that could hurt if handled inappropriately; please be careful if using around young children.*

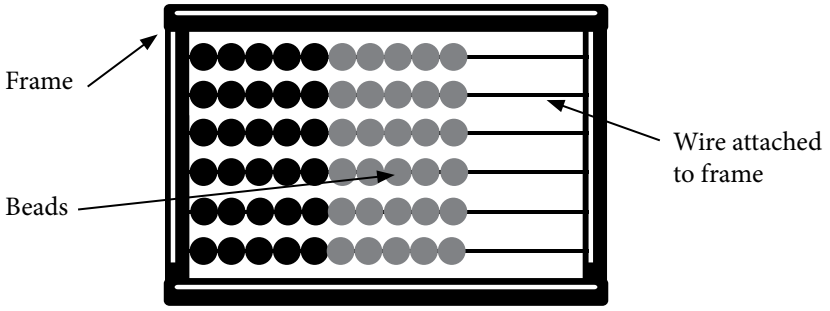
**Supplies:**

- **Wooden frame** — You will need an 8 x 10 or larger picture frame with the glass removed, or make your own frame out of 1 x 2s.
- **Multicolor beads** — Basic pony beads will work—look in the craft section of your local department or craft store. The number of beads you need depends on the size of your frame. You need 50 beads for an 8 x 10 frame.
- **Wire** — You can use plant wire, stripped electrical wire, or any sort of thin, flexible wire you can wrap around a carpet tack/small nail. Alternately, if you have a thick enough picture frame to drill holes into, you can use any sort of thick wire that is sturdy enough to insert into drilled holes.
- **Needle-nose pliers and carpet tacks/small nails**, or, if using thicker wire, a **drill**

**Instructions:**

1. Cut the wire into strips a few inches longer than the width of your frame. Five is a good number of rows for most medium frames and the minimum required for the problems in this text; really large frames can handle more.
2. Mark the frame at evenly spaced intervals along both sides where you want your rows to be.

3. Prepare the frame for the wire by either inserting carpet tacks or tiny nails at each of the marks, or else drilling holes in the frame. A lot will depend on what type of frame and wire you have. You must have a sturdy frame and wire to drill holes; otherwise, you will need to use the carpet tacks or tiny nails.
4. Secure one end of the wire by wrapping it around the carpet tacks/tiny nails, or by pushing a thicker wire into the drilled holes.
5. Add the beads to the first row of the abacus. Alternate between 5 beads of one color and 5 beads of another color (grouping makes it easier to see the quantity represented). You should have at least 10 beads on each row.
6. Secure the second end of the wire to the frame the same way you did in step 4.
7. Repeat steps 4–6 until you have completed all the rows.



1. **Writing Numbers**[1] **—** Write out the following quantities using our place-value system.
   a. 2011 Population of the U.S.: three hundred eleven million, fifty thousand, nine hundred seventy-seven

   b. 2010 U.S. National Debt: thirteen trillion, five hundred sixty-one billion, six hundred million

   c. 2011 Population of China: one billion, three hundred thirty-six million, seven hundred eighteen thousand, fifteen

2. **Reading Numbers**[2] **—** Write the words you would use to read these numbers.
   a. 2010 Population of California: 27,253,956

   b. 2010 Population of Texas: 25,145,561

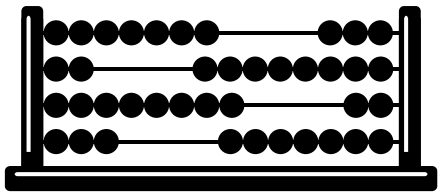
   c. 2010 Population of New York: 19,378,102

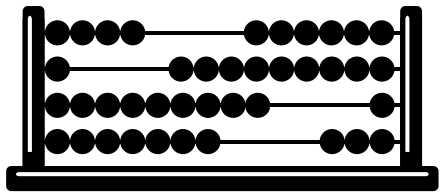
3. **Greater Than, Less Than, or Equal To —** Put the appropriate symbol (>, <, or =) in between each pair to show how they relate.
   a. 1,589 1,590
   b. 445,020,008 445,008,500
   c. 3,427 3,359

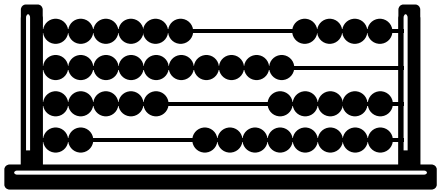
4. **History Check —** Use one of the historic equal signs shown in today's text to show 5 = 5.

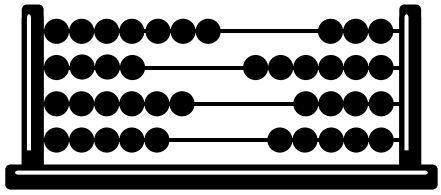
1 Facts from Sarah Janssen, sr. ed., M. L. Liu, Shmuel Ross, and Nan Badgett, eds., *The World Almanac and Book of Facts, 2012* (Infobase Learning, NY: 2012), pp. 63, 734.
2 Facts from Ibid., p. 607.

1. **Reading an Abacus —** Identify the following quantities and record the quantity using the decimal system.

a. 

b. 

c. 

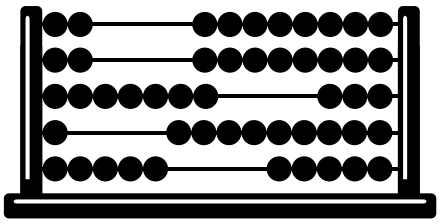
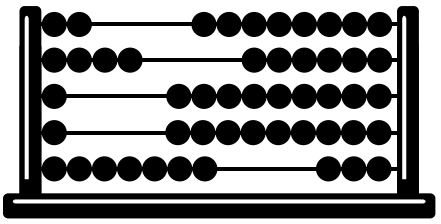
d. 

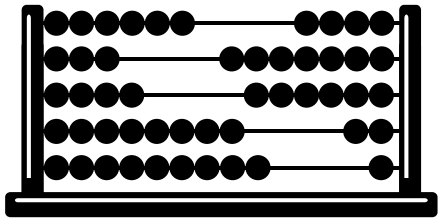
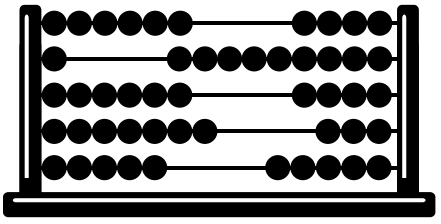
2. **Abacus/Place Value**[1] **—** Use the abacus you made or located (see Worksheet 1.3) to form the following 2010 populations. (If you do not have an abacus or access to one online, draw one on paper for each problem.)
   a. Population of Bismarck, ND: 61,272
   b. Population of Dickinson, ND: 17,727
   c. Population of Amherst, OH: twelve thousand, twenty-one
   d. Population of Mansfield, OH: forty-seven thousand, eight hundred twenty- one

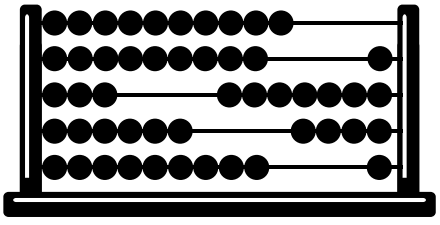
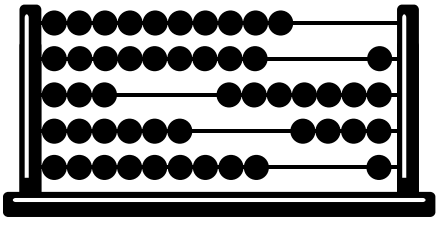
3. **Reading and Writing Numbers —** Express the first two quantities in the last problem (2a and 2b) with words, and the last two (2c and 2d) in the decimal system.
   a.
   b.
   c.
   d.

1 Facts from Sarah Janssen, sr. ed., M. L. Liu, Shmuel Ross, and Nan Badgett, eds., *The World Almanac and Book of Facts, 2012* (Infobase Learning, NY: 2012), p. 639.

4. **Comparing on an Abacus —** Put the appropriate symbol in between each pair of abacuses to show how the quantities they represent relate.

a.  

b.  

c.  

5. **Question —** What do we call the number system we use today?

6. **Thinking It Through —** If one city has a population of 102,300 people, and another has a population of 123,000, which city has the greater population?

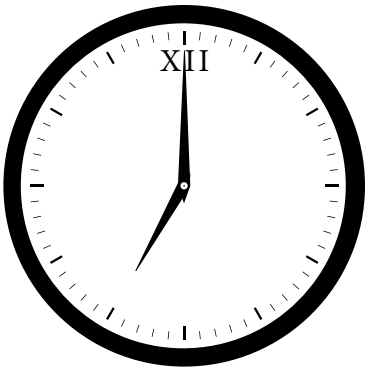
7. **Question —** Describe in your own words how place value works.

8. **Egyptian Hieroglyphics —** Looking at the figures presented in this lesson, do your best to represent the following quantities using Egyptian hieroglyphics (don't worry if you're not sure of a detail—just try to use the necessary symbols to convey the correct quantity and don't forget to put the smaller quantities on the left, opposite the way we do in our place value system).

   a. 26 b. 75 c. 89

**9. Numerals**

a. Finish labeling this clock using Roman numerals to mark each hour.




b. Books will sometimes list their publication date in Roman numerals. Suppose one says it was published in MCMXCVIII. What year is that in decimal notation? *Hint*: Work from left to right.

c. In music, Roman numerals are used to number chords. The V chord (read "fifth chord") is the chord based off the fifth note of a scale. Knowing this, take a guess at what the IV chord means.

d. Sundials keep track of time using the sun's shadow as the "hour" hand. Notice that the shadow on this sundial is falling near the spot labeled II. What hour is the sundial indicating?


**10. Question —** How do different numbering systems help us see our place-value system from a biblical worldview?

**1. Binary —** The following numbers are written in binary. Translate them into the decimal system by filling in the blanks.

a. 1100

| 1 | 1 | 0 | 0 |
|---|---|---|---|
| 0, 1 | 0, 1 | 0, 1 | 0, 1 |
| **Eights** (Each digit represents sets of eight, or two fours.) | **Fours** (Each digit represents sets of fours, or two twos.) | **Twos** (Each digit represents sets of two, or two ones.) | **Ones** (Each digit represents sets of one.) |

Meaning:

___ set(s) of 8 = ___ x 8 = _____

___ set(s) of 4 = ___ x 4 = _____

___ set(s) of 2 = ___ x 2 = _____

___ set(s) of 1 = ___ x 1 = _____

1100 in binary is the same as _____ in the decimal system.

b. 10000

| 1 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|
| 0, 1 | 0, 1 | 0, 1 | 0, 1 | 0, 1 |
| **Sixteens** (Each digit represents sets of sixteen, or two eights.) | **Eights** (Each digit represents sets of eight, or two fours.) | **Fours** (Each digit represents sets of fours, or two twos.) | **Twos** (Each digit represents sets of two, or two ones.) | **Ones** (Each digit represents sets of one.) |

Meaning:

___ set(s) of 16 = ___ x 16 = _____

___ set(s) of 8 = ___ x 8 = _____

___ set(s) of 4 = ___ x 4 = _____

___ set(s) of 2 = ___ x 2 = _____

___ set(s) of 1 = ___ x 1 = _____

10000 in binary is the same as _____ in the decimal system.

c. 10100

| 1 | 0 | 1 | 0 | 0 |
|---|---|---|---|---|
| 0, 1 | 0, 1 | 0, 1 | 0, 1 | 0, 1 |
| **Sixteens** (Each digit represents sets of sixteen, or two eights.) | **Eights** (Each digit represents sets of eight, or two fours.) | **Fours** (Each digit represents sets of fours, or two twos.) | **Twos** (Each digit represents sets of two, or two ones.) | **Ones** (Each digit represents sets of one.) |

Meaning:

___ set(s) of 16 = ___ x 16 = _____

___ set(s) of 8 = ___ x 8 = _____

___ set(s) of 4 = ___ x 4 = _____

___ set(s) of 2 = ___ x 2 = _____

___ set(s) of 1 = ___ x 1 = _____

10100 in binary is the same as _____ in the decimal system.

**Hexadecimal System (Base 16)**
16 Symbols: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

*A represents the decimal value of 10.*
*B represents the decimal value of 11.*
*C represents the decimal value of 12.*
*D represents the decimal value of 13.*
*E represents the decimal value of 14.*
*F represents the decimal value of 15.*

**2. Hexadecimal Number and Color —** Website programmers often specify colors using hexadecimal numbers in the RGB color system. *RGB* stands for *R*ed, *G*reen, and *B*lue. We can represent the intensity of each color using a scale, with 0 being none of the color and values increasing from there. A color with 0 red would have no red in it.

We use two hexadecimal digits for each color. For example, in 8EC5E9 the 8E tells us the amount of red in the color, the C5 the amount of green, and the E9 the amount of blue. When all these colors mix together, we get a specific shade of blue.

| 8E | C5 | E9 |
|---|---|---|
| Red | Green | Blue |

Use what you know about the hexadecimal system to answer the question.

*Example*: Write the amount of red—hexadecimal number 8E—using the decimal system.

| 8 | E |
|---|---|
| 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F | 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F |
| **Sixteens** (Each digit represents sets of sixteen, or sixteen ones.) | **Ones** (Each digit represents sets of one.) |

8 set(s) of 16 = 8 x 16 = *128*

14 set(s) of 1 = 14 x 1 = *14*

*128 + 14 = 142*

a. Write the amount of green—hexadecimal number C5—using the decimal system.

| C | 5 |
|---|---|
| 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F | 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F |
| **Sixteens** (Each digit represents sets of sixteen, or sixteen ones.) | **Ones** (Each digit represents sets of one.) |

___ set(s) of 16 = ___ x 16 = _____

___ set(s) of 1 = ___ x 1 = _____

C5 in hexadecimal is the same as _____ in the decimal system.

b. Write the amount of blue—hexadecimal E9—using the decimal system.

| E | 9 |
|---|---|
| 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F | 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F |
| **Sixteens** (Each digit represents sets of sixteen, or sixteen ones.) | **Ones** (Each digit represents sets of one.) |

___ set(s) of 16 = ___ x 16 = _____

___ set(s) of 1 = ___ x 1 = _____

E9 in hexadecimal is the same as _____ in the decimal system.

c. Find the value of hexadecimal FF. *Note*: FF is the highest hexadecimal value we could form using just two digits; it is thus the max amount of red, green, or blue we could represent in the RGB color system.

| F | F |
|---|---|
| 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F | 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F |
| **Sixteens** (Each digit represents sets of sixteen, or sixteen ones.) | **Ones** (Each digit represents sets of one.) |

___ set(s) of 16 = ___ x 16 = _____

___ set(s) of 1 = ___ x 1 = _____

FF in hexadecimal is the same as _____ in the decimal system.

3. **Comparing Numbers —** Put a comparison symbol (<, >, =) to show how the quantities compare. *Hint*: You don't actually need to convert these binary numbers to our decimal system in order to tell how they compare. Instead, just look at where the 1s and 0s are and use place value to tell you which one must represent the greater quantity.

   a. 1100 1000

   b. 10000 1000

   c. 1010 1011

   d. 1111 1111

4. **Writing Numbers —** Write these numbers using our decimal system.[1]

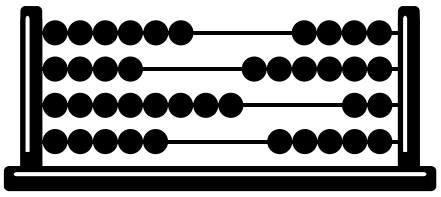
   a. Land and water area for 50 states and Washington, D.C., in square miles: three million, seven hundred ninety-six thousand, seven hundred forty-two

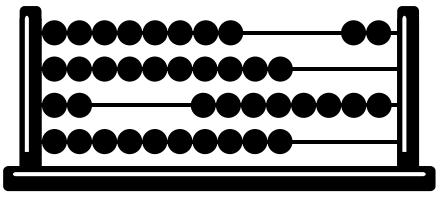
   b. Distance to the sun in miles: ninety-two million, nine hundred sixty thousand

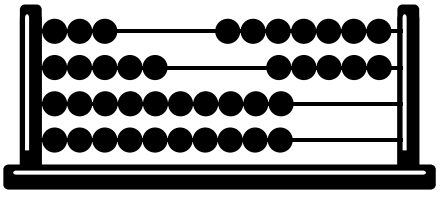
   c. Mean radius of the sun in miles: four hundred thirty-two thousand, two hundred

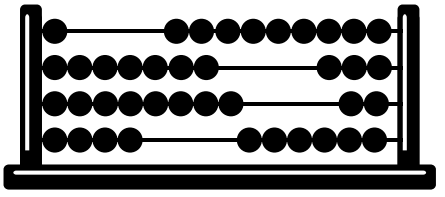
1 Facts from Sarah Janssen, sr. ed., M. L. Liu, Shmuel Ross, and Nan Badgett, eds, *The World Almanac and Book of Facts, 2012* (Infobase Learning, NY: 2012), pp. 428, 344.

5. **Reading an Abacus —** Identify the following quantities and record the quantity using the decimal system.

a. 

b. 

c. 

d. 

6. **Roman numerals —** Express these quantities using Roman numerals.
   a. 2014
   b. 1,076
   c. 592

7. **Questions**
   a. What would it mean if you were told a number was written in a base-5 place-value system?

   b. How many digits would you need to write a number in a base-5 place-value system? *Hint*: Think through what you learned about the base-10 (decimal), base-2 (binary), and base-16 (hexadecimal) systems.

# Quizzes and Tests

1. **Comparing Numbers —** Use the symbols <, >, or = to show how these quantities compare.
   a. 56 + 8 2 + 60
   b. 88 – 4 49 + 17
   c. VII IX

2. **Place Value**
   a. Describe how a place-value system works.

   b. What does it mean if a number is written in a base-12 place-value system?

3. **Time for Time**
   a. If a luncheon starts at 10:30 a.m. and lasts 2 hours, when will it end?

   b. If a TV show is airing at 7 p.m. PST and you're in EST, at what time is it airing in your time zone?

   c. If it is 1600 military time, what time is it in 12-hour clock?

4. **Keeping a Checkbooks —** Find the ending balance of this checkbook register.

| Check Number | Date | Memo | Payment Amount | Deposit Amount | $ Balance |
|---|---|---|---|---|---|
| | 2/1 | Opening Balance | | | 5,612 |
| 120 | 2/5 | Music Lessons | 57 | | |
| | 2/10 | Birthday Check | | 75 | |
| 121 | 2/15 | Groceries | 104 | | |
| | 2/15 | Interest | | 1 | |
| | 2/15 | Paycheck | | 508 | |

5. **Bonus Question —** Why does math work?

**1. Fractions in Action**

a. You have divided up your land into sections and have evaluated the lighting and soil conditions. You have $1\frac{1}{2}$ acres on one side of the farm and $\frac{1}{3}$ of an acre on the other that you've determined are ideal for planting strawberries. How many acres of strawberries will you have altogether if you plant both sections?

b. If you're cooking and want to triple a recipe that calls for $1\frac{2}{3}$ cup flour, how much flour should you use?

c. If you need $\frac{1}{2}$ a yard of trim for one part of a dress and another $\frac{2}{3}$ a yard for another part, how many yards altogether should you buy?

d. If you bought $12\frac{1}{2}$ inches of wood and used $5\frac{3}{4}$ inches, how much do you have left?

**2. Pricing Items for Sale —** You are trying to price tomatoes you're growing to sell at a farmer's market. You spent $16 on seeds, $60 on starter containers, $13 on fertilizer, and $11 on potting soil. You have 10 plants, which according to the package should yield about 20 pounds of tomatoes each. How much should you charge per pound to make 8 times your expenses? (You need to charge more than your expenses to cover your actual cost…including overhead costs such as your time in planting and selling, the water you used to water the tomatoes, etc.…plus make money!)

3. **Keeping Track of the Checkbook —** Input these transactions into the checkbook register, updating the balance column as you go.
   07/01 Opening Balance: $24,587
   07/02 Deposit Sales for Week: $1,568
   07/02 Pay Farmer Supply Company $120 with check 292
   07/03 Pay Tractor Repair Company $134 with check 293

| Check Number | Date | Memo | Payment Amount | | Deposit Amount | | $ Balance | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

4. **Computing a Total Mentally —** Solve these problems mentally.
   a. 89 cents – 62 cents
   b. 78 cents – 25 cents
   c. 32 cents + 65 cents
   d. Round 56 to the nearest ten.
   e. Round 35 to the nearest ten.

5. **Checking the Skills —** Remember, all fractional answers should be simplified.
   a. $\frac{3}{4} \times \frac{7}{9}$
   b. $\frac{8}{9} \div \frac{4}{5}$
   c. $\frac{2}{5} + \frac{7}{21}$
   d. $4(25 - 6 \times 2)$
   e. $(2 + 7)8$
   f. What is the greatest common factor of 88 and 66?
   g. What is the least common multiple of 88 and 66?

**Bonus Question —** Name a biblical truth that helps shape our view of math.

# Answer Key

## *General Grading Notes*

Please use your own judgment when grading. Below are some general principles to keep in mind.

- **Different Strategies** — There is often more than one legitimate approach to a problem. You want to evaluate if students are learning the concepts and solving the problems carefully, correctly, and logically.
- **Open-Ended Questions** — On open-ended questions, answers may vary significantly from what is listed.
- **Partial Credit** — Feel free to give partial credit if a student set up the problem correctly but made a calculation error.
- **Units of Measurement** — If a unit is given in the problem (dollars, feet, etc.), students need to **include the unit in their answer**. For example, if a student lists "6" instead of "6 in" on a problem where the answer key lists "6 in," their answer is only partially correct. Watching their units carefully will serve them well, both in real life and in upper-level courses.
- **Word Problems** — Mental arithmetic should be encouraged, but when solving word problems, students should still always show their work, writing down the equation(s) they solved so you can see what process they followed. It's a very helpful habit to develop, as it makes it easier to find any errors. However, unless requested in the problem, it's not necessary for them to write down every step that is shown in the answer key—*just enough steps that you can tell how they approached the problem.*

- **Decimals** — From Worksheet 7.4 on, decimal answers should be rounded to the hundredth digit unless otherwise specified. Also, unless otherwise specified, it doesn't matter if students round their answer at the end or after each step.

  Be aware that **answers may be slightly off the answer in the key due to differences in rounding at the end or after each step**. This is not a problem. The important thing is that students followed instructions and solved the problem accurately. Exceptions: When finding a percentage, students should not round the percent amount, and when doing unit conversion, students should not round a conversion ratio until the end.

  For example, if told to find a 7.5% sales tax, students should use 0.075 to calculate the tax, and if told to convert between pints and cubic inches (1 pint = 28.875 $in^3$), students should not round 28.875 (they can, however, round their answer).

- **Fractions** — From Worksheet 5.3 on, fractional answers should be denoted in simplest terms, unless otherwise specified. This includes writing mixed numbers as improper fractions.

  Not only will this make it easier to grade and avoid confusion, it will also provide the student with practice forming equivalent fractions.

  Even after decimals are covered in Chapter 7, students should continue solving problems given in fractions as fractions, so as to become proficient in working with fractions. If the problem includes both fractions and decimals, however, students may give their answer in either.

## *Assigning a Grade*

The grade column in the Suggested Schedule (page 6–18) is available for you to keep track of a student's grade should you choose to do so. Feel free to use whatever method for grading you've chosen to adopt, or to leave those columns blank if you prefer not to assign grades.

## *Extra-Credit Assignments*

Throughout the course, some of the worksheets include extra-credit assignments. It is up to you to decide how the assignment should affect the student's grade. For example, you could decide that completing an assignment will raise their worksheet grade by a certain number of points, or that it will increase their quarter or final grade by a certain amount.

## *Additional Resources and Course Notes*

Please see http://www.christianperspective.net/math/pom1 for links to helpful online resources (such additional drill worksheets, an online abacus, and an online scientific calculator), along with additional notes and information related to this course. There is also a way to contact the author there.

## Chapter 1: Introduction and Place Value

### Worksheet 1.1

1. Possibilities include numbers on an alarm clock, dates on a milk carton, grams of sugar on a cereal box, Bible verse numbers, speed-limit signs, prices at a grocery store, zip codes and street numbers on envelopes, page numbers in books, rulers (including rulers in computer programs), and font sizes. Other ideas are measuring ingredients, figuring out how many places to set for company, figuring out how long you have left before an appointment, and keeping track of money.
2. Answer should be a dictionary definition of "worldview."
3. Math is neutral; a biblical math curriculum is the same as any other, with a Bible verse or problem thrown in now and then; and math is a textbook exercise.
3. I can use a calculator any time I see the symbol  .

### Worksheet 1.2

1. Numerous possibilities were given within the text. Examples should not be repeated from yesterday's worksheet.
2. Math notebook should be prepped.
3. Math is a way of describing the consistent way this universe operates; it works outside of a textbook because God is faithful to uphold all things.

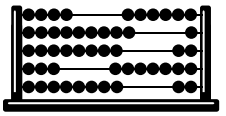
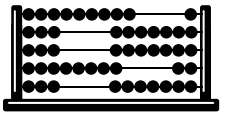
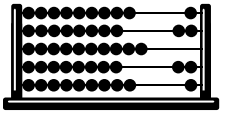
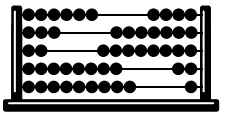
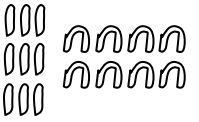
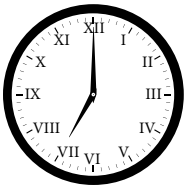
### Worksheet 1.3

1. Within math, there's a battle to remember our dependency on the Lord.
2. Should be a dictionary definition of "naturalism" and "humanism."
3. Abacus needs to be prepped or located.

### Worksheet 1.4

1. a. 311,050,977
   b. 13,561,600,000,000
   c. 1,336,718,015
2. a. twenty-seven million, two hundred fifty-three thousand, nine hundred fifty-six
   b. twenty-five million, one hundred forty-five thousand, five hundred sixty-one
   c. nineteen million, three hundred seventy-eight thousand, one hundred two
3. a. <
   b. >
   c. >
4. Check text for possible symbols.

### Worksheet 1.5

1. a. 3,827
   b. 6,913
   c. 4,058
   d. 3,645
2. a. 
   b. 
   c. 
   d. 
3. a. Sixty-one thousand, two hundred seventy- two
   b. Seventeen thousand, seven hundred twenty-seven
   c. 12,021
   d. 47,821
4. a. >
   b. <
   c. =
5. decimal system (or Hindu-Arabic decimal system)
6. the city with 123,000
7. Answer should communicate that in a place-value system, the place, or location, of a number determines its value.
8. Since students won't actually have to use Egyptian hieroglyphics again and their purpose here is simply to help students understand that there are different ways to express quantities, it does not matter if every detail is the same. Just check to make sure that the  symbols are on the left of the  ones, and that there are the appropriate number of each.
   a. 
   b. 
   c. 
9. a. 
   b. 1998
   c. A chord based off the fourth note of a scale.
   d. 2:00

10. All the different number systems remind us not to start looking at our current system as math itself, but rather as one way of describing God's creation.

**Worksheet 1.6**

1. a. 1 set(s) of 8 = 1 x 8 = 8
   1 set(s) of 4 = 1 x 4 = 4
   0 set(s) of 2 = 0 x 2 = 0
   0 set(s) of 1 = 0 x 1 = 0
   1100 in binary is the same 12 in the decimal system.

   b. 1 set(s) of 16 = 1 x 16 = 16
   0 set(s) of 8 = 0 x 8 = 0
   0 set(s) of 4 = 0 x 4 = 0
   0 set(s) of 2 = 0 x 2 = 0
   0 set(s) of 1 = 0 x 1 = 0
   10000 in binary is the same as 16 in the decimal system.

   c. 1 set(s) of 16 = 1 x 16 = 16
   0 set(s) of 8 = 0 x 8= 0
   1 set(s) of 4 = 1 x 4= 4
   0 set(s) of 2= 0 x 2= 0
   0 set(s) of 1= 0 x 1 = 0
   10100 in binary is the same as 20 in the decimal system.

2. a. 12 set(s) of 16 = 12 x 16 = 192
   5 set(s) of 1 = 5 x 1 = 5
   C5 in hexadecimal is the same as 197 in the decimal system.

   b. 14 set(s) of 16 = 14 x 16 = 224
   9 set(s) of 1 = 9 x 1 = 9
   E9 in hexadecimal is the same as 233 in the decimal system.

   c. 15 set(s) of 16 = 15 x 16 = 240
   15 set(s) of 1 = 15 x 1 = 15
   C5 in hexadecimal is the same as 255 in the decimal system.

3. a. >
   b. >
   c. <
   d. =

4. a. 3,796,742
   b. 92,960,000
   c. 432,200

5. a. 4,625
   b. 2,080
   c. 7,500
   d. 9,326

6. a. MMXIV
   b. MLXXVI
   c. DXCII

7. a. It would mean each place was worth 5 of the previous place's value.

   b. I would need five digits. *Example*: 0, 1, 2, 3, 4

## Chapter 2: Operations, Algorithms, and Problem Solving

**Worksheet 2.1**

1. a. 4 and 9 are the addends, and 13 is the sum.
   b. 15 is the minuend, 9 is the subtrahend, and 6 is the difference.
   c. 8 and 5 are the addends, and 13 is the sum.
   d. 17 is the minuend, 6 is the subtrahend, and 11 is the difference.

2. a. 11
   b. 7
   c. 4
   d. 10
   e. X
   f. VIII
   g. IX

3. a. = *or* 8 = 8
   b. > *or* 9 > 8
   c. > *or* 5 > 4
   d. < *or* 8 < 9
   e. < *or* 11 < 13

4. Hebrews 1:3 and Jeremiah 33:25-26 should have been added to notebook.

**Worksheet 2.2**

1. a. 8 p.m.
   b. 12 p.m. (noon)
   c. 1:15 p.m.
   d. 4 hours

2. a. God was in the beginning and created day and night.
   b. Yes, time as we know it with day and night will have an end.
   c. No, eternity will not have an end.
   d. We should diligently seek to be found of God in peace, without spot, and blameless.

3. a. 6 a.m.
   b. 6 p.m.
   c. 5 p.m.
   d. 5 p.m.
   e. 2 hours
   f. Student should have added time zones to notebook and made flashcards to learn those within the continental United States.

   Extra Credit — Write out at least one interesting tidbit on the history of time zones.

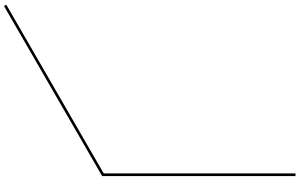
**Worksheet 2.3**

1. Students were told to solve these problems on an abacus.
   a. 27
   b. 1,012
   c. 1,257

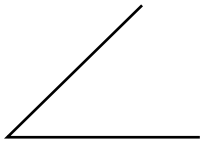
2. Students were told to solve these problems on an abacus.
   a. 708
   b. 448
   c. 1,101

3. $90° + 130° = 220°$

4. a. Angle should measure 120°.



b. Angle should measure 45°.



5. a. $0.45 \bullet 360° = 162°$
   b. $0.3 \bullet 360° = 108°$
   c. $0.25 \bullet 360° = 90°$

Bonus: Because math and reasoning were held up as the source of truth, men did not question the Greek proof of an earth-centered universe or see if it matched reality.

**Quiz 18 (Chapter 20)**

1. a. 3 m
   b. 17°

2. a. yes; AA Similarity Theorem
   b. $\frac{14 \text{ ft}}{? \text{ ft}} = \frac{42 \text{ ft}}{70 \text{ ft}}$; 23.33 ft
   c. 5°
   d. Finding $\overline{AC}$; $\frac{14 \text{ ft}}{? \text{ ft}} = \frac{42 \text{ ft}}{30 \text{ ft}}$; 10 ft
   $P = 10 \text{ ft} + 14 \text{ ft} + 23.33 \text{ ft} = 47.33 \text{ ft}$

3. $\frac{2 \text{ ft}}{1.5 \text{ ft}} = \frac{? \text{ ft}}{16.5 \text{ ft}}$; 22 ft

4. $\overline{AC}$ and $\overline{BC}$
   $\overline{AB}$ and $\overline{DE}$ and $\overline{GF}$
   $\overline{DG}$ and $\overline{EF}$

5. a. 180°
   b. $180° - 45° - 45° = 90°$

6. a. A and D are similar to each other, and B and C aare similar to each other (congruent shapes are also similar).
   b. B and C are congruent.

Bonus: Reasoning and proofs start with assumptions.

## Answer to Tests

**Test 1 ( Chapters 1–6)**

1. a. $\frac{3}{2}$ acres + $\frac{1}{3}$ acres = $\frac{9}{6}$ acres + $\frac{2}{6}$ acres = $\frac{11}{6}$ acres = $1\frac{5}{6}$ acres
   b. $\cancel{3} \bullet \frac{5}{\cancel{3}}$ cups = 5 cups
   c. $\frac{1}{2}$ yd + $\frac{2}{3}$ yd = $\frac{3}{6}$ yd + $\frac{4}{6}$ yd = $\frac{7}{6}$ yd = $1\frac{1}{6}$ yard
   d. $12\frac{1}{2}$ in – $5\frac{3}{4}$ in = $\frac{25}{2}$ in – $\frac{23}{4}$ in = $\frac{50}{4}$ in – $\frac{23}{4}$ in = $\frac{27}{4}$ in = $6\frac{3}{4}$ inches

2. *total expenses* = \$16 + \$60 + \$13 + \$11 = \$100
   *number of pounds* = 10 x 20 lb = 200 lb
   *8 times expenses* = 8 x \$100 = \$800
   *price to charge per pound* = \$800 ÷ 200 lb = \$4 per pound

3.

| Check Number | Date | Memo | Payment Amount | Deposit Amount | $ Balance |
|---|---|---|---|---|---|
| | 7/1 | Opening Balance | | | 24,587 |
| | 7/2 | Deposit | | 1,568 | 26,155 |
| 292 | 7/2 | Farmer Supply Company | 120 | | 26,035 |
| 293 | 7/3 | Tractor Repair Company | 134 | | **25,901** |

4. Students were told to solve these problems mentally.
   a. 27 cents
   b. 53 cents
   c. 97 cents
   d. 60
   e. 40

5. a. $\frac{\overset{1}{\cancel{3}}}{4} \times \frac{7}{\underset{3}{\cancel{9}}} = \frac{7}{12}$

   b. $\frac{\overset{2}{\cancel{8}}}{9} \times \frac{5}{\underset{1}{\cancel{4}}} = \frac{10}{9} = 1\frac{1}{9}$

   c. $\frac{42}{105} + \frac{35}{105} = \frac{77}{105} = \frac{11}{15}$
   d. $4(25 - 12) = 4(13) = 52$
   e. $9(8) = 72$
   f. $88 = 2 \times 2 \times 2 \times 11$
   $66 = 2 \times 3 \times 11$
   GCF = $2 \times 11 = 22$
   g. LCM = $2 \times 2 \times 2 \times 3 \times 11 = 264$

Bonus: Answer should be a biblical truth that helps shape our view of math; possibilities include that God created and sustains all things, that He created us in His image, and that God never changes and is faithful.

**Test 2 (Chapters 7–11)**

1. a. $\frac{15 \text{ pictures}}{3 \text{ pages}} = \frac{75 \text{ pictures}}{? \text{ pages}}$; 15 pages
   b. $\frac{\$3.50}{5 \text{ pages}} = \frac{\$ ?}{15 \text{ pages}}$; \$10.50
   c. $\frac{\$0.99}{2 \text{ pages}} = \frac{\$ ?}{15 \text{ pages}}$; \$7.43
   \$10.50 – \$7.43 = \$3.07
   d. *amount to spend on ribbon* = $\frac{1}{2}$ x \$75 = \$37.50
   *spools can buy* = \$37.50 ÷ \$1.99 = 18.84, or 18 spools
   *Note*: We can't round up, as we don't have enough money to get 19.

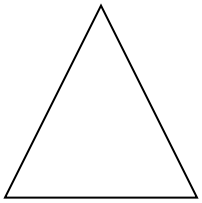
2. Students were told to solve these problems mentally.
   a. \$7.50
   b. \$2.50

# Reference Sheets

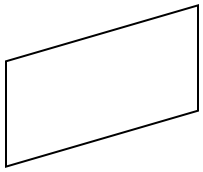
Please tear these pages out and place in your math notebook, along with blank paper to use in adding your own notes.

## *Polygon*

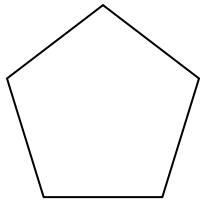
(closed, two-dimensional figure with straight lines)



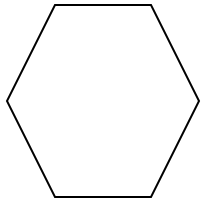
**Triangle**
(3 sides)



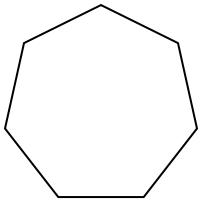
**Quadrilateral**
(4 sides)



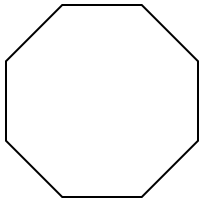
**Pentagon**
(5 sides)



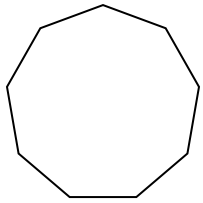
**Hexagon**
(6 sides)



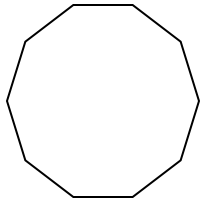
**Heptagon**
(7 sides)



**Octagon**
(8 sides)



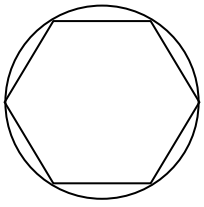
**Nonagon**
(9 sides)

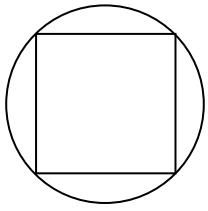


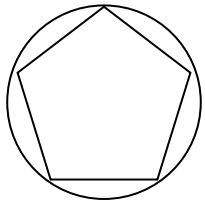
**Decagon**
(10 sides)

## *Regular Polygon*

(All sides are equal; all edges would touch a circle drawn around the figure, as all angles are the same.)

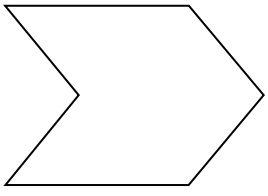


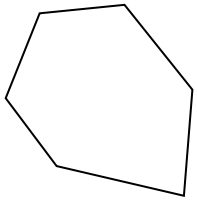


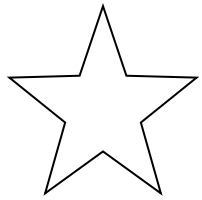


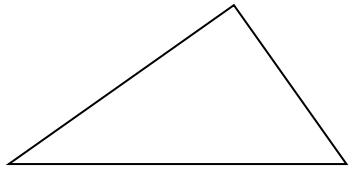
## *Irregular Polygon*

(Polygons that are not regular.)







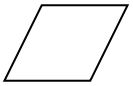


## *Specific Quadrilaterals*

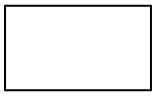
**Trapezoid**
(quadrilateral with 1 pair of parallel sides)

Some books define a trapezoid as a quadrilateral with 1, and only 1, pair of parallel sides, while others as a quadrilateral with 1 (or more) pair of parallel sides. Likewise, some define a rhombus/diamond differently than listed here. Always remember that definitions can — and do — vary!

**Parallelogram**
(quadrilateral with both pairs of opposite sides parallel)



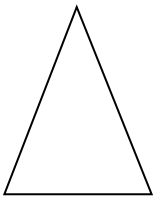
**Rhombus/Diamond**
(parallelogram with equal-length sides)



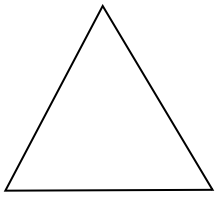
**Rectangle**
(parallelogram with right angles)

**Square**
(parallelogram with equal-length sides *and* right angles)

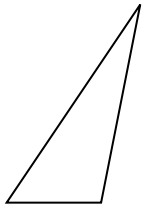
## *Triangles Categorized by Length of Sides*



**Isosceles**
(two equal sides)

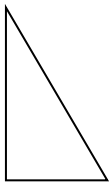


**Equilateral**
(all equal sides)

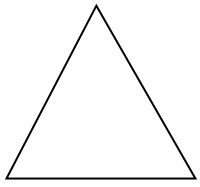


**Scalene**
(no equal sides)

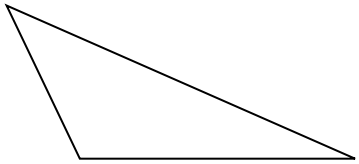
## *Triangles Categorized by Angles*



**Right Triangle**
(a right angle)



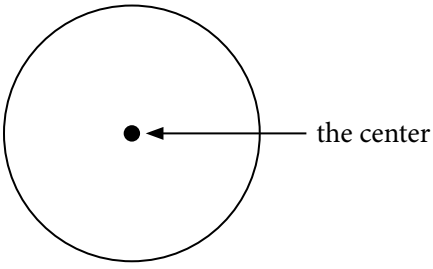
**Acute Triangle**
(all acute angles)



**Obtuse Triangle**
(an obtuse angle)

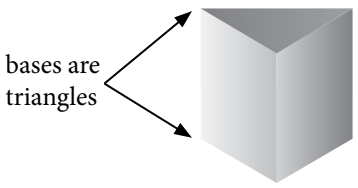
## *Circle*

(closed two-dimensional figure; each part of the edge is equally distant from the center)

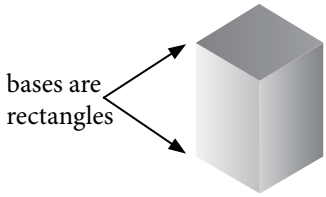


## *Prism*

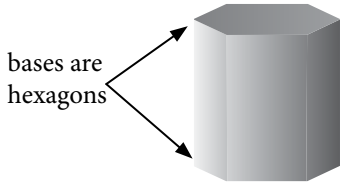
(A solid with two bases that are parallel polygons, and faces [sides] that are parallelograms; the prism is named after the shape of the bases.)



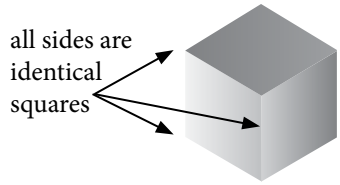

**Triangular Prism**




**Rectangular Prism**




**Hexagonal Prism**



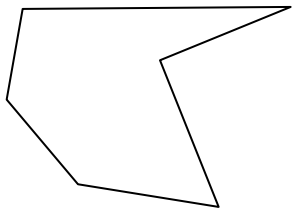
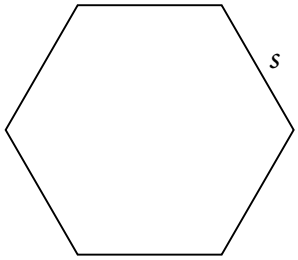
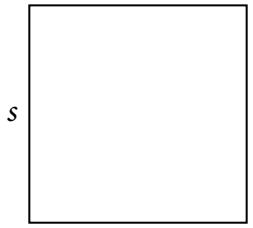
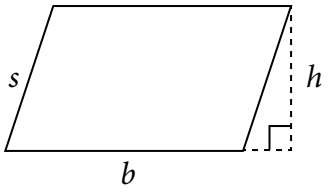
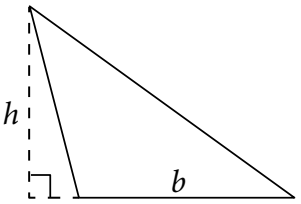

**Cube**

## *Cylinder*

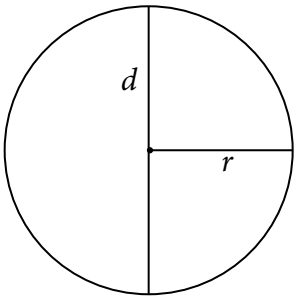
(A solid with two bases that are equal parallel circles, having an equal diameter in any parallel plane between them.)

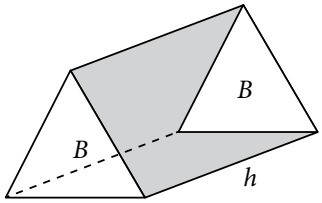
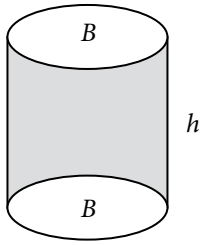
Prism and cylinder definitions were based on *Ray's New Higher Arithmetic*, Revised (Cincinnati: Van Antwerp, Bragg & Co., 1880), p. 390.

# Formulas

| Shape Name | Type of Shape | Perimeter | Area |
|---|---|---|---|
| Polygons |  | ***P* = *sum of the lengths of each side***<br>*or* $P = s_1 + s_2 \ldots s_n$ | View as multiple triangles or other shapes. |
| Regular Polygon |  | ***P* = *(number of sides) • (length of a side)***<br>*or* $P = n \cdot s$<br>*or* $P = n(s)$<br>*or* $P = ns$ | View as multiple triangles or other shapes. |
| Rectangle |  | $P = (2 \cdot length) + (2 \cdot width)$<br>*or* $P = 2 \cdot l + 2 \cdot w$<br>*or* $P = 2(l) + 2(w)$<br>*or* $P = 2l + 2w$ | $A = length \cdot width$<br>*or* $A = l \cdot w$<br>*or* $A = l(w)$<br>*or* $A = lw$ |
| Square |  | $P = 4 \cdot side$<br>*or* $P = 4 \cdot l$<br>*or* $P = 4(s)$<br>*or* $P = 4s$ | $A = side \cdot side$<br>*or* $A = s \cdot s$<br>*or* $A = s(s)$<br>*or* $A = s^2$ |
| Parallelogram |  | $P = (2 \cdot base) + (2 \cdot side)$<br>*or* $P = 2 \cdot b + 2 \cdot s$<br>*or* $P = 2(b) + 2(s)$<br>*or* $P = 2b + 2s$ | $A = base \cdot height$<br>*or* $A = b \cdot h$<br>*or* $A = b(h)$<br>*or* $A = bh$ |
| Triangle |  | ***Perimeter = sum of the lengths of each side***<br>*or* $P = s_1 + s_2 + s_3$ | $A = \frac{1}{2} \cdot base \cdot height$<br>*or* $A = \frac{base \cdot height}{2}$<br>$A = \frac{1}{2} \cdot b \cdot h$<br>*or* $A = \frac{b \cdot h}{2}$ |

*A = Area*
*B = area of the base*
*b = base*
*C = circumference*
*d = diameter*
*h = height*
*l = length*
*n = number of sides*
*P = Perimeter*
*π = 3.14*
*r = radius*
*s = side*
*V = Volume*
*w = width (or height)*

| Shape Name | Type of Shape | Perimeter | Area |
|---|---|---|---|
| Circle |  | ***Circumference* = π • *diameter***<br>*or* **C = π • *d***<br>*or* **C = π(*d*)**<br>*or* **C = π*d***<br><br>***Circumference* = 2 • π • *radius***<br>*or* **C = 2 • π • *r***<br>*or* **C = 2(π)(*r*)**<br>*or* **C = 2π*r*** | ***Area* = π • *radius* • *radius***<br>*or* **A = π • $r^2$**<br>*or* **A = π($r^2$)**<br>*or* **A = π$r^2$** |
| | | ***diameter* = 2 • *radius*** *or* **d = 2 • r**<br>***radius* = $\frac{1}{2}$ • *diameter*** *or* **r = $\frac{1}{2}$ • d** | |

| Shape Name | Type of Shape | Perimeter | Area |
|---|---|---|---|
| Prism |  | ***Volume* = *area of base* • *height***<br>*or* **V = B • h** | ***Total surface area* = *area of all the sides (i.e., surfaces) of a solid object*** |
| Cylinder |  | ***Volume* = *area of base* • *height***<br>*or* **V = B • h** | did not cover |

*A = Area*
*B = area of the base*
*b = base*
*C = circumference*
*d = diameter*
*h = height*
*l = length*
*n = number of sides*
*P = Perimeter*
*π = 3.14*
*r = radius*
*s = side*
*V = Volume*
*w = width (or height)*

# Units of Measure

## *Distance*

**Distance – U.S. Customary**

12 inches (in) = 1 foot (ft)
3 feet / 36 inches = 1 yard (yd)
1,760 yard / 5,280 feet = 1 mile (mi)

**Conversion Between Systems**

1 inches (in) = 2.54 centimeter (cm)
1 foot (ft) = 30.48 centimeter (cm)
1 yard (yd) = 0.9144 meter (m)
1 mile (mi) = 1.60934 kilometer (km)

**Distance – Metric/SI**

10 millimeters (mm) = 1 centimeter (cm)
10 centimeters = 1 decimeter (dm)
10 decimeters / 100 centimeters / 1,000 millimeters = 1 meter (m)
10 meters = 1 decameters (dam)
10 decameters / 1,000 meters = 1 hectometer (hm)
10 hectometers = 1 kilometer (km)

## *Time*

60 seconds (s) = 1 minute (min)
60 minutes = 1 hour (hr)
24 hours = 1 day (d)
7 days = 1 week (wk)
365 days = 1 year (yr *or* y)

## *Liquid Capacity*

**U.S. Customary**

3 teaspoons (tsp) = 1 tablespoon (Tbsp)
16 tablespoons = 1 cup (c)
2 cups = 1 pint (pt)
2 pints = 1 quart (qt)
4 quarts = 1 gallon (gal)

2 tablespoons (Tbsp) ≈ 1 fluid ounce (fl oz)
8 fl oz = 1 cup (c)
16 fl oz = 1 pint (pt)
32 fl oz = 1 quart (qt)
128 fl oz = 1 gallon (gal)

**Conversion Between Systems**

1 teaspoon ≈ 5 milliliters
1 gallon = 3.78541 liters

1 pint = 28.875 $in^3$
1 quart = 57.75 $in^3$
1 gallon = 231 $in^3$

**Metric**

10 milliliters (ml *or* mL) = 1 centiliter (cl *or* cL)
10 centiliter / 100 milliliter = 1 deciliter (dl *or* dL)
10 deciliter / 100 centiliter / 1,000 milliliter = 1 liter (*l or* L)
10 liters = 1 dekaliter (dal *or* daL)
10 dekaliter = 1 hectoliter (hl *or* hL)
10 hectoliter / 1,000 liters = 1 kiloliter (kl *or* kL)

## *Dry Capacity*

**U.S. Customary**

2 pints (pt) = 1 quart (qt)
8 quart = 1 peck (pk)
4 peck = 1 bushel (bu) / 32 quarts (qt)

**Conversion Between Systems**

1 quart = 67.2006 inches$^3$
1 bushel = 2,150.42 inches$^3$

*Note*: The pint and quart here represent a larger capacity than the ones measuring liquid—they should not be used interchangeably. Unless the problem specifically states otherwise, you can assume pint and quart in this course refer to the liquid units.

## *Mass*

**U.S. Customary**

16 ounces (oz) = 1 pound (lb)
2,000 pounds = 1 ton (called a "short ton")

**Conversion Between Systems**

1 ounce = 28.3495 grams
1 pound = 453.592 grams
1 U.S. ton (called a short ton) = 0.907185 metric tons

*Note*: These ounces are different than the fluid ounces listed under liquid capacity.

**Metric**

10 milligrams (mg) = 1 centigram (cg)
10 centigrams / 100 milligrams = 1 decigram (dg)
10 decigrams / 100 centigrams / 1,000 milligrams = 1 gram (g)
10 grams = 1 dekagram (dag)
10 dekagrams = 1 hectogram (hg)
10 hectograms / 1,000 grams = 1 kilogram (kg)

For more unit details, see the official standards given in Tina Butcher, Linda Crown, Rick Harshman, and Juana Williams, eds. *NIST Handbook 44: 97th National Conference on Weights and Measures 2012*, 2013 ed. (Washington: U. S. Department of Commerce, 2012), Appendix C. Found on http://www.nist.gov/pml/wmd/pubs/h44-13.cfm (accessed 10/6/2014).