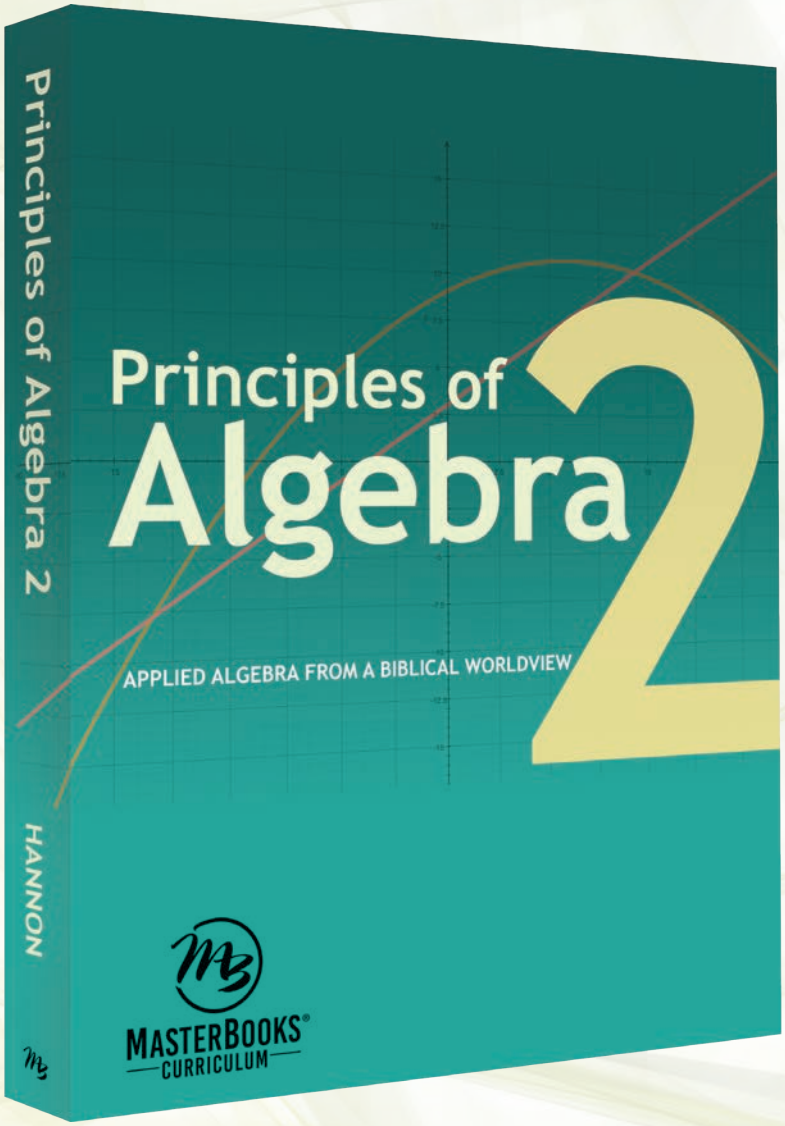
TEACHER GUIDE

10th–12th Grade | Algebra 2

- Weekly Lesson Schedule
- Daily Worksheets
- Quizzes, Tests, & Final Exam



MASTERBOOKS®
CURRICULUM

TEACHER GUIDE

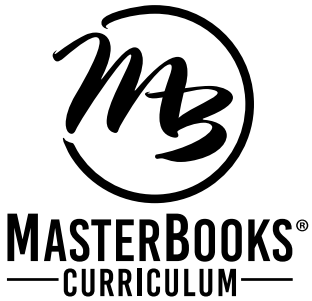
10th–12th Grade

Includes Student Worksheets

Math

- Weekly Lesson Schedule
- Student Worksheets
- Quizzes and Tests

Principles of Algebra 2: Applied Algebra from a Biblical Worldview



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"Best books ever. Their illustrations are captivating and content amazing!
—Kathy ★★★★★

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Table of Contents

Based on and designed to go with *Principles of Algebra 2: Applied Algebra from a Biblical Worldview Student Textbook*. Please see the *Student Textbook* for further information and sources.

We've adapted and included math problems from late 1800 or early 1900 math books. We've attempted to mark each of these problems with different symbols for easy identification. The sources are listed here for your reference. Feel free to look up the books and have fun with additional problems. These sources, especially *Franklin Elementary Algebra*, inspired other problems as well.

Problems marked with a  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

Problems marked with a  were adapted from Edwin Seaver and George Walton, *The Franklin Elementary Algebra* (Boston: William War & Co., 1882), https://books.google.com/books?id=RA8AAAAAYAAJ&dq=franklin's%20elementary%20algebra

Problems marked with a  were adapted from Jos. V. Collins, *Practical Algebra: First Year Course* (New York: American Book Co., 1910), https://books.google.com/books?id=hNdHAAAAIAAJ

Problems marked with a  were adapted from Henry Lewis Rietz, Arthur Robert Oratoren, and Edson Homer Taylor. *School Algebra* (New York: Henry Holt and Co., 1915), https://books.google.com/books?id=FawXAAAAIAAJ

Note: In putting this material together, many different resources were consulted, many of which are footnoted where appropriate. We do not necessarily recommend these materials; while they were consulted for facts, some do not claim to be from a biblical worldview and should be approached with discernment.

Using This Teacher Guide

Features: The suggested weekly schedule enclosed has easy-to-manage lessons that guide the reading, worksheets, and all assessments. The pages of this guide are perforated and three-hole punched so materials are easy to tear out, hand out, grade, and store. Parents/teachers are encouraged to adjust the schedule and materials as needed in order to best work within their unique educational program.

Lesson Scheduling: Students are instructed to read the pages in the *Student Textbook* (or watch the lesson video if using the optional ecourse and then consult the textbook as needed) and then complete the corresponding section provided by the teacher. There is a quiz after each chapter, and a test after each quarter, plus a final exam. Space is provided on the weekly schedule for assignment dates, and flexibility in scheduling is encouraged. Parents/teachers may adapt the scheduled days per each unique student situation. As the student completes each assignment, this can be marked with an "X" in the box.

	**Approximately 60–90 minutes per lesson, five days a week**
	**Worksheets for each section**
	**Quizzes and tests are included to help reinforce learning and provide assessment opportunities. Note that quizzes test the material covered in the chapter, while the tests are full quarter examinations.**
	**Designed as a full-year, one credit course.** **Prerequisite: Algebra 1.** **(Geometry is recommended, but not required.)**

Course Objectives: Students completing this course will

- See to an even deeper level how algebra's very existence points us to a faithful Creator we can trust.
- See algebra in connection with God's creation, understanding how it applies outside of a textbook and brings a deeper understanding of God's world.
- Have a solid foundation for precalculus, understanding and knowing how to work with advanced equations and functions.
- Further develop problem-solving skills that will help in future math and science courses, as well as in real-life settings.

Course Description

This complete Algebra 2 program not only teaches algebra, but also shows students why they're learning concepts and how algebra's very existence points us to God. Students will see algebra in action . . . and find their biblical worldview built along the way.

Preparing to Use the Curriculum

The *Student Textbook* contains all the explanation of the material. Important terms are **bolded** in the textbook so you can easily spot them. Examples you can work through with the student if needed (or use to teach a classroom) are all included there. Here is one suggestion for how to prep the information in this *Teacher Guide*:

- ✔ Tear out the schedule, quizzes, and tests.
- ✔ Put them in a binder to use as needed.
- ✔ Hand the student the rest of the guide to work from when instructed.

Note that the pages in the *Teacher Guide* are hole punched for you and ready to go.

The schedule on page 9 explains what to assign each day. This schedule can be adapted to fit your needs. For example, if you only want to do math 3 days a week, then simply spread the work assigned for the week over 3 days instead of 5.

Teachers using the program in a classroom or co-op will find that there are about 2–3 presentations of concepts per week. Those 2–3 lessons could be taught in the classroom using the student text as a guide (with students able to read the textbook later for more clarity/reminders if needed), with the worksheets assigned as homework.

Additional Resources and Corrections

The *Solutions Manual* includes notes, step-by-step explanations on problems, and other features to make grading easier.

Please see the Book Extras page on ChristianPerspective.net for links to helpful online resources, along with additional notes and information related to this course.

Supplies Needed

- ☐ ***Principles of Algebra 2: Applied Algebra from a Biblical Worldview*** — This textbook contains the presentation of the concepts. Teachers can use it as a basis for presentations. Students should either read through it if learning the material on their own or use it as a reference/read as instructed if they are using the Academy eCourse or have a teacher explaining the concepts.
- ☐ ***Principles of Algebra 2 Solutions Manual*** — Contains solutions to all the worksheets, quizzes, and test problems.
- ☐ **Principles of Algebra 2 eCourse** (optional) — These videos offer presentations of lessons produced by the author. They're great for students that are more visual/auditory in learning or need more walking through the concepts. Students using the videos should watch the video for that lesson then look over the text, studying it as needed. The eCourse is available through the Master Books Academy at MasterBooksAcademy.com. *Note:* The *Student Book*, *Teacher Guide*, and *Solutions Manual* are required when using the eCourse.
- ☐ **Binder with Lined Paper or Other Note-Taking Method** — Whether a binder or something else (like a computer program), students should have a way to take/store/organize their notes.
- ☐ **Calculator (or Online Calculator)** — For most problems, students only need a scientific calculator (one that can handle exponents, roots, and scientific notation). However, there are a good number of problems that also require the ability to graph equations, as well as a few that require the ability to solve matrices. Students can use free online calculators for these functions; however, if students are planning on heading to college, owning their own graphing calculator and becoming familiar with it is recommended. Examples in this course are explained using the TI-83 Plus or TI-84 Plus. Other calculators can be used; students should consult their user manuals to see how to perform certain operations on them. *Important:* Students should *not* use a calculator to simplify algebraic expressions — simplifying algebraic expressions is an important skill for them to learn to do off a calculator, and it will also save them time in the long run. (*Example:* When asked to simplify $\frac{8a}{a}$, this should be done by hand, not with the help of a calculator.) It's suggested that students only use a scientific calculator (one without the graphing feature) on quizzes and tests except where specified; if a graphing calculator is used, that feature should not be used.
- ☐ **A College Notebook** — Students should have a notebook in which they can work out their problems and write their answers, as problems at this level require significant space to solve. They should number all problems and make it easy to see what their final answer is (perhaps by circling it). If students get a problem wrong, looking back at how they solved the problem can be helpful in finding the error (and in awarding partial credit if appropriate).
- ☐ **A Second Notebook or Additional Lined Paper** — Students should have a separate notebook or paper to use for quizzes and tests.
- ☐ **Index Cards (optional)** — Making flashcards of definitions or formulas can be a helpful way to learn and review the material. Students are encouraged to use index cards to make flashcards as needed or to use a computer program to do so.
- ☐ **Graph Paper** — Students will need graph paper for some of the graphing problems.
- ☐ **Computer Programs** (optional) — Excel, Google Sheets, or Libre Office.

General Instructions for Students

Don't panic when you hit hard problems. Some problems on the worksheets are designed to challenge you. Worksheets should be viewed as learning aids to help build problem-solving skills and exercise the mathematical tools being taught rather than as something to panic over getting wrong. If you get a problem wrong, you have a second chance to go back and figure it out with whatever hints your parent/educator deem appropriate before your grade for the worksheet is determined. (Don't abuse this—if you start making careless errors, your parent/educator may count those problems wrong the first time.) Just like when you learned to walk, you probably fell quite a bit, it's okay if you struggle on problems too, so long as you then get up and learn from it. Note that by the quizzes and tests you should have learned the material, so you won't have the same second chance on them.

Some problems are labeled as "Challenge Problems" and marked with a  . Ask your parent/educator if they want you to complete them. Note that they are designed to stretch your thinking in an extra way . . . but many will give you amazing glimpses into how algebra applies.

Here are a few notes to keep in mind when solving problems in this course.

- **Review** — If at any point you hit a concept that does not make sense, back up and review. Be sure to take advantage of any notes you've taken.
- **Calculator** — You will need a graphing calculator for some problems in this course and are allowed to use a calculator except where instructed not to. However, while some calculators can perform calculations with variables for you, it's important for you to learn how to do them yourself. If you master the skill, you should be able to perform many more problems much more quickly than you could with a calculator — and you'll have a better understanding of the concepts. So if your calculator can simplify algebraic expressions, don't use that feature.
- **Simplify Your Answers** — Unless otherwise indicated, **simplify your answers** as much as possible. Simplified answers are easier to read and work with. Plus, that way your teacher will not have to work so hard to grade your problems, as your answer will be in the same form as the *Solutions Manual*. *Note:* When you simplify fractions in algebra, **do not convert improper fractions to mixed numbers.** However, simplify the fraction as much as possible. For example, simplify $\frac{10}{4x}$ to $\frac{5}{2x}$ (the improper fraction is simplified but left as an improper fraction).
- **Units of Measure** — Unless told otherwise, always include units of measure in your answer when they were part of the problem. *Example:* 8 in + 2 in. *Answer:* 10 in. An answer of 10 to this problem would only get partial credit. Note that in this course, units of measure are not italicized, while letters standing for unknowns are.
- **Showing Steps** — As problems increase in complexity, writing down each step used to solve them in an orderly fashion becomes more and more important. On word problems or problems with a lot of steps especially, try to show how you obtained your answers. Writing down enough steps that someone can see the process followed is a helpful habit to develop, as it makes it easier to find any errors. You could potentially get partial credit if you set the problem up correctly. It is also required in many college courses.
- **Indicate Your Answer Clearly** — For grading purposes, make sure you circle or clearly indicate your answer to each problem.
- **Pi** (π) — In solving problems, you can use whatever rounded value of π you've memorized (such as 3.14) or simply use the π button on your calculator.

- **Fractions Versus Decimals** — To keep things simple to grade, if a problem is given to you in fractional form and there's a fractional part in the answer, give your answer as a fraction. If there's a decimal in the problem and there's a fractional part in the answer, then give the answer using a decimal. If a problem has both fractions and decimals, you can give your answer in either form.

  Example: Find $\frac{1}{2a} + \frac{1}{3a}$. *Answer:* $\frac{5}{6a}$.

  Example: Find $0.5a + 0.333a$. *Answer:* $0.833a$

  Example: Find $\frac{1}{2}a + 0.25a$ *Answer:* $\frac{3}{4}a$ *or* $0.75a$

- **Rounding** — Unless otherwise indicated, when giving a decimal answer, **round your final answer** in this course to the third decimal (the thousandths' place). (Note that you shouldn't round until the very end.) And when you rounded when solving a problem, try to use the approximately sign (≈) rather than an equal's sign to let others know it's a rounded value. (If needed, see the footnote for a reminder on how to round.[1])

  Example: Round an answer of 6.7888 to ≈ 6.789.

  Exception: In Chapter 12, you'll be instructed to round population growth down to the nearest whole value, as a part of a person, animal, etc., doesn't make sense. You'll also be instructed in problems to round dollars to the nearest cent.

- **Case Matters** — If an answer is listed in the *Solutions Manual* as $8v$, $8V$ is not an acceptable answer. Whether you use uppercase or lowercase matters! It's important to form the habit of using the correct case, as you might encounter problems that have both an uppercase and lowercase letter in the same problem, each representing a different unknown. Always use the case given in the problem; if v is used, use v, not V.

- **Specific Instructions** — You'll be given specific instructions on how to show graphs you graphed on a calculator on Worksheet 7.3B, how to list answers containing complex numbers on Worksheet 9.5, how to list answers when factoring and finding roots on Worksheet 9.6, and how to list answers to simplifying transformed functions on Worksheet 14.2A. Make notes of these instructions as you come to them, as following them will make grading easier since your answer will then be in the same format as the *Solutions Manual*.

Studying for Quizzes/Tests

Here are a few suggestions to help you study for quizzes/tests:

- Start by looking at the chapter synopsis (or synopses) for the chapter(s) you're studying. Review any concepts listed there you may have forgotten. Look over the worksheets for the chapter(s), especially the final review worksheet at the end of each chapter or quarter. Except where it says otherwise, the end-of-chapter worksheets and the test review worksheets give you a type of "pretest" to help you figure out what concepts to study. When studying for a test, also go back over the quizzes for the chapters covered on the test. And it's always a good idea in general to look at any concepts or problems you know were hard for you to make sure you understand them.
- Review any concepts you know were more challenging for you.
- Look at any notes you've taken. Review any flashcards you've made (or make some if you've not made any yet).

1 When rounding, look at the value to the right of the place to which you want to round. If it is 5 or greater, round up; if it is less than 5, you just round down, or in the case of decimals, leave the place you're rounding to as it is. For example, if rounding 9.578542 to the 3rd decimal, we would look at the 4th decimal place, which is a 5. Since 5 is 5 or greater, we'd round the 3rd decimal place up to the next number, giving us a rounded value of 9.579. But if we had 9.578342 instead, we'd round to 9.578 instead.

First Semester Suggested Daily Schedule

While the schedule shows how to complete the course in one school year, different students may require different amounts of time. Feel free to let students go faster if they are able, especially through the first quarter, which includes a lot of review from Algebra 1. In fact, it's suggested that students who already have a firm grasp of Algebra 1 get ahead in the first quarter if possible to allow for extra time on some of the more advanced concepts in the latter parts of the book (or to start their next course of study earlier).

Those using the eCourse on the Master Books Academy (MasterBooksAcademy.com) should complete the corresponding lesson there first, using the *Student Textbook* as a reference. For example, on Day 1, students would watch video 1.1 and then work the worksheet, consulting their textbook as needed.

Date	Day	Assignment	Due Date	✓	Grade
First Semester-First Quarter					
Week 1	Day 1	Lesson 1.1 (*Student Textbook*, pages 11–16) Worksheet 1.1 (*Teacher Guide,* page 19)			
	Day 2	Lesson 1.2 (*Student Textbook*, pages 17–20) Worksheet 1.2 (*Teacher Guide,* page 20)			
	Day 3	Lesson 1.3 (*Student Textbook*, pages 21–25) Worksheet 1.3 (*Teacher Guide,* pages 21–22)			
	Day 4	Lesson 1.4 (*Student Textbook*, pages 26–28) Worksheet 1.4 (*Teacher Guide,* pages 23–24)			
	Day 5	Lesson 1.5 (*Student Textbook*, pages 29–32) Worksheet 1.5 (*Teacher Guide,* page 25)			
Week 2	Day 6	Lesson 1.6 (*Student Textbook*, pages 33–36) Worksheet 1.6 (*Teacher Guide,* pages 26–27)			
	Day 7	Lesson 1.7 (*Student Textbook*, pages 37–40) Worksheet 1.7 (*Teacher Guide,* pages 28–29)			
	Day 8	Lesson 1.8–1.9 (*Student Textbook*, pages 41–48) Worksheet 1.8 (*Teacher Guide,* pages 30–31)			
	Day 9	Quiz 1 (*Teacher Guide,* pages 361–362)			
	Day 10	Lesson 2.1 (*Student Textbook*, pages 49–53) Worksheet 2.1 (*Teacher Guide,* pages 33–34)			
Week 3	Day 11	Lesson 2.2 (*Student Textbook*, pages 54–57) Worksheet 2.2 (*Teacher Guide,* pages 35–36)			
	Day 12	Lesson 2.3 (*Student Textbook*, pages 58–61) Worksheet 2.3A (*Teacher Guide,* page 37)			
	Day 13	Worksheet 2.3B (*Teacher Guide,* pages 38–39)			
	Day 14	Lesson 2.4 (*Student Textbook*, pages 62–63) Worksheet 2.4 (*Teacher Guide,* pages 40–41)			
	Day 15	Lesson 2.5 (*Student Textbook*, pages 64–67) Worksheet 2.5A (*Teacher Guide,* page 42)			
Week 4	Day 16	Worksheet 2.5B (*Teacher Guide,* pages 43–44)			
	Day 17	Lesson 2.6 (*Student Textbook*, pages 68–71) Worksheet 2.6A (*Teacher Guide,* page 45)			
	Day 18	Worksheet 2.6B (*Teacher Guide,* pages 46–47)			
	Day 19	Lesson 2.7 (*Student Textbook*, pages 72–76) Worksheet 2.7A (*Teacher Guide,* page 48)			
	Day 20	Worksheet 2.7B (*Teacher Guide,* pages 49–50)			

Date	Day	Assignment	Due Date	✓	Grade
Week 5	Day 21	Lesson 2.8 (*Student Textbook*, pages 77–80) Worksheet 2.8 (*Teacher Guide,* page 51)			
	Day 22	Quiz 2 (*Teacher Guide,* page 363–364)			
	Day 23	Lesson 3.1 (*Student Textbook*, pages 81–86) Worksheet 3.1A (*Teacher Guide,* page 53)			
	Day 24	Worksheet 3.1B (*Teacher Guide,* pages 54–55)			
	Day 25	Lesson 3.2 (*Student Textbook*, pages 87–91) Worksheet 3.2A (*Teacher Guide,* page 56)			
Week 6	Day 26	Worksheet 3.2B (*Teacher Guide,* pages 57–58)			
	Day 27	Lesson 3.3 (*Student Textbook*, pages 92–94) Worksheet 3.3A (*Teacher Guide,* page 59)			
	Day 28	Worksheet 3.3B (*Teacher Guide,* pages 60–61)			
	Day 29	Lesson 3.4 (*Student Textbook*, pages 95–99) Worksheet 3.4A (*Teacher Guide,* page 62)			
	Day 30	Worksheet 3.4B (*Teacher Guide,* pages 63–64)			
Week 7	Day 31	Lesson 3.5 (*Student Textbook*, pages 100–102) Worksheet 3.5A (*Teacher Guide,* page 65)			
	Day 32	Worksheet 3.5B (*Teacher Guide,* pages 66–67)			
	Day 33	Lesson 3.6 (*Student Textbook*, pages 103–106) Worksheet 3.6 (*Teacher Guide,* page 68)			
	Day 34	Quiz 3 (*Teacher Guide,* page 365)			
	Day 35	Lesson 4.1 (*Student Textbook*, pages 107–112) Worksheet 4.1 (*Teacher Guide,* pages 69–70)			
Week 8	Day 36	Lesson 4.2 (*Student Textbook*, pages 113–117) Worksheet 4.2 (*Teacher Guide,* page 71)			
	Day 37	Lesson 4.3 (*Student Textbook*, pages 118–123) Worksheet 4.3A (*Teacher Guide,* page 72)			
	Day 38	Worksheet 4.3B (*Teacher Guide,* pages 73–74)			
	Day 39	Lesson 4.4 (*Student Textbook*, pages 124–128) Worksheet 4.4A (*Teacher Guide,* page 75)			
	Day 40	Worksheet 4.4B (*Teacher Guide,* page 76)			
Week 9	Day 41	Lesson 4.5 (*Student Textbook*, pages 129–130) Worksheet 4.5 (*Teacher Guide,* pages 77–78)			
	Day 42	Lesson 4.6 (*Student Textbook*, pages 131–132) Worksheet 4.6 (*Teacher Guide,* pages 79–81)			
	Day 43	Quiz 4 (*Teacher Guide,* pages 367–368)			
	Day 44	Worksheet 4.7 (*Teacher Guide,* pages 82–83)			
	Day 45	Test 1 (*Teacher Guide,* pages 393–394)			

Date	Day	Assignment	Due Date	✓	Grade
First Semester-Second Quarter					
Week 1	Day 46	Lesson 5.1 (*Student Textbook*, pages 133–137) Worksheet 5.1 (*Teacher Guide,* pages 85–86)			
	Day 47	Lesson 5.2 (*Student Textbook*, pages 138–141) Worksheet 5.2 (*Teacher Guide,* page 87)			
	Day 48	Lesson 5.3 (*Student Textbook*, pages 142–144) Worksheet 5.3 (*Teacher Guide,* page 88)			
	Day 49	Lesson 5.4 (*Student Textbook*, pages 145–148) Worksheet 5.4A (*Teacher Guide,* page 89)			
	Day 50	Worksheet 5.4B (*Teacher Guide,* pages 90–91)			
Week 2	Day 51	Lesson 5.5 (*Student Textbook*, pages 149–152) Worksheet 5.5A (*Teacher Guide,* page 92)			
	Day 52	Worksheet 5.5B (*Teacher Guide,* pages 93–94)			
	Day 53	Lesson 5.6 (*Student Textbook*, pages 153–157) Worksheet 5.6A (*Teacher Guide,* page 95)			
	Day 54	Worksheet 5.6B (*Teacher Guide,* pages 96–97)			
	Day 55	Lesson 5.7 (*Student Textbook*, pages 158–160) Worksheet 5.7 (*Teacher Guide,* page 98)			
Week 3	Day 56	Quiz 5 (*Teacher Guide,* pages 369–370)			
	Day 57	Lesson 6.1 (*Student Textbook*, pages 161–165) Worksheet 6.1A (*Teacher Guide,* page 99)			
	Day 58	Worksheet 6.1B (*Teacher Guide,* pages 100–101)			
	Day 59	Lesson 6.2 (*Student Textbook*, pages 166–169) Worksheet 6.2A (*Teacher Guide,* page 102)			
	Day 60	Worksheet 6.2B (*Teacher Guide,* pages 103–104)			
Week 4	Day 61	Lesson 6.3 (*Student Textbook*, pages 170–174) Worksheet 6.3A (*Teacher Guide,* pages 105–106)			
	Day 62	Worksheet 6.3B (*Teacher Guide,* pages 107–110)			
	Day 63	Lesson 6.4 (*Student Textbook*, pages 175–176) Worksheet 6.4 (*Teacher Guide,* pages 111–112)			
	Day 64	Quiz 6 (*Teacher Guide,* pages 371–372)			
	Day 65	Lesson 7.1 (*Student Textbook*, pages 177–182) Worksheet 7.1A (*Teacher Guide,* page 113)			
Week 5	Day 66	Worksheet 7.1B (*Teacher Guide,* pages 114–117)			
	Day 67	Lesson 7.2 (*Student Textbook*, pages 183–186) Worksheet 7.2A (*Teacher Guide,* page 118)			
	Day 68	Worksheet 7.2B (*Teacher Guide,* pages 119–121)			
	Day 69	Lesson 7.3 (*Student Textbook*, pages 187–193) Worksheet 7.3A (*Teacher Guide,* page 122)			
	Day 70	Worksheet 7.3B (*Teacher Guide,* pages 123–126)			

Date	Day	Assignment	Due Date	✓	Grade
Week 6	Day 71	Lesson 7.4 (*Student Textbook*, pages 194–199) Worksheet 7.4 (*Teacher Guide,* pages 127–128)			
	Day 72	Lesson 7.5 (*Student Textbook*, pages 200–206) Worksheet 7.5 (*Teacher Guide,* pages 129–130)			
	Day 73	Lesson 7.6 (*Student Textbook*, pages 207–211) Worksheet 7.6A (*Teacher Guide,* page 131)			
	Day 74	Worksheet 7.6B (*Teacher Guide,* pages 132–133)			
	Day 75	Lesson 7.7 (*Student Textbook*, pages 212–215) Worksheet 7.7A (*Teacher Guide,* page 134)			
Week 7	Day 76	Worksheet 7.7B (*Teacher Guide,* pages 135–138)			
	Day 77	Lesson 7.8 (*Student Textbook*, pages 216–220) Worksheet 7.8A (*Teacher Guide,* page 139)			
	Day 78	Worksheet 7.8B (*Teacher Guide,* pages 140–142)			
	Day 79	Lesson 7.9 (*Student Textbook*, pages 221–226) Worksheet 7.9 (*Teacher Guide,* pages 143–144)			
	Day 80	Quiz 7 (*Teacher Guide,* pages 373–374)			
Week 8	Day 81	Lesson 8.1 (*Student Textbook*, pages 227–232) Worksheet 8.1 (*Teacher Guide,* pages 145–147)			
	Day 82	Lesson 8.2 (*Student Textbook*, pages 233–239) Worksheet 8.2A (*Teacher Guide,* page 148)			
	Day 83	Worksheet 8.2B (*Teacher Guide,* pages 149–151)			
	Day 84	Lesson 8.3 (*Student Textbook*, pages 240–245) Worksheet 8.3A (*Teacher Guide,* page 152)			
	Day 85	Worksheet 8.3B (*Teacher Guide,* pages 153–155)			
Week 9	Day 86	Lesson 8.4 (*Student Textbook*, pages 246–249) Worksheet 8.4 (*Teacher Guide,* pages 156–157)			
	Day 87	Lesson 8.5 (*Student Textbook*, pages 250–252) Worksheet 8.5 (*Teacher Guide,* pages 158–160)			
	Day 88	Quiz 8 (*Teacher Guide,* pages 375–376)			
	Day 89	Worksheet 8.6 (*Teacher Guide,* pages 161–164)			
	Day 90	Test 2 (*Teacher Guide,* pages 395–397)			
		Mid-Term Grade			

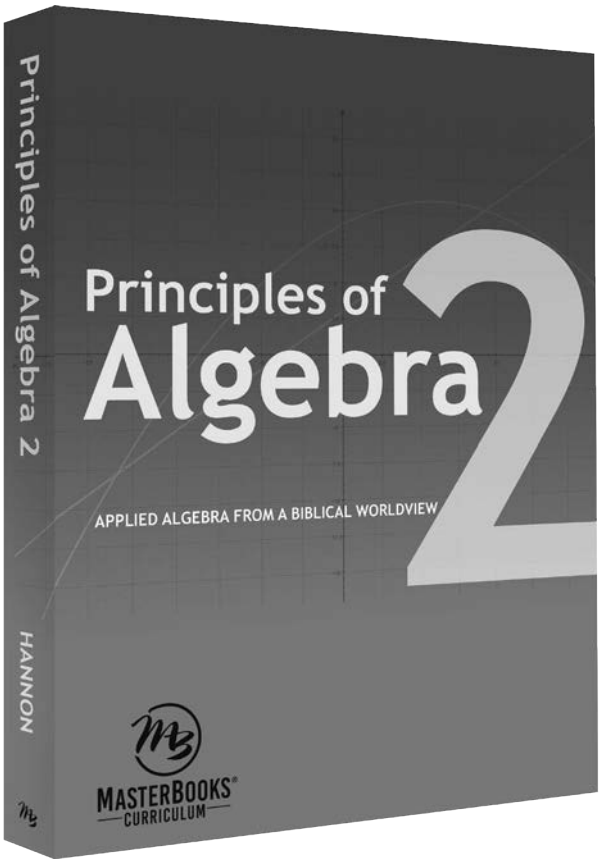
Second Semester Suggested Daily Schedule

Date	Day	Assignment	Due Date	✓	Grade
Second Semester-Third Quarter					
Week 1	Day 91	Lesson 9.1 (*Student Textbook*, pages 253–261) Worksheet 9.1A (*Teacher Guide,* pages 165–166)			
	Day 92	Worksheet 9.1B (*Teacher Guide,* pages 167–170)			
	Day 93	Lesson 9.2 (*Student Textbook*, pages 262–267) Worksheet 9.2A (*Teacher Guide,* page 171)			
	Day 94	Worksheet 9.2B (*Teacher Guide,* pages 172–174)			
	Day 95	Lesson 9.3 (*Student Textbook*, pages 268–272) Worksheet 9.3A (*Teacher Guide,* pages 175–176)			
Week 2	Day 96	Worksheet 9.3B (*Teacher Guide,* pages 177–178)			
	Day 97	Lesson 9.4 (*Student Textbook*, pages 273–279) Worksheet 9.4A (*Teacher Guide,* page 179)			
	Day 98	Worksheet 9.4B (*Teacher Guide,* pages 180–182)			
	Day 99	Lesson 9.5 (*Student Textbook*, pages 280–282) Worksheet 9.5 (*Teacher Guide,* pages 183–184)			
	Day 100	Lesson 9.6 (*Student Textbook*, pages 283–287) Worksheet 9.6 (*Teacher Guide,* pages 185–187)			
Week 3	Day 101	Lesson 9.7 (*Student Textbook*, pages 288–294) Worksheet 9.7 (*Teacher Guide,* pages 188–190)			
	Day 102	Quiz 9 (*Teacher Guide,* pages 377–378)			
	Day 103	Lesson 10.1 (*Student Textbook*, pages 295–300) Worksheet 10.1A (*Teacher Guide,* page 191)			
	Day 104	Worksheet 10.1B (*Teacher Guide,* pages 192–193)			
	Day 105	Lesson 10.2 (*Student Textbook*, pages 301–305) Worksheet 10.2A (*Teacher Guide,* page 194)			
Week 4	Day 106	Worksheet 10.2B (*Teacher Guide,* pages 195–196)			
	Day 107	Lesson 10.3 (*Student Textbook*, pages 306–314) Worksheet 10.3A (*Teacher Guide,* pages 197–198)			
	Day 108	Worksheet 10.3B (*Teacher Guide,* pages 199–201)			
	Day 109	Lesson 10.4 (*Student Textbook*, pages 315–316) Worksheet 10.4 (*Teacher Guide,* pages 202–204)			
	Day 110	Quiz 10 (*Teacher Guide,* pages 379–380)			
Week 5	Day 111	Lesson 11.1 (*Student Textbook*, pages 317–322) Worksheet 11.1A (*Teacher Guide,* pages 205–207)			
	Day 112	Worksheet 11.1B (*Teacher Guide,* pages 208–210)			
	Day 113	Lesson 11.2 (*Student Textbook*, pages 323–328) Worksheet 11.2A (*Teacher Guide,* page 211)			
	Day 114	Worksheet 11.2B (*Teacher Guide,* pages 212–214)			
	Day 115	Lesson 11.3 (*Student Textbook*, pages 329–334) Worksheet 11.3 (*Teacher Guide,* pages 215–217)			

Date	Day	Assignment	Due Date	✓	Grade
Week 6	Day 116	Lesson 11.4 (*Student Textbook*, pages 335–339) Worksheet 11.4A (*Teacher Guide,* pages 218–219)			
	Day 117	Worksheet 11.4B (*Teacher Guide,* pages 220–222)			
	Day 118	Lesson 11.5 (*Student Textbook*, pages 340–345) Worksheet 11.5A (*Teacher Guide,* pages 223–224)			
	Day 119	Worksheet 11.5B (*Teacher Guide,* pages 225–227)			
	Day 120	Lesson 11.6 (*Student Textbook*, pages 346–348) Worksheet 11.6 (*Teacher Guide,* pages 228–231)			
Week 7	Day 121	Quiz 11 (*Teacher Guide,* pages 381–382)			
	Day 122	Lesson 12.1 (*Student Textbook*, pages 349–353) Worksheet 12.1 (*Teacher Guide,* pages 233–234)			
	Day 123	Lesson 12.2 (*Student Textbook*, pages 354–356) Worksheet 12.2 (*Teacher Guide,* pages 235–237)			
	Day 124	Lesson 12.3 (*Student Textbook*, pages 357–360) Worksheet 12.3A (*Teacher Guide,* page 238)			
	Day 125	Worksheet 12.3B (*Teacher Guide,* pages 239–240)			
Week 8	Day 126	Lesson 12.4 (*Student Textbook*, pages 361–365) Worksheet 12.4A (*Teacher Guide,* page 241)			
	Day 127	Worksheet 12.4B (*Teacher Guide,* pages 242–243)			
	Day 128	Lesson 12.5 (*Student Textbook*, pages 366–370) Worksheet 12.5A (*Teacher Guide,* page 244)			
	Day 129	Worksheet 12.5B (*Teacher Guide,* pages 245–246)			
	Day 130	Lesson 12.6 (*Student Textbook*, pages 371–374) Worksheet 12.6A (*Teacher Guide,* page 247)			
Week 9	Day 131	Worksheet 12.6B (*Teacher Guide,* pages 248–250)			
	Day 132	Lesson 12.7 (*Student Textbook*, pages 375–378) Worksheet 12.7 (*Teacher Guide,* pages 251–253)			
	Day 133	Quiz 12 (*Teacher Guide,* pages 383–384)			
	Day 134	Worksheet 12.8 (*Teacher Guide,* pages 254–257)			
	Day 135	Test 3 (*Teacher Guide,* pages 399–403)			

Date	Day	Assignment	Due Date	✓	Grade
Second Semester-Fourth Quarter					
Week 1	Day 136	Lesson 13.1 (*Student Textbook*, pages 379–384) Worksheet 13.1 (*Teacher Guide,* pages 259–260)			
	Day 137	Lesson 13.2 (*Student Textbook*, pages 385–388) Worksheet 13.2 (*Teacher Guide,* pages 261–262)			
	Day 138	Lesson 13.3 (*Student Textbook*, pages 389–394) Worksheet 13.3A (*Teacher Guide,* page 263)			
	Day 139	Worksheet 13.3B (*Teacher Guide,* pages 264–265)			
	Day 140	Lesson 13.4 (*Student Textbook*, pages 395–398) Worksheet 13.4A (*Teacher Guide,* pages 266–267)			
Week 2	Day 141	Worksheet 13.4B (*Teacher Guide,* pages 286–269)			
	Day 142	Lesson 13.5 (*Student Textbook*, pages 399–404) Worksheet 13.5A (*Teacher Guide,* page 270)			
	Day 143	Worksheet 13.5B (*Teacher Guide,* pages 271–273)			
	Day 144	Lesson 13.6 (*Student Textbook*, pages 405–413) Worksheet 13.6 (*Teacher Guide,* pages 274–276)			
	Day 145	Lesson 13.7 (*Student Textbook*, pages 414–418) Worksheet 13.7 (*Teacher Guide,* pages 277–279)			
Week 3	Day 146	Lesson 13.8 (*Student Textbook*, pages 418–419) Worksheet 13.8 (*Teacher Guide,* pages 280–282)			
	Day 147	Quiz 13 (*Teacher Guide,* pages 385–386)			
	Day 148	Lesson 14.1 (*Student Textbook*, pages 421–428) Worksheet 14.1A (*Teacher Guide,* pages 283–284)			
	Day 149	Worksheet 14.1B (*Teacher Guide,* pages 285–287)			
	Day 150	Lesson 14.2 (*Student Textbook*, pages 429–439) Worksheet 14.2A (*Teacher Guide,* pages 288–289)			
Week 4	Day 151	Worksheet 14.2B (*Teacher Guide,* pages 290–293)			
	Day 152	Lesson 14.3 (*Student Textbook*, pages 440–446) Worksheet 14.3 (*Teacher Guide,* pages 294–296)			
	Day 153	Lesson 14.4 (*Student Textbook*, pages 447–454) Worksheet 14.4 (*Teacher Guide,* pages 296–297)			
	Day 154	Lesson 14.5 (*Student Textbook*, pages 455–461) Worksheet 14.5A (*Teacher Guide,* pages 298–299)			
	Day 155	Worksheet 14.5B (*Teacher Guide,* pages 300–302)			
Week 5	Day 156	Lesson 14.6 (*Student Textbook*, pages 462–464) Worksheet 14.6 (*Teacher Guide,* pages 303–305)			
	Day 157	Lesson 14.7 (*Student Textbook*, pages 465–469) Worksheet 14.7 (*Teacher Guide,* pages 306–308)			
	Day 158	Lesson 14.8 (*Student Textbook*, pages 470–476) Worksheet 14.8 (*Teacher Guide,* pages 309–313)			
	Day 159	Lesson 14.9 (*Student Textbook*, pages 477–480) Worksheet 14.9 (*Teacher Guide,* pages 314–316)			
	Day 160	Quiz 14 (*Teacher Guide,* pages 387–389)			

Date	Day	Assignment	Due Date	✓	Grade
Week 6	Day 161	Lesson 15.1 (*Student Textbook*, pages 481–484) Worksheet 15.1 (*Teacher Guide,* pages 317–318)			
	Day 162	Lesson 15.2 (*Student Textbook*, pages 485–490) Worksheet 15.2 (*Teacher Guide,* pages 319–321)			
	Day 163	Lesson 15.3 (*Student Textbook*, pages 491–493) Worksheet 15.3 (*Teacher Guide,* pages 322–324)			
	Day 164	Lesson 15.4 (*Student Textbook*, pages 494–499) Worksheet 15.4 (*Teacher Guide,* pages 325–326)			
	Day 165	Lesson 15.5 (*Student Textbook*, pages 500–504) Worksheet 15.5 (*Teacher Guide,* pages 327–329)			
Week 7	Day 166	Lesson 15.6 (*Student Textbook*, pages 505–507) Worksheet 15.6 (*Teacher Guide,* pages 330–332)			
	Day 167	Lesson 15.7 (*Student Textbook*, pages 508–514) Worksheet 15.7A (*Teacher Guide,* pages 333–335)			
	Day 168	Worksheet 15.7B (*Teacher Guide,* pages 336–338)			
	Day 169	Lesson 15.8 (*Student Textbook*, pages 515–520) Worksheet 15.8A (*Teacher Guide,* page 339)			
	Day 170	Worksheet 15.8B (*Teacher Guide,* pages 340–342)			
Week 8	Day 171	Lesson 15.9 (*Student Textbook*, pages 521–528) Worksheet 15.9 (*Teacher Guide,* pages 343–344)			
	Day 172	Lesson 15.10 (*Student Textbook*, pages 529–534) Worksheet 15.10 (*Teacher Guide,* pages 345–347)			
	Day 173	Quiz 15 (*Teacher Guide,* pages 391–392)			
	Day 174	Lesson 16.1 (*Student Textbook*, pages 535–536) Worksheet 16.1 (*Teacher Guide,* pages 348–350)			
	Day 175	Lesson 16.2 (*Student Textbook*, pages 537–541) Worksheet 16.2 (*Teacher Guide,* page 351–355)			
Week 9	Day 176	Lesson 16.3 (*Student Textbook*, pages 542–545) Worksheet 16.3 (*Teacher Guide,* pages 356–358)			
	Day 177	Test 4 (*Teacher Guide,* pages 405–407)			
	Day 178	Study Day			
	Day 179	Study Day			
	Day 180	Test 5 Final Exam (*Teacher Guide,* pages 409–415)			
		Final Grade			


Principles of Algebra 2
Principles of
Algebra
2
APPLIED ALGEBRA FROM A BIBLICAL WORLDVIEW
HANNON
MASTERBOOKS
CURRICULUM

Worksheets

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Make sure you know the names of the different properties covered in Lesson 1.1. *You may want to make flashcards for any that you do not already know.*

Decide how you're going to help yourself learn new concepts and get that set up. *You may want to grab a three-ring binder and put paper for taking notes inside it. If you find flashcards helpful, get some blank ones ready to go (or find a way to make them online using a site such as Quizlet). If you ever get confused, go back and review previous concepts. (Notes prove very helpful!)*

Solve problems and write your answers in a notebook*, as there is not room on the worksheets to write your answers. Be sure to number the problems and circle your final answer to aid in grading.*

1. **Term Check** – What is one mathematical *property* covered on pages 3–4 of the *Student Textbook* and what does it mean?

2. **Reviewing Properties and More** – Insert an = sign between any of these expressions that you can absolutely tell are equal. Otherwise, write "can't tell" and explain why.

   Example: $a + c \qquad b + a$

   Answer: Can't tell; depends on what c and b equal. If they are equal, then the expressions are equal. If not, they are not.

   a. $a + b + c \qquad d + b + c$
   b. $2a + b \qquad b + 2a$
   c. $(8 + y) + 3d \qquad 8 + (y + 3d)$
   d. $x + 0 \qquad 0$
   e. $a + 0 \qquad a$
   f. $1y \qquad y$
   g. $8 \div 8 \qquad 1$
   h. $A \qquad a$

3. **Reviewing Properties**
   a. For which problem in section 2 do you know that the expression on the left equals the expression on the right because of the identity property of multiplication?
   b. For which problem in section 2 do you know that the expression on the left equals the expression on the right because of the associative property of addition?

4. **Thinking It Through** – If we want to divide 5 by $3 - x$, what number can x *not* be and why?

5. **Algebra and Formulas** – Look at the Reference Section (Appendix B in the *Student Textbook*) to find the formulas to solve these problems if they are not ones you know. Be sure to include units of measure in your answers. You should always include a unit of measure in the answer when one is given.
   a. Find the perimeter of a rectangular field that is 60 ft long and 30 ft wide.
   b. Find the circumference of a circular bowl that has a diameter of 7 in.

***Review the "General Instructions for Students" section on pages 7–8 of this* Teacher Guide** *that contains some general things you need to know in this course. Note that many of the points there are conventions specific to this course! The* Student Textbook *will go over many of the points as we encounter them for the first time as well, so don't worry if you don't fully understand each one, as we haven't reviewed some of the concepts mentioned. Keep the general instructions somewhere you can reference them later.*

1. **Term Check** – What is one mathematical *convention* covered in Lesson 1.2 and what does it mean?

2. **Comparing** – Draw a >, <, or = sign between these expressions to make a true statement.
   a. $8(8)$ 60
   b. 52 80
   c. xy yx

3. **Simplifying** – Simplify these expressions. Notice how much easier it is to read and compare simplified expressions. Simplifying helps us work with quantities.
   a. $(5\text{ m})(20\text{ kg})$
   b. $4(a)$
      Hint: Remember that we don't need to use parentheses to show multiplication between a numeral and letter.
   c. $(6\text{ m})(15\text{ s})$

4. **Applying Algebra** – Find the circumference of a bowl if it is 5 in across.

5. **Comprehension Check** – In this course, does kg stand for a unit of measure or 2 unknowns being multiplied together (i.e., k times g)?
   ○ unit of measure ○ 2 unknowns being multiplied together
   How do you know? _____

6. **Capital and Lowercase Letters** – If a problem gives an unknown using a, and you discover that unknown equals 6, can you list your answer of what a equals as $A = 6$?
   ○ yes ○ no
   Why or why not? _____

1. **Rewrite as a Fraction** – Rewrite each of these division problems as a fraction. Do not simplify.

   Example: $60 \div 5 = \frac{60}{5}$

   a. $11 \div 3$

   b. $\frac{1}{5} \div \frac{2}{6}$

   c. $8 \div F$

   Example Meaning: A power of 8 watts divided by the force to get the velocity.

   d. $x \div 2y$

   Example Meaning: Your total cost divided by twice the cost for each person.

2. **Thinking It Through** – In the expression $\frac{8a}{x-7}$, what number can x not be?

   $x \neq$ _____

   Explain: _____

3. **Multiplicative Inverse** – Write the multiplicative inverse (i.e., the reciprocal) of each of the following fractions.

   a. $\frac{5}{9}$

   b. $\frac{5a}{2}$

   c. $\frac{x}{y}$

4. **Rewriting as a Fraction** – Rewrite the value to the left of the fraction as part of the numerator. Note that both the problem and your answer mean the same thing.

   Example: $x\left(\frac{y}{z}\right)$ *Answer:* $\frac{xy}{z}$

   a. $5\left(\frac{x}{3}\right)$

   b. $y\left(\frac{ab}{c}\right)$

5. **Multiplying and Dividing Fractions** – Complete the multiplication or division.

   a. $\frac{2}{3}\left(\frac{1}{5}\right)$

   b. $\frac{8}{x}\left(\frac{y}{3}\right)$

   c. $\dfrac{\frac{x}{2}}{\frac{y}{3}}$

   d. $\dfrac{\frac{3}{x}}{\frac{2a}{y}}$

   e. $\dfrac{\frac{a}{b}}{\frac{3x}{2}}$

6. **Applying Algebra**

   a. Suppose that a car gets a gas mileage of 40 miles per gallon. If another car gets a third of that gas mileage, what gas mileage does it get? Leave your answer as an improper fraction.

   b. Say that you've been told there's a $\frac{2}{3}$-off sale going on at a consignment store. If an item costs \$4, what dollar discount would you get? Leave your answer as an improper fraction.

   c. If you have 50 yards of fabric and want to cut it into $\frac{1}{3}$-yd swatches, how many swatches will you have? Leave off units when solving, as we've not gone over how to simplify the units (they cancel out).

   d. Write a formula based on 6c showing how the total yards of fabric (T), portion of a yard you make each swatch (s), and number of swatches (n) compare for any amount of fabric you might want to cut into swatches.

      $n =$ _____

7. **Skill Sharpening** – Find 2 kg times 4 m.

Review the "General Instructions for Students" to remind yourself about when to use fractions and how to simplify your fractional answers in this course.

1. **Simplifying Fractions** – Simplify the following fractions.
   a. $\frac{88}{22}$
   b. $\frac{8a}{3a}$
   c. $\frac{2xy}{y}$

2. **Rewrite as a Fraction** – Rewrite these quantities as fractions. Remember that any quantity divided by 1 equals itself.

   Example: 2 *Example: x*
   Answer: $\frac{2}{1}$ *Answer:* $\frac{x}{1}$

   a. 4
   b. b

3. **Complete the Multiplication** – Simplify into a single fraction.
   a. $4\left(\frac{x}{b}\right)$
   b. $b\left(\frac{c}{d}\right)$

4. **Combining the Skills** – Simplify the following.
   a. $\frac{2}{3}\left(\frac{3}{5}\right)$

   Example Meaning: A combined gear ratio for a gear with a gear ratio of $\frac{2}{3}$ and one with a gear ratio of $\frac{3}{5}$.

   b. $\frac{2}{6}\left(\frac{1}{3}\right)$

   Example Meaning: If $\frac{2}{6}$ of the city's population support a candidate for mayor, and $\frac{1}{3}$ of those are strong supporters, what fraction of the city's population are strong supporters?[1]

1 Example meaning adapted from Katherine Loop, *Principles of Mathematics: Book 2 Teacher Guide* (Green Forest, AZ: Master Books, 2016), Worksheet 4.2.

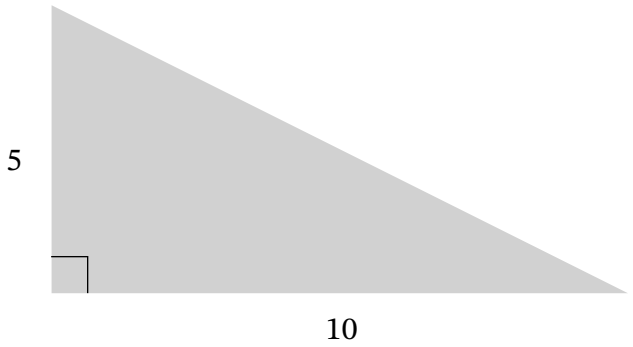
c. $4\frac{x}{2}$

Example Meaning: 4 times the biweekly cost of a magazine divided by the 2 months over which that cost occurs.

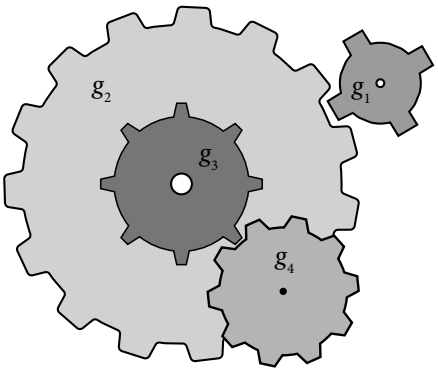
d. $\dfrac{\frac{2x}{3a}}{\frac{b}{3}}$

Example Meaning: $\frac{2}{3}$ times the pounds of peaches grown in a year (x) divided by the number of peaches per pound (a), all divided by the total volume of the peaches (b), divided by 3.

5. **Applying Algebra –** Find the area of this triangle using the formula given in Appendix B of the *Student Textbook*. The units are in cm (i.e., centimeters), so your answer will be in cm^2 (i.e., square centimeters). Be sure to simplify your answer.



1. **Ratios** – Represent the following quantities as a ratio. Notice that you could reword each one to include the word *per*. Include units of measure. Do not simplify.
   a. $4 per 3 dozen
   b. 5 for $1
   c. 40 passengers per train
   d. 1 gallon for every 3 trips
2. **Basic Unit Conversion** – Use conversion ratios (see Appendix B of the *Student Textbook* if needed) to complete these conversions.
   a. 4 m to yd
   b. 800 yd to mi
3. **Proportions**
   a. Find x: $\frac{4}{10} = \frac{x}{20}$
   b. Find x: $\frac{2}{x} = \frac{10}{20}$
   c. Find x: $\frac{8}{22} = \frac{x}{11}$
   d. If it took someone 3 days to go 100 miles on horseback, how many miles could they go in 9 days if they travel at the same pace?
   e. If it took someone 3 days to go 100 miles on horseback, how many miles could they go in 2 days if they travel at the same pace?
4. **Applying Algebra**[1] – Using the equation for a combined gear ratio given in the text ($R = \frac{g_1 g_3}{g_2 g_4}$), find the combined gear ratio if g_1 equals 4, g_2 equals 15, g_3 equals 8, and g_4 equals 10.



1 See PLTW, Inc., *Engineering Formulas (n.p., n.d.), p. 6., and Woodgears.ca, "Gear Ratios and Compound Gear Ratios," (n.d.),* https://woodgears.ca/gear/ratio.html.

1. **Representing Rates** – Represent the following units of measure using ratios to show units per another unit.
   a. \$7 per bushel (bushel is abbreviated bu.)
   b. \$7 per 3 bushels
   c. 9 meters per 3 minutes (a speed of 9 meters every 3 minutes)
2. **Simplifying the Rates** – Simplify your answer to 1c to find the meters per each minute.
3. **Unit Conversion** – Let's say you need to convert $3\frac{\text{m}}{\text{s}}$ to $\frac{\text{mi}}{\text{hr}}$. The following problems break this task down into steps. Use the conversion ratios in Appendix B of the *Student Textbook* to complete the following conversions. **Do not round on problems 3a and 3b**, as they are intermediary steps to solving the problem and rounding intermediary steps will make your answer less precise.
   a. Convert $3\frac{\text{m}}{\text{s}}$ to $\frac{\text{yd}}{\text{s}}$.
   b. Convert your answer from 3a to $\frac{\text{mi}}{\text{s}}$.
   c. Convert your answer from 3b to $\frac{\text{mi}}{\text{hr}}$, rounding your answer this time. Note that you've now successfully converted $3\frac{\text{m}}{\text{s}}$ to $\frac{\text{mi}}{\text{hr}}$.
4. **Rewriting as a Fraction** – Rewrite the value to the left of the fraction as part of the numerator. Note that both the problem and your answer mean the same thing (i.e., they're equal).
   Example: $4\frac{\text{m}}{\text{s}}$
   Answer: $\frac{4\ \text{m}}{\text{s}}$
   a. $2\frac{\text{m}}{\text{s}}$
   b. $7\frac{\text{ft}}{\text{s}}$
5. **Units in the Numerator and the Denominator** – Sometimes we have to divide one rate by another! Rewrite the following division using a fraction: $8\frac{\text{m}}{\text{s}} \div 6\frac{\text{m}}{\text{s}}$. You do not need to simplify.
   Example Meaning: One speed divided by another.

6. **Multiplying and Dividing Units** – Simplify.

   a. $\frac{8\text{ m}}{4\text{ s}}$

   b. $8\frac{\text{ft}}{\text{s}}(2\text{ s})$ *Hint:* Your seconds (s) will cancel out, as you have one in the numerator and one in the denominator. You're really finding your distance, which equals speed times time!

   c. $\frac{\frac{8\text{ ft}}{\text{s}}}{\frac{2\text{ ft}}{\text{s}}}$ *Hint:* Invert and multiply the bottom fraction to complete the division, canceling out your units of measure just as you would unknowns.

7. **Applying Algebra**

   a. If a certain milk sample yields 2.5 lb of butter fat per gallon, how many pounds of butter fat will 100 gallons of such milk yield?

   b. If a change of elevation of about 295 m makes a difference of 1° Centigrade in the boiling point of water, what is the change in boiling point at a place whose elevation is 1.5 mi?
   Hint: Notice that you've been given the ratio between the change in elevation and the change in the boiling point in *meters*, but are asked to find the ratio for 1.5 *miles*.

Review the "General Instructions for Students" to remind yourself about when to use fractions and how to simplify your fractional answers in this course.

1. **Adding and Subtracting Fractions** – Rewrite so you have only one large fraction. You will not be able to actually add the numerators when they are unknowns. Be sure to watch your units!
   a. $\frac{4}{b}+\frac{2}{c}$
   b. $\frac{xy}{2ab}+\frac{3y}{b}$
   c. $x+\frac{a}{b}$
   d. $7\frac{\text{m}}{\text{s}}+3\frac{\text{m}}{\text{min}}$ (Give your answer in $\frac{\text{m}}{\text{min}}$.)
   Hint: Remember, $7\frac{\text{m}}{\text{s}}$ can also be written as $\frac{7\text{ m}}{\text{s}}$.
   e. $6\frac{\text{ft}}{\text{min}}+5\frac{\text{in}}{\text{s}}$ (Give your answer in $\frac{\text{in}}{\text{s}}$.)
2. **Equality** – Put an = sign between expressions that are equal and a ≠ sign between those that are not. On 2a, you can assume $x \neq 0$.
   a. $7x\frac{3}{x}$ 21
   b. $\frac{5}{2}c$ $\frac{5c}{2}$
   c. $\frac{5xy}{10}$ $\frac{1}{3}xy$
3. **Combining the Tools** – Solve. Remember to simplify your answers!
   a. If a robot can travel at 4.5 meters per second, how many yards can it travel per minute?
   Hint: You can do all of the conversions in one equation — you just need to multiply by a conversion ratio to convert meters to yards, and another to convert from seconds to minutes.
   b. If a robot can travel at 3.2 yards per minute, how many meters per second can it go?

4. **Skill Sharpening** – Find $\dfrac{3\frac{\text{yd}}{\text{min}}}{\frac{6\text{ yd}}{\text{min}}}$.

5. **Applying Algebra** – If Jack can solve algebra problems at an average rate of 4 problems per 20 minutes and Mike can do it an average rate of 5 problems per 30 minutes, how many problems on average can the 2 combined get done in 1 hour? The questions below will help you answer the question.

   a. Write Jack's and Mike's rates.

      Jack's Rate = _____

      Mike's Rate = _____

   b. Convert both rates from minutes to hours.

      Jack's Rate = _____

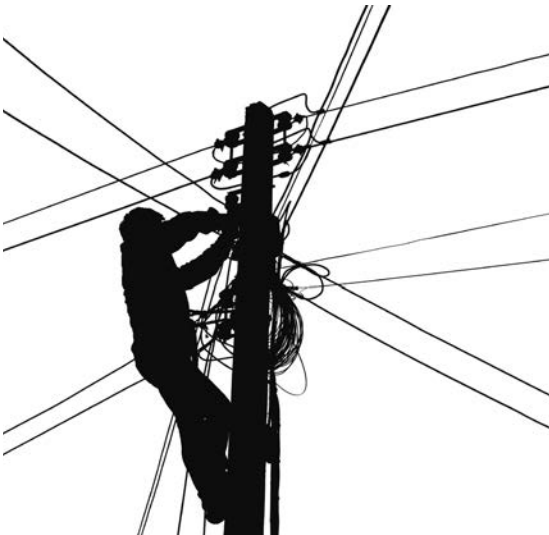
      Mike's Rate = _____

   c. Use your answer to 5b to figure out how many problems they can both get done in 1 hour.

6. **More Applying Algebra** – Say that you've been told there's a $\frac{2}{3}$-off sale going on at a consignment store. If an item costs $6, how much will the item cost?
   Hint: Notice that you're given the fraction of the discount, not the fraction of the cost you'll actually pay. You need to find the discount and then subtract it from the cost . . . or find the fraction of the cost you'll pay and then calculate that.

Be sure to also review as needed in preparation for the quiz. See the "General Instructions for Students" for some suggestions to help you review.

1. **Negative Numbers** – Simplify. Remember, each negative sign means *the opposite of*!
   a. $-\big(-\big(-\big(-x\big)\big)\big)$
   b. $-\dfrac{b}{-x}$
   c. $-\dfrac{-1}{2}$
   d. $(-a)(-b)(-c)$
   e. $\dfrac{5a}{2}-\dfrac{-3}{2}$
   f. 5 – 7
   g. 3 – 8
2. **More with Negative Numbers**
   a. Find $-ax$ if $a=-2$ and $x=3$.
   b. Rewrite the subtraction as the addition of a negative number: 6 – *t*.
   c. Simplify: *t* – *t*
3. **Applying Algebra** – Remember, we use negative signs to show *the opposite of*. Thus, they come up all over as we look at creation. Here are just a few examples.
   a. If we are traveling 50 miles per hour in the negative direction for 2 hours, how far (and in what direction) will we have traveled?
   Hint: Distance equals speed multiplied by time
   . . . and use a negative number to show the negative direction.
   b. Is a speed of $50\,\dfrac{\text{mi}}{\text{hr}}$ faster or slower than a speed of $29\,\dfrac{\text{ft}}{\text{s}}$ and by how much? Give how much faster or slower the speed is in $\dfrac{\text{mi}}{\text{hr}}$.
   c. Electricity can flow in different directions . . . and we can use a positive value to show flow in one direction and a negative value in the other! Thus, a negative current means a current that is flowing in the *opposite* direction and a negative voltage means the voltage drops in the *opposite* direction of the net current flow. In an electrical outlet, the power (P) equals the voltage (V) times the current (I), or $P=VI$. If the voltage is $-4\,\dfrac{\text{J}}{\text{C}}$ and the current is $-5\,\dfrac{\text{C}}{\text{s}}$, what is the power? Note that the C stands for a unit called a coulomb.



d. If we *owe* \$30 per month for a utility, how much will we owe after 1 year? Show amounts owed with negative numbers.

4. Skill Sharpening – Simplify. When asked to add fractions, rewrite as a single fraction.

a. $\frac{2x}{y} + \frac{-3a}{b}$

b. $\frac{5a}{3}\left(\frac{-6}{2a}\right)$ *Hint:* Watch your negative sign!

c. $\frac{-50 \text{ in}}{\frac{-5 \text{ in}}{\text{hr}}}$ *Hint:* Invert and multiply, watching your negative signs!

5. **More Skill Sharpening**

a. Convert $40\frac{\text{m}}{\text{s}}$ to $\frac{\text{ft}}{\text{min}}$.

b. Add $30\frac{\text{m}}{\text{s}}$ and $50\frac{\text{ft}}{\text{min}}$, giving your final answer in $\frac{\text{ft}}{\text{min}}$.

6. **Understanding Review**

a. Rewrite the following expression so that the numerical value is first, and then the letters, in alphabetical order: $zxa8$

b. What names do we use to describe the consistent way God governs multiplication that allows us to change the order and the grouping of quantities being multiplied, knowing that doing so won't affect the value?

c. In $\frac{a}{2-x}$, what value can x not equal?

$x \neq$ _____

Why? _____

Intentionally left blank

1. **Understanding Exponents** – Rewrite using exponents.
   a. $4(4)(4)(4)$
   b. $-4(-4)(-4)$
   c. $xxxxxx$
      Example Meaning: An unknown population that multiplies by itself 6 times.
   d. $(-a)(-a)$
   e. $yyyxx$
   f. x
2. **Reviewing the Order of Operations** – Simplify, watching the order of operations as you do.
   a. $(2^2 + 3 \times 1)^2 \bullet 10$
   b. $(2-1)^3 - 2$
3. **Working with Exponents and Negative Numbers** – Do *not* use a calculator, as the point of these exercises is to make sure you understand how to correctly handle exponents.
   a. Rewrite using exponents: $-a(-a)(-a)$
   b. Simplify if $x = 2$: $(-x)^4$
   c. Simplify if $x = 2$: $-(x)^4$
   d. Simplify: $-(-2)^2$
   e. Simplify: $\big(-(-2)\big)^2$
4. **Reviewing the Order of Operations** – Simplify, watching the order of operations as you do.
   a. $(4 + 3 - 2)^2$
   b. $\left(\dfrac{3^2 + 7(3)}{5}\right)^2$
5. **Skill Sharpening** – Simplify the following expressions.
   a. $\dfrac{\frac{2x}{y}}{\frac{x}{4}}$
   b. $\dfrac{6}{b} + \dfrac{-2}{a}$

c. $15\frac{\text{yd}}{\text{min}} - 5\frac{\text{ft}}{\text{s}}$. Give your answer in $\frac{\text{yd}}{\text{min}}$.

d. $\frac{98}{392}$

6. **Applying Algebra**

a. Given that the power (P) equals the voltage (V) times the current (I), or $P = VI$, and remembering that we use positive numbers to describe flow in one direction and negative in the other, if the voltage is $-3\frac{\text{J}}{\text{C}}$ and the current is $2\frac{\text{C}}{\text{s}}$, what is the power? The C stands for a unit of measure called the coulomb.

b. A trash can shaped like a cylinder has a height of 0.8 m and a diameter at the base of 0.25 m. What is its volume? Your answer will be in m^3. (We'll review how you could have calculated this yourself in a few lessons.)
Hint: Use the formulas in Appendix B of the *Student Textbook*. Notice the one for finding the volume of a cylinder has an exponent in it! Draw out the problem to help you if needed.

1. **Thinking It Through** – Rewrite the following so each expression contains a negative exponent.

   a. $\frac{1}{4^5}$

   b. $\frac{1}{4^1}$

   c. $\frac{1}{x}$

   d. $\frac{\text{m}}{\text{s}}$

   e. $\frac{1}{xxx}$

   Example Meaning: The probability of an event happening 3 out of 3 times, if it has equal probability of happening each time.

2. **Thinking It Through** – Rewrite the following using positive exponents only for each expression.

   a. $\frac{1}{x^{-4}}$

   b. $\frac{1}{-x^{-4}}$

   c. x^{-9}

   d. $\frac{1}{-b}\left(\frac{1}{-b}\right)\left(\frac{1}{-b}\right)$

   e. $-\frac{yyy}{-xxx}$

3. **More Thinking It Through** – When the National Institute of Standards and Technology (NIST) lists the Josephson constant, they list the unit as Hz V^{-1}, which means Hertz times Volts to the negative first, or Hz • V^{-1}. Rewrite these units so as to eliminate the negative exponent.

4. **Scientific Notation** – Rewrite using scientific notation. Do not round. In some cases, units have been omitted for simplicity.

   a. 62,540,000,000 km^3

   Volume of Neptune[1]

   b. 0.0000000000012 kg • mol^{-1} (A mol is a unit of measure.)

   Standard uncertainty for the alpha particle molar mass listed by NIST[2]

1 Based on value given by Dr. David Williams, "Neptune Fact Sheet" (NASA, September 27, 2018 update), https://nssdc.gsfc.nasa.gov/planetary/factsheet/neptunefact.html

2 P.J. Mohr, B.N. Taylor, and D.B. Newell (2015), "The 2014 CODATA Recommended Values of the Fundamental Physical Constants," web version 7.0, database developed by J. Baker, M. Douma, and S. Kotochigova (Gaithersburg, MD: National Institute of Standards and Technology), https://physics.nist.gov/constants, accessed 10/27/19.

5. **More Scientific Notation** – Rewrite using standard decimal notation. Do not round.[3] Units (which are in SI base units) have been omitted for simplicity.

   a. $4.84 \times 10^{14}\ \text{Hz} \cdot \text{V}^{-1}$

      Approximate Josephson constant

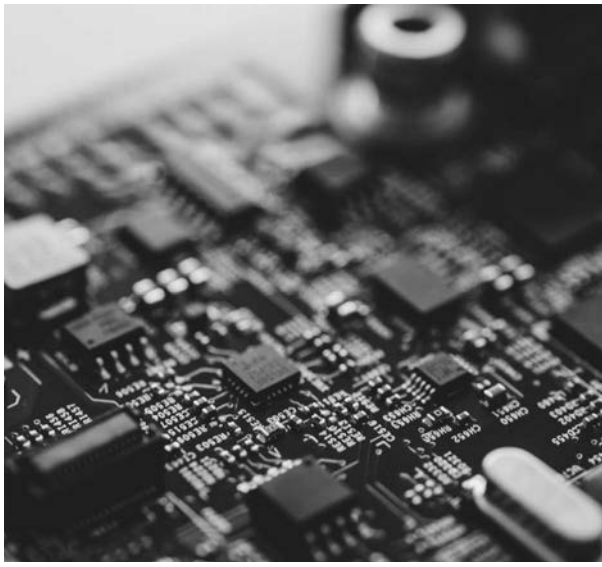
   b. $1.00001495 \times 10^{-10}\ \text{m}$

      Angstrom star

   c. $6.2 \times 10^{7}\ \Omega^{-1} \cdot m^{-1}$ (An Ω is a unit of measure.)

      Conductivity of silver[4]

6. **Applying Algebra** – If a computer circuit has a transistor that has an area of $1 \times 10^{-14}\ \text{m}^2$, and a company is trying to figure out a way to make it $\frac{1}{4}$ that size, what size does it need to be?



7. **Skill Sharpening**

   a. Simplify into a single fraction: $\frac{5a}{2c} + \frac{2}{x}$

   b. Simplify, giving your answer in $\frac{\text{ft}}{\text{s}}$: $2\frac{\text{ft}}{\text{s}} - 60\frac{\text{in}}{\text{s}}$

3 Unless otherwise indicated, scientific values quoted are based on P.J. Mohr, B.N. Taylor, and D.B. Newell (2015), "The 2014 CODATA Recommended Values of the Fundamental Physical Constants," web version 7.0, database developed by J. Baker, M. Douma, and S. Kotochigova (Gaithersburg, MD: National Institute of Standards and Technology), https://physics.nist.gov/constants, accessed 10/27/19.

4 Randall D. Knight, *Physics for Scientists and Engineers with Modern Physics: A Strategic Approac*h (Pearson, Addison Wesley, NY: 2004), Back Cover Reference Section.

1. **Multiplying and Dividing Exponents** – Simplify these expressions by completing the multiplication or division. Notice how much easier it is to read simplified expressions.

   a. d^5d^{-4}

   b. y^5yy^{-9}

   c. $\frac{a^8}{a^4}$

   d. $\frac{a^8}{a^{-4}}$

   e. $\frac{-4ab^2}{-ab}$

   f. $\frac{5x^2}{x^{-9}}$

1. **More Multiplying and Dividing Exponents** – Write an = sign between any two expressions that are equal. For these expressions, assume the variables are not zero.

   a. yy^5 $\qquad$ $2y^5$, if $y \neq 2$

   b. d^2d $\qquad$ d^3

   c. $\frac{1}{a^2}(a^2)$ $\qquad$ 1

   d. $\frac{1}{-a^2}(-a)^2$ $\qquad$ 1

   e. $\frac{2ab}{3^2}$ $\qquad$ $\frac{2ab}{9}$

2. **Comparing** – Draw a >, <, or = sign between these expressions to make the statement true.

   a. $\frac{1}{8^2}$ $\qquad$ 6^3

   b. 5^1 $\qquad$ 2^2

   c. $\frac{3^6}{3^2}$ $\qquad$ 3^4

   d. $\frac{3^6}{(-3)^2}$ $\qquad$ 3^4

   e. $\frac{3^6}{-3^2}$ $\qquad$ 3^4

3. **More with Exponents** – Simplify.

   a. $\frac{y^6}{y^2}$

   b. $\frac{3x^{-1}}{x^6}$

   c. $-5ab^2(2a^{-2})$

4. **Thinking It Through** – Why are we able to simplify the multiplication and division in $5ab^2(2a^{-2})$, yet we can't simplify the addition in $5ab^2 + 2a^{-2}$ (unless we knew the value of a and b or had other information)?

5. **Scientific Notation** – Simplify.

   a. $(5.0 \times 10^{-12})(4.0 \times 10^{-6})$

   Example Meaning: Multiplying the mass of two small particles together.

   b. $(3 \times 10^{32})(2 \times 10^{6})$

   Example Meaning: Two distances of space multiplied together.

6. **Applying Algebra**

   a. If a 1 mm^2 computer chip contains 1.5×10^8 transistors, how many transistors would a 2 mm^2 chip contain if the ratio were the same?

   b. Rewrite this equation, which is known as Coulomb's Law (it's a useful electrical equation), using a negative exponent rather than a fraction line: $F = k\left(\frac{q_1 q_2}{r^2}\right)$.

A note from Dr. Adam: When my college professor taught us Coulomb's Law, the equation given up above, a student asked where it came from.

The professor responded along the lines that people had just figured out the equation from observing how nature worked . . . but I knew it's because God created the equation when He determined how the world worked in regards to electrical charge. That comment was one reason I decided to get my doctorate. I wanted to teach students the truth: the consistencies of creation (which math describes) point to the Creator.

1. **Repeated Multiplications of Exponents** – Simplify.
   a. $(2ac^3)^3$
   b. $\left(\frac{1}{x^2}\right)^2$
   c. $(m^{-6})^2$
   d. $\frac{(m^{-6})^2}{m^2}$

2. **Seeing the Rule in Action**
   Note: Units of measure have been left off, since we'll review exponents and units in the next lesson.
   a. Find the volume $(V = s^3)$ of a cube, where $s = 4$.
   b. Now find the volume of the same cube when its side is expressed as 2^2 instead of 4, simplifying any terms inside of the parentheses first. Use this equation: $V = (2^2)^3$. *Show your work.*
   c. Now let's say that the side of a cube equals some unknown distance squared, which we'll write as b^2. So $V = (b^2)^3$. Simplify.
   d. Now find the volume using the equation you found in 1c if b equals 2. Notice how what we did in simplifying really did preserve the meaning!

3. **Repeated Multiplications of Exponents** – Simplify.
   a. $(2^{-5})^{-3}$
   b. $\frac{(4b^2)^4}{b^6}$
   c. $\left(\frac{1}{x^{-2}}\right)^3$

4. **Understanding Check** – Write out this multiplication *without* using exponents: $(2a^3)^2$
   Example: $(5c^2)^4 = (5cc)(5cc)(5cc)(5cc)$ or $625ccccccc$

5. **More with Exponents** – Simplify.
   a. $\frac{(-y)^4}{y^2}$ *Hint:* Think this through. We want to multiply $-y$ by itself 4 times. Will that answer be positive or negative?
   b. $\frac{-y^4}{y^2}$ *Hint:* Here we're taking the opposite of y^4.
   c. $-\frac{-(x^3)^{-3}}{x^4}$ *Hint:* Don't let all the negative signs scare you! You have all the skills you need.

6. **Scientific Notation** – Simplify. Give your answer in scientific notation, with only 1 digit to the left of the decimal point.

   a. $(2.0 \times 10^{-2})(3.0 \times 10^{-1})$

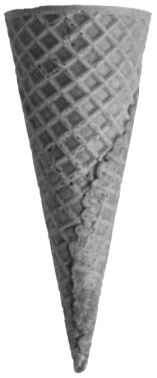
   b. $(7.0 \times 10^{30})(6.0 \times 10^{1})$

7. **Skill Sharpening** – Simplify. Assume $x \neq 0$.

   a. x^2x

   b. $\dfrac{x^2x}{\dfrac{x^3}{2}}$

8. **Applying Algebra** – Find the volume of ice cream that would be needed to fill an ice cream cone that has a diameter at the base of 1 in and a height of 5 in. Your answer will be in in^3. (We'll review how you could have calculated this yourself in the next lesson.)
   Hint: The formula for the volume of a cone is part of Appendix B of the *Student Textbook*.



1. **Unit Conversion with Square and Cubed Units** – Remember to treat units with more than 1 letter as a single entity — in^2 means *inches* squared, not i times n^2.
   a. Convert 4 in^2 to cm^2.
   b. Convert 100 in^3 to ft^3.
2. **Repeated Multiplications of Exponents** – Simplify.
   a. $\left(2\frac{\text{ft}}{\text{s}^2}\right)^3$
   b. $\frac{\left(2\frac{\text{ft}}{\text{s}^2}\right)^3}{-2\ \text{ft}}$ *Hint:* Notice that the numerator is the same as 2a.
   c. $\left(3\frac{\text{mi}}{\text{hr}^2}\right)^4$

1. **Simplifying Units of Measure with Division** – Simplify by *inverting and multiplying* the denominators.

   a. $\dfrac{\dfrac{\text{J}}{\text{K}}}{\dfrac{\text{J}}{\text{m}^3}}$ *Note:* J stands for joules, K for kelvins, and m for meters.

   b. $\dfrac{\text{kg}\dfrac{\text{m}}{\text{s}^2}}{\dfrac{\text{m}^2}{\text{s}^2}}$ *Hint:* Rewrite the numerator as $\dfrac{\text{kg} \bullet \text{m}}{\text{s}^2}$ to avoid confusion.

2. **Applying Algebra** – Use the relationship $P = Fv$ to solve.

   a. If the force (F) is 7 kg $\bullet \dfrac{\text{m}}{\text{s}^2}$ and the velocity (v) is 6 $\dfrac{\text{m}}{\text{s}}$, what is the power ($P$)? Give your answer in a unit that includes kg, m, and s.

   b. Rewrite your answer to 2a using either a newton, watt, or joule (whichever is the appropriate unit to equal the units you had in 2a).

   c. If the force is 6 kg $\bullet \dfrac{\text{m}}{\text{s}^2}$ and the velocity is 8 $\dfrac{\text{m}}{\text{s}}$, what is the power?

   d. Rewrite kg $\bullet \dfrac{\text{m}^2}{\text{s}^3}$ using a negative exponent to show s^{-3}. Note that some materials will write the unit that way.

3. **More Applying Algebra** – Using the gravity formula of $F = G\dfrac{m_1 m_2}{r^2}$ and the gravity constant (G) of $(6.67 \times 10^{-11})\left(\dfrac{\text{m}^3}{\text{kg} \bullet \text{s}^2}\right)$, find the force due to gravity (F) between two objects if the first mass (m_1) is 45 kg, the second mass (m_2) is 2,000 kg, and the radius (r) is 200 m.

   The steps below will help you walk through this problem.

   We'll start by inserting the values given. Since there are more units of measure than normal, this step is done for you.

   $$F = G\left(\frac{m_1 m_2}{r^2}\right)$$

   $$F \approx (6.67 \times 10^{-11})\left(\frac{\text{m}^3}{\text{kg} \bullet \text{s}^2}\right)\left(\frac{45\ \text{kg}(2{,}000\ \text{kg})}{(200\ \text{m})^2}\right)$$

   a. Start by simplifying $\dfrac{45\ \text{kg}(2{,}000\ \text{kg})}{(200\ \text{m})^2}$.

b. Now multiply your result from 3a by the 6.67×10^{-11}. Remember to keep the units of measure from your result in 3a (we'll deal with the $\frac{m^3}{kg\ s^2}$ in a minute). Be sure to write your answer in scientific notation.
Hint: You will need to move the decimal place over and adjust the exponent of 10 accordingly.

c. Multiply your answer to 3b by $\left(\frac{m^3}{kg \bullet s^2}\right)$ and simplify to finish finding the force. You will just be multiplying the units of measure and using what you know about multiplying exponents to simplify your result. Your answer will be in $kg \bullet \frac{m}{s^2}$, but you need to show how you obtained those units.

d. Rewrite your answer to 3d using either a newton, watt, or joule (whichever is the appropriate unit to equal the units you had in 3c).

Notice how similar the gravity equation ($F = G\frac{m_1 m_2}{r^2}$) is to that of Coulomb's Law, the useful electrical equation we looked at a few worksheets ago that's written $F = k\frac{q_1 q_2}{r^2}$. Is this just a coincidence? We would argue it's a reminder to us that the same Creator created both the microscopic and the vast distances of space.

1. **Rewriting Roots as Fractional Exponents** – Rewrite each of these roots using a fractional exponent. Do not simplify.

   Example: $\sqrt{25} = 25^{\frac{1}{2}}$

   a. $\pm\sqrt{16}$

   b. $\sqrt[4]{55}$

   c. $\sqrt[3]{17}$

   d. $\sqrt[5]{30}$

   e. $\sqrt{36}$

   f. $\sqrt[4]{81}$

2. **Finding Roots** – Find the value for each of the roots in problem 1.

   Example: $25^{\frac{1}{2}} = 5$

   Example: $25^{\frac{1}{3}} \approx 2.924$

   a.

   b.

   c.

   d.

   e.

   f.

3. **Negative Fractional Exponents** – Rewrite these fractional exponents using a root sign in the denominator.

   a. $\dfrac{1}{a^{\frac{1}{4}}}$

   b. $\dfrac{3}{5x^{\frac{1}{2}}}$

1. **Roots/Fractional Exponents** – Find the value of these expressions. Remember to follow the order of operations.

   Example: $25^{\frac{1}{2}} = 5$

   Example: $25^{\frac{1}{3}} \approx 2.924$

   a. $\pm 64^{\frac{1}{2}}$

   b. $\sqrt{4+6}$

   c. $(4+5+234)^{\frac{1}{5}}$

2. **Understanding Check** – While the root symbol $\left(\sqrt{\ }\right)$ and fractional exponent notation are defined in this course as meaning the positive roots for even roots unless ± is written in front, it's important to know when using roots for yourself that even roots *can* be either positive *or* negative. Keep this in mind when answering the following questions.

   a. If you were to take the square root of 15 to solve a real-life problem, the answer would be
   ○ positive ○ negative ○ either

   b. If you were to take the cubed root of 15 to solve a real-life problem, the answer would be
   ○ positive ○ negative ○ either

   c. If you were to take the fourth root of 15 to solve a real-life problem, the answer would be
   ○ positive ○ negative ○ either

3. **More with Fractional Exponents** – Solve these without a calculator by first rewriting using a root sign.

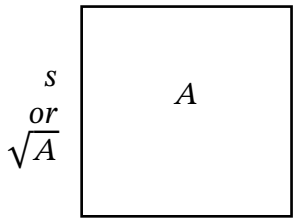
   a. $27^{\frac{1}{3}}$

   b. $27^{-\frac{1}{3}}$ (Give your answer as a fraction.)

4. **Applying Algebra**

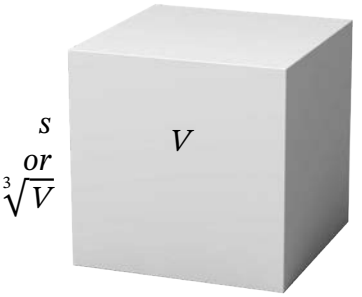
   a. Rewrite using a fractional exponent: $s = \sqrt{A}$

   Example Meaning: The length of a side of a square equals the square root of the area. (Since the area of a square equals the side length times itself, the side length also equals the square root of the area.)

   b. Rewrite using a fractional exponent: $s = \sqrt[3]{V}$

   Example Meaning: The length of a side of a cube equals the cubed root of the volume. (Since the volume of a cube equals the side length times itself 3 times, the side length also equals the cubed root of the volume.)

c. Say you want to design a can that has a height (h) of 6 in. If you also want its volume (V) to be 45.36 in^3, how much should its radius (r) be if $r = \left(\frac{V}{\pi h}\right)^{\frac{1}{2}}$?

5. **Roots/Fractional Exponents and Unknowns** – Rewrite using fractional exponents.

   a. $\sqrt{y}$

   b. $\frac{1}{\sqrt{A}}$

   c. $\frac{1}{\sqrt[3]{V}}$

6. **Scientific Notation** – Simplify. Give your answer in scientific notation, with only 1 digit to the left of the decimal point.

   a. $(6.0 \times 10^{8})(2.0 \times 10^{-15})$

   b. $(4.0 \times 10^{-6})(5.0 \times 10^{0})$

7. **Skill Sharpening**

   a. $\left(4\frac{\text{ft}^2}{\text{s}}\right)^2$

   b. $\frac{\left(5\frac{\text{m}^2}{\text{s}}\right)^2}{5\ \text{m}^2}$

1. **Working with Roots/Fractional Exponents** – Simplify. Remember to follow the *same rules* for working with exponents you have been, coupling them with what you know about working with fractions.

   a. $a^{\frac{1}{3}}a^{\frac{4}{3}}a^{2}$

   b. $\left(a^{\frac{3}{4}}\right)^{2}$

   c. $(a^{2})^{\frac{3}{4}}$

   d. $b^{\frac{3}{4}}b^{4}$

   e. $b^{-\frac{3}{4}}b^{4}$

   f. $\left(d^{\frac{1}{2}}\right)^{3}$

   g. $(x^{4})^{\frac{1}{3}}$

   h. $(27\ \text{ft}^{3})^{\frac{1}{3}}$

   i. Solve problem 2f for when d is 4.
   Hint: Remember that even roots (such as $\frac{1}{2}$) can be either positive or negative.

1. **Thinking It Through**

   a. Rewrite $4^{\frac{3}{2}}$ using a square root symbol and a whole-number exponent.

   b. Find $16^{\frac{3}{2}}$.
   Hint: Remember, you can input this into your calculator as 16, ^, $(3 \div 2)$.

   c. Simplify by simplifying the fractional exponent as much as possible: $x^{\frac{4}{8}}$.

   d. Rewrite $\left(\sqrt{9}\right)^3$ using a fractional exponent.

   e. Use your answer to 1d to find $\left(\sqrt{9}\right)^3$ on a calculator. Then solve without a calculator. You should get the same answer both ways.

   f. Simplify $b^{\frac{1}{2}}b^{\frac{1}{2}}$.

   g. Simplify $\sqrt{b}\sqrt{b}$.

   h. Simplify $b^{\frac{1}{2}}b^{\frac{-1}{2}}$.

   i. Simplify $b^{\frac{1}{2}}b^{\frac{1}{2}}b^{\frac{1}{2}}$.

2. **Roots and Fractional Exponents** – Simplify. Remember to follow the *same rules* for working with exponents you have been, coupling them with what you know about working with fractions.

   a. $y^{\frac{2}{3}}y^4y$

   b. $\left(y^{\frac{2}{3}}\right)^3$

   c. $\left(x^6\right)^{\frac{1}{3}}$

   d. $\left(a^{-2}\right)^{\frac{3}{4}}$

3. **Understanding Time** – Go back to each problem in section 2 and find the answer if a equals 2.

   a.

   b.

   c.

   d.

4. **Applying Algebra**

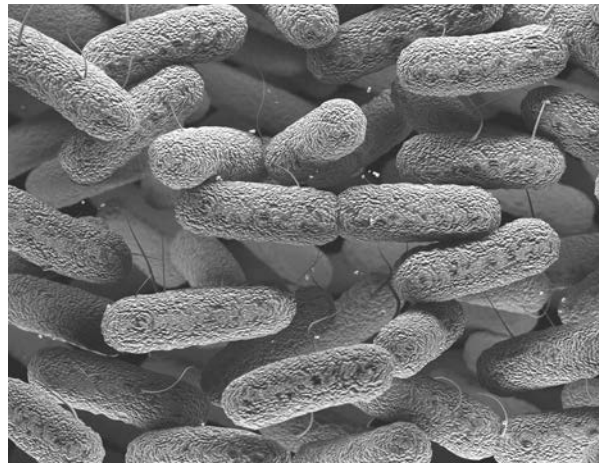
a. The area of a regular hexagon equals $A = \left(\frac{3\sqrt{3}}{2}\right)s^2$, where s is the length of each side.

Find the area if the length of the side is 4 mm.
Hint: Note that mm is a unit of measure here, not m times m.

b. Rewrite the formula in 4a using a fractional exponent for the square root. Do not simplify.

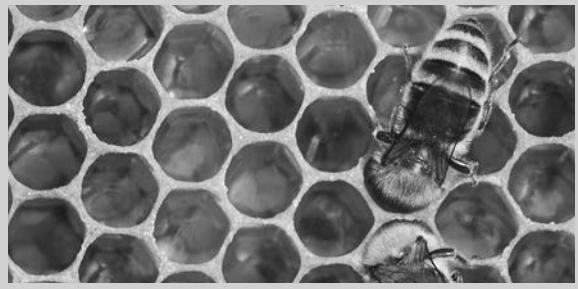
c. Using the equation below (notice the fractional exponent!), where b_c equals the current bacteria population, b_0 the initial population, t_c the time since the initial bacteria population was measured, and t_d the doubling time, find the current bacteria population if it has been 17 hours since the initial bacteria population was measured (t_c), the initial bacteria population (b_0) was 800, and the doubling time (t_d) is 10 hr.

$$b_c = b_0 2^{\frac{t_c}{t_d}}$$



d. If a box has a volume of 85 in^3, what is its volume in cubic feet?

In 4a, we looked at the area of a regular hexagon. Notice the hexagons in a honeycomb. When we use math to look at the area of honeycombs and compare it to other shapes, such as a square and a triangle, we see the wisdom God placed in bees, as the hexagon has the largest area per perimeter, allowing the bee to use less supplies in building per amount of honey they can store.



This worksheet is designed to help you review the chapter in preparation for the chapter quiz. Be sure to also look over the Key Skills in the Student Textbook *and review as needed. The "General Instructions for Students" section you should have put with your notes includes some study suggestions.*

1. **Understanding Check** – Rewrite using a negative exponent: $\frac{1}{x^7}$
2. **Skill Checking** – Simplify or follow instructions in parentheses.
   a. $\frac{7y^3}{y^{-2}}$
   b. $\left(b^{\frac{3}{4}}\right)^{-4}$
   c. $(5.0 \times 10^{-8})(6.0 \times 10^{-30})$ (Give your answer in scientific notation.)
   d. $b^{\frac{1}{2}}b^{\frac{2}{3}}$
   e. $\frac{\frac{18 \text{ ft}^2}{\text{s}}}{-6 \text{ ft}}$
   f. $\sqrt{x}\sqrt{x}$
   g. $\frac{1}{x^{\frac{3}{4}}}$ (Rewrite using a negative exponent.)
   h. $-(-a)^2$
   i. $\pm\sqrt{23}$ (Find the value on a calculator.)
   j. $\sqrt{23}$ (Find the value on a calculator.)
   k. $\sqrt{50}$ (Find the value on a calculator.)
   l. $5^{\frac{4}{7}}$ (Find the value on a calculator.)
3. **Applying Algebra**
   a. When you go to move something, it requires effort. To help us quantify that effort, we call it *work*. That work (W) equals the force (F) you have to apply to move the object times the distance (d) you have to move it, or $W = Fd$. Say you apply a force of 7 kg • $\frac{\text{m}}{\text{s}^2}$ and you move it a distance of 40 m. How much work was required?

   b. Convert an area of 8 ft² to cm².
   c. Suppose you're trying to carpet a closet that is a rectangular area that is 4 ft by 60 in. How many square inches is this area?

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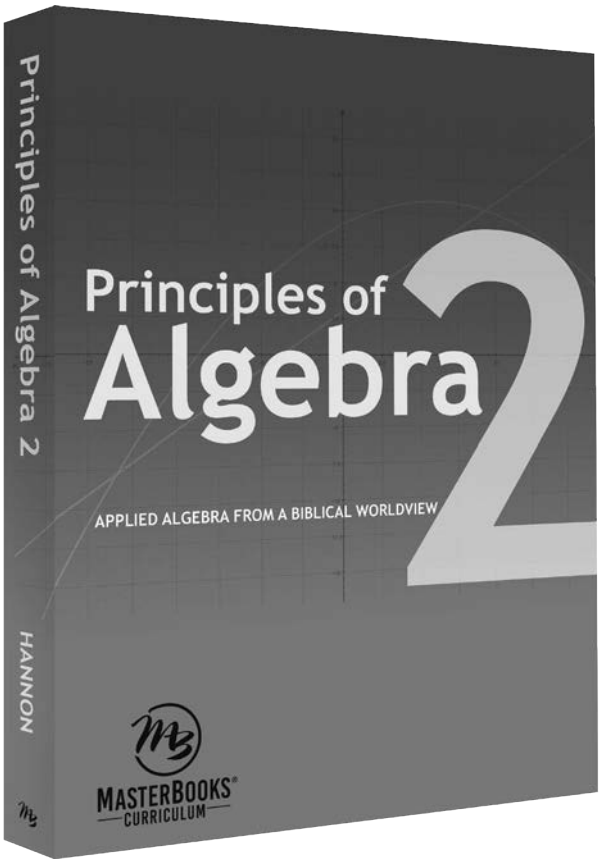

Quizzes and Tests

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You are allowed to use a calculator on this quiz. However, calculators that can solve algebraic expressions are not allowed (or if used, that feature should not be used).

These are unit conversion ratios you may need:

5,280 ft = 1 mi	100 cm = 1 m	60 s = 1 min
1 ft ≈ 30.480 cm	1 yd = 3 ft	60 min = 1 hr

On all quizzes or tests, unless otherwise indicated or instructed, you are not allowed to consult any other notes or resources.

1. **Understanding Check** – Write an equal sign between any of these expressions that you can tell are equal.
   Each problem is worth 2 points.
   a. $5ab$ $ab5$
   b. $3\left(\frac{a}{x}\right)$ $\frac{3a}{x}$
   c. $3\frac{\text{m}}{\text{s}}$ $\frac{3\text{ m}}{\text{s}}$
   d. $a7$ $7a$
   e. $a(7x)$ $7ax$

2. **Skill Testing** – Simplify. When asked to add fractions, give your answer as a single fraction.
   Each problem is worth 9 points.
   a. $\frac{x}{-a}\left(\frac{-3a}{b}\right)$
   b. $\frac{6x}{\frac{3b}{2}}$
   c. $\frac{6a}{b}-\frac{-5c}{d}$
   d. $15\frac{\text{m}}{\text{s}}+3\frac{\text{ft}}{\text{min}}$; give your answer in $\frac{\text{m}}{\text{s}}$.
   e. $\frac{4\frac{\text{yd}}{\text{min}}}{-2\frac{\text{ft}}{\text{min}}}$; solve so that all of the units cancel out, leaving you with a unitless answer.
   f. $-xy$ if $x=-2$ and $y=-1$
   g. $15\text{ ft}\left(\frac{5\text{ s}}{3\text{ ft}}\right)$

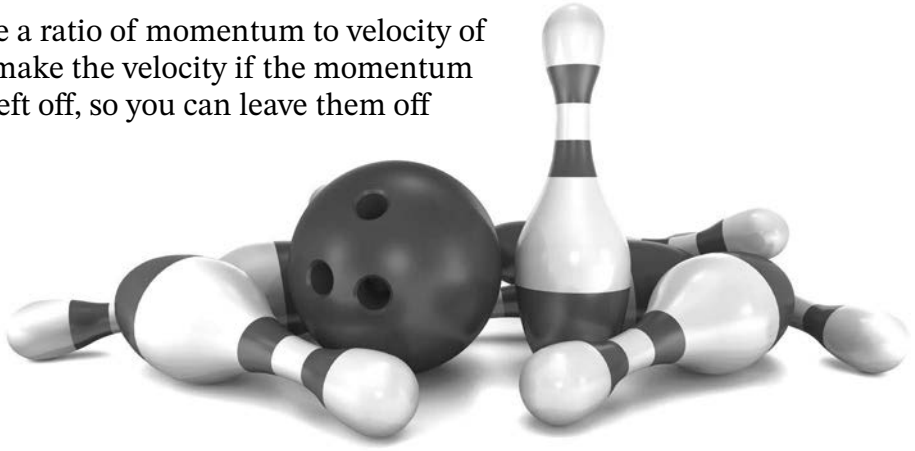
3. **Applying Algebra** – Have you ever noticed how heavier bowling balls, if thrown at the same speed as lighter ones, are more powerful in knocking down the pins, but that you can throw a light ball faster and still knock them down with the same or more power? There's a property called momentum that describes this. Momentum (p) equals the mass (m) times the velocity (v), or $p = mv$. (Mass is related to weight, and velocity is like speed but includes direction.) Use this information to answer the questions. Be sure to include the units in your answer (for 3a and 3b, leave units in those given; for 3c, convert to $\text{kg}\frac{\text{mi}}{\text{hr}}$ to do the comparison).
Each problem except 3c is worth 9 points; problem 3c is worth 9 points if correct and no points deducted if wrong or skipped.

   a. What is the momentum (p) of a ball with a mass (m) of 5 kg if it's thrown at a velocity (v) of $16\frac{\text{mi}}{\text{hr}}$?

   b. What is the momentum (p) of a ball with a mass (m) of 6 kg if it's thrown at a velocity (v) of $17\frac{\text{ft}}{\text{s}}$?

   c. **Challenge Problem for Extra Credit:** Which ball (the one in 3a or the one in 3b) has the greater momentum, and by how much?

   d. If we want a ball to have a ratio of momentum to velocity of 3 to 2, what should we make the velocity if the momentum is 10? Units have been left off, so you can leave them off in your answer.



You are not allowed to consult any reference materials on Part 1 of the exam. You are also not allowed to use a graphing calculator, although simple or scientific calculators are allowed.

Problems marked with this symbol were adapted from School Algebra.

1. **Simplifying Expressions –** Simplify the expressions below.

   Each problem is worth 2 points.

   a. $\dfrac{x^2+3x-18}{x+6}$ (Be sure to specify what x cannot equal.)

   b. $\log_3(5x)$ (Calculate any logarithm you can.)

   c. $\dfrac{2i(i^2+3i)}{(2i^2)^2}$, where $i =$ the imaginary number (Your answer should include at least one fraction.)

   d. $5e^{2t}+10e^{6t}$ (Factor out any common factors.)

   e. $5t-(-t^2)+t(-4+3a)^2+2a^0$

   f. $\sqrt{-5}\sqrt{-10}$ (Do not approximate any square roots that are not integers.)

2. **Miscellaneous Problems**

   Each problem is worth 2 points.

   a. Solve for x: $-c<\dfrac{x}{-3}$

   b. Solve for t: $\dfrac{5t}{t-6}=50$

   c. If set $A=\{4, 8, -30\}$ and set $B=\{-30, 3\}$, what is $A\cup B$? Your answer should be in the form $A\cup B=\{\quad\quad\}$.

   d. Write an equation in function notation showing how your frequent flier account mile balance (b) varies based on or is dependent on the amount in dollars you spend on your credit card (s) if you earn 3 miles on every dollar spent. Do not write units in your answer.

   e. Rewrite as a single fraction, factoring out any common factors: $f(t)=\dfrac{2t+t}{3t+6}-\dfrac{6t}{5}$

   f. Solve for x: $40=\log(2x)$. Give your answer in scientific notation.

   g. How many roots (including real and repeat) does x^5+4x-3 have?

   h. Find the roots of $-4x^2+3x-7$.

   i. Transform $f(x)=2x^2+6x$ horizontally to the left by 2. Simplify the transformed function as much as you can.

j. Is $x^2 + 3x - 6$ odd, even, or neither?

○ odd ○ even ○ neither

k. Find x and y:

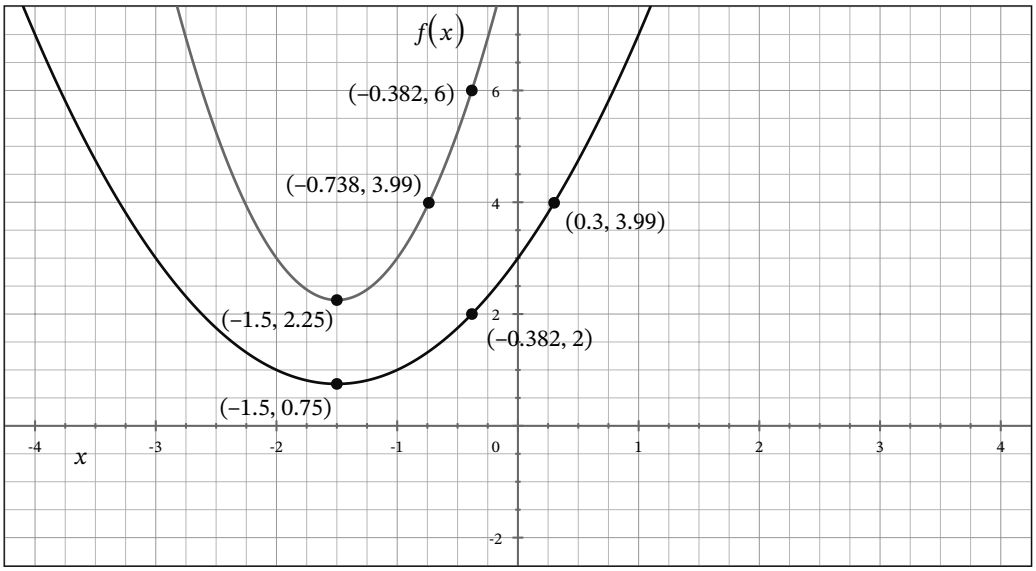
$2x + 3y = 4$

$\frac{1}{2}x - \frac{3}{4}y = -2$

l. Find $f(2)$ if $-2f(x + 8) = 5x^2 + x + 2$.

m. Find $y(x)z(x)$ if $y(x) = 4^{3t}$ and $z(x) = 2^{6t}$. Simplify your answer as much as possible. You should give your final answer as a number raised to an unknown.

n. The black curve can be described $f(x) = x^2 + 3x + 3$. Which function describes the grey curve, given it is a transformation of the solid curve using one of the transformations we've looked at?



○ A. $f(x + 3) = (x + 3)^2 + 3(x + 3) + 3$

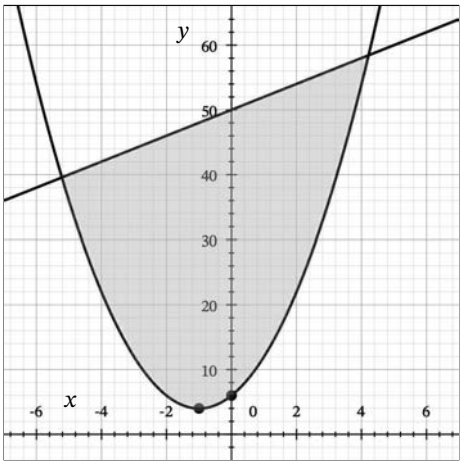
○ B. $f(x - 3) = (x - 3)^2 + 3(x - 3) + 3$

○ C. $3f(x) = 3(x^2 + 3x + 3)$

o. If (1, 4) is a point on a function, find the corresponding point on a function that is transformed from that function by *first* being reflected across the x-axis, *then* scaled vertically by 2, *then* compressed horizontally by 2, and *then* shifted horizontally to the left by 3.

3. **Identifying Functions –** List the equation(s) that correctly describe(s) these graphs. *Each problem is worth 2 points.*

a.



○ A. $y \geq 5x^2 + 3x + 6$ and $y \leq 2x + 6$

○ B. $y \geq 2x^2 + 4x + 6$ and $y \leq 2x + 6$

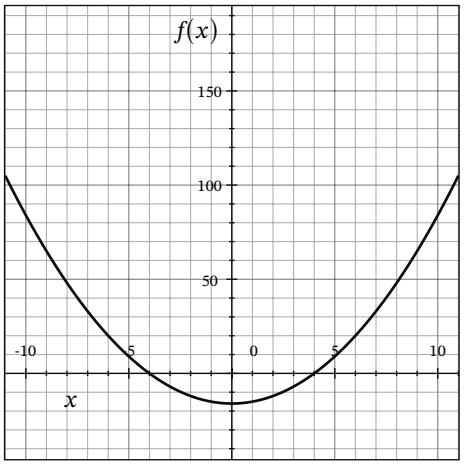
○ C. $y \leq 2x^2 + 4x + 6$ and $y \leq 2x + 6$

○ D. $y \geq 5x^2 + 3x + 6$ and $y \leq 2x + 50$

○ E. $y \geq 2x^2 + 4x + 6$ and $y \leq 2x + 50$

○ F. $y \leq 2x^2 + 4x + 6$ and $y \leq 2x + 50$

b.

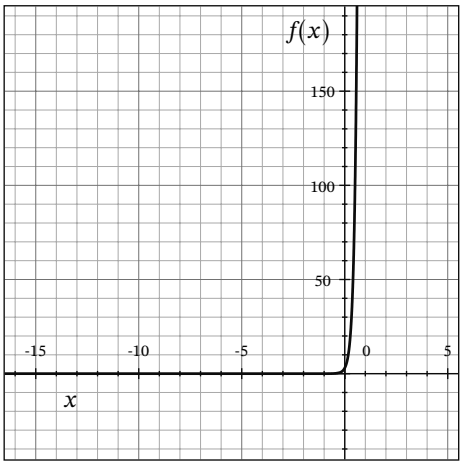


○ A. $f(x) = x^2 + 4x + 6$

○ B. $f(x) = 4x^2 + 3x - 12$

○ C. $f(x) = x^2 - 16$

c.



○ A. $f(x) = x^2 + 5$

○ B. $f(x) = 3e^{7x}$

○ C. $f(x) = 3e^{-7x}$

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You may consult your Student Textbook *and notes to help you solve the remainder of these problems, as their purpose is to see if you can apply algebra, not your memorization of formulas. You may also use a graphing calculator.*

4. **Miscellaneous**

   Each problem is worth 2 points.

   a. Identify the pattern and describe this sequence algebraically: {5, 7, 9, . . . }. You may decide whether to start counting the positions at 0 or 1. Your answer should be in the form of $a_n =$ _____, where $n \geq$ _____.

   b. Find the requested sum:

   $$\sum_{k=0}^{3} 2^k + 5$$

5. **Applying Algebra**

   Each problem is worth 4 points.

   a. Suppose you have done an informal test study on college students regarding changing their method of receiving information. For the first day of the study, your test group reported spending 2 times their normal average amount of time studying using a book, $\frac{1}{2}$ the amount of their normal average time studying on electronic devices, and 2 times the normal amount of time studying in class. Altogether, on the first day they spent 11 hours studying. The next day, they spent 3 times their normal amount of time studying using a book, and they spent just their normal time studying on an electronic device and just their normal time at class, for a total of 9 hr. The third day, they spent just their normal amount of time studying from a book, 4 times their normal amount of time studying on an electronic device, and no time at class, for a total of 9 hr. What was their normal average time spent studying using a book, on an electronic device, and in the class? *Normal average time spent studying using a book:* _____

   Normal average time spent studying using an electronic device: _____

   Normal average time spent studying at class: _____

   b. Suppose a gum ball machine has 4 red gum balls, 5 yellow gum balls, 3 black gum balls, and 10 blue gum balls. How probable is it that someone will get 2 black gum balls in a row?

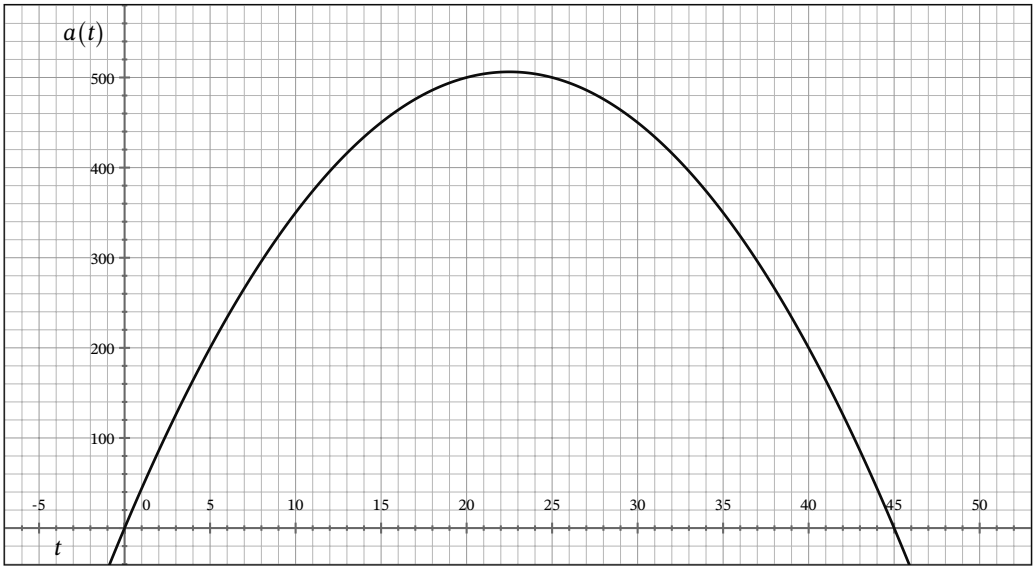
c. 10 Scripture verses are placed inside of a box for people to draw from. 5 are from the New Testament, and 5 are from the Old Testament. Of the 5 from the New Testament, 2 are from the book of Philippians. Of the 5 from the Old Testament, 3 are from the book of Isaiah. How probable is it that someone will draw either a New Testament verse *or* a verse from the books of Philippians or Isaiah?

$P(NT \cup Philippians\ or\ Isaiah) =$ _____

d. In physics, something called the time-dilation formula[1] can be thought of as a composite function of $g(v) = \dfrac{1}{\sqrt{1 - \dfrac{v^2}{c^2}}}$ into $f(v) = t_0 v$. Find the composite function by finding $f(g(v))$.

e. Suppose that the graph describes the altitude of a missile over time (in seconds). At what point in time does the missile hit its highest point?

$a(t) = -t^2 + 45t$



f. A man is planning for his retirement. Say he has $100,000 in the bank earning 5% annual interest compounded monthly. How much will this be worth in 20 years? Round your answer to the nearest cent.

g. How long will it take an animal population of 500 to shrink to 200 at a continuous rate of $\dfrac{-0.0035}{\text{day}}$?

h. Suppose a computer program randomly generates a quiz of 10 questions from 100 questions it has programmed into it. How many different versions of the quiz could it generate? You only care about quizzes with different problems, not the order of the problems.

1 W. Thomas Griffith and Juliet Brosing, *The Physics of Everyday Phenomena: A Conceptual Introduction to Physics,* 6th ed. (New York: McGraw-Hill, 2009), p. 442–443. *Note:* What we've written as $g(v)$ is frequently written as γ and used as its own formula too.

i. **Challenge Problem for Extra Credit**

Problem is worth 2 points if correct and no points deducted if wrong or skipped.

Given you have already selected one quiz, what is the probability in the situation described in 5h of getting a second quiz the same as the first?

j. If a ball is thrown upward, its height as a function of time can be described like this: $h = vt - 16.1t^2$, where v is the initial velocity. If the initial velocity is $100 \frac{\text{ft}}{\text{s}}$, at approximately what times will it be at a height of 100 feet?

k. A farmer bought 100 acres of land for $4,000. If part of it cost him $34 an acre and the remainder $49 an acre, find the number of acres bought at each price.

_____ acres at $34 an acre

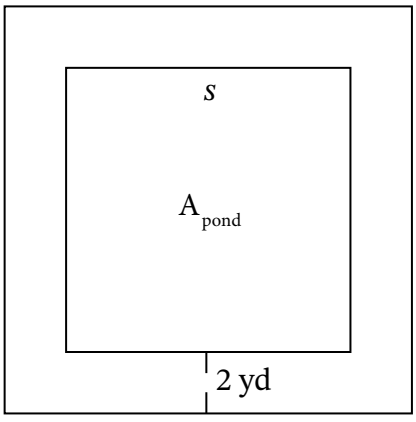
_____ acres at $49 an acre

l. If the voltage flowing through an outlet (V) equals the current (I) times the resistance (R), or $V = IR$, and the power (P) equals the current squared times the resistance (or $P = I^2R$), what will the power (P) be if the voltage is 1.5 volts and the resistance is 10 ohms?[2] Be sure to include the correct units of measure in your answer.

6. **Challenge Problems for Extra Credit**

Each problem is worth 4 if correct and no points deducted if wrong or skipped.

a. A square pond is surrounded by a gravel walk with a uniform width of 2 yards. The area of the walk is equal to that of the pond. Find the approximate dimensions of the sides of the pond.



$A_{pond} = A_{walk}$

$s \approx$ _____

b. The perimeter of a triangle is 74. The sum of two sides is greater by 10 than the third side, and the difference of the same two sides is 10 less than the third side. Find the length of each side.

length of each side: _____, _____, and _____

2 Equations from W. Thomas Griffith and Juliet Brosing, *The Physics of Everyday Phenomena: A Conceptual Introduction to Physics*, 6th ed. (New York: McGraw-Hill, 2009), p. 269.