# Contents

## Chapter 8: Fractions: Multiply and Divide



## Chapter 9: Geometry

# Foreword

Math Mammoth Grade 5, Canadian Version, comprises a complete math curriculum for the fifth grade mathematics studies. This curriculum is essentially the same as the U.S. version of Math Mammoth Grade 5, only customized for Canadian audiences in a few aspects (listed below). The curriculum meets the Common Core Standards in the United States, but it may not perfectly align to the fifth grade standards in your province (it will more likely match with various 6th grade Canadian standards).

The Canadian version of Math Mammoth differs from the US version in these aspects:

- The curriculum uses mainly metric measurement units, and a few customary (imperial) units.
- The spelling conforms to British international standards.
- The pages are formatted for letter paper size.
- Large numbers are formatted with a space as the thousands separator (such as 12 394). (The decimals are formatted with a decimal point, as in the US version.)

Fifth grade is when we focus on fractions and decimals and their operations in great detail. Students also deepen their understanding of whole numbers, are introduced to the calculator, learn more problem solving and geometry, and study graphing. The main areas of study in Math Mammoth Grade 5 are:

- Multi-digit addition, subtraction, multiplication, and division (including division with two-digit divisors)
- Solving problems involving all four operations;
- The place value system, including decimal place value
- All four operations with decimals and conversions between measurements;
- The coordinate system and line graphs;
- Addition, subtraction, and multiplication of fractions; division of fractions in special cases;
- Geometry: volume and categorizing two-dimensional figures (especially triangles);

This book, 5-B, covers more on decimal arithmetic, in chapter 6. The focus is on decimal multiplication and division, and on conversions between measurement units. Chapter 7 has to do with fraction addition and subtraction, and chapter 8 with fraction multiplication and division. The last chapter (chapter 9) is about geometry. Students classify quadrilaterals and triangles, and learn about volume.

The part 5-A covers the four operations, place value and large numbers, problem solving, decimals, and graphing.

I heartily recommend that you read the full user guide in the following pages.

*I wish you success in teaching math!*

*Maria Miller, the author*

# User Guide

Note: You can also find the information that follows online, at **https://www.mathmammoth.com/userguides/** .

## Basic principles in using Math Mammoth Complete Curriculum

Math Mammoth is mastery-based, which means it concentrates on a few major topics at a time, in order to study them in depth. The two books (parts A and B) are like a "framework", but you still have a lot of liberty in planning your child's studies. You can even use it in a *spiral* manner, if you prefer. Simply have your student study in 2-3 chapters simultaneously. In fifth grade, chapter 4 should be studied before chapter 6, and chapter 7 before chapter 8, but you can be flexible with the other chapters and schedule them earlier or later.

Math Mammoth is not a scripted curriculum. In other words, it is not spelling out in exact detail what the teacher is to do or say. Instead, Math Mammoth gives you, the teacher, various tools for teaching:

- **The two student worktexts** (parts A and B) contain all the lesson material and exercises. They include the explanations of the concepts (the teaching part) in blue boxes. The worktexts also contain some advice for the teacher in the "Introduction" of each chapter.

  The teacher can read the teaching part of each lesson before the lesson, or read and study it together with the student in the lesson, or let the student read and study on his own. If you are a classroom teacher, you can copy the examples from the "blue teaching boxes" to the board and go through them on the board.

- There are hundreds of **videos** matched to the curriculum available at https://www.mathmammoth.com/videos/ . There isn't a video for every lesson, but there are dozens of videos for each grade level. You can simply have the author teach your child or student!

- Don't automatically assign all the exercises. Use your judgement, trying to assign just enough for your student's needs. You can use the skipped exercises later for review. For most students, I recommend to start out by assigning about half of the available exercises. Adjust as necessary.

- For each chapter, there is a **link list to various free online games** and activities. These games can be used to supplement the math lessons, for learning math facts, or just for some fun. Each chapter introduction (in the student worktext) contains a link to the list corresponding to that chapter.

- The student books contain some **mixed review lessons**, and the curriculum also provides you with additional **cumulative review lessons**.

- There is a **chapter test** for each chapter of the curriculum, and a comprehensive end-of-year test.

- The **worksheet maker** allows you to make additional worksheets for most calculation-type topics in the curriculum. This is a single html file. You will need Internet access to be able to use it.

- You can use the free online exercises at https://www.mathmammoth.com/practice/
  This is an expanding section of the site, so check often to see what new topics we are adding to it!

- Some grade levels have **cut-outs** to make fraction manipulatives or geometric solids.

- And of course there are answer keys to everything.

## How to get started

Have ready the first lesson from the student worktext. Go over the first teaching part (within the blue boxes) together with your child. Go through a few of the first exercises together, and then assign some problems for your child to do on their own.

Repeat this if the lesson has other blue teaching boxes. Naturally, you can also use the videos at https://www.mathmammoth.com/videos/

Many students can eventually study the lessons completely on their own — the curriculum becomes self-teaching. However, students definitely vary in how much they need someone to be there to actually teach them.

## Pacing the curriculum

Each chapter introduction contains a suggested pacing guide for that chapter. You will see a summary on the right. (This summary does not include time for optional tests.)

Most lessons are 2 or 3 pages long, intended for one day. Some lessons are 4-5 pages and can be covered in two days. There are also some optional lessons (not included in the tables on the right).

It can also be helpful to calculate a general guideline as to how many pages per week the student should cover in order to go through the curriculum in one school year.

The table below lists how many pages there are for the student to finish in this particular grade level, and gives you a guideline for how many pages per day to finish, assuming a 180-day (36-week) school year. The page count in the table below *includes* the optional lessons.

| Worktext 5-A | |
|---|---|
| Chapter 1 | 21 days |
| Chapter 2 | 12 days |
| Chapter 3 | 9 days |
| Chapter 4 | 18 days |
| Chapter 5 | 11 days |
| **TOTAL** | **71 days** |

| Worktext 5-B | |
|---|---|
| Chapter 6 | 22 days |
| Chapter 7 | 18 days |
| Chapter 8 | 20 days |
| Chapter 9 | 12 days |
| **TOTAL** | **72 days** |

**Example:**

| Grade level | School days | Days for tests and reviews | Lesson pages | Days for the student book | Pages to study per day | Pages to study per week |
|---|---|---|---|---|---|---|
| 5-A | 89 | 10 | 176 | 79 | 2.23 | 11.1 |
| 5-B | 91 | 10 | 182 | 81 | 2.25 | 11.2 |
| Grade 5 total | 180 | 20 | 358 | 160 | 2.24 | 11.2 |

The table below is for you to fill in. Allow several days for tests and additional review before tests — I suggest at least twice the number of chapters in the curriculum. Then, to get a count of "pages to study per day", **divide the number of lesson pages by the number of days for the student book**. Lastly, multiply this number by 5 to get the approximate page count to cover in a week.

| Grade level | Number of school days | Days for tests and reviews | Lesson pages | Days for the student book | Pages to study per day | Pages to study per week |
|---|---|---|---|---|---|---|
| 5-A | | | 176 | | | |
| 5-B | | | 182 | | | |
| Grade 5 total | | | 358 | | | |

Now, something important. Whenever the curriculum has lots of similar practice problems (a large set of problems), feel free to **only assign 1/2 or 2/3 of those problems**. If your student gets it with less amount of exercises, then that is perfect! If not, you can always assign the rest of the problems for some other day. In fact, you could even use these unassigned problems the next week or next month for some additional review.

In general, 1st-2nd graders might spend 25-40 minutes a day on math. Third-fourth graders might spend 30-60 minutes a day. Fifth-sixth graders might spend 45-75 minutes a day. If your student finds math enjoyable, they can of course spend more time with it! However, it is not good to drag out the lessons on a regular basis, because that can then affect the student's attitude towards math.

## Working space, the usage of additional paper and mental math

The curriculum generally includes working space directly on the page for students to work out the problems. However, feel free to let your students to use extra paper when necessary. They can use it, not only for the "long" algorithms (where you line up numbers to add, subtract, multiply, and divide), but also to draw diagrams and pictures to help organize their thoughts. Some students won't need the additional space (and may resist the thought of extra paper), while some will benefit from it. Use your discretion.

Some exercises don't have any working space, but just an empty line for the answer (e.g. 200 + _____ = 1000). Typically, I have intended that such exercises to be done using MENTAL MATH.

However, there are some students who struggle with mental math (often this is because of not having studied and used it in the past). As always, the teacher has the final say (not me!) as to how to approach the exercises and how to use the curriculum. We do want to prevent extreme frustration (to the point of tears). The goal is always to provide SOME challenge, but not too much, and to let students experience success enough so that they can continue enjoying learning math.

Students struggling with mental math will probably benefit from studying the basic principles of mental calculations from the earlier levels of Math Mammoth curriculum. To do so, look for lessons that list mental math strategies. They are taught in the chapters about addition, subtraction, place value, multiplication, and division. My article at https://www.mathmammoth.com/lessons/practical_tips_mental_math also gives you a summary of some of those principles.

## Using tests

For each chapter, there is a **chapter test**, which can be administered right after studying the chapter. **The tests are optional.** Some families might prefer not to give tests at all. The main reason for the tests is for diagnostic purposes, and for record keeping. These tests are not aligned or matched to any standards.

In the digital version of the curriculum, the tests are provided both as PDF files and as html files. Normally, you would use the PDF files. The html files are included so you can edit them (in a word processor such as Word or LibreOffice), in case you want your student to take the test a second time. Remember to save the edited file under a different file name, or you will lose the original.

The end-of-year test is best administered as a diagnostic or assessment test, which will tell you how well the student remembers and has mastered the mathematics content of the entire grade level.

## Using cumulative reviews and the worksheet maker

The student books contain mixed review lessons which review concepts from earlier chapters. The curriculum also comes with additional cumulative review lessons, which are just like the mixed review lessons in the student books, with a mix of problems covering various topics. These are found in their own folder in the digital version, and in the Tests & Cumulative Reviews book in the print version.

The cumulative reviews are optional; use them as needed. They are named indicating which chapters of the main curriculum the problems in the review come from. For example, "Cumulative Review, Chapter 4" includes problems that cover topics from chapters 1-4.

Both the mixed and cumulative reviews allow you to spot areas that the student has not grasped well or has forgotten. When you find such a topic or concept, you have several options:

1. Check if the worksheet maker lets you make worksheets for that topic.
2. Check for any online games and resources in the Introduction part of the particular chapter in which this topic or concept was taught.
3. If you have the digital version, you could simply reprint the lesson from the student worktext, and have the student restudy that.
4. Perhaps you only assigned 1/2 or 2/3 of the exercise sets in the student book at first, and can now use the remaining exercises.
5. Check if our online practice area at https://www.mathmammoth.com/practice/ has something for that topic.
6. Khan Academy has free online exercises, articles, and videos for most any math topic imaginable.

## Concerning challenging word problems and puzzles

While this is not absolutely necessary, I heartily recommend supplementing Math Mammoth with challenging word problems and puzzles. You could do that once a month, for example, or more often if the student enjoys it.

The goal of challenging story problems and puzzles is to **develop the student's logical and abstract thinking and mental discipline**. I recommend starting these in fourth grade, at the latest. Then, students are able to read the problems on their own and have developed mathematical knowledge in many different areas. Of course I am not discouraging students from doing such in earlier grades, either.

Math Mammoth curriculum contains lots of word problems, and they are usually multi-step problems. Several of the lessons utilize a bar model for solving problems. Even so, the problems I have created are usually tied to a specific concept or concepts. I feel students can benefit from solving problems and puzzles that require them to think "out of the box" or are just different from the ones I have written.

I recommend you use the free Math Stars problem-solving newsletters as one of the main resources for puzzles and challenging problems:

**Math Stars Problem Solving Newsletter (grades 1-8)**
**https://www.homeschoolmath.net/teaching/math-stars.php**

I have also compiled a list of other resources for problem solving practice, which you can access at this link:

**https://l.mathmammoth.com/challengingproblems**

Another idea: you can find puzzles online by searching for "brain puzzles for kids," "logic puzzles for kids" or "brain teasers for kids."

## Frequently asked questions and contacting us

If you have more questions, please first check the FAQ at https://www.mathmammoth.com/faq-lightblue

If the FAQ does not cover your question, you can then contact us using the contact form at the Math Mammoth.com website.

# Chapter 6: Decimals, Part 2
## Introduction

This chapter focuses on decimal multiplication and division, and conversions between measurement units.

We start out with the topic of multiplying and dividing decimals by powers of ten, presented with the help of place value charts.. This is familiar to students from chapter 2, where they multiplied and divided whole numbers by powers of ten. The number being multiplied or divided *moves* in the place value chart, as many places as there are zeros in the power of ten.

As a shortcut, we can move the decimal point. However, the movement of the decimal point is an "illusion"—that is what seems to happen—but in reality, the number itself got bigger or smaller; thus, its digits actually changed positions in the place value chart.

Next, we study how to multiply decimals by decimals. The common rule (or shortcut) for it says to multiply the numbers without the decimal points, and then add the decimal point to the product (answer) so that it has as many decimal digits as the factors have in total. We justify this rule using the recently learned technique for dividing decimals by powers of ten. Students are also encouraged to use estimation in decimal multiplications, and they solve problems connected to real life.

Then students learn about multiplication as *scaling*. We cannot view decimal multiplications, such as $0.4 \times 1.2$, as repeated addition. Instead, they are viewed as scaling—shrinking or enlarging—the number or quantity by a scaling factor. So, $0.4 \times 1.2$ is thought of as scaling 1.2 by 0.4, or as four-tenths *of* 1.2. You may recognize this as the same as 40% of 1.2.

Next, we go on to decimal divisions that can be done with mental math. Students divide decimals by whole numbers (such as $0.8 \div 4$ or $0.45 \div 4$) by relating them to equal sharing. They divide decimals by decimals in situations where the divisor goes evenly into the dividend, thus yielding a whole-number quotient (e.g. $0.9 \div 0.3$ or $0.072 \div 0.008$).

In the lesson *More Division with Decimals*, we review long division with decimals, when the divisor is a whole number.

Then, we study the metric system and how to convert various metric units (within the metric system), such as converting kilograms to grams, or dekalitres to hectolitres. The first of the two lessons mainly deals with very commonly used metric units, and we use the meaning of the prefix to do the conversion. For example, centimetre is a hundredth part of a metre, since the prefix "centi" means 1/100. Knowing that, gives us a means of converting between centimetres and metres.

The second lesson deals with more metric units, even those not commonly used, such as dekalitres and hectograms, and teaches a method for conversions using a chart. These two methods for converting measuring units within the metric system are sensible and intuitive, and help students not to rely on mechanical formulas.

Next, we turn our attention to dividing decimals by decimals, which then completes our study of all decimal arithmetic. The principle here is fairly simple, but it is easy to forget (multiply both the dividend and the divisor by a power of ten, until you have a whole-number divisor).

After learning that, students practise measurement conversions within the customary system and do some generic problem solving with decimals.

Recall that not all students need all the exercises; use your judgement. Problems accompanied by a small picture of a calculator are meant to be solved with the help of a calculator. Otherwise, a calculator should not be allowed.

## Pacing Suggestion for Chapter 6

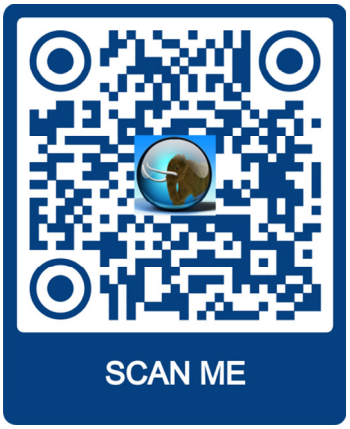
This table does not include the chapter test as it is found in a different book (or file).
Please add one day to the pacing for the test if you use it.

| The Lessons in Chapter 6 | page | span | suggested pacing | your pacing |
|---|---|---|---|---|
| Multiply and Divide by Powers of Ten, Part 1 ..... | 13 | *3 pages* | 1 day | |
| Multiply and Divide by Powers of Ten, Part 2 ..... | 16 | *3 pages* | 1 day | |
| Multiply and Divide by Powers of Ten, Part 3 (optional) | 19 | (*2 pages*) | (1 day) | |
| Multiply Decimals by Decimals 1 ..... | 21 | *2 pages* | 1 day | |
| Multiply Decimals by Decimals 2 ..... | 23 | *3 pages* | 1 day | |
| Multiplication as Scaling ..... | 26 | *4 pages* | 2 days | |
| Decimal Multiplication — More Practice ..... | 30 | *2 pages* | 1 day | |
| Dividing Decimals—Mental Math ..... | 32 | *3 pages* | 1 day | |
| More Division with Decimals ..... | 35 | *3 pages* | 1 day | |
| The Metric System, Part 1 ..... | 38 | *4 pages* | 2 days | |
| The Metric System, Part 2 ..... | 42 | *3 pages* | 1 day | |
| Divide Decimals by Decimals 1 ..... | 45 | *3 pages* | 1 day | |
| Divide Decimals by Decimals 2 ..... | 48 | *4-5 pages* | 2 days | |
| Problem Solving ..... | 53 | *4 pages* | 2 days | |
| Mixed Review Chapter 6 ..... | 57 | *2 pages* | 1 day | |
| Chapter 6 Review ..... | 59 | *5 pages* | 2 days | |
| Chapter 6 Test (optional) | | | | |
| **TOTALS** | | *48 pages* | 20 days | |
| with optional content | | *(52 pages)* | (22 days) | |

## Helpful Resources on the Internet

We have compiled a list of Internet resources that match the topics in this chapter. We heartily recommend you take a look! Many of our customers love using these resources to supplement the bookwork. You can use these resources as you see fit for extra practice, to illustrate a concept better and even just for some fun. Enjoy!

https://l.mathmammoth.com/gr5ch6



# Multiply and Divide by Powers of Ten 1

Remember? The number system we use is based on number 10. Therefore, each place value unit is always ten times the previous unit: 10 ones makes a ten, 10 tens makes a hundred, 10 hundreds makes a thousand. Because of this, when a number is multiplied by ten, the digits of the number essentially *move* in the place value chart!

**Example 1.** When 215 is multiplied by 10, each of its digits moves one slot to the left in the place value chart.

- The "2" in the hundreds place, signifying 200, becomes 2000.
- The "1" in the tens place, signifying 10, becomes 100.
- The "5" in the ones place (signifying 5) becomes 50.

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | **2** | **1** | **5** | **.** | | | |

becomes

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| **2** | **1** | **5** | **0** | **.** | | | |

It works **the same way with decimals:** each place value unit is ten times the previous unit.

**Example 2.** 10 hundredths makes a tenth (or 10 × 0.01 = 0.1).

Using the place value chart, the digit one (signifying one hundredth) *moves* in the chart one slot to the left.

What if 0.01 was multiplied by 100?

**10 × 0.01 = 0.1**

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | **.** | 1 ← | **1** | |

**Example 3.** Since 10 × 0.01 = 0.1, it follows that 10 times *seven* hundredths equals seven tenths. The digit 7 moves in the place value chart one step to the left.

What if seven hundredths was multiplied by 100? By 1000?

What if there were other digits?

**10 × 0.07 = 0.7**

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | **.** | 7 ← | **7** | |

1. **a.** Using this technique, what happens to 7 thousandths when it is multiplied by 100? Explain, using the place value chart.

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

**b.** What happens to 0.35 when it is multiplied by 1000? Explain.

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

When you multiply a number by a power of ten (10, 100, 1000, etc.), each digit of the number *moves* in the place value chart as many steps as there are zeros in the power of ten.

The same thing happens when *dividing* a number by a power of ten. This time, the number moves to the *right* — again, as many steps as there are zeros in the power of ten.

See the examples on the right.

**0.47 ÷ 10 = 0.047**

| H | T | O | | t | h | th |
|---|---|---|---|---|---|---|
| | | **0** | **.** | **4** | **7** | |

becomes

| | | | | | | |
|---|---|---|---|---|---|---|
| | | **0** | **.** | **0** | **4** | **7** |

**21.5 ÷ 100 = 0.215**

| H | T | O | | t | h | th |
|---|---|---|---|---|---|---|
| | **2** | **1** | **.** | **5** | | |

becomes

| | | | | | | |
|---|---|---|---|---|---|---|
| | | **0** | **.** | **2** | **1** | **5** |

2. Fill in the missing numbers. Use the place value charts to help.

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

**a.** 100 × 0.208 = _____

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

**b.** 7.5 ÷ 100 = _____

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

**c.** _____ × 0.915 = 9.15

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

**d.** 16 ÷ _____ = 0.016

3. Multiply and divide. Notice the patterns. You can use the place value charts to help.

**a.** 10 × 0.04 = _____

100 × 0.04 = _____

1000 × 0.04 = _____

10 000 × 0.04 = _____

**b.** 450 ÷ 10 = _____

450 ÷ 100 = _____

450 ÷ 1000 = _____

450 ÷ 10 000 = _____

**c.** 0.5 ÷ 10 = _____

0.5 ÷ 100 = _____

**d.** 10 × 0.056 = _____

100 × 0.056 = _____

**e.** 2 ÷ 100 = _____

2 ÷ 1000 = _____

**f.** 100 × 2.3 = _____

1000 × 2.3 = _____

**g.** _____ × 0.89 = 89

_____ × 0.209 = 2.09

**h.** 78.6 ÷ _____ = 0.786

24 ÷ _____ = 0.024

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | . | | | |

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | . | | | |

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | . | | | |

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | . | | | |

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | . | | | |

| Th | H | T | O | | t | h | th |
|---|---|---|---|---|---|---|---|
| | | | | . | | | |

**A neat trick that makes it easy!**

**Example 4.** What is 100 × 2.105?

Instead of thinking of the movement of the digits, consider what happens to the digit 2 when it is multiplied by 100. It becomes 200. So, you can simply write the digits "2105", and then place the decimal point in such a manner that the answer ends up being 200-something: **210.5**.

**Example 5.** What is 5460 ÷ 100?

When divided by 100, the 400 in 5460, becomes 4. That fixes the decimal point: it has to come right after the digit 4. So, the answer is 54.60, which simplifies to 54.6.

4. Solve. You can use any method.

| | | |
|---|---|---|
| **a.** 100 × 5.439 = _____ | **c.** 1000 × 3.06 = _____ | **e.** 30.73 ÷ 10 = _____ |
| **b.** 100 × 4.03 = _____ | **d.** 100 × 30.54 = _____ | **f.** 9608 ÷ 100 = _____ |

**Reminder:** Finding one tenth of a number is the same as dividing it by 10. Finding one-hundredth of a number is the same as dividing it by 100.

For example, one tenth of 4.5 kg is the same as 4.5 kg ÷ 10 = 0.45 kg.

5. Find one-tenth of... **a.** $8 **b.** $25.50 **c.** 126 km

6. **a.** Find one-tenth of 45 kg.

**b.** Find three tenths of 45 kg.

7. A 10-lb sack of nuts costs $72.
How much does one pound cost?

8. Find one-hundredth of... **a.** $78 **b.** 4 kg **c.** $390

9. Find the price of 100 ping-pong balls if one ball costs $0.89.

10. One-hundredth of a certain number is 0.03. What is the number?

# Multiply and Divide by Powers of Ten 2

**Shortcut.** If we look at how a number changes when it is multiplied or divided by a power of ten, it is as if the *decimal point moves*. In reality, each of the digits moves to a different place (in the place value chart), but it gives the illusion of the decimal point moving within the number. We can use this as a shortcut:

**The decimal point moves as many steps as there are zeros in the power of ten.**

| Multiply by 10: | Multiply by 100: | Divide by 100: |
|---|---|---|
| **0.49** ↓ **4.9** | **2.65** ↓ **265** | **2.8** ↓ **0.028** |
| $10 \times 0.49 = 04.9 = 4.9$ | $100 \times 2.65 = 265. = 265$ | $002.8 \div 100 = 0.028$ |
| It is as if the decimal point moved **one** step to the right. | It is as if the decimal point moved **two** steps to the right. | The decimal point moved **two** steps to the left. You need to add decimal zeros. |

Will the decimal point move to the *right* or *left*? Determine that by thinking whether your number needs to get bigger or smaller. For example, if you divide by 100, your number has to get smaller.

1. Multiply and divide.

| | |
|---|---|
| **a.** $10 \times 5.64 =$ _____<br>$100 \times 0.038 =$ _____ | **b.** $1000 \times 0.908 =$ _____<br>$100 \times 34.7 =$ _____ |
| **c.** $15.4 \div 10 =$ _____<br>$7.1 \div 100 =$ _____ | **d.** $0.9 \div 10 =$ _____<br>$94.5 \div 100 =$ _____ |

2. Solve, and continue the patterns.

| | |
|---|---|
| **a.** $10 \times 0.091 =$ _____<br>$100 \times 0.091 =$ _____<br>$1000 \times 0.091 =$ _____<br>_____ $\times 0.091 =$ _____ | **b.** $4000 \div 100 =$ _____<br>$4000 \div 1000 =$ _____<br>$4000 \div$ _____ $=$ _____<br>$4000 \div$ _____ $=$ _____ |

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# The Metric System, Part 1

The basic unit of LENGTH in the metric system is the **metre**. All the other units of length are formed by adding a prefix to the word "metre."

For example, in "centimetre," the prefix is *centi*, which signifies 1/100. This means that a centi-metre is 1/100 of a metre.

Or, in "hectometre," the prefix is *hecto*, which signifies 100. So, a hecto-metre is 100 metres.

Notice that the conversion factor between each two neighbouring units is always **10**.

**Units of Length in the Metric System**

| | | | |
|---|---|---|---|
| 10 | **kilometre** | **km** | 1000 metres |
| 10 | **hectometre** | **hm** | 100 metres |
| 10 | **decametre** | **dam** | 10 metres |
| 10 | **metre** | **m** | the basic unit |
| 10 | **decimetre** | **dm** | 1/10 of a metre |
| 10 | **centimetre** | **cm** | 1/100 of a metre |
| 10 | **millimetre** | **mm** | 1/1000 of a metre |

We can convert quantities with units with prefixes back to the basic unit by translating the prefix.

**Example 1.** Convert 26 cm into metres. Since *centi* signifies a hundredth, 26 centimetres is simply 26 *hundredths* of a metre, or 0.26 m.

**Example 2.** Since *kilo* signifies 1000, then 7 kilometres is 7 thousand metres, or 7000 m.

1. Convert these amounts to the basic unit, metres, by "translating" the prefixes.

**a.** 2 cm = *2/100 m* = *0.02 m*

6 dm = _____ m = _____ m

8 mm = _____ m = _____ m

**b.** 3 dam = _____ m

9 km = _____ m

2 hm = _____ m

**c.** 6 mm = _____ m

20 cm = _____ m

8 dm = _____ m

2. Now let's look at metric units of weight, which are based on the basic unit **gram**. Convert these amounts to the basic unit, grams, by "translating" the prefixes.

**a.** 2 mg = *2/1000 g* = *0.002 g*

6 cg = _____ g = _____ g

8 dg = _____ g = _____ g

**b.** 7 dg = _____ g

6 kg = _____ g

8 dag = _____ g

**c.** 2 cg = _____ g

15 kg = _____ g

80 mg = _____ g

**Units of Weight in the Metric System**

| | | | |
|---|---|---|---|
| 10 | **kilogram** | **kg** | 1000 grams |
| 10 | **hectogram** | **hg** | 100 grams |
| 10 | **dekagram** | **dag** | 10 grams |
| 10 | **gram** | **g** | the basic unit |
| 10 | **decigram** | **dg** | 1/10 of a gram |
| 10 | **centigram** | **cg** | 1/100 of a gram |
| 10 | **milligram** | **mg** | 1/1000 of a gram |

These same prefixes are used with *all* metric units, including the litre, the joule, the volt, the ampere, the second, and so on. Study the chart on the right.

Some of the units formed with the prefixes, such as dekagrams or hectometres, are not widely used. The most common prefixes are milli-, centi-, kilo-, and mega- (*mega* means 1 000 000).

**Example 3.** Eight decilitres (8 dl) means 8 tenths of a litre, or 0.8 litres, because *deci* signifies one tenth.

| Prefix | meaning |
|---|---|
| kilo- | 1000 |
| hecto- | 100 |
| deka- | 10 |
| - | (the basic unit) |
| deci- | 1/10 |
| centi- | 1/100 |
| milli- | 1/1000 |

3. Write the amounts in the basic unit by translating the prefixes. V means volt, and A means ampere.

| | | |
|---|---|---|
| **a.** 2 ml = *2/1000 L = 0.002 L* | **b.** 7 kV = _____ V | **c.** 3 dag = _____ g |
| 6 cl = _____ L = _____ L | 6 ml = _____ L | 8 kg = _____ g |
| 8 mA = _____ A = _____ A | 8 dl = _____ L | 2 hl = _____ L |

We will now practise conversions between the two very common units of length, kilometres and metres. As you know, 1 km is 1000 m. Therefore:

- One-tenth of a kilometre (0.1 km) is 100 m;
- One-hundredth of a kilometre (0.01) km is 10 m;
- One-thousandth of a kilometre (0.001 km) is 1 m.

**Example 4.** Since one-tenth of a kilometre is 100 m, then 0.8 km is 800 m.

**Example 5.** How many meters is 0.032 km?

Read 0.032 km using a fraction: it is **32/1000 of a kilometre**. Since each 1/1000 of a kilometre is one meter, then 32/1000 km is equal to 32 metres.

4. Write as meters or kilometres.

| | | |
|---|---|---|
| **a.** 0.7 km = _____ m | **b.** 0.04 km = _____ m | **c.** 2400 m = _____ km |
| 2.1 km = _____ m | 0.319 km = _____ m | 500 m = _____ km |
| 0.25 km = _____ m | 2.001 km = _____ m | 60 m = _____ km |

5. Jack ran around a 550-metre track four times.
What distance did he run in kilometres?

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# Chapter 7: Fractions: Add and Subtract

## Introduction

In 5th grade, students study most aspects of fraction arithmetic: addition, subtraction, multiplication, and then in some special cases, division. Division of fractions is studied in more detail in 6th grade.

This chapter starts out with a lesson reviewing mixed numbers, and then with lessons on various ways to add and subtract mixed numbers. These are meant partially to review and partially to develop speed in fraction calculations. The lesson *Subtracting Mixed Numbers 2* presents an optional way to subtract, where we use a negative fraction. This is only meant for students who can easily grasp subtractions such as $(1/5) - (4/5) = -3/5$, and is not intended to become a "stumbling block." Simply skip it if necessary.

Students have already added and subtracted *like* fractions in fourth grade. Now it is time to "tackle" the more complex situation of *unlike* fractions (with different denominators). To that end, students learn how to convert fractions into other equivalent fractions. These lessons first use a visual model of splitting pie pieces further, and from that, we develop the common procedure for equivalent fractions.

This skill is used immediately in the next lessons about adding and subtracting unlike fractions. We begin this topic by using visual models, and then gradually advance toward the abstract. Several lessons are devoted to understanding and practising the basic concept, and also to applying this new skill to mixed numbers.

The lesson *Comparing Fractions* reviews some mental math methods for comparing fractions. Students also learn a "brute force" method based on converting fractions to equivalent fractions.

The chapter ends with an optional lesson on measuring in inches, using units as small as 1/16 of an inch (that can be skipped if you wish).

### Pacing Suggestion for Chapter 7

This table does not include the chapter test as it is found in a different book (or file).
Please add one day to the pacing for the test if you use it.

| The Lessons in Chapter 7 | page | span | suggested pacing | your pacing |
|---|---|---|---|---|
| Mixed Review Chapter 7 ..... | 105 | *3 pages* | 1 day | |
| Chapter 7 Review ..... | 108 | *2.5 pages* | 1 day | |
| Chapter 7 Test (optional) | | | | |
| **TOTALS** | | *40.5 pages* | 16 days | |
| with optional content | | *(45.5 pages)* | (19 days) | |

## Helpful Resources on the Internet

We have compiled a list of Internet resources that match the topics in this chapter, including pages that offer:

- **online practice** for concepts;
- online **games**, or occasionally, printable games;
- **animations** and interactive **illustrations** of math concepts;
- **articles** that teach a math concept.

We heartily recommend you take a look! Many of our customers love using these resources to supplement the bookwork. You can use these resources as you see fit for extra practice, to illustrate a concept better and even just for some fun. Enjoy!

https://l.mathmammoth.com/gr5ch7

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# Fraction Terminology

*As we study fraction operations, it is important that you understand the terms, or words, that we use. This page is for reference. You can post it on your wall or even make your own fraction poster based on it. Some of the terms below you already know; some we will study in this chapter.*

$\frac{3}{11}$

The top number is the **numerator**. It *enumerates*, or numbers (counts), *how many* pieces there are.

The bottom number is the **denominator**. It *denominates*, or names, *what kind* of parts they are.

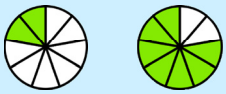
**A mixed number** has two parts: a whole-number part and a fractional part.

For example, in $2\frac{3}{7}$, the whole-number part is 2, and the fractional part is $\frac{3}{7}$.

The mixed number $2\frac{3}{7}$ actually means $2 + \frac{3}{7}$.

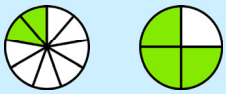
$2\frac{3}{7}$

**Like fractions** have the same denominator. They have the same kind of parts. It is easy to add and subtract like fractions, because all you have to do is look at *how many* of that kind of part there are.



$\frac{2}{9}$ and $\frac{7}{9}$ are like fractions.

**Unlike fractions** have a different denominator. They have different kinds of parts. It is a little more complicated to add and subtract unlike fractions. You need to first change them into like fractions. Then you can add or subtract them.

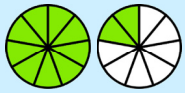


$\frac{2}{9}$ and $\frac{3}{4}$ are unlike fractions.

**A proper fraction** is a fraction that is less than 1 (less than a whole pie). 2/9 is a proper fraction.

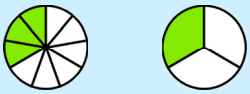
**An improper fraction** is more than 1 (more than a whole pie). Being a *fraction*, it is written as a fraction and *not* as a mixed number.

$\frac{2}{9}$ is a proper fraction.



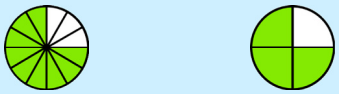
$\frac{11}{9}$ is an improper fraction.

**Equivalent fractions** are equal in value. If you think in terms of pies, they have the same amount of "pie to eat," but they are written using different denominators, or are "cut into different kinds of slices."



$\frac{3}{9}$ and $\frac{1}{3}$ are equivalent fractions.

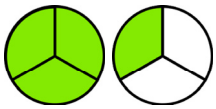
**Simplifying or reducing a fraction** means that, for a given fraction, you find an equivalent fraction that has a "simpler," or smaller, numerator and denominator. (It has fewer but bigger slices.)

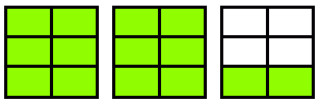


$\frac{9}{12}$ simplifies to $\frac{3}{4}$.

# Review: Mixed Numbers

1. Write the mixed numbers that these pictures illustrate.

**a.** 

**b.** 

**c.** 

2. Draw pictures that illustrate these mixed numbers.

**a.** $3\frac{2}{6}$

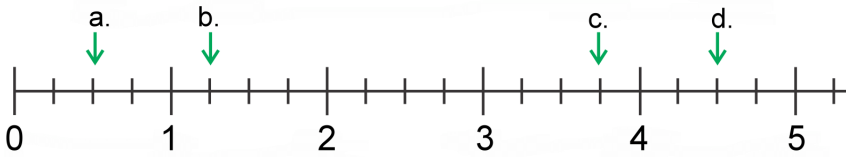
**b.** $4\frac{7}{8}$

3. Write the mixed number that is illustrated by each number line.

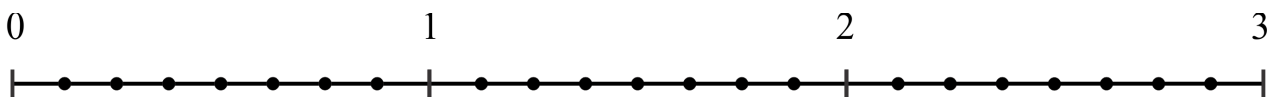
**a.** 


**b.** 


4. Write the fractions and mixed numbers that the arrows indicate.




5. Mark the fractions on the number line. $\frac{9}{8}$, $\frac{22}{8}$, $\frac{13}{8}$, $\frac{24}{8}$, $\frac{11}{8}$

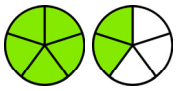


## Mixed numbers to fractions

**Example 1.** To write $4\frac{2}{9}$ as a fraction, we *count* all the ninths:

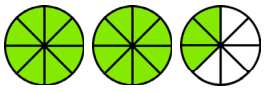
- Each pie has nine ninths, so the four complete pies have 4 × ____ = _____ ninths.
- Additionally, the incomplete pie has ____ ninths.
- The total is _____ ninths or $\square\!\!\square$.

6. Write as mixed numbers and as fractions.



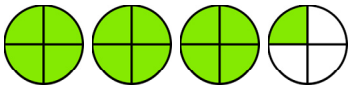
**a.** $1\frac{2}{5} = \frac{\square}{5}$

**b.** $\square\frac{\square}{\square} = \frac{\square}{\square}$



**c.** $\square\frac{\square}{\square} = \frac{\square}{\square}$

**d.** $\square\frac{\square}{\square} = \frac{\square}{\square}$



**e.** $\square\frac{\square}{\square} = \frac{\square}{\square}$

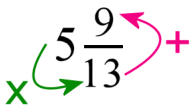
**Shortcut:** $5\frac{3}{4} = \frac{23}{4}$

Numerator: 5 × 4 + 3 = 23

Denominator: 4

Multiply the whole number times the denominator, then add the numerator, to get the number of fourths, or the numerator for the fraction. The denominator will remain the same.

7. Explain how the shortcut works, and why. Use the image on the right as an example.




8. Write as fractions. Think of the shortcut.

**a.** $7\frac{1}{2}$ **b.** $6\frac{2}{3}$ **c.** $8\frac{3}{9}$ **d.** $6\frac{6}{10}$

**e.** $2\frac{5}{11}$ **f.** $8\frac{1}{12}$ **g.** $2\frac{5}{16}$ **h.** $4\frac{7}{8}$

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# Word Problems

**Example 1.** A recipe calls for 1 ⅓ cups of flour and ½ cup of coconut flakes. How much in total (in cups) are these two dry ingredients?

Harry added: $1\frac{1}{3} + \frac{1}{2} = 1\frac{2}{5}$, and gave the answer as 1 2/5 cups of dry ingredients.

That is wrong, and you can easily see that, because 2/5 is less than ½!

You cannot add ⅓ and ½ and get an answer that is less than ½!

**Always check if your answer is reasonable.**

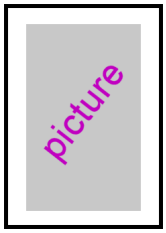
1. Cindy needs to make two cakes, one batch of pancakes, and some sauce. She needs 3 ½ dl (*decilitres*) of flour for one cake, 5 dl of flour for a batch of pancakes, and ¾ dl of flour for the sauce.

   **a.** How much flour does she need in total?

   **b.** A 1-kilogram bag of flour is about 15 decilitres. Will one bag of flour be enough for her to make the three recipes?

2. Lily's notebook is 20 cm wide and 28 cm long. She wants to glue a picture on the front so that the margins on all sides are 2 cm.

   What size should the picture be (width and length)?



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# Chapter 8: Fractions: Multiply and Divide

## Introduction

This is another chapter devoted solely to fractions. It rounds out our study of fraction arithmetic. If you feel that your student(s) would benefit from taking a break from fractions, you could have them study chapter 9 (geometry) in between chapters 7 and 8.

We start out by simplifying fractions. Since this process is the opposite of making equivalent fractions, studied in chapter 7, it should be relatively simple for students to understand. We also use the same visual model, just backwards: this time the pie pieces are joined together instead of split apart.

Next we study multiplying a fraction and a whole number. The lesson shows how, for example, $3 \times (4/5)$ can be seen as three copies of 4/5 — as repeated addition. In this case, all that is needed is to find the number of fifths (number of slices), and that is simply $3 \times 4$.

We also delve into the idea of interpreting a fraction times a whole number as a fractional part of a quantity. For example, $(2/3) \times 18$ is seen as two-thirds of 18 (say 18 km or \$18). In this sense, the word "of" is as if it "translates" into the multiplication symbol.

The next lesson continues to build on this idea, explaining the multiplication of a fraction by a fraction as taking a certain part of a fraction. The lesson also shows the usual shortcut for the multiplication of fractions.

Then, we study the area of a rectangle with fractional side lengths, and show that the area is the same as it would be found by multiplying the side lengths. Students multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.

Simplifying before multiplying is a process that is not absolutely necessary for fifth graders. I have included it here because it prepares students for the same process in future algebra studies, and also because it makes fraction multiplication easier. I have also included explanations of *why* we are allowed to simplify before multiplying, so that students can become familiar with mathematical reasoning (actually, proofs).

Students also multiply mixed numbers, and study how multiplication can be seen as resizing or scaling.

Next, we study division of fractions in special cases. The first one is seeing fractions *as* divisions; in other words recognizing that 5/3 is the same as $5 \div 3$. This gives us a means of dividing whole numbers in such a manner that the answer has a fractional part (for example, $20 \div 6 = 3\ 2/6$).

The next case is sharing divisions—divisions that can be interpreted as equal sharing. For example, if 4/5 of a pie is shared equally between two people, how much does each person get? In particular, we look at dividing a unit fraction by a whole number (e.g. $(1/4) \div 3$) in this context of equal sharing. Students work with visual models, and via their work, find a shortcut for this type of division.

The following lesson then focuses on "measurement divisions", where we think how many times the divisor "fits into" the dividend. Again, visual models help a lot. The focus is on dividing a whole number by a unit fraction (e.g. $3 \div (1/4)$).

The last lesson, on the shortcut for fraction division, is optional. It reveals the common rule for fraction division: each division is actually changed into a *multiplication* by the reciprocal of the divisor. In 5th grade, students are not required to master fraction division in all cases, and that is why this is an optional lesson. This rule is studied in 6th grade in detail.

### Pacing Suggestion for Chapter 8

This table does not include the chapter test as it is found in a different book (or file).
Please add one day to the pacing for the test if you use it.
* These lessons exceed the Common Core Standards (CCS) for 5th grade.

| The Lessons in Chapter 8 | page | span | suggested pacing | your pacing |
|---|---|---|---|---|
| * Simplifying Fractions 1 | 113 | *3 pages* | 1 day | |
| * Simplifying Fractions 2 | 116 | *3 pages* | 1 day | |
| Multiply Fractions and Whole Numbers 1 | 119 | *2 pages* | 1 day | |
| Multiply Fractions and Whole Numbers 2 | 121 | *2 pages* | 1 day | |
| Multiply Fractions by Fractions 1 | 123 | *3 pages* | 1 day | |
| Multiply Fractions by Fractions 2 | 126 | *2 pages* | 1 day | |
| Fraction Multiplication and Area | 128 | *6 pages* | 2 days | |
| * Simplifying Before Multiplying | 135 | *3 pages* | 1 day | |
| Multiplying Mixed Numbers | 138 | *3 pages* | 1 day | |
| Multiplication as Scaling/Resizing | 141 | *3 pages* | 2 days | |
| Fractions Are Divisions | 144 | *4 pages* | 2 days | |
| Dividing Fractions: Sharing Divisions | 148 | *3 pages* | 1 day | |
| Dividing Fractions: Fitting the Divisor | 151 | *3 pages* | 1 day | |
| Dividing Fractions: Summary | 154 | *2 pages* | 1 day | |
| * Dividing Fractions: The Shortcut (optional) | 156 | *(3 pages)* | (1 day) | |
| Mixed Review Chapter 8 | 159 | *3 pages* | 1 day | |
| Chapter 8 Review | 162 | *4 pages* | 2 days | |
| Chapter 8 Test (optional) | | | | |
| **TOTALS** | | *49 pages* | 20 days | |
| with optional content | | *(52 pages)* | (21 days) | |

## Helpful Resources on the Internet

We have compiled a list of Internet resources that match the topics in this chapter, including pages that offer:

- **online practice** for concepts;
- online **games**, or occasionally, printable games;
- **animations** and interactive **illustrations** of math concepts;
- **articles** that teach a math concept.

https://l.mathmammoth.com/gr5ch8

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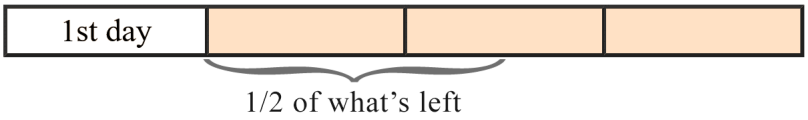
# Multiply Fractions by Fractions 2

**Example 1.** Henry finished 1/4 of a job he was given in one day. The next day, he finished half of what was left. Now what part of the task is left to do?

After the first day of work, he has 3/4 of the job left:




Then he finished *half* of that. This means we need to figure out half of 3/4. This is found with fraction multiplication: $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$. What does this 3/8 signify?

It is 3/8 of the original whole:


1. There was 1/4 of the pizza left. Marie ate 2/3 of that.

   **a.** Write a fraction multiplication. You can also draw a picture.

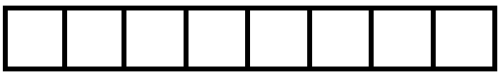
   **b.** What part of the *whole* (original) pizza did she eat?

   **c.** What part of the *whole* (original) pizza is left now?

2. Theresa has painted 5/8 of the room.

   **a.** What part is still left to paint?

   **b.** Now, Theresa has painted *half* of what was still left.

   Write a fraction multiplication.

   Use the bar model on the right to help you.
   What part of the room is still left to paint?

3. Sally wants to make 1/3 of the recipe on the right. How much does she need of each ingredient?

Carob Brownies

3 cups sweetened carob chips
8 tablespoons olive oil
2 eggs
1/2 cup honey
1 teaspoon vanilla
3/4 cup whole wheat flour
3/4 teaspoon baking powder
1 cup walnuts or other nuts

4. Multiply. Give your answers in the lowest terms (simplified) and as mixed numbers, if possible.

| | |
|---|---|
| **a.** $\frac{3}{4} \times \frac{7}{8} =$ | **b.** $\frac{7}{10} \times \frac{8}{5} =$ |
| **c.** $\frac{9}{20} \times \frac{4}{5} =$ | **d.** $\frac{2}{5} \times 18 =$ |
| **e.** $30 \times \frac{5}{7} =$ | **f.** $\frac{9}{4} \times \frac{8}{11} =$ |

5. Ted has completed 2/3 of a job that his boss gave him.

**a.** What part is still left to do?

**b.** Now Ted completes a third of what was still left to do. Draw a bar model and write a fraction multiplication. What part of the original job is still left undone?

What part is completed?

6. For an upcoming get-together, Alison uses the recipe on the right.

Coffee (5 servings)

3 1/2 cups water
1/4 cup ground coffee

**a.** Let's say that each guest drinks one serving of coffee. Find the amount of ground coffee she will need for 30 guests.

**b.** Now let's say that each guest drinks two servings, and that she will have 50 guests. Find the amount of ground coffee she will need.

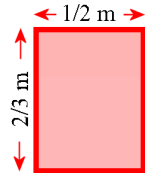
**Puzzle Corner**

Find the missing factors.

**a.** $\square \times \frac{6}{7} = \frac{1}{7}$ **b.** $\square \times \frac{1}{4} = \frac{5}{16}$ **c.** $\square \times \frac{2}{5} = \frac{3}{10}$

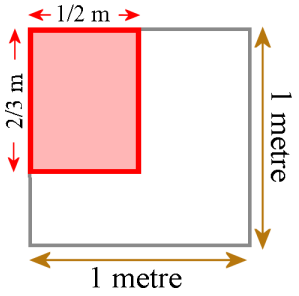
# Fraction Multiplication and Area

What is the area of this rectangle?



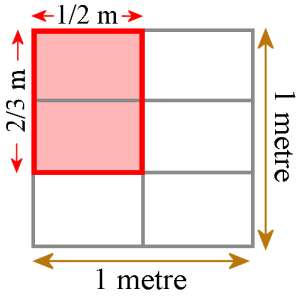

Notice, its side lengths are *fractional* (1/2 metre and 2/3 metre).

Let's extend its sides and draw a square metre around it.




Surely the area of our rectangle is less than a half square metre. But exactly how much is the area?

To solve this problem, let's draw a grid inside our square metre:



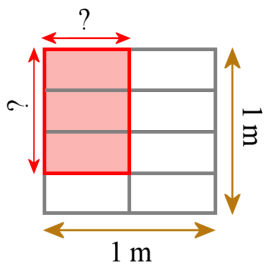

Now it is easy to see that the area of the coloured rectangle is exactly 2/6 or 1/3 of the square metre.

(Why? Because the square metre is divided into 6 equal parts, and our rectangle covers two of them).

Notice that we get the same result (1/3 square metre) if we *multiply* the side lengths, using fraction multiplication:

$$\frac{2}{3}\text{ m} \cdot \frac{1}{2}\text{ m} = \frac{2}{6}\text{ m}^2 = \frac{1}{3}\text{ m}^2$$

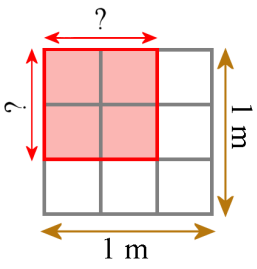
1. Each picture shows some kind of square unit, and a coloured rectangle. Figure out the side lengths and the area of the rectangle from the picture.




**a.**

Side lengths: ____ m and ____ m

Area (from the picture): ____ $\text{m}^2$




**b.**

Side lengths: ____ m and ____ m

Area (from the picture): ____ $\text{m}^2$

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# Multiplication as Scaling/Resizing

You know that **scaling** means **expanding or shrinking something** by some factor.

We use **multiplication** to accomplish this. The number we multiply by is called the **scaling factor**.

**Example 1.** When a stick 40 pixels long is scaled to be 3/5 as long as it was, it will shrink!



We could write this type of a multiplication equation: (3/5) × ——— = ——— .

Using the length of 40 pixels, we write (6/10) × 40 px = 24 px or 0.6 × 40 px = 24 px.

**Example 2.** The multiplication (1 2/3) × 18 km means taking the distance of 18 km one and two-thirds times. We are scaling the quantity 18 km by the factor 1 2/3.

To calculate it, we can multiply in parts: take 1 × 18 km, and (2/3) × 18 km, and add those. Since two-thirds of 18 km is 12 km, then **(1 2/3) × 18 km** is **18 km + 12 km = 30 km.**

1. The stick and other quantities are being scaled—either expanded or shrunk. Find the quantity after scaling. Compare the problems in each box.

**a.**

½ × ——— = ———

½ × 50 px = _____ px

1 ½ × ——— = ———

1 ½ × 50 px = _____ px

**b.**

¼ × ——— = ———

¼ × 40 px = _____ px

2 ¼ × ——— = ———

2 ¼ × 40 px = _____ px

**c.**

⅝ × 400 km = _____

2 ⅝ × 400 km = _____

**d.**

⅗ × $600 = _____

3 ⅗ × $600 = _____

2. A 1200×800 photo (in pixels) is scaled by scaling factor *s*.

**a.** If you want the resulting photo to be slightly smaller than the original, what kind of number would you use for *s*?

**b.** If *s* = 2 ¾, calculate the dimensions of the resulting photo.

# Chapter 9: Geometry
## Introduction

The focus of this chapter is on two topics: classifying two-dimensional shapes, and volume.

The chapter starts out with a lesson that reviews the topic of angles from fourth grade. The next lesson (Polygons) covers the concept of a polygon and the names of several common ones. Students classify figures into polygons and non-polygons, and also into regular polygons versus non-regular polygons.

The next topic is classifying quadrilaterals. The focus is on understanding the classification, and understanding that attributes defining a certain quadrilateral also belong to all the "children" (subcategories) of that type of quadrilateral. For example, squares are also rhombi, because they have four congruent sides (the defining attribute of a rhombus).

A possible confusion point is the definition of a trapezoid. There exist two possible definitions:

- (Exclusive definition:) A trapezoid has exactly one pair of parallel sides.
- (Inclusive definition:) A trapezoid has at least one pair of parallel sides.

Both definitions are legitimate, but lead to different analysis when classifying quadrilaterals. Under the exclusive definition, a parallelogram is not a trapezoid, but under the inclusive definition, it is. Most college-bound textbooks favour the *inclusive* definition, and that is what is used in this text, also.

Then we study the classification of triangles. Students are now able to classify triangles both in terms of their sides and also in terms of their angles.

The second focus topic of this chapter is volume. Students learn that a cube with the side length of 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. They find the volume of right rectangular prisms by "packing" them with unit cubes and by using formulas. They recognize volume as additive and solve both geometric and real-word problems involving volume.

The chapter includes three optional lessons listed in the end: area and perimeter problems, star polygons, and circles. Use them as time allows. The lesson on area and perimeter can be important for those students who tend to forget these concepts. The lesson on star polygons is intended as a fun artistic topic. The lesson on circles involves the usage of a compass, which may be hard for some children at this age. Those who can master it will probably find the exercises involving multiple circles fascinating.

Note: Any problem marked with "  " means the exercise should be done in a notebook or on blank paper.

### Pacing Suggestion for Chapter 9

This table does not include the chapter test as it is found in a different book (or file).
Please add one day to the pacing for the test if you use it.

| The Lessons in Chapter 9 | page | span | suggested pacing | your pacing |
|---|---|---|---|---|
| Classifying Triangles 1 ..... | 185 | *3 pages* | 1 day | |
| Classifying Triangles 2 ..... | 188 | *2 pages* | 1 day | |
| Volume ..... | 190 | *5 pages* | 2 days | |
| Volume of Rectangular Prisms ..... | 195 | *3 pages* | 1 day | |
| Volume is Additive ..... | 198 | *3 pages* | 1 day | |
| * Area and Perimeter Problems (optional) ..... | 201 | *(5 pages)* | (2 days) | |
| * Star Polygons (optional) ..... | 205 | *(2 pages)* | (1 day) | |
| Mixed Review Chapter 9 ..... | 207 | *3 pages* | 1 day | |
| Chapter 9 Review..... | 210 | *3 pages* | 1 day | |
| Chapter 9 Test (optional) | | | | |
| **TOTALS** | | *35 pages* | 12 days | |
| with optional content | | *(44 pages)* | (16 days) | |

* These lessons exceed the Common Core Standards (CCS) for 5th grade.

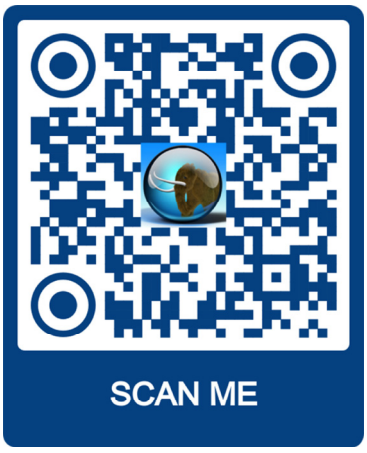
## Helpful Resources on the Internet

We have compiled a list of Internet resources that match the topics in this chapter, including pages that offer:

- **online practice** for concepts;
- online **games**, or occasionally, printable games;
- **animations** and interactive **illustrations** of math concepts;
- **articles** that teach a math concept.

We heartily recommend you take a look! Many of our customers love using these resources to supplement the bookwork. You can use these resources as you see fit for extra practice, to illustrate a concept better and even just for some fun. Enjoy!

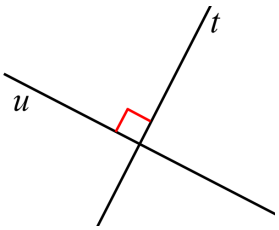
https://l.mathmammoth.com/gr5ch9



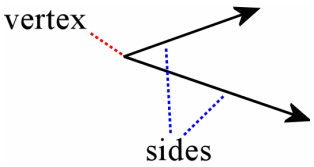
# Geometry Vocabulary Reference Sheet

I encourage you to draw pictures to illustrate the terms, or even make your own geometry notebook!

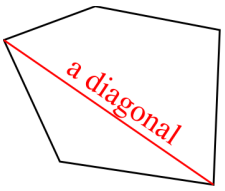
Two lines are **perpendicular** if they form a right angle.




An **angle** consists of two rays that start at the same point, called vertex. The two rays form the sides of the angle.




- A **polygon** is a flat, two-dimensional figure that consists of line segments, and is closed.
- A **regular polygon** is one with congruent sides and angles.
- A **vertex** is a "corner" of a polygon.
- A **diagonal** is a line segment drawn from one vertex of a polygon to another.



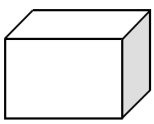

- A **quadrilateral** – a polygon with *four* sides
- A **pentagon** – a polygon with *five* sides.
- A **hexagon** – a polygon with *six* sides.
- A **heptagon** – a polygon with *seven* sides.
- An **octagon** – a polygon with *eight* sides.

- A **right triangle** is a triangle with one right angle.
- An **obtuse triangle** is a triangle with one obtuse angle.
- An **acute triangle** is a triangle with all three angles acute.

- An **equilateral triangle** is a triangle with three congruent sides.
- An **isosceles triangle** is a triangle with two congruent sides.
- A **scalene triangle** is a triangle where none of the sides are congruent.

- A **trapezoid** is a quadrilateral with at least one pair of parallel sides.
- A **parallelogram** is a quadrilateral with two pairs of parallel sides.
- A **rhombus** is a parallelogram with four congruent sides.
- A **kite** is a quadrilateral that has two pairs of congruent sides, and the congruent sides are adjacent (neighbouring each other).
- A **rectangle** is a quadrilateral with four right angles.
- A **square** is a rectangle with four congruent sides.
- A **scalene quadrilateral** has no congruent sides.

- A **rectangular prism** is a box-shaped solid (three-dimensional shape) with edges that meet at right angles.

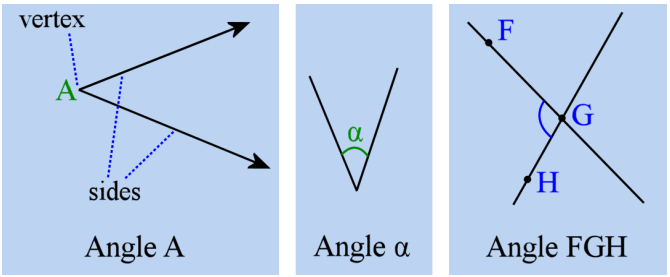


# Review: Angles

**An angle** is a figure formed by two rays that have the same beginning point. That point is called the **vertex**. The two rays are called the **sides** of the angle.

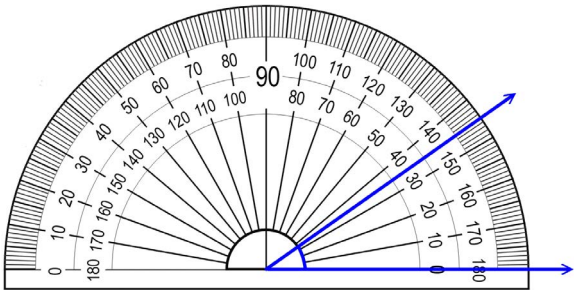
Imagine the two sides as being like two sticks that open up a certain amount. The more they open, the bigger the angle.

An angle can be named (1) after the vertex point, (2) with a letter inside the angle, or (3) using one point on the ray, the vertex point, and one point on the other ray.

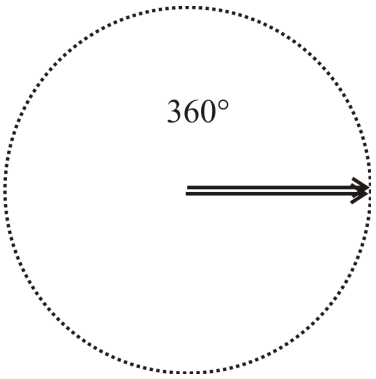



We use **a protractor** to measure angles. The vertex of the angle has to be placed in the middle of the protractor, and ONE side of the angle has to line up with the "zero line" of the protractor.

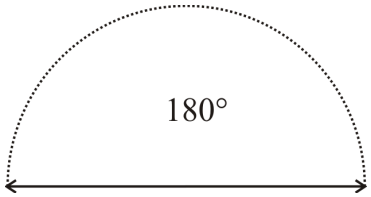
The angle on the right measures 35 degrees.



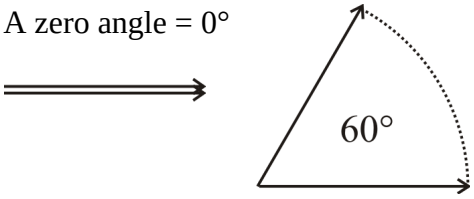
A full angle = 360°



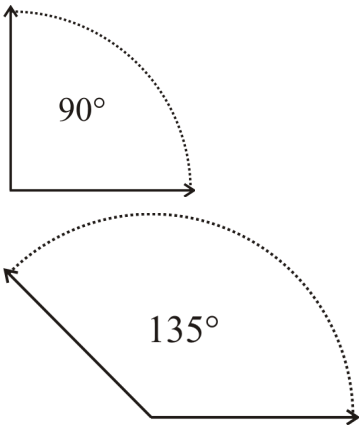

A straight angle = 180°




A zero angle = 0°



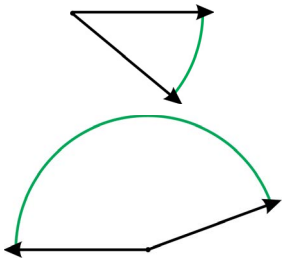

**A right angle = 90°**




Angles that are more than 0° but less than 90° are called **acute** ("sharp") angles.

Angles that are more than 90° but less than 180° are called **obtuse** ("dull") angles.

Angles that are more than 180° but less than 360° are called *reflex* angles.



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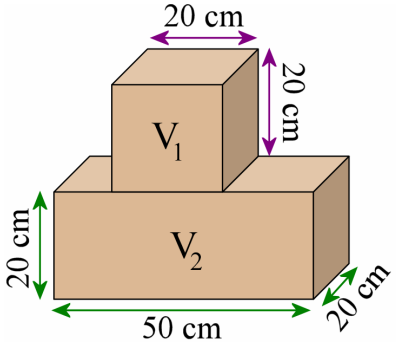
# Volume Is Additive

Volume is **additive**. What we mean by that is that we can ADD to find the total volume of a shape that is in several parts.

To find the total volume of the shape on the right, first find the volume of the top box, then the volume of the bottom box, and add the two volumes.




1. Find the total volume of the shape in the teaching box above.
   Show your work, and organize your work carefully, to avoid mistakes.

   $V_1$ =

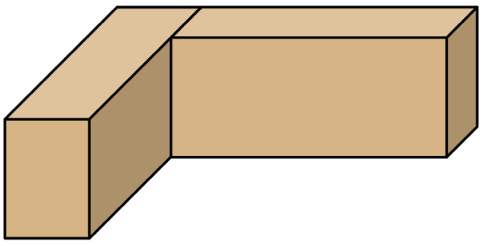
   $V_2$ =

   $V_{total} = V_1 + V_2$ =

2. This is a two-part storage cabinet. Its height is 2 m and depth 1 m. One part is 5 m long, and the other is 4 m long.

   **a.** Mark the given dimensions in the picture.

   **b.** Calculate the volume.



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# Mixed Review Chapter 9

1. Divide using long division. Check by multiplying.
(A Two-Digit Divisor/Ch.1; Divide Decimals by Whole Numbers 1/Ch 4)

| | |
|---|---|
| **a.** 9890 ÷ 46 | **b.** 71.5 ÷ 65 |

2. A bunch of five orchids costs $40 and a bunch of twenty daisies costs $40. Find the price difference between *one* orchid and *one* daisy.

3. Round these numbers to the nearest thousand, nearest ten thousand, and nearest million.
(Rounding/Ch.2)

| number | 102 925 | 632 996 029 | 56 087 530 721 |
|---|---|---|---|
| to the nearest 1000 | | | |
| to the nearest 10 000 | | | |
| to the nearest million | | | |

4. Multiply and divide mentally. (Various lessons/Ch.4 and 6)

| | | |
|---|---|---|
| **a.** 3 × 0.25 = _____ | **b.** 8 × 0.08 = _____ | **c.** $10^4$ × 0.009 = _____ |
| **d.** 0.9 × 0.8 = _____ | **e.** 0.02 × 0.5 = _____ | **f.** 2 × 0.3 × 7 = _____ |
| **g.** 0.8 ÷ 4 = _____ | **h.** 100 × 0.04 × 2 = _____ | **i.** 7.2 ÷ 8 = _____ |
| **j.** 0.8 ÷ 0.4 = _____ | **k.** 2 ÷ 0.01 = _____ | **l.** 0.056 ÷ 0.007 = _____ |

5. Solve. (Various lessons/Ch.8)

| | | |
|---|---|---|
| **a.** $6 \times \frac{1}{5} =$ | **b.** $\frac{1}{3} \times \frac{2}{7} =$ | **c.** $\frac{6}{11} \times \frac{1}{8} =$ |
| **d.** $\frac{10}{15} \times \frac{5}{6} =$ | **e.** $3 \div \frac{1}{5} =$ | **f.** $5 \div \frac{1}{3} =$ |
| **g.** $\frac{1}{5} \div 2 =$ | **h.** $\frac{1}{10} \div 3 =$ | **i.** $7 \div 5 =$ |
| **j.** $4 \div 9 =$ | **k.** $40 \div 3 =$ | **l.** $62 \div 9 =$ |

6. Jack has four rugs that are 1 3/8 metres long. What is the total length of the four rugs?

7. Mark an "x" if the number is divisible by 2, 3, 4, 5, 6, 8, or 9. (Divisibility and Factors/Ch.1)

| Divisible by | 2 | 3 | 4 | 5 | 6 | 8 | 9 |
|---|---|---|---|---|---|---|---|
| 125 | | | | | | | |
| 98 | | | | | | | |

| Divisible by | 2 | 3 | 4 | 5 | 6 | 8 | 9 |
|---|---|---|---|---|---|---|---|
| 560 | | | | | | | |
| 768 | | | | | | | |

8. This morning one of her children is sick, so Mom is making only 2/3 of her usual recipe for pancakes. How much of each ingredient will she need? (*dl* stands for *decilitre*)
(Multiply Fractions by Whole Numbers/Ch.8)

**Pancakes**

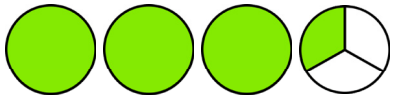
4 dl water
2 eggs
3 dl whole wheat flour
(pinch of salt)
50 g butter for frying

**Pancakes** (2/3 of the recipe)

_____ dl water
1 large egg
_____ dl whole wheat flour
(pinch of salt)
_____ g butter for frying

9. Solve. You can use the pie images to help. (Adding and Subtracting Mixed Numbers/Ch.7)

**a.** $4\frac{1}{2} - 1\frac{3}{8} =$



**b.** $3\frac{1}{3} - 2\frac{7}{12} =$