Lesson 12: Fractional lengths

Goals

- Apply dividing by fractions to solve a problem about comparing lengths or measuring with non-standard units, and explain (orally and in writing) the solution method.
- Interpret a question (in written language) about multiplicative comparison, e.g., “How many times as long?” and write a division equation to represent it.

Learning Targets

- I can use division and multiplication to solve problems involving fractional lengths.

Lesson Narrative

This is the first of four lessons in which students use multiplication and division of fractions to solve geometric problems. In this lesson, they encounter problems involving fractional lengths. They use their understanding of the two interpretations of division—“how many groups?” and “how much in each group?”—to solve problems that involve multiplicative comparison.

In these geometry-themed lessons, students work with a wider range of fractions and mixed numbers, which gives them opportunities to choose their methods and tools for problem solving.

Building On

- Apply properties of operations as strategies to multiply and divide. Students need not use formal terms for these properties. Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.)

Addressing

- Interpret and calculate quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. For example, create a story context for $\left(\frac{2}{3}\right) \div \left(\frac{3}{4}\right)$ and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that $\left(\frac{2}{3}\right) \div \left(\frac{3}{4}\right) = \frac{8}{9}$ because $\frac{3}{4}$ of $\frac{8}{9}$ is $\frac{2}{3}$. In general, $\left(\frac{a}{b}\right) \div \left(\frac{c}{d}\right) = \frac{ad}{bc}$. How much chocolate will each person get if 3 people share $\frac{1}{2}$ lb of chocolate equally? How many $\frac{3}{4}$ cup servings are in $\frac{2}{3}$ of a cup of yogurt? How wide is a rectangular strip of land with length $\frac{3}{4}$ mi and area $\frac{1}{2}$ square mi?

Instructional Routines

- Clarify, Critique, Correct
- Information Gap Cards
- Co-Craft Questions
- Discussion Supports
- Notice and Wonder
- Number Talk

Required Materials

Geometry toolkits

tracing paper, graph paper, coloured pencils, scissors, and an index card to use as a straightedge or to mark right angles.

When compasses are required they are listed as a separate Required Material.

Pre-printed slips, cut from copies of the blackline master

Required Preparation

You will need the Info Gap: How Many Would It Take? blackline master for this lesson. Make 1 copy for every 4 students, and cut them up ahead of time.

Consider preparing the objects mentioned in the Info Gap: How Many Would It Take? activity for students to verify their answers. These objects are: $\frac{3}{4}$-inch square stickers, $1\frac{1}{4}$-inch binder clips, and $1\frac{3}{4}$-inch paper clips.

If the optional Comparing Paper Rolls activity is chosen, consider preparing the paper towel and toilet paper rolls as displayed in the image.

Student Learning Goals

Let's solve problems about fractional lengths.

12.1 Number Talk: Multiplication Strategies

Warm Up: 5 minutes

This number talk encourages students to think carefully about the numbers in a computation problem and rely on what they know about structure, patterns, and properties of operations to mentally solve it. The reasoning helps students develop fluency and will support students in calculating products and quotients in upcoming work.

Instructional Routines

- Discussion Supports

- Number Talk

Launch

Give students 2 minutes of quiet think time and ask them to give a signal when they have an answer and a strategy. Follow with a whole-class discussion.

Representation: Internalise Comprehension. To support working memory, provide students with sticky notes or mini whiteboards.
Supports accessibility for: Memory; Organisation

Anticipated Misconceptions

When multiplying 19×14, students may only multiply the tens digits and multiply the ones digits and add them to get 136. Ask these students to estimate an answer for the problem and consider whether their answer makes sense.

Student Task Statement

Find the product mentally.

19×14

Student Response

$19 \times 14 = 266$. Possible strategies:

- Think of 14 as $10 + 4$, multiply 19 by 10 and 19 by 4 separately, and add the two products: $19 \times 10 + 19 \times 4 = 266$
- Think of 19 as $20 - 1$, multiply 14 by 20 and 14 by 1 separately, and subtract the two products: $20 \times 14 - 1 \times 14 = 266$
- Picture a rectangle (an area diagram) with $10 + 9$ for one side length and $10 + 4$ for the other, partition the rectangle into 4 sub-rectangles, and find the sum of their areas: $(10 \times 10) + (10 \times 4) + (9 \times 10) + (9 \times 4) = 266$

Activity Synthesis

Ask students to share their strategies for each problem. Record and display their explanations for all to see. Ask students if or how the factors in the problem impacted their strategy choice. To involve more students in the conversation, consider asking:

- "Who can restate ___'s reasoning in a different way?"
- "Did anyone solve the problem the same way but would explain it differently?"
- "Did anyone solve the problem in a different way?"
- "Does anyone want to add on to _____'s strategy?"

- "Do you agree or disagree? Why?"

Speaking: Discussion Supports.: Display sentence frames to support students when they explain their strategy. For example, "First, I _____ because . . ." or "I noticed _____ so I . . . ." Some students may benefit from the opportunity to rehearse what they will say with a partner before they share with the whole class.
Design Principle(s): Optimise output (for explanation)

12.2 Info Gap: How Many Would It Take?

15 minutes

In this activity, students use division to solve problems involving lengths. No methods are specified for any of the questions, so students need to choose an appropriate strategy.

The info gap structure requires students to make sense of problems by determining what information is necessary, and then to ask for information they need to solve it. This may take several rounds of discussion if their first requests do not yield the information they need. It also allows them to refine the language they use and ask increasingly more precise questions until they get the information they need.

Here is the text of the cards for reference and planning:

Info Gap: How Many Would It Take? Problem Card 1 Jada is using square stickers to decorate the spine of a photo album. If she places the stickers in a line, side by side without gaps or overlaps, how many stickers will it take?	Info Gap: How Many Would It Take? Data Card 1 • The photo album is $8\frac{1}{4}$ inches wide by $10\frac{1}{2}$ inches tall by $1\frac{1}{2}$ inches thick. • The photo album's spine is $10\frac{1}{2}$ inches long. • The side length of the stickers is $\frac{3}{4}$ inch. • Jada places the stickers in one straight line along the length of the spine.
Info Gap: How Many Would It Take? Problem Card 2 Tyler is using binder clips to decorate the edges of a poster. If he places the binder clips in a line, side by side without gaps or overlaps, how many binder clips will it take?	Info Gap: How Many Would It Take? Data Card 2 • The poster is 16 inches wide by 20 inches tall. • The binder clips are $1\frac{1}{4}$ inches wide. • Tyler places the binder clips in two straight lines, one along the left side of the poster and one along the right side.

Instructional Routines

- Information Gap Cards

Launch

Arrange students in groups of 2. In each group, distribute the first problem card to one student and a data card to the other student. After debriefing on the first problem, distribute the cards for the second problem, in which students switch roles.

Engagement: Develop Effort and Persistence. Display or provide students with a physical copy of the written directions. Check for understanding by inviting students to rephrase directions in their own words. Keep the display of directions visible throughout the activity.
Supports accessibility for: Memory; Organisation Conversing: This activity uses *Information Gap* to give students a purpose for discussing information needed to solve problems involving lengths using division. Display questions or question starters for students who need a starting point such as: "Can you tell me . . . (specific piece of information)", and "Why do you need to know . . . (that piece of information)?"
Design Principle(s): Cultivate Conversation

Anticipated Misconceptions

Some students may not know what is meant by the "spine" of a book. Consider holding up a book and pointing out where its spine is.

If students struggle to represent the situations mathematically, suggest that they draw diagrams to represent the situations. They could start with sketches of the objects and then move toward other simpler or more abstract representations as they make better sense of the problems.

Student Task Statement

Your teacher will give you either a *problem card* or a *data card*. Do not show or read your card to your partner.

If your teacher gives you the *problem card*:

1. Silently read your card and think about what information you need to be able to answer the question.

2. Ask your partner for the specific information that you need.

3. Explain how you are using the information to solve the problem.

   Continue to ask questions until you have enough information to solve the problem.

4. Share the *problem card* and solve the problem independently.

5. Read the *data card* and discuss your reasoning.

If your teacher gives you the *data card*:

1. Silently read your card.

2. Ask your partner *"What specific information do you need?"* and wait for them to *ask* for information.

   If your partner asks for information that is not on the card, do not do the calculations for them. Tell them you don't have that information.

3. Before sharing the information, ask "*Why do you need that information?*" Listen to your partner's reasoning and ask clarifying questions.

4. Read the *problem card* and solve the problem independently.

5. Share the *data card* and discuss your reasoning.

Student Response

1. It takes 14 stickers to make a line that is $10\frac{1}{2}$ inches long. $10\frac{1}{2} \div \frac{3}{4} = \frac{21}{2} \times \frac{4}{3} = 14$.

2. It takes 32 binder clips to make two lines that are each 20 inches long. $20 \div \frac{5}{4} = 20 \times \frac{4}{5} = 16$ and $16 \times 2 = 32$.

Are You Ready for More?

Lin has a work of art that is 14 inches by 20 inches. She wants to frame it with large paper clips laid end to end.

1. If each paper clip is $1\frac{3}{4}$ inch long, how many paper clips would she need? Show your reasoning and be sure to think about potential gaps and overlaps. Consider making a sketch that shows how the paper clips could be arranged.

2. How many paper clips are needed if the paper clips are spaced $\frac{1}{4}$ inch apart? Describe the arrangement of the paper clips at the corners of the frame.

Student Response

Answers vary. Sample response:

1. 38 paper clips.

   - One side of the paper is 20 inches long. $20 \div 1\frac{3}{4} = 11\frac{3}{7}$, so Lin can fit 11 paper clips along the side with a gap of $\frac{3}{4}$ inch since $11 \times 1\frac{3}{4} = 19\frac{1}{4}$. If the paper clips are centered along the 20-inch length, there will be $\frac{3}{8}$ inch of gap on either side.

   - The other side is 14 inches long. $14 \div 1\frac{3}{4} = 8$, so Lin can fit 8 paper clips along the side with no gap at all.

- At each corner of the paper, two paper clips will meet. If the paper clip has a width that is about $\frac{3}{8}$ inch (to fit in the $\frac{3}{8}$ gap left by the 11 paper clips along the longer side), then there will be no gap or overlap.
- Altogether, Lin will need 38 paper clips. $11 + 11 + 8 + 8 = 38$

2. 34 paper clips. If space is put between the paper clips, then fewer paper clips will be needed. If a gap of $\frac{1}{4}$ inch is between the paper clips, then each paper clip could have $\frac{1}{8}$ inch of space on either end so that the paper clip and its space takes up 2 inches. Then there are 7 paper clips along the sides of length 14 inches of the frame, and there are 10 paper clips along the sides of length 20 inches. There is a gap of $\frac{1}{8}$ inch between the end of the paper clip and the end of the frame.

Activity Synthesis

Select previously identified students to share their solutions and reasoning for each question. Start with students who used the more involved methods and move toward the more efficient ones. Record the approaches for all to see.

Highlight the connections between the different methods (e.g., between diagrams and equations, between a multiplication equation one student wrote and a division equation another person wrote for the same situation, etc.).

12.3 How Many Times as Tall or as Far?

15 minutes

In this activity, students practice performing division of fractions and using it to solve multiplicative comparison problems. The activity extends the work students have done earlier in the unit. In the Fractions of Ropes activity (in Lesson 7), students use diagrams to reason about how many times as long one rope is compared to another. Having had more experience in interpreting division situations and having learned a division algorithm, students can solve a wider range of problems that involve a greater variety of fractions. Minimal scaffolding is given here, so students need to decide what representations or strategies would be fruitful.

Instructional Routines

- Co-Craft Questions

Launch

Arrange students in groups of 4. Give students 1–2 minutes of quiet time to think about and draw a diagram for each question in the first problem. Ask them also to think about and write two equations that can represent the two questions. Afterward, give each group 2 minutes to compare their diagrams and equations.

Invite a couple of students to share their diagrams and equations. Ask the class whether they agree that the diagrams and equations represent the questions. Once students agree that the representations are appropriate, give them 8–10 minutes to complete the activity, either independently or collaboratively with their group. Encourage students to estimate the answer before calculating and to check their quotients using multiplication.

Reading, Conversing, Writing: Co-Craft Questions. To help students make sense of the language of mathematical comparisons, start by displaying only the context for the first question ("A Year 3 student is 4 feet tall. Her teacher is $5\frac{2}{3}$ feet tall."). Give students 1–2 minutes to write their own mathematical questions about the situation. Invite students to share their questions with the class, then reveal the activity's questions. Help students notice similarities and differences in how they phrased comparison questions and how the activity phrases these questions. For example, "Who's taller?" versus "How many times as tall . . . ." This will build student understanding of the language of mathematical comparisons and help ensure students interpret the task correctly.
Design Principle(s): Maximise meta-awareness; Cultivate conversation

Anticipated Misconceptions

If students have trouble drawing and using a diagram to compare lengths, ask them to revisit the Fractions of Ropes activity (in Lesson 7) and use the diagrams there as examples. Suggest that they try drawing a diagram on graph paper, as the grid could support them in drawing and making sense of the fractional lengths.

Student Task Statement

1. A Year 3 student is 4 feet tall. Her teacher is $5\frac{2}{3}$ feet tall.
   a. How many times as tall as the student is the teacher?
   b. What fraction of the teacher's height is the student's height?
2. Find each quotient. Show your reasoning and check your answer.
   a. $9 \div \frac{3}{5}$
   b. $1\frac{7}{8} \div \frac{3}{4}$
3. Write a division equation that can help answer each of these questions. Then find the answer. If you get stuck, consider drawing a diagram.
   a. A runner ran $1\frac{4}{5}$ miles on Monday and $6\frac{3}{10}$ miles on Tuesday. How many times her Monday's distance was her Tuesday's distance?
   b. A cyclist planned to ride $9\frac{1}{2}$ miles but only managed to travel $3\frac{7}{8}$ miles. What fraction of his planned trip did he travel?

Student Response

1.

a. The teacher is $\frac{17}{12}$ or $1\frac{5}{12}$ times as tall as the student. $5\frac{2}{3} \div 4 = \frac{17}{3} \times \frac{1}{4} = \frac{17}{12}$

b. The student is $\frac{12}{17}$ as tall as the teacher. $4 \div 5\frac{2}{3} = 4 \times \frac{3}{17} = \frac{12}{17}$

2.

a. $9 \times \frac{5}{3} = 15$

b. $\frac{15}{8} \times \frac{4}{3} = \frac{5}{2} = 2\frac{1}{2}$

3.

a. $6\frac{3}{10} \div 1\frac{4}{5}$. On Tuesday, she ran $3\frac{1}{2}$ times Monday's distance. $6\frac{3}{10} \div 1\frac{4}{5} = \frac{63}{10} \times \frac{5}{9} = \frac{7}{2} = 3\frac{1}{2}$

b. $3\frac{7}{8} \div 9\frac{1}{2}$. He travelled $\frac{31}{76}$ of his planned trip. $3\frac{7}{8} \div 9\frac{1}{2} = \frac{31}{8} \times \frac{2}{19} = \frac{31}{76}$

Activity Synthesis

Consider giving students access to the answers so they can check their work. Much of the discussion will have happened in small groups. If time permits, reconvene as a class to discuss the last set of questions and the different ways they were represented and solved.

12.4 Comparing Paper Rolls

Optional: 15 minutes

This optional activity gives students another opportunity to solve a contextual problem using what they know about fractions, relationships between multiplication and division, and diagrams. Students observe a photograph of two paper rolls of differing lengths and estimate the relationship between the lengths. The photograph shows that the longer roll is about $2\frac{1}{2}$ or $\frac{5}{2}$ times as long as the shorter roll. Students use this observation to find out the length of the shorter roll.

The two paper rolls are from paper towels and toilet paper. If possible, consider providing one of each roll to each group of students so they can physically compare their lengths in addition to observing the picture.

As students work, notice the different starting equations or diagrams they use to begin solving the problems. Ask students using different entry points to share later.

Instructional Routines

- Clarify, Critique, Correct
- Notice and Wonder

Launch

Keep students in groups of 4. Ask students to keep their materials closed. Display the image of the paper rolls for all to see. Give students 1–2 minutes to observe the picture. Ask them to be prepared to share at least one thing they notice and one thing they wonder. Then, invite students to share their observations and questions. If no students mention the relationship between the lengths of the rolls, ask them questions such as:

- "What do you notice about the lengths of the paper rolls or the relationships between those lengths?"
- "What questions can you ask about the lengths of the rolls?"
- "What information would you need to answer these questions?"

Then, give students 7–8 minutes of quiet time to complete the questions.

Action and Expression: Internalise Executive Functions. Provide students with a graphic organiser to include a table with the following headings: What do you notice?, What do you wonder?, What information do you need to answer these questions?
Supports accessibility for: Language; Organisation

Anticipated Misconceptions

Students might estimate the relationships between the lengths of rolls by rounding too much. For example, they might say that the length of the shorter roll is $\frac{1}{3}$ the length of the longer roll, or that the longer roll is twice as long as the shorter roll. If this happens, ask students to take a closer look and make a more precise estimate. Suggest that they divide the larger roll into smaller segments, each of which matches the length of the shorter rolls.

Student Task Statement

The photo shows a situation that involves fractions.

1. Complete the sentences. Be prepared to explain your reasoning.

a. The length of the long tube is about ______ times the length of a short tube.

b. The length of a short tube is about ______ times the length of the long tube.

2. If the length of the long paper roll tube is $11\frac{1}{4}$ inches, what is the length of each short paper roll tube?

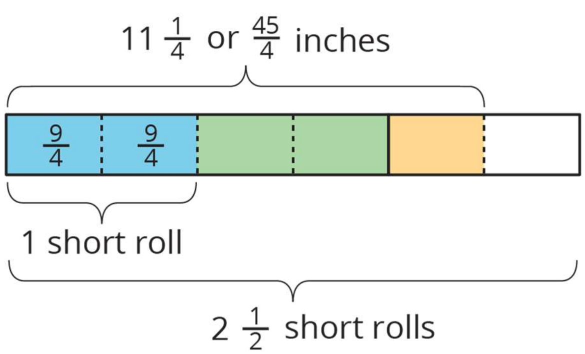
Student Response

a. About $\frac{5}{2}$ (or $2\frac{1}{2}$ or 2.5) times.

b. About $\frac{2}{5}$ (or 0.4) times.

1. $4\frac{1}{2}$ (or equivalent) inches. Sample reasoning:

- $11\frac{1}{4} \div 2\frac{1}{2} = \frac{45}{4} \div \frac{5}{2} = \frac{45}{4} \times \frac{2}{5} = 4\frac{1}{2}$
- $\frac{2}{5} \times 11\frac{1}{4} = \frac{2}{5} \times \frac{45}{4} = \frac{9}{2} = 4\frac{1}{2}$



Activity Synthesis

Invite previously identified students to share their strategies for finding the length of the short roll. Display their diagram and record their reasoning for all to see.

To find the length of the short roll, some students may use $11\frac{1}{4} \div \frac{5}{2} =?$ and others $\frac{2}{5} \times \frac{45}{4} =?$, depending on how they view the relationship between the rolls. Highlight the idea that to find the length of the short roll, one way is to partition the length of the large roll into 5 equal pieces and find that length and multiply it by 2, because the length of the shorter roll is about $\frac{2}{5}$ of that of the longer roll. This is an opportunity to reinforce the structure behind the division algorithm.

If appropriate, discuss the merits of writing the numbers as fractions versus as mixed numbers. Mixed numbers such as $2\frac{1}{2}$ and $11\frac{1}{4}$ are easier to visualise but $\frac{5}{2}$ and $\frac{45}{4}$ are easier to work with. In fact, we have to use the fractions (rather than mixed numbers) to easily multiply. Explain that two forms serve different purposes and that it is helpful to be able to change from one to the other depending on what we aim to do. When writing them as solutions to problems, both forms are mathematically correct.

Writing, Conversing: Clarify, Critique, Correct. Use this routine to help students evaluate the reasonableness of their answers. Display the following incorrect response: "The length of each short paper roll is $28\frac{1}{8}$ inches because I multiplied $\frac{45}{4} \times \frac{5}{2}$." Share with students that $\frac{45}{4} \times \frac{5}{2}$ is indeed $28\frac{1}{8}$. Give students 1 minute of quiet think time to consider this information. Ask students to discuss with their partner why the answer $28\frac{1}{8}$ doesn't make sense (the length of the short paper roll should be less than the length of the long paper roll). Next, ask students to identify why the equation $\frac{45}{4} \times \frac{5}{2} =?$ does not correctly represent this situation. Listen for and amplify corrections that include mathematical language and reasoning.
Design Principle(s): Maximise meta-awareness; Cultivate conversation

Lesson Synthesis

In this lesson, we used division to solve problems that involve fractional lengths. For example: How many $\frac{5}{8}$ inch paper clips, laid end to end, are in a length of $12\frac{1}{2}$ inches? Review how we can interpret such problems.

- "How is this question like those we have seen? How can division help us answer it?" (It is a 'how many groups?' question. We can think of it as 'how many $\frac{5}{8}$s in $12\frac{1}{2}$?' and solve it by finding $12\frac{1}{2} \div \frac{5}{8}$.)

- "Here is another question: 'What is the length of one stick if 9 sticks, laid end to end, make $12\frac{3}{8}$-inch?' How does division help us answer it?" (It is a 'how much in one group?' question. We can answer it by finding $12\frac{3}{8} \div 9$.)

We also saw that division can help us compare two lengths and find out how many times one is as long as the other. For example, suppose one hiking trail, Trail A, is $1\frac{1}{8}$ miles and another, Trail B, is $\frac{3}{4}$ miles.

- "How do we find out how many times as long as Trail A is Trail B?" (We can interpret the question as "___ times the length of A equals the length of B" or $? \times 1\frac{1}{8} = \frac{3}{4}$, and then find $\frac{3}{4} \div 1\frac{1}{8}$.)

- "What is another comparison question we could ask?" (How many times as long as Trail B is Trail A?)

- "How do we represent and answer that question?" (We can interpret it as "___ times the length of B is the length of A" or $? \times \frac{3}{4} = 1\frac{1}{8}$, and then find $1\frac{1}{8} \div \frac{3}{4}$.)

12.5 Building A Fence

Cool Down: 5 minutes

Student Task Statement

A builder was building a fence. In the morning, he worked for $\frac{2}{5}$ of an hour. In the afternoon, he worked for $\frac{9}{10}$ of an hour. How many times as long as in the morning did he work in the afternoon?

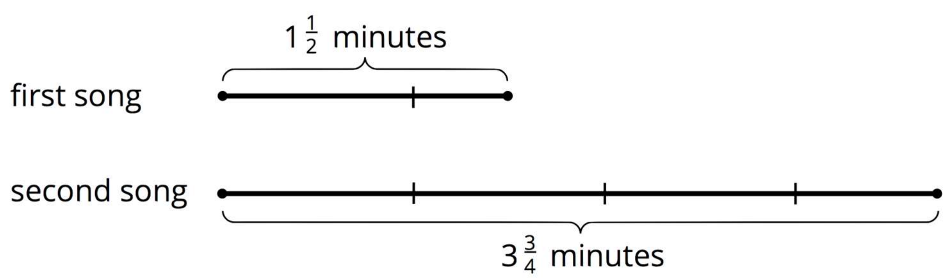
Write a division equation to represent this situation, then answer the question. Show your reasoning. If you get stuck, consider drawing a diagram.

Student Response

Division equation: $\frac{9}{10} \div \frac{2}{5} = ?$ (or $\frac{9}{10} \div ? = \frac{2}{5}$). In the afternoon, he worked $2\frac{1}{4}$ times as long as he did in the morning. Sample reasoning: $\frac{9}{10} \div \frac{2}{5} = \frac{9}{10} \times \frac{5}{2} = \frac{45}{20} = \frac{9}{4}$.

Student Lesson Summary

Division can help us solve comparison problems in which we find out how many times as large or as small one number is compared to another. For example, a student is playing two songs for a music recital. The first song is $1\frac{1}{2}$ minutes long. The second song is $3\frac{3}{4}$ minutes long.



We can ask two different comparison questions and write different multiplication and division equations to represent each question.

- How many times as long as the first song is the second song?

$$? \times 1\frac{1}{2} = 3\frac{3}{4}$$

$$3\frac{3}{4} \div 1\frac{1}{2} = ?$$

- What fraction of the second song is the first song?

$$?\times 3\frac{3}{4}=1\frac{1}{2}$$

$$1\frac{1}{2}\div 3\frac{3}{4}=?$$

We can use the algorithm we learned to calculate the quotients.

$$\begin{aligned}&=\frac{15}{4}\div\frac{3}{2}\\&=\frac{15}{4}\times\frac{2}{3}\\&=\frac{30}{12}\\&=\frac{5}{2}\end{aligned}$$

This means the second song is $2\frac{1}{2}$ times as long as the first song.

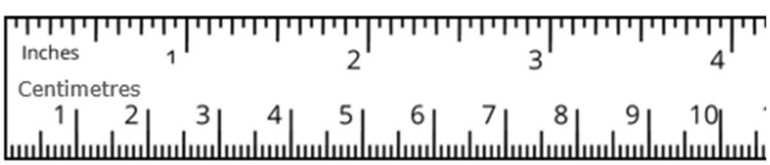
$$\begin{aligned}&=\frac{3}{2}\div\frac{15}{4}\\&=\frac{3}{2}\times\frac{4}{15}\\&=\frac{12}{30}\\&=\frac{2}{5}\end{aligned}$$

This means the first song is $\frac{2}{5}$ as long as the second song.

Lesson 12 Practice Problems

1. **Problem 1 Statement**

   One inch is around $2\frac{11}{20}$ centimetres.



   a. How many centimetres long is 3 inches? Show your reasoning.

   b. What fraction of an inch is 1 centimetre? Show your reasoning.

   c. What question can be answered by finding $10\div 2\frac{11}{20}$ in this situation?

Solution

a. $7\frac{13}{20}$ centimetres. $3 \times 2\frac{11}{20} = \frac{3}{1} \times \frac{51}{20} = \frac{153}{20}$, which is $7\frac{13}{20}$.

b. $\frac{20}{51}$. $1 \div 2\frac{11}{20} = 1 \times \frac{20}{51}$, which is $\frac{20}{51}$.

c. How many inches are in 10 centimetres?

2. **Problem 2 Statement**

A zookeeper is $6\frac{1}{4}$ feet tall. A young giraffe in his care is $9\frac{3}{8}$ feet tall.

a. How many times as tall as the zookeeper is the giraffe?

b. What fraction of the giraffe's height is the zookeeper's height?

Solution

a. $9\frac{3}{8} \div 6\frac{1}{4} = \frac{75}{8} \div \frac{25}{4}$, and $\frac{75}{8} \div \frac{25}{4} = \frac{75}{8} \times \frac{4}{25}$, which equals $\frac{3}{2}$. The giraffe is $\frac{3}{2}$ or $1\frac{1}{2}$ times as tall as the zookeeper.

b. $6\frac{1}{4} \div 9\frac{3}{8} = \frac{25}{4} \div \frac{75}{8}$, and $\frac{25}{4} \div \frac{75}{8} = \frac{25}{4} \times \frac{8}{75}$, which equals $\frac{2}{3}$. The zookeeper's height is $\frac{2}{3}$ of the giraffe's height.

3. **Problem 3 Statement**

A rectangular bathroom floor is covered with square tiles that are $1\frac{1}{2}$ feet by $1\frac{1}{2}$ feet. The length of the bathroom floor is $10\frac{1}{2}$ feet and the width is $6\frac{1}{2}$ feet.

a. How many tiles does it take to cover the length of the floor?

b. How many tiles does it take to cover the width of the floor?

Solution

a. 7 tiles ($10\frac{1}{2} \div 1\frac{1}{2} = \frac{21}{2} \div \frac{3}{2}$, and $\frac{21}{2} \div \frac{3}{2} = \frac{21}{2} \times \frac{2}{3}$, which equals 7.)

b. $4\frac{1}{3}$ tiles ($6\frac{1}{2} \div 1\frac{1}{2} = \frac{13}{2} \div \frac{3}{2}$, and $\frac{13}{2} \div \frac{3}{2} = \frac{13}{2} \times \frac{2}{3}$, which equals $\frac{13}{3}$ or $4\frac{1}{3}$)

4. **Problem 4 Statement**

The Food and Drug Administration (FDA) recommends a certain amount of nutrient intake per day called the "daily value." Food labels usually show percentages of the daily values for several different nutrients—calcium, iron, vitamins, etc.

Consider the problem: In $\frac{3}{4}$ cup of oatmeal, there is $\frac{1}{10}$ of the recommended daily value of iron. What fraction of the daily recommended value of iron is in 1 cup of oatmeal?

Write a multiplication equation and a division equation to represent the question. Then find the answer and show your reasoning.

Solution

$\frac{3}{4} \times ? = \frac{1}{10}$ (or equivalent), $\frac{1}{10} \div \frac{3}{4} = ?$.

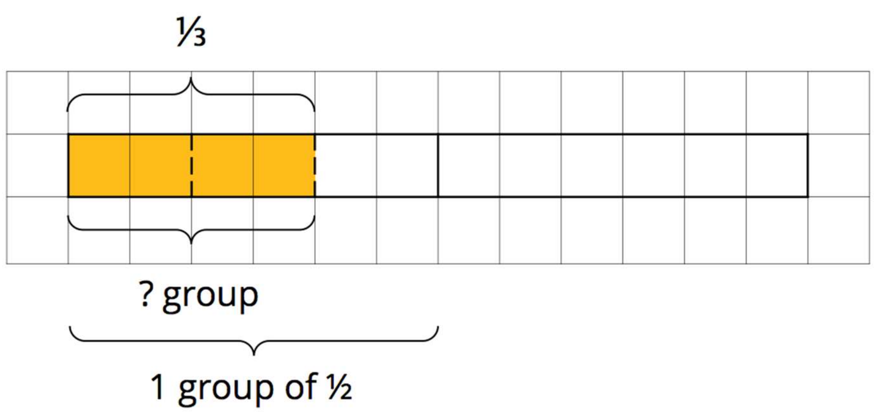
$\frac{2}{15}$ of the daily value of iron. Reasoning varies. Sample reasoning: $\frac{1}{10} \div \frac{3}{4} = \frac{1}{10} \times \frac{4}{3} = \frac{4}{30}$ or $\frac{2}{15}$.

5. **Problem 5 Statement**

What fraction of $\frac{1}{2}$ is $\frac{1}{3}$? Draw a bar model to represent and answer the question. Use graph paper if needed.

Solution

$\frac{2}{3}$

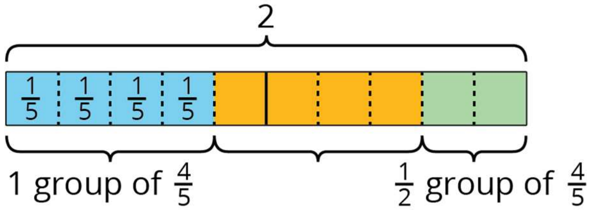


6. **Problem 6 Statement**

Noah says, “There are $2\frac{1}{2}$ groups of $\frac{4}{5}$ in 2.” Do you agree with him? Draw a bar model to show your reasoning. Use graph paper, if needed.

Solution

Agree. Sample diagram:


2
1/5
1/5
1/5
1/5
1 group of 4/5
1/2 group of 4/5