Problems About Length, Liquid Volume, Mass, and Weight

Dear Family,

This week your child is learning to solve problems about length, liquid volume, mass, and weight.

Your child is learning different ways to solve multi-step problems that involve converting larger units to smaller units for measurements of length, liquid volume, mass, and weight. Here is a liquid volume problem your child might see.

> *Robert makes punch for a party. He combines 1 liter of lemonade, a 2-liter bottle of sparkling water, and 750 milliliters of fruit juice. How many milliliters of punch does Robert make for the party?*

One way to help solve the problem is to use a table to think about the measurements and units given in the problem. Since the problem is in liters and milliliters, the first step is to convert liters to milliliters. Then combine the milliliters to find the total. You can organize the measurements in a table like the one below.

Given Volume	Volume in Milliliters
1 liter	1,000 milliliters
2 liters	2,000 milliliters
750 milliliters	750 milliliters

There are 1,000 milliliters in 1 liter. Multiply 1,000 by 2 to convert 2 liters to milliliters: $2 \times 1,000 = 2,000$. Add all the milliliter measurements to find the total: $1,000 + 2,000 + 750 = 3,750$ milliliters.

Invite your child to share what he or she knows about converting units to solve multi-step problems about length, liquid volume, mass, and weight by doing the following activity together.

SOLVING PROBLEMS ABOUT LENGTH, LIQUID VOLUME, MASS, AND WEIGHT

Do this activity with your child to solve multi-step problems about length, liquid volume, mass, and weight.

Make up multi-step problems about length, liquid volume, mass, and weight that might occur in everyday life. Here are some examples you might use:
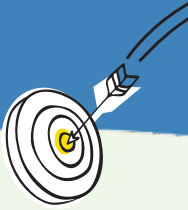
1. Josh wants to put in a new washing machine. The machine is 27 inches wide. Josh measured the width of his doorway. The doorway is 2 feet 8 inches wide. Will the new washing machine fit through the doorway? Remember that there are 12 inches in 1 foot.

2. Morgan wants to find out how much paint she has. She has two cans with 1 gallon of paint each, one can with 1 quart of paint, and one can with $\frac{1}{2}$ of a gallon of paint. How many quarts of paint does she have in all? Remember that there are 4 quarts in 1 gallon.

3. Aki has 3 pounds of cheese. He uses 4 ounces of cheese on each serving of pasta. How many servings of pasta can Aki put cheese on using the cheese he has? Remember that there are 16 ounces in 1 pound.

Look for other real-life opportunities to practice converting units to solve multi-step problems about length, liquid volume, mass, and weight with your child.

Answers: **1.** Yes, because 2 feet 8 inches is the same as 32 inches, and 27 inches is less than 32 inches; **2.** 11 quarts of paint: $4 + 4 + 1 + 2 = 11$; **3.** 12 servings, because 3 pounds is $3 \times 16 = 48$ ounces, and $48 \div 4 = 12$.

Explore Problems About Length, Liquid Volume, Mass, and Weight

You have learned how to solve multi-step problems. Now you will solve multi-step problems involving length, liquid volume, mass, and weight. Use what you know to try to solve the problem below.

> Julia buys a spool with 12 yards of wire. The students in her jewelry-making class use 4 yards 2 feet of the wire for one project and 7 feet of the wire for another project. How many feet of wire does Julia have left?

Learning Target

- Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

SMP 1, 2, 3, 4, 5, 6, 7, 8

TRY IT

Math Toolkit
- counters
- rulers
- math reference sheet
- number lines

DISCUSS IT

Ask your partner: Why did you choose that strategy?

Tell your partner: I do not understand how . . .

CONNECT IT

1 LOOK BACK

Explain how to find how many feet of wire Julia has left.

2 LOOK AHEAD

You can use a visual model or equation to solve a multi-step problem that involves converting units of length. Suppose you have the problem below.

Martin has **8 yards of twine**. He uses **2 yards 1 foot for one project** and **4 feet for another project**. How many **feet of twine does Martin have left**?

a. The bar model shows the information in the problem. Convert yards to feet and complete the bar model. 8 yards is the same as .... **feet** and **2 yards 1 foot** is the same as .... **feet**.

8 yards = ... feet

7 feet	4 feet	t feet
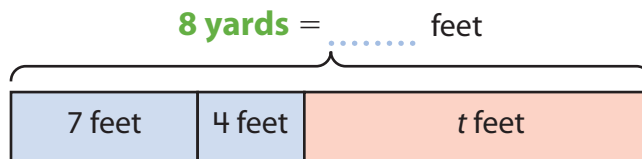
b. Use the bar model to write an expression to represent the number of feet of twine Martin uses for both projects. ....

c. Write and solve an equation to find the number of feet of twine Martin has left.

d. How many feet of twine does Martin have left? ....

3 REFLECT

How does the bar model show what operation(s) to use to solve the problem?

....

....

Prepare for Problems About Length, Liquid Volume, Mass, and Weight

1 Think about what you know about measurement. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

Examples	Examples	Examples

units of length

Examples	Examples	Examples

2 Write two different units you could use to measure the following.

your finger: ....

your desk: ....

the length of your classroom: ....

3 Maya has 7 yards of ribbon. She uses 4 yards to make bows and 1 yard 2 feet for a wreath. How many feet of ribbon does Maya have left?

Solution

4 Check your answer. Show your work.

Develop Solving Problems About Length

Read and try to solve the problem below.

Cindy buys a party sandwich that is 5 feet long. Her brother cuts off a piece of the sandwich that is $\frac{3}{4}$ of a foot long. Cindy cuts the remaining sandwich into 3-inch pieces to share with guests. How many 3-inch pieces does she make?
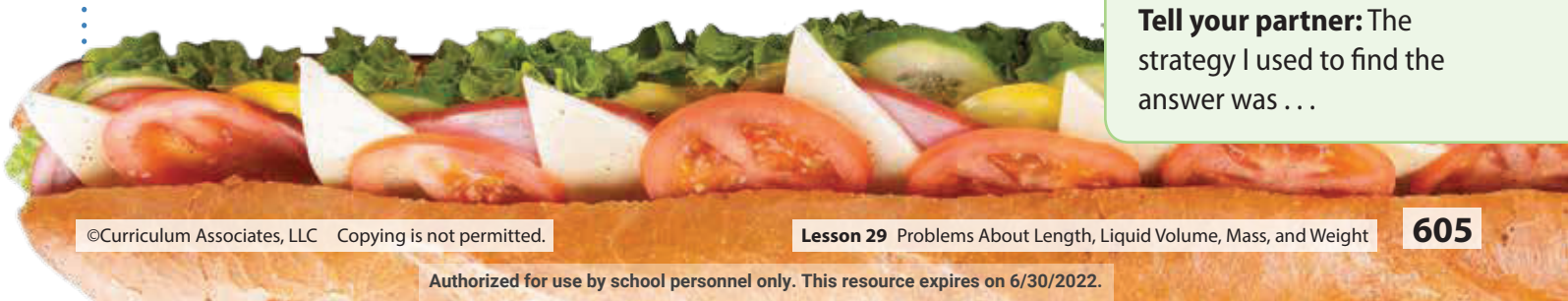
TRY IT

🧰 Math Toolkit
- counters
- rulers
- math reference sheet
- number lines

DISCUSS IT

Ask your partner: Can you explain that again?

Tell your partner: The strategy I used to find the answer was . . .

Explore different ways to understand how to solve problems about length.

> **Cindy buys a party sandwich that is 5 feet long. Her brother cuts off a piece of the sandwich that is $\frac{3}{4}$ of a foot long. Cindy cuts the remaining sandwich into 3-inch pieces to share with guests. How many 3-inch pieces does she make?**

MODEL IT

You can use a model to help solve length problems.

The top bar of the model shows the length of the full sandwich. The bottom bar shows the amount of sandwich that is cut off, $\frac{3}{4}$ **of a foot**, and the part of the sandwich that will be **cut into 3-inch pieces**.

5 feet

	$\frac{3}{4}$ foot

Amount cut into 3-inch pieces   **Amount cut off**
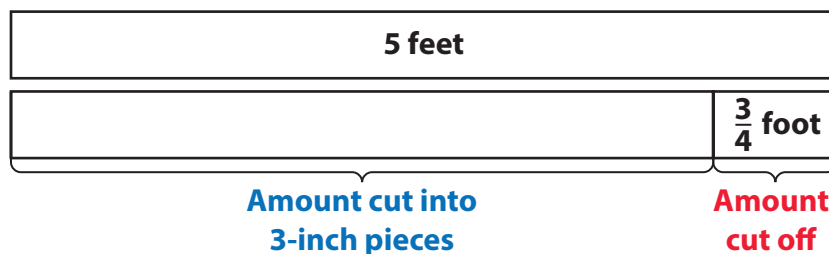
MODEL IT

You can use a number line to solve length problems.

The number line shows the length of the sandwich, 5 feet.
Each foot is divided into four 3-inch sections.
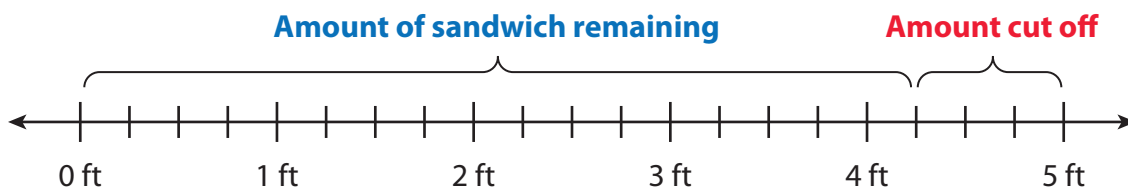
Amount of sandwich remaining   **Amount cut off**

0 ft   1 ft   2 ft   3 ft   4 ft   5 ft

CONNECT IT

Now you will use the problem from the previous page to help you understand how to solve problems about length.

1 How are the bar model and the number line similar? How are they different?

2 What part of a foot does each tick mark on the number line model stand for?

....

How many inches does each tick mark stand for? ....

3 Use the number line to find the length of the sandwich that is left, in feet.

....

4 How many 3-inch pieces are there in the remaining sandwich? Explain.

5 Explain how a number line helps you see both inches and fractional parts of a foot at the same time.

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model Its**. Which models or strategies do you like best for solving multi-step problems about length? Explain.

....

....

....

....

APPLY IT

Use what you just learned to solve these problems.

7 Lulu has 10 feet of ribbon. She uses $1\frac{1}{3}$ feet of ribbon for a project. She uses the rest of the ribbon to make bows. She uses 8 inches of ribbon for each bow. How many bows does Lulu make? Show your work.

Solution ....

8 Raquel and Bernie drive a total of 1,836 kilometers in 4 days. They drive 630 kilometers on the first day. They drive an equal number of kilometers of the remaining distance on each of the next 3 days. How many kilometers do they drive on each of these 3 days? Show your work.

Solution ....

9 Tom and Paul enter the long jump contest at Field Day. Tom jumps a distance of 2 yards 9 inches. Paul jumps a distance of 4 yards. How many inches farther does Paul jump than Tom?

Solution ....

Practice Solving Problems About Length

Study the Example showing how to solve a multi-step problem about length.
Then solve problems 1–5.

EXAMPLE

Wendy has a fence that is 10 feet long. Vines cover a section of fence that is $\frac{1}{2}$ of a foot long. Wendy and 2 friends each paint an equal length of the rest of the fence. How long, in inches, is the section of the fence each friend paints? (1 foot = 12 inches)

Length of fence		

Length
with vines   Each length
                               to paint
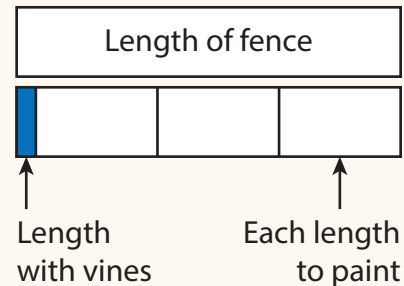
Length of fence: 10 feet = 120 inches

Length covered with vines: $\frac{1}{2}$ of a foot = 6 inches

Length painted: 120 − 6 = 114 inches

Length of each section: 114 ÷ 3 = 38 inches

The section of fence that each friend paints is 38 inches long.

1 Nestor needs 750 centimeters of rope. Rope comes in lengths of $4\frac{1}{2}$ meters and 9 meters at the hardware store. Which length of rope should Nestor buy? (1 meter = 100 centimeters)

$4\frac{1}{2}$ meters = _____ centimeters   9 meters = _____ centimeters

a. Which length is greater than 750 centimeters? _____ centimeters

b. Nestor should buy rope with a length of _____ meters.

2 Which length is greater, $\frac{1}{2}$ of a meter or 240 centimeters? Explain.

3 Jorge carries a football forward $5\frac{2}{3}$ yards on one play. He carries the football backward 1 foot on the next play. How far forward is the ball, in feet, from the place where Jorge started to carry the ball? Show your work. (1 yard = 3 feet)

Solution ....

4 Marion is $3\frac{1}{2}$ feet tall. She is 4 inches taller than her brother Elijah. She is $1\frac{1}{4}$ feet shorter than her sister Lorie. How tall are Elijah and Lorie, in inches? Show your work. (1 foot = 12 inches)

Elijah: .... Lorie: ....

5 Tracy needs 31.5 meters of wood for a porch railing. She has three pieces of wood that are each 8 meters long and one piece that is 7 meters long. Does Tracy have enough wood for the porch railing? Show your work.

Solution ....

Develop Solving Problems About Liquid Volume

Marco, Javier, and Jim go to a party. Marco brings $1\frac{1}{2}$ liters of lemonade, Javier brings a 2-liter bottle of lemonade, and Jim brings 450 milliliters of lemonade. How many milliliters of lemonade do the boys bring to the party in all? (1 liter = 1,000 milliliters)

TRY IT

Math Toolkit
- math reference sheet
- number lines
- grid paper

DISCUSS IT

Ask your partner: How did you get started?

Tell your partner: I started by . . .

Explore different ways to understand how to solve problems about liquid volume.

> **Marco, Javier, and Jim go to a party. Marco brings $1\frac{1}{2}$ liters of lemonade, Javier brings a 2-liter bottle of lemonade, and Jim brings 450 milliliters of lemonade. How many milliliters of lemonade do the boys bring to the party in all? (1 liter = 1,000 milliliters)**

PICTURE IT
You can use a picture to help solve liquid volume problems.

Think about the units for each amount of lemonade.

$1\frac{1}{2}$ liters   2 liters   450 milliliters

MODEL IT
You can use a table to help solve liquid volume problems.

Make a table to show the volumes of the three containers in the given units in one column and the volumes in milliliters in the other column.

1 liter = 1,000 milliliters and $\frac{1}{2}$ of a liter = 500 milliliters

Given Volume	Volume in Milliliters
$1\frac{1}{2}$ liters	1,500 milliliters
2 liters	2,000 milliliters
450 milliliters	450 milliliters

CONNECT IT

Now you will use the problem from the previous page to help you understand how to solve problems about liquid volume.

1. Use the amounts of lemonade given in the problem to write an equation that shows the total amount of lemonade, *t*, the boys bring to the party.

2. What units are included in the equation? ....

3. Look at the table in **Model It**. Explain how to convert $1\frac{1}{2}$ liters to milliliters.

    How many milliliters are in 2 liters? ....

4. What is the total amount of lemonade the three boys bring to the party? Explain.

5. Explain how to solve a problem about liquid volume when measurements are given in different units.

6. **REFLECT**

    Look back at your **Try It**, strategies by classmates, and **Picture It** and **Model It**. Which models or strategies do you like best for solving multi-step problems about liquid volume? Explain.

    ....

    ....

    ....

APPLY IT

Use what you just learned to solve these problems.

7 Joanne is making punch. She uses $\frac{1}{2}$ of a gallon of orange juice, 3 quarts of lemonade, and $1\frac{1}{4}$ gallons of apple cider. How many quarts of punch does Joanne have in all? How many 1-cup servings are there in all? Show your work. (1 gallon = 4 quarts and 1 quart = 4 cups)

Solution ....

8 Matt has $4\frac{3}{4}$ cups of milk. He drinks 10 fluid ounces of the milk. How many fluid ounces of milk does Matt have left? Show your work. (1 cup = 8 fluid ounces)

Solution ....

9 Carlos makes 3 liters of horchata. His sister drinks 300 milliliters. His brother drinks 550 milliliters. How many milliliters of horchata does Carlos have left? Show your work. (1 liter = 1,000 milliliters)

Solution ....

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Practice Solving Problems About Liquid Volume

Study the example showing how to solve a multi-step problem about liquid volume. Then solve problems 1–5.

EXAMPLE

Naomi has a container of water. She uses 4 liters to water her vegetable garden. She uses $3\frac{1}{2}$ liters to water flowers. She uses the remaining 500 milliliters in the container to fill up a bird bath. How many milliliters of water did Naomi have in the container? (1 liter = 1,000 milliliters)

Write an equation to find the total amount of water.	$w = 4\,L + 3\frac{1}{2}\,L + 500\,mL$
Convert liters to milliliters.	$4 \times 1,000\,mL = 4,000\,mL$ $3 \times 1,000\,mL = 3,000\,mL$ and $\frac{1}{2}$ of $1,000\,mL$ is $500\,mL$
Write the equation using milliliters and solve.	$w = 4,000\,mL + 3,500\,mL + 500\,mL$ $w = 8,000\,mL$

Naomi had 8,000 milliliters of water in the container.

Benny has two small fish tanks with one fish in each tank. One tank has $3\frac{1}{2}$ quarts of water. The other tank has 12 cups of water. Benny combines the water into one large fish tank with both fish in the large tank.

1　How many cups of water are in the large tank? (1 quart = 4 cups)

$3\frac{1}{2}$ quarts: 3×4 cups = _____ cups and $\frac{1}{2}$ of 4 cups is _____ cups

$3\frac{1}{2}$ quarts = _____ cups; _____ cups + _____ cups = _____ cups

There are _____ of water in the large tank.

2　At least 5 cups of water are needed for each fish in a tank. How many more fish would Benny be able to put in the large tank? Explain.

Solution ....

....

3 Ms. Tam has three containers to use in an experiment. The first container has 600 milliliters of water, the second has 2 liters, and the third has 1.5 liters. How many milliliters of water does Ms. Tam have in all? Show your work. (1 liter = 1,000 milliliters)

Solution ....

4 Sharon and her cousin make smoothies at a family reunion. Sharon brings $2\frac{1}{2}$ gallons of milk. Her cousin brings 2 quarts of milk. The girls use 8 quarts of milk for the smoothies. How much milk is left? (1 gallon = 4 quarts)

Ⓐ 4 quarts   Ⓑ 6 quarts

Ⓒ 4 gallons   Ⓓ 6 gallons

5 Rob has 6 quarts of apple cider for the fall fair. He pours all the cider into glasses to set on picnic tables. He pours 6 fluid ounces of cider into each glass. How many glasses of cider does Rob set on the tables? Show your work. (1 quart = 4 cups; 1 cup = 8 fluid ounces)

Solution ....

Develop Solving Problems About Mass and Weight

Kyle has a jar filled with quarters. The empty jar has a mass of 400 grams. The same jar filled with quarters has a mass of 1.5 kilograms. If each quarter has a mass of about 5 grams, about how many quarters are in the jar? (1 kilogram = 1,000 grams)

TRY IT

🧰 Math Toolkit
- math reference sheet
- number lines

DISCUSS IT

Ask your partner: Do you agree with me? Why or why not?

Tell your partner: I agree with you about . . . because . . .

Explore different ways to understand how to solve problems about mass and weight.

> **Kyle has a jar filled with quarters. The empty jar has a mass of 400 grams. The same jar filled with quarters has a mass of 1.5 kilograms. If each quarter has a mass of about 5 grams, about how many quarters are in the jar? (1 kilogram = 1,000 grams)**

PICTURE IT

You can use a picture to help understand the problem.

Think about the relationship between the mass of each quarter, the mass of the empty jar, and the mass of the jar filled with quarters.

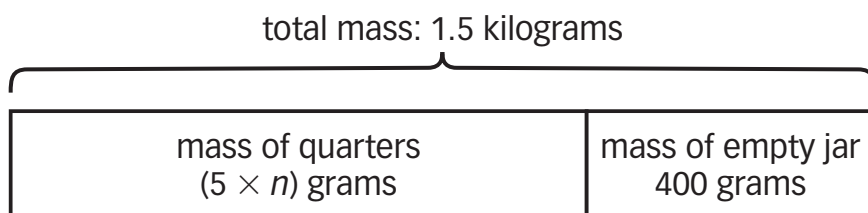| 5 grams | 400 grams | 1.5 kilograms |

MODEL IT

You can use a bar model to help solve problems about mass and weight.

Use n to represent the number of quarters.

The mass of 1 quarter is 5 grams, so the expression $5 \times n$ represents the mass of the quarters in the jar, in grams.

total mass: 1.5 kilograms

mass of quarters $(5 \times n)$ grams	mass of empty jar 400 grams

CONNECT IT

Now you will use the problem from the previous page to help you understand how to solve problems about mass and weight.

1 The mass of the empty jar is .... grams.

The total mass of the jar filled with quarters is .... kilograms or

.... grams.

2 Write and solve an equation to find the mass of the quarters in grams.

3 Write and solve an equation to find about how many quarters are in the jar.

4 How does using a bar model to write an equation help you solve a word problem about mass?

5 REFLECT

Look back at your **Try It**, strategies by classmates, and **Picture It** and **Model It**. Which models or strategies do you like best for solving multi-step problems about mass or weight? Explain.

....

....

....

....

....

APPLY IT

Use what you just learned to solve these problems.

6 A baker has one recipe for dinner rolls that uses 1 kilogram of flour. The baker has another recipe that uses 700 grams of flour. How many grams of flour does the baker use to make two batches of each recipe? Show your work. (1 kilogram = 1,000 grams)

Solution ....

....

7 A can of nuts weighs 1 pound, 1 ounce. The empty can weighs 3 ounces. Suppose you pour half the nuts from the can into a bowl. How many ounces of nuts are in the bowl? Show your work. (1 pound = 16 ounces)

Solution ....

8 Tia picks 2 kilograms of strawberries. Her brother picks 850 grams of strawberries. Her sister picks $2\frac{1}{2}$ kilograms of strawberries. How many grams of strawberries do they pick in all? Show your work. (1 kilogram = 1,000 grams)

Solution ....

Practice Solving Problems About Mass and Weight

Study the example problem showing how to solve a multi-step problem about weight. Then solve problems 1–5.

EXAMPLE

The softball coach has a box filled with softballs. The weight of the empty box is 3 pounds. When it is filled with softballs, the box weighs 12 pounds. Each softball has a weight of 6 ounces. How many softballs are in the box? (1 pound $=$ 16 ounces)

Find the weight of the softballs in ounces.
   $s = 12$ pounds $- 3$ pounds $= 9$ pounds
   $s = 9 \times 16$ ounces $= 144$ ounces

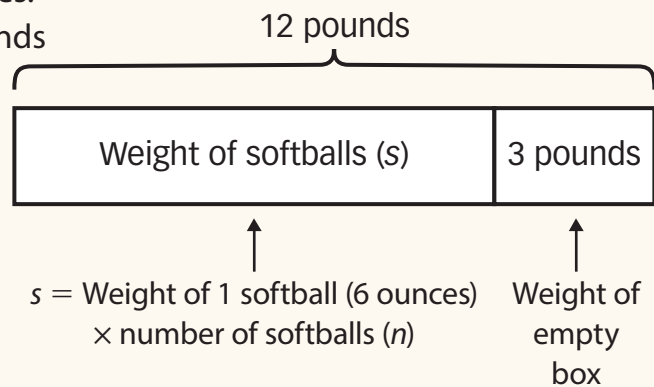Find the number of softballs.
   $s = 6 \times n$
$144 = 6 \times n$
   $24 = n$

There are 24 softballs in the box.

12 pounds

| Weight of softballs (s) | 3 pounds |

$s =$ Weight of 1 softball (6 ounces) $\times$ number of softballs (n)

Weight of empty box

1 Look at the example above. Explain why you need to find the weight of the softballs in the box in ounces.

2 Tyson's baby brother weighed 7 pounds, 3 ounces when he was born. The baby lost 9 ounces after a few days, and then gained 1 pound, 6 ounces by the end of the second week. How many ounces did the baby weigh at the end of the second week? Show your work. (1 pound $=$ 16 ounces)

Solution ....

3) Melinda makes 5 pounds of trail mix. She puts 4 ounces in each bag. She has 20 ounces of trail mix left over. How many bags of trail mix does Melinda make? Show your work. (1 pound = 16 ounces)

Solution ....

4) A large truck that moves cars can carry a maximum load of 15,720 pounds. The table below shows the weight of each kind of car that could be loaded onto the truck. (1 ton = 2,000 pounds)

Kind of Car	Compact	Mid-size	Full-size
Weight (in tons)	$1\frac{1}{2}$	$2\frac{1}{4}$	3

Tell whether the truck is able to carry each load of cars below.

	Yes	No
2 full-size cars, 1 compact car	Ⓐ	Ⓑ
2 compact cars, 2 full-size cars	Ⓒ	Ⓓ
2 mid-size cars, 2 compact cars	Ⓔ	Ⓕ
4 mid-size cars	Ⓖ	Ⓗ

5) A paper clip has a mass of 1 gram. A box of paper clips has 100 paper clips. Which equations below can be used to find the number of boxes of paper clips that have a mass of 1 kilogram? Let n be the number of boxes. (1 kilogram = 1,000 grams)

Ⓐ $100 = 1,000 \div n$

Ⓑ $n = 1,000 \times 100$

Ⓒ $n = 1,000 \div 100$

Ⓓ $1,000 = n \times 100$

Ⓔ $n = 1,000 - 100$

Refine Problems About Length, Liquid Volume, Mass, and Weight

Complete the Example below. Then solve problems 1–9, using the Math Reference Sheet as necessary.

EXAMPLE

Vera has a piece of ribbon. She cuts off a 40-centimeter length for a project. She cuts the remaining length of ribbon into 7 pieces that are each 30 centimeters long. How long was the original piece of ribbon?

Look at how you could show your work using a bar model.

40	30	30	30	30	30	30	30

?
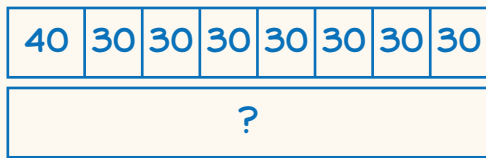
$$40 + (7 \times 30) = 40 + 210 = 250$$

Solution ....

Vera can multiply to find the length of the 7 equal-sized pieces and then add the length of the cut-off piece to find the original length.

PAIR/SHARE
How else could you solve the problem?

APPLY IT

1 Mary has a board that is 7 feet long. She cuts off $\frac{1}{4}$ of a foot of the board to make an even edge. Then Mary cuts the remaining board into 3 pieces that are the same length. How long, in feet, is each piece? Show your work.

Will Mary add, subtract, multiply, or divide to get 3 equal lengths?

PAIR/SHARE
How did you solve the problem? Why did you choose that method?

Solution ....

2 A wildlife sanctuary has two elephants. One has a weight of 11,028 pounds and the other has a weight of $5\frac{1}{2}$ tons. A platform can hold 22,000 pounds. Can the platform hold both elephants? Explain your reasoning. Show your work.

> Will the combined weight be measured in pounds or tons?

Solution ....

....

3 Jessica is making punch. She mixes 132 fluid ounces of juice and 15 cups of seltzer. How many 6-ounce glasses can she fill with punch?

Ⓐ   20 glasses

Ⓑ   22 glasses

Ⓒ   24 glasses with 3 ounces left over

Ⓓ   42 glasses

Jason chose Ⓒ as the correct answer. How did he get that answer?

> How can you convert 15 cups to fluid ounces?

4 John is mixing paint for an art project. He combines 4 quarts of white paint with $3\frac{1}{2}$ gallons of blue paint. He uses 2 quarts of the paint. How much paint does he have left?

Ⓐ 4 quarts

Ⓑ $9\frac{1}{2}$ quarts

Ⓒ 16 quarts

Ⓓ 20 quarts

5 Four friends pick small pumpkins at a pumpkin patch. The table below shows the weight of each pumpkin.

Friend	Kelly	Neelam	Jackson	Raul
Weight of Pumpkin	2 pounds 9 ounces	30 ounces	$2\frac{1}{2}$ pounds	38 ounces

Order the weights of the pumpkins, in ounces, from least to greatest.

....................., ..., ..., ...

6 Tara has a 5-liter container of water. She pours 3 liters of the water into a pitcher. She pours the rest of the water into 8 glasses so that each glass has an equal amount of water. How many milliliters of water does Tara pour into each glass?

Ⓐ 25 milliliters

Ⓑ 250 milliliters

Ⓒ 500 milliliters

Ⓓ 1,000 milliliters

7 A parking lot is 316 feet long. Workers paint lines to make one row of parking spaces. They do not paint lines on a 28-foot length at one end of the row in order to allow cars room to turn. The workers paint lines along the rest of the row to make 9-foot-wide parking spaces. How many parking spaces does the parking lot have? Show your work.

Solution ....

8 Tony is making potato salad for a school picnic. He needs a total of 3 kilograms of potatoes. He has a 1.5- kilogram bag and an 850-gram bag. How many more grams of potatoes does Tony need? Show your work.

Solution ....

9 MATH JOURNAL

Frida has 14 yards of yarn. She gives 5 feet of the yarn to a friend. Then she uses 8 yards, 1 foot of the yarn to finish a project. How many feet of yarn does Frida have left? Explain how to find the answer.

☑ SELF CHECK Go back to the Unit 4 Opener and see what you can check off.