Model and Solve Multi-Step Problems

LESSON 10

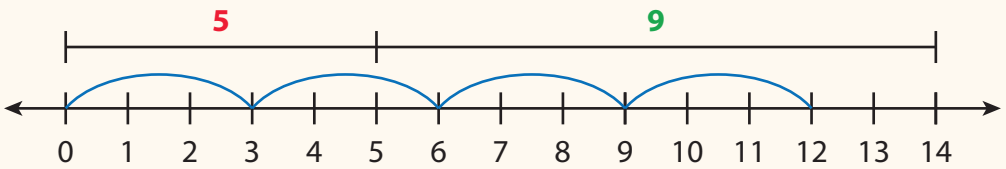
Dear Family,

This week your child is learning to model and solve multi-step problems.

Your child might see a problem like the one below.

> *Jana is making apple tarts. Each tart uses 3 apples. Jana has 5 red apples and 9 green apples. Write and solve an equation to find out how many apple tarts she can make.*

Your child is learning to use a number line to help understand the problem and write an equation.



The number line shows the **5 red apples** and the **9 green apples** that Jana has. The curves above the number line show jumps of 3 because **3 apples** are needed to make each apple tart. Looking at the number line can help your child write an equation such as the one shown below.

$(5 + 9) \div 3 = t$

Your child can solve the equation for t, the number of apple tarts that Jana can make.

$14 \div 3 = 4 \text{ R } 2$

The answer to the problem is that Jana can make 4 apple tarts with 2 apples left over.

Invite your child to share what he or she knows about solving multi-step problems by doing the following activity together.

ACTIVITY MODELING AND SOLVING MULTI-STEP PROBLEMS

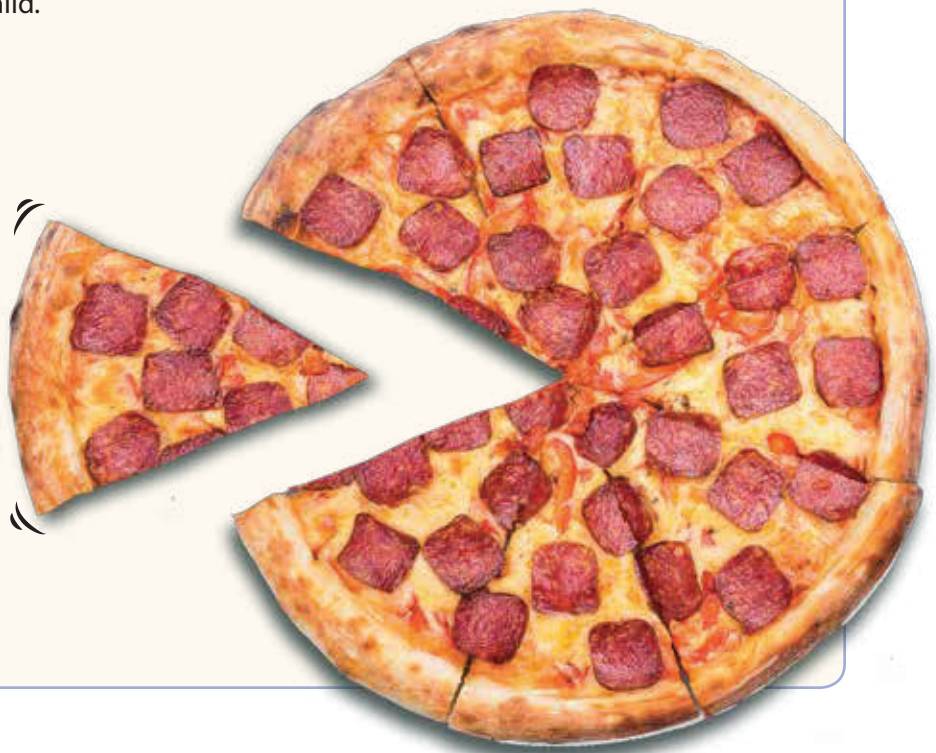
Do this activity with your child to model and solve multi-step problems.

- Work together with your child to look around the house or think about family activities that involve more than one of an item. Examples might be buying 6-packs of sports drinks or ordering an 8-slice pizza.
- Take turns. One person says a sentence about the item that includes the number of the item (for example, 6 bottles of sports drink or 8 slices of pizza). The second person asks a question about the item that uses a one-digit number.

  For example: *There are 8 slices of pizza in a pizza pie.*
  How many slices are in 2 pizzas?

- Work together with your child to answer the question. Then the first person asks how many of each item (sports drinks, slices of pizza, etc.) each person in your family would get if you divided the items among the number of people in your family. Would there be any items left over?
- Work together with your child to solve the problem. Encourage your child to write an equation that shows the information in the problem. Then work together to solve the equation.

Look for real-life opportunities to model and solve multi-step problems with your child.



Explore Modeling and Solving Multi-Step Problems

You know how to solve two-step problems. Now you will write equations in order to solve problems that have multiple steps. Use what you know to try to solve the problem below.

On a test, Lola scores 6 points on each of the first three questions and 4 points on each of the other two questions. How many points does Lola score on all five questions?

Learning Target

- Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

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

TRY IT

Math Toolkit

- counters
- cups
- paper plates
- number lines
- index cards
- base-ten blocks
- multiplication models

DISCUSS IT

Ask your partner: How did you get started?

Tell your partner: I knew . . . so I . . .

CONNECT IT

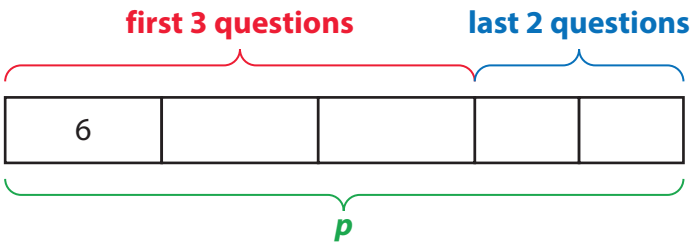
1 LOOK BACK

Explain how you found the number of points Lola scores on all five questions.

2 LOOK AHEAD

You can model and solve problems in different ways.

a. You can use a bar model to model the problem. Complete the bar model to show the points Lola scores on all five questions.



b. You can also model the problem with an equation. In an equation, you can use a letter, such as ***p*** in the bar model above, to represent the unknown. The unknown in this problem is the total number of points Lola scores.

Complete one way to write an equation.

(..... × .....) + (..... × .....) = ***p***

points on first 3 questions **points on last 2 questions**

c. How many points does Lola score in all? ***p*** = ...

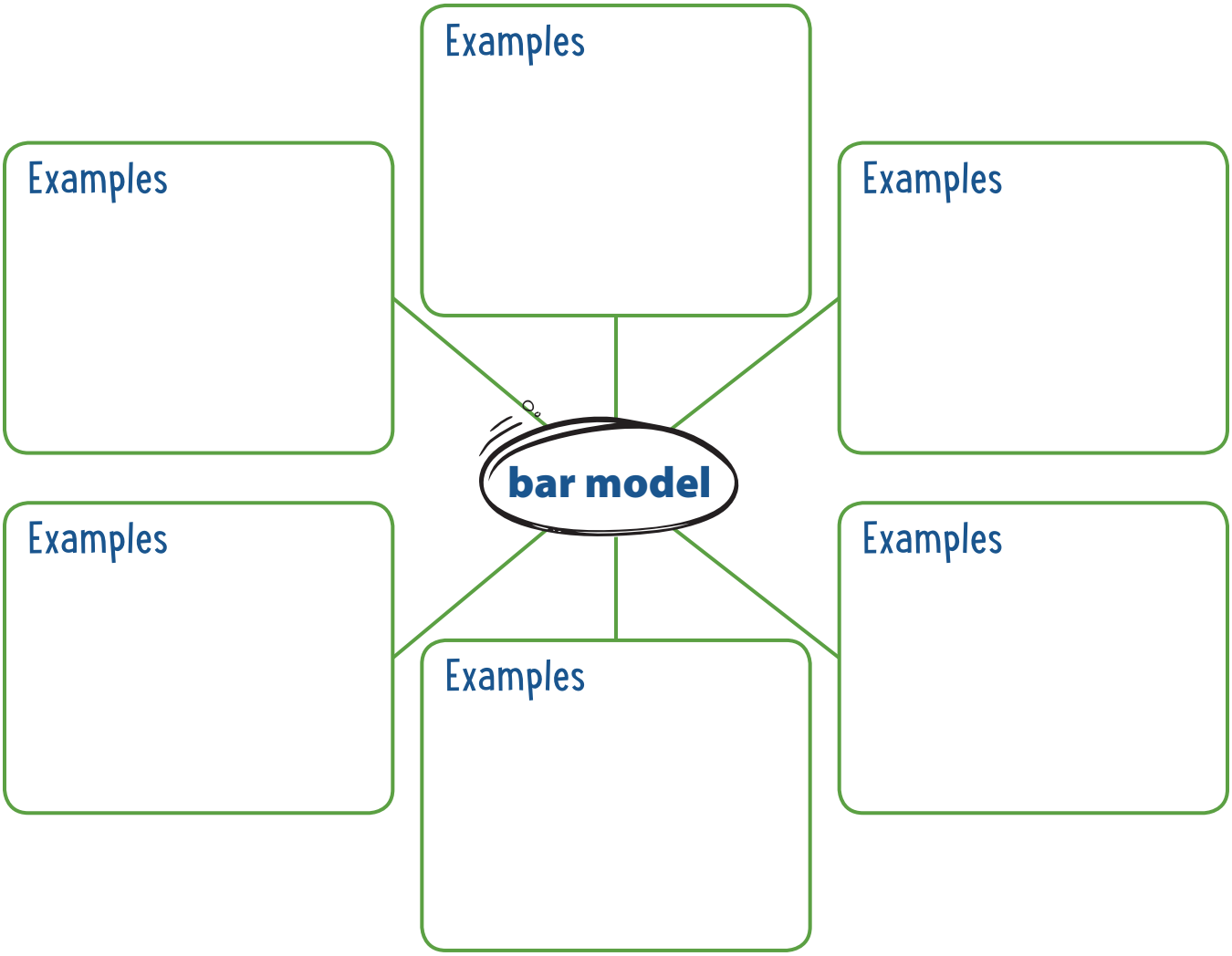
3 REFLECT

You can model problems in different ways. Look at the bar model in problem 2a and your equation in problem 2b. What different equation could you write to represent this problem?

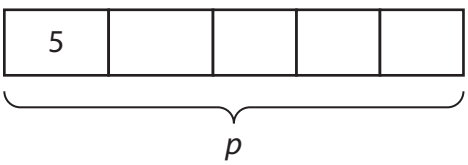
.....

Prepare for Modeling and Solving Multi-Step Problems

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



2 Fill in the bar model below to represent the equation $5 + 5 + 4 + 4 + 4 = p$. Then find the value of p.



3 Solve the problem. Show your work.

In a video game, Adrien earns 5 bonus spins on each of the first three levels and 2 bonus spins on each of the next three levels. How many bonus spins does Adrien earn on all six levels?

Solution

4 Check your answer. Show your work.

Develop Modeling Multi-Step Problems

Read and try to solve the problem below.

Garrett is paid $4 for each hour he babysits. Mrs. Becker pays him for 5 hours of babysitting. On the way home, Garrett spends $9 on a book and $6 on a puzzle. Write an equation to find how much money Garrett has left from the money Mrs. Becker pays him.

TRY IT

Math Toolkit

- play money
- counters
- paper plates
- number lines
- index cards
- base-ten blocks
- multiplication models

DISCUSS IT

Ask your partner: Why did you choose that strategy?

Tell your partner: A model I used was . . . It helped me . . .

Explore different ways to understand modeling multi-step problems.

Garrett is paid $4 for each hour he babysits. Mrs. Becker pays him for 5 hours of babysitting. On the way home, Garrett spends $9 on a book and $6 on a puzzle. Write an equation to find how much money Garrett has left from the money Mrs. Becker pays him.

MODEL IT

You can use a bar model to help understand the problem.

$4	$4	$4	$4	$4
$9		$6		?

The top bar of the model shows the amount Garrett is paid for each hour and the number of hours he babysits.

The bottom bar of the model shows the total amount he spends. You do not know how much money Garrett has left.

MODEL IT

You can use the bar model to write equations for the problem.

Let b equal the amount Mrs. Becker pays Garrett.

$$b = 5 \times 4$$

He spends $9 on a book and $6 on a puzzle, so represent the amount he spends with the **expression** $9 + 6$.

Let g be the amount Garrett has left after he spends money on a book and a puzzle.

$$g = b - (9 + 6)$$

CONNECT IT

Now you will use the problem from the previous page to help you understand how to model multi-step problems.

1. Look at the second **Model It**. What is represented by $\times 4$ in the equation $b = 5 \times 4$?

2. Why are the two amounts that Garrett spends in parentheses in the equation $g = b - (9 + 6)$?

3. Alissa combines the two equations into one equation: $g = 20 - (9 + 6)$. What does the 20 in her equation represent?

4. Ben uses the equation $g = (4 \times 5) - 9 - 6$. Is his equation correct? Explain.

5. Explain how it is possible for two equations to look different but still represent the same problem.

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model Its**. Which models or strategies do you like best for modeling a multi-step problem using an equation? Explain.

APPLY IT

Use what you just learned to solve these problems.

7 There are 4 vans and 2 cars going to a museum. Each van carries 9 people. Each car carries 3 people.

Write an equation to represent the number of people who travel in a van, v. Then write an equation to represent the total number of people who go to the museum, t. Show your work.

Solution

8 Miguel has 28 markers. His sister has 33 markers. They buy 3 more boxes of markers. Each box has 8 markers. Write an equation to represent the total number of markers Miguel and his sister have. Show your work.

Solution

9 Mrs. Barker buys tickets to the school play. She buys 2 adult tickets for $8 each and 3 child tickets for $5 each. She uses a coupon for $2 off the total amount. Write an equation to represent the total amount Mrs. Barker pays for tickets. Show your work.

Solution

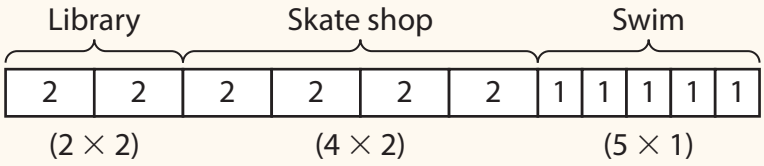
Practice Modeling Multi-Step Problems

Study the Example showing how to model a multi-step problem and write an equation. Then solve problems 1–4.

EXAMPLE

The table shows Eli's after-school activities. Write an equation to show how many hours a week Eli spends doing activities, a.

Activity	How long?	How often?
Volunteer at the library	2 hours	2 times a week
Work at the skate shop	2 hours	4 times a week
Swim practice	1 hour	5 times a week

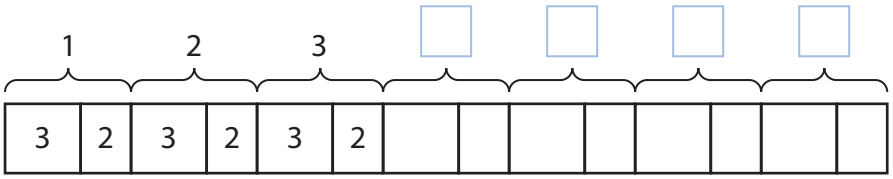


$a = (2 \times 2) + (4 \times 2) + (5 \times 1)$

Mia volunteers at the animal shelter on 7 weekends. On Saturdays, she volunteers for 3 hours. On Sundays, she volunteers for 2 hours.

1 Write an equation to find how many hours Mia volunteers.

a. Complete the bar model.



b. What do the numbers above the bar represent?

c. What do the numbers in each part of the bar represent?

d. Write an equation.

2 A bike rental is $3 for an hour. The rental for a day is 6 times as much. Caroline rents a bike for 1 day and 2 hours. Which equations could you use to find how much money, m, Caroline spends on a bike rental?

Ⓐ $m = (6 \times 3) + (2 \times 3)$

Ⓑ $m = (6 \times 1) + (2 \times 3)$

Ⓒ $m = (6 \times 2) \times (3 \times 3)$

Ⓓ $m = (3 \times 6) + (3 \times 2)$

Ⓔ $m = (1 \times 6) + (3 \times 2)$

3 Zara goes to the book fair and buys 3 comic books for $5 each, 2 chapter books for $9 each, 4 posters for $2 each, and 1 picture book for $7. Write an equation that can be used to find how much Zara spends at the book fair. Show your work.

Solution

4 The table below shows clothing sales at a school fair. Use the information in the table to write an expression that equals t, the total amount of money spent on clothing at the school fair.

Item	Price	Number Sold
T-shirts	$12	100
Sweatshirts	$20	50

$t =$

Vocabulary

equation a mathematical statement that uses an equal sign (=) to show that two expressions have the same value. For example, $r = (6 \times 3) + 4$.

expression a group of one or more numbers, unknowns, and/or operation symbols that represents a quantity. For example, 3×4 or $5 \times h$.

Develop Solving Multi-Step Problems

Read and try to solve the problem below.

Ms. Dennison packs up the books in her classroom for the summer. Each box holds 9 books. She has 24 math books and 27 science books to pack in boxes. Write and solve an equation to find how many boxes Ms. Dennison needs for the books.

TRY IT

Math Toolkit

- counters
- cups
- paper plates
- number lines
- index cards
- base-ten blocks
- multiplication models

DISCUSS IT

Ask your partner: Can you explain that again?

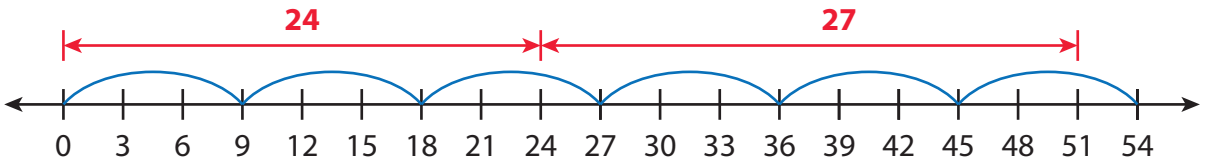
Tell your partner: I am not sure how to find the answer because . . .

Explore different ways to understand using equations to model and solve multi-step problems.

Ms. Dennison packs up the books in her classroom for the summer. Each box holds 9 books. She has 24 math books and 27 science books to pack in boxes. Write and solve an equation to find how many boxes Ms. Dennison needs for the books.

MODEL IT

You can use a number line to help understand the problem and write an equation.



The total number of books is shown above the number line (24 + 27). The number line shows jumps of 9 because each box holds 9 books.

Let x equal the number of boxes needed. Remember to use parentheses to show what to do first.

$x = (24 + 27) \div 9$

SOLVE IT

You can solve the equation that represents the problem.

This is one way to represent the problem with equations.

$x = (24 + 27) \div 9$

$x = 51 \div 9$

When a number does not divide another number a whole number of times, you have some left over. The amount left over is called a **remainder**, shown with an R.

$51 \div 9 \longrightarrow 5 \text{ R } 6$

CONNECT IT

Now you will use the problem from the previous page to help you understand how to solve multi-step problems.

1. What does the 5 in the solution 5 R 6 mean?

   What does the R 6 mean?

2. How many books are left over that do not make a full box? .....

   Is another box needed to hold the 6 leftover books? .....

3. How many boxes does Ms. Dennison need? .....

4. Check the solution to the equation:

   ..... boxes × ..... books per box + ... books = 51 total books

5. How could you estimate to make sure your answer is reasonable?

6. Explain why the solution to an equation is not always the answer to a problem when there is a remainder.

7 REFLECT

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

APPLY IT

Use what you just learned to solve these problems.

8 Cadence shops for hiking gear. She picks out a $95 tent, a pair of boots for $54, and a $38 backpack. She has $200 to spend on gear. Write and solve an equation to find out if she has enough money for the hiking gear. Estimate to check that your answer is reasonable. Show your work.

Solution

9 Look at your answer to problem 8. Does Cadence get any change back from her $200? Explain how you know.

Solution

10 Adam wants to buy the same number of puppets for 4 of his friends. He has $53, and each puppet costs $2.

a. Write and solve an equation to find how many puppets Adam can buy for each friend. Show your work.

Solution

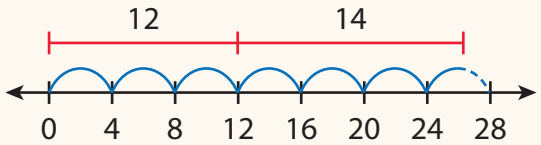
b. Explain what the remainder in your equation represents.

Practice Solving Multi-Step Problems

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

EXAMPLE

Mrs. Murray has 12 students in one science class and 14 students in another. She wants to combine both classes to do group work. Each table in the science room can seat 4 students. How many tables does Mrs. Murray need?



Let t equal the number of tables needed.

$t = (12 + 14) \div 4$
$t = 26 \div 4$
$26 \div 4 = 6 \text{ R } 2$

Mrs. Murray needs 7 tables.

6 R 2 means:
- 6 tables with 4 students each
- 2 more students need another table

1 Check the solution to the equation in the Example.

..... tables × ..... students per table + ... students = ... total students

2 Leticia earns $8 each time she rakes the yard. She has earned $24 so far. Write and solve an equation to show how many more times Leticia needs to rake the yard to earn enough to buy a music player that costs $45. Show your work.

Solution .....

Vocabulary

remainder the amount left over when one number does not divide another number a whole number of times.

$26 \div 4 = 6 \text{ R } 2$

3 Meghan found 15 pieces of sea glass on the beach. The next day she found 4 more pieces than she found the day before. Write and solve an equation to find how many pieces of sea glass she found altogether. Estimate to check that your answer is reasonable. Show your work.

Solution

4 The table shows ticket prices at a movie theater. Ticket sales to an afternoon show were $106. There were 10 child tickets sold. Write and solve an equation to find how many adult tickets were sold. Show your work.

	Child	Adult
Ticket price	$5	$7

Solution

5 Ticket prices for 3-D movies are $10 for a child and $15 for an adult. One adult spends $55 to take a group of children to the movies. Write and solve an equation to find how many children go to the movies. Show your work.

Solution

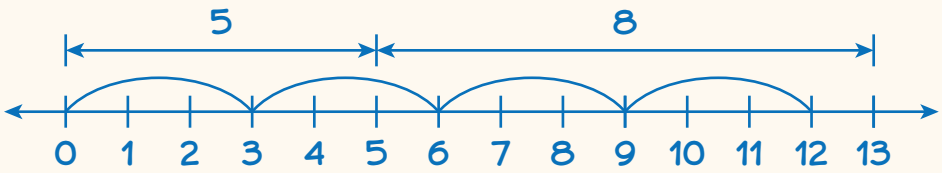
Refine Modeling and Solving Multi-Step Problems

Complete the Example below. Then solve problems 1–8.

EXAMPLE

Myron and Suzanne make banana bread. Each batch uses 3 bananas. Myron has 5 bananas, and Suzanne has 8 bananas. Write and solve an equation to find how many batches of banana bread they make. Do they have bananas left over?

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



Let b = number of batches

$b = (5 + 8) \div 3$

$b = 13 \div 3$

$13 \div 3 = 4$ R 1

Solution

The student could estimate the answer to check whether it is reasonable!

PAIR/SHARE
Discuss the reasonableness of the answer.

APPLY IT

1 A pet store has 18 rabbits. That is 3 times the number of cats the store has. Write and solve an equation to find how many rabbits and cats the store has altogether. Check the reasonableness of your answer. Show your work.

How many cats does the store have?

Solution

PAIR/SHARE
Do you get the same answer if you write the equation a different way?

2 Taylor earns $5 each time she walks her neighbor's dog. She has already earned $25. Write and solve an equation to find out how many more times Taylor needs to walk the dog to earn enough to buy a bike that costs $83. Check the reasonableness of your answer. Show your work.

What does the remainder tell you?

Solution

PAIR/SHARE

What would happen if Taylor did not think about the remainder?

3 Tiana sells 47 boxes of oranges for a fundraiser. Tim sells 12 fewer boxes than Tiana. How many more boxes of oranges does Tim need to sell in order to sell 60 boxes?

Ⓐ 1

Ⓑ 25

Ⓒ 35

Ⓓ 48

A picture can help make sense of all the numbers!

Shonda chose Ⓐ as the correct answer. How did she get that answer?

PAIR/SHARE

Compare the strategies you both used to solve the problem.

4 Franklin uses 3 eggs to make a large omelet and 2 eggs to make a small omelet. How many eggs does he need to make 5 large omelets and 4 small omelets?

Ⓐ 14 eggs

Ⓑ 22 eggs

Ⓒ 23 eggs

Ⓓ 26 eggs

5 Petra walks 9 miles the first week of this month, twice that far the second week, and 6 miles the third week. Which equations can you use to find how many miles Petra walks altogether this month?

Ⓐ $m = 9 + 9 + (3 \times 6)$

Ⓑ $m = 9 + 9 + 9 + 6$

Ⓒ $m = (2 \times 9) + (3 \times 6)$

Ⓓ $m = 9 + 18 + 6$

Ⓔ $m = 9 + (2 \times 9) + 6$

6 Ms. Ruiz plants 14 flowers in three pots. She plants 4 flowers in the one blue pot and splits the rest of the flowers equally between the two red pots.

Write and solve an equation to find the number of flowers Ms. Ruiz plants in each of the two red pots. Show your work.

Solution

7 Gabriel owns 27 fiction books and 23 nonfiction books. Each shelf can hold 8 books. How many shelves does Gabriel need for all of his books?

Solve the problem and explain how the remainder affects your answer. Show your work.

Solution

8 MATH JOURNAL

Write your own numbers in the boxes to complete the word problem. Use different numbers in each box. Do not use the numbers 0 or 1. Write and solve an equation to find the number of robots the toy store has to sell.

A toy store had ☐ robots on its shelves. The store ordered ☐ more boxes of robots to sell. Each box has ☐ robots. How many robots does the store have to sell now?

☑ SELF CHECK Go back to the Unit 2 Opener and see what you can check off.