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RIGHTSTART™ MATHEMATICS

by Joan A. Cotter, Ph.D.

LEVEL C LESSONS

FOR HOME EDUCATORS

FIRST EDITION
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Special thanks to Sharalyn Colvin, who converted *RightStart™ Mathematics: Grade 2 Lessons* into *RightStart™ Mathematics: Level C For Home Educators*.

Note: Rather than use the designation, K-4, to indicate a grade, levels are used. Level A is kindergarten, Level B is first grade, and so forth.

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RightStart™ MATHEMATICS: OBJECTIVES FOR LEVEL C

Name _____

Year _____

Teacher _____

Numeration

- Can skip count the first ten multiples for the 2s through the 10s
- Can read and construct Roman numerals to 1000

1ST QTR	2ND QTR	3RD QTR	4TH QTR
N/A	N/A		

Addition

- Can add 2-digit numbers mentally
- Can add 4-digit numbers
- Knows addition facts

Subtraction

- Understands subtraction
- Can subtract 2-digit numbers mentally
- Can subtract 4-digit numbers
- Knows subtraction facts

N/A			
N/A			

Multiplication

- Understands multiplication
- Knows multiplication facts

N/A	N/A		

Calculator

- Can add and subtract whole numbers
- Can multiply whole numbers

N/A	N/A	N/A	

Money

- Can find the value of up to five coins

N/A			
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Problem Solving

- Can solve problems in more than one way

--	--	--	--

Geometry

- Can construct an equilateral triangle with drawing tools
- Understands line symmetry

N/A			
N/A	N/A		

Time

- Can tell time to the minute

--	--	--	--

Measurement

- Can measure in inches
- Can measure in whole centimeters
- Can find perimeter
- Can find area in square inches or square cm

N/A			
N/A			
N/A			
N/A	N/A	N/A	

Fractions

- Understands fractions as a type of division
- Knows unit fractions up to 1/10

N/A			
N/A	N/A	N/A	

How This Program Was Developed

We have been hearing for years that Japanese students do better than U.S. students in math in Japan. The Asian students are ahead by the middle of first grade. And the gap widens every year thereafter.

Many explanations have been given, including less diversity and a longer school year. Japanese students attend school 240 days a year.

A third explanation given is that the Asian public values and supports education more than we do. A first grade teacher has the same status as a university professor. If a student falls behind, the family, not the school, helps the child or hires a tutor. Students often attend after-school classes.

A fourth explanation involves the philosophy of learning. Asians and Europeans believe anyone can learn mathematics or even play the violin. It is not a matter of talent, but of good teaching and hard work.

Although these explanations are valid, I decided to take a careful look at how mathematics is taught in Japanese first grades. Japan has a national curriculum, so there is little variation among teachers.

I found some important differences. One of these is the way the Asians name their numbers. In English we count ten, eleven, twelve, thirteen, and so on, which doesn't give the child a clue about tens and ones. But in Asian languages, one counts by saying ten-1, ten-2, ten-3 for the teens, and 2-ten 1, 2-ten 2, and 2-ten 3 for the twenties.

Still another difference is their criteria for manipulatives. Americans think the more the better. Asians prefer very few, but insist that they be imaginable, that is, visualizable. That is one reason they do not use colored rods. You can imagine the one and the three, but try imagining a brown eight—the quantity eight, not the color. It cannot be done without grouping.

Another important difference is the emphasis on non-counting strategies for computation. Japanese children are discouraged from counting; rather they are taught to see quantities in groups of fives and tens.

For example, when an American child wants to know $9 + 4$, most likely the child will start with 9 and count up 4. In contrast, the Asian child will think that if he takes 1 from the 4 and puts it with the 9, then he will have 10 and 3, or 13. Unfortunately, very few American first-graders at the end of the year even know that $10 + 3$ is 13.

I decided to conduct research using some of these ideas in two similar first grade classrooms. The control group studied math in the traditional workbook-based manner. The other class used the lesson plans I developed. The children used that special number naming for three months.

They also used a special abacus I designed, based on fives and tens. I asked 5-year-old Stan how much is $11 + 6$. Then I asked him how he knew. He replied, "I have the abacus in my mind."

The children were working with thousands by the sixth week. They figured out how to add 4-digit numbers on paper after learning how on the abacus.

Every child in the experimental class, including those enrolled in special education classes, could add numbers like $9 + 4$, by changing it to $10 + 3$.

I asked the children to explain what the 6 and 2 mean in the number 26. Ninety-three percent of the children in the experimental group explained it correctly while only 50% of third graders did so in another study.

I gave the children some base ten rods (none of them had seen them before) that looked like ones and tens and asked them to make 48. Then I asked them to subtract 14. The children in the control group counted 14 ones, while the experimental class removed 1 ten and 4 ones. This indicated that they saw 14 as 1 ten and 4 ones and not as 14 ones. This view of numbers is vital to understanding algorithms, or procedures, for doing arithmetic.

I asked the experimental class to mentally add $64 + 20$, which only 52% of nine-year-olds on the 1986 National test did correctly; 56% of those in the experimental class could do it.

Since children often confuse columns when taught traditionally, I wrote $2304 + 86 =$ horizontally and asked them to find the sum any way they liked. Fifty-six percent did so correctly, including one child who did it in his head.

The following year I revised the lesson plans and both first grade classes used these methods. I am delighted to report that on a national standardized test, both classes scored at the 98th percentile.

Joan A. Cotter, Ph.D.

Some General Thoughts on Teaching Mathematics

1. Only five percent of mathematics should be learned by rote; 95 percent should be understood.
2. Real learning builds on what the child already knows. Rote teaching ignores it.
3. Contrary to the common myth, “young children can think both concretely and abstractly. Development is not a kind of inevitable unfolding in which one simply waits until a child is cognitively ‘ready.’” —*Foundations for Success* NMAP
4. What is developmentally appropriate is not a simple function of age or grade, but rather is largely contingent on prior opportunities to learn.” —Duschl & others
5. Understanding a new model is easier if you have made one yourself. So, a child needs to construct a graph before attempting to read a ready-made graph.
6. Good manipulatives cause confusion at first. If a new manipulative makes perfect sense at first sight, it is not needed. Trying to understand and relate it to previous knowledge is what leads to greater learning. —Richard Behr & others.
7. According to Arthur Baroody, “Teaching mathematics is essentially a process of translating mathematics into a form children can comprehend, providing experiences that enable children to discover relationships and construct meanings, and creating opportunities to develop and exercise mathematical reasoning.”
8. Lauren Resnick says, “Good mathematics learners expect to be able to make sense out of rules they are taught, and they apply some energy and time to the task of making sense. By contrast, those less adept in mathematics try to memorize and apply the rules that are taught, but do not attempt to relate these rules to what they know about mathematics at a more intuitive level.”
9. Mindy Holte puts learning the facts in proper perspective when she says, “In our concern about the memorization of math facts or solving problems, we must not forget that the root of mathematical study is the creation of mental pictures in the imagination and manipulating those images and relationships using the power of reason and logic.” She also emphasizes the ability to imagine or visualize, an important skill in mathematics and other areas.
10. The only students who like flash cards are those who do not need them.
11. Mathematics is not a solitary pursuit. According to Richard Skemp, solitary math on paper is like reading music, rather than listening to it: “Mathematics, like music, needs to be expressed in physical actions and human interactions before its symbols can evoke the silent patterns of mathematical ideas (like musical notes), simultaneous relationships (like harmonies) and expositions or proofs (like melodies).”
12. “More than most other school subjects, mathematics offers special opportunities for children to learn the power of thought as distinct from the power of authority. This is a very important lesson to learn, an essential step in the emergence of independent thinking.” —*Everybody Counts*

13. The role of the teacher is to encourage thinking by asking questions, not giving answers. Once you give an answer, thinking usually stops.
14. Putting thoughts into words helps the learning process.
15. Help the children realize that it is their responsibility to ask questions when they do not understand. Do not settle for “I don’t get it.”
16. The difference between a novice and an expert is that an expert catches errors much more quickly. A violinist adjusts pitch so quickly that the audience does not hear it.
17. Europeans and Asians believe learning occurs not because of ability, but primarily because of effort. In the ability model of learning, errors are a sign of failure. In the effort model, errors are natural. In Japanese classrooms, the teachers discuss errors with the whole class.
18. For teaching vocabulary, be sure either the word or the concept is known. For example, if a child is familiar with six-sided figures, we can give him the word, hexagon. Or, if he has heard the word, multiply, we can tell him what it means. It is difficult to learn a new concept and the term simultaneously.
19. Introduce new concepts globally before details. This lets the children know where they are headed.
20. Informal mathematics should precede paper and pencil work. Long before a child learns how to add fractions with unlike denominators, she should be able to add one half and one fourth mentally.
21. Some pairs of concepts are easier to remember if one of them is thought of as dominant. Then the non-dominant concept is simply the other one. For example, if even is dominant over odd; an odd number is one that is not even.
22. Worksheets should also make the child think. Therefore, they should not be a large collection of similar exercises, but should present a variety. In RightStart™ Mathematics, they are designed to be done independently.
23. Keep math time enjoyable. We store our emotional state along with what we have learned. A person who dislikes math will avoid it and a child under stress stops learning. If a lesson is too hard, stop and play a game. Try the lesson again later.
24. In Japan students spend more time on fewer problems. Teachers do not concern themselves with attention spans as is done in the U.S.
25. In Japan the goal of the math lesson is that the student has understood a concept, not necessarily has done something (a worksheet).
26. The calendar must show the entire month, so the children can plan ahead. The days passed can be crossed out or the current day circled.
27. A real mathematical problem is one in which the procedures to find the answer is not obvious. It is like a puzzle, needing trial and error. Emphasize the satisfaction of solving problems and like puzzles, of not giving away the solution to others.

RightStart™ Mathematics

Ten major characteristics make this research-based program effective:

1. Refers to quantities of up to 5 as a group; discourages counting individually. Uses fingers and tally sticks to show quantities up to 10; teaches quantities 6 to 10 as 5 plus a quantity, for example $6 = 5 + 1$.
2. Avoids counting procedures for finding sums and remainders. Teaches five- and ten-based strategies for the facts that are both visual and visualizable.
3. Employs games, not flash cards, for practice.
4. Once quantities 1 to 10 are known, proceeds to 10 as a unit. Temporarily uses the “math way” of naming numbers; for example, “1 ten-1” (or “ten-1”) for eleven, “1-ten 2” for twelve, “2-ten” for twenty, and “2-ten 5” for twenty-five.
5. Uses expanded notation (overlapping) place-value cards for recording tens and ones; the ones card is placed on the zero of the tens card. Encourages a child to read numbers starting at the left and not backward by starting at the ones.
6. Proceeds rapidly to hundreds and thousands using manipulatives and place-value cards. Provides opportunities for trading between ones and tens, tens and hundreds, and hundreds and thousands with manipulatives.
7. Teaches mental computation. Investigates informal solutions, often through story problems, before learning procedures.
8. Teaches four-digit addition on the abacus, letting the child discover the paper and pencil algorithm.
9. Introduces fractions with a linear visual model, including all fractions from $\frac{1}{2}$ to $\frac{1}{10}$. “Pies” are not used initially because they cannot show fractions greater than 1. Later, the tenths will become the basis for decimals.
10. Teaches short division (where only the answer is written down) for single-digit divisors, before long division.

Second Edition

Many changes have occurred since the first RightStart™ lessons were begun in 1994. First, mathematics is used more widely in many fields, for example, architecture, science, technology, and medicine. Today, many careers require math beyond basic arithmetic. Second, research has given us new insights into how children learn mathematics. Third, kindergarten has become much more academic, and fourth, most children are tested to ensure their preparedness for the next step.

This second edition is updated to reflect new research and applications. Topics within a grade level are always taught with the most appropriate method using the best approach with the child and teacher in mind.

Daily Lessons

Objectives. The objectives outline the purpose and goal of the lesson. Some possibilities are to introduce, to build, to learn a term, to practice, or to review.

Materials. The Math Set of manipulatives includes the specially crafted items needed to teach RightStart™ Mathematics. Occasionally, common objects such as scissors will be needed. These items are indicated by boldface type.

Warm-up. The warm-up time is the time for quick review, memory work, and sometimes an introduction to the day's topics. The dry erase board makes an ideal slate for quick responses.

Activities. The Activities for Teaching section is the heart of the lesson; it starts on the left page and continues to the right page. These are the instructions for teaching the lesson. The expected answers from the child are given in square brackets.

Establish with the children some indication when you want a quick response and when you want a more thoughtful response. Research shows that the quiet time for thoughtful response should be about three seconds. Avoid talking during this quiet time; resist the temptation to rephrase the question. This quiet time gives the slower child time to think and the quicker child time to think more deeply.

Encourage the child to develop persistence and perseverance. Avoid giving hints or explanations too quickly. Children tend to stop thinking once they hear the answer.

Explanations. Special background notes for the teacher are given in Explanations.

Worksheets. The worksheets are designed to give the children a chance to think about and to practice the day's lesson. The children are to do them independently. Some lessons, especially in the early levels, have no worksheet.

Games. Games, not worksheets or flash cards, provide practice. The games, found in the *Math Card Games* book, can be played as many times as necessary until proficiency or memorization takes place. They are as important to learning math as books are to reading. The *Math Card Games* book also includes extra games for the child needing more help, and some more challenging games for the advanced child.

In conclusion. Each lesson ends with a short summary called, "In conclusion," where the child answers a few short questions based on the day's learning.

Number of lessons. Generally, each lesson is to be done in one day and each manual, in one school year. Complete each manual before going on to the next level. Other than Level A, the first lesson in each level is an introductory test with references to review lessons if needed.

Comments. We really want to hear how this program is working. Please let us know any improvements and suggestions that you may have.

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Lesson 39

Subtracting by Going Up

- OBJECTIVES**
1. To review the terms *parallel* and *perpendicular*
 2. To write subtraction equations
 3. To solve subtraction equations by going up

MATERIALS A geared clock and abacus
2 pencils or other rods for showing parallel and perpendicular
Worksheet 21, Subtracting by Going Up

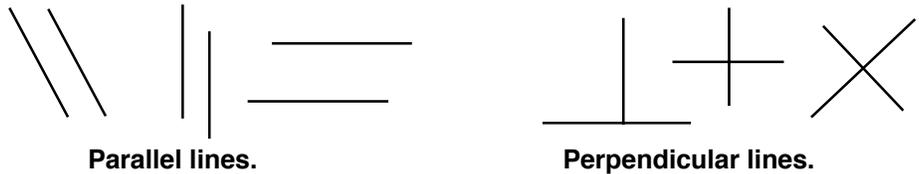
WARM-UP Play the Comes Before Game with multiples of 3. Ask the child what comes before 9 [6], before 24 [21], and before 30 [27].

Enter on the abacus the array of 8×6 and ask for the equation. [$8 \times 6 = 48$] Repeat for 8×8 . [$8 \times 8 = 64$] Ask how she found the answer.

Ask the child to say the days of the week.

Set the hands of the clock at several times for the child to name.

Hold the pencils parallel in various positions and ask what those lines are called. [parallel] Repeat for perpendicular.



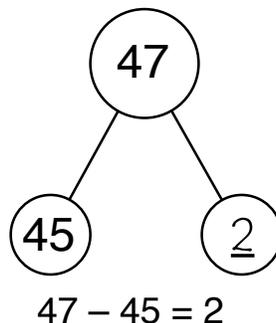
Ask the child to add $2937 + 6428$ [9365] in her journal.

ACTIVITIES **Problem 1.** Give the child this problem. Jack and Jill are cousins who live in different states. They want to find out who is taller and how much taller. Jack is 45 inches tall and Jill is 47 inches tall. Who is taller and how much taller? [Jill, 2 inches]

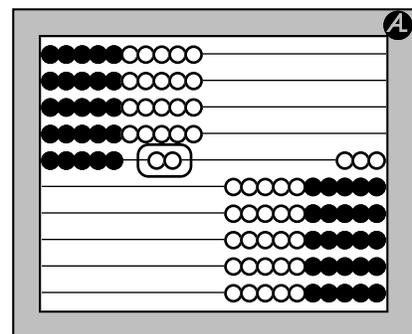
Note: To help the child develop a broader understanding of subtraction, the going up procedure is discussed first. Also research has shown it to be easier for a child.

After the child describes how she solved the problem, ask her if it makes sense to her to write the numbers in a part-whole circle set and to write the equation. If she writes the addition equation, ask if she could also write the subtraction equation. Ask her to write them in her journal.

You might also enter 45 on an abacus. and ask the child to think in her mind how many more are needed to have 47. [2] See the figures below.



The Jack and Jill problem of comparing 47 and 45.



Visualizing what is needed with 45 to make 47. [2]

Problem 2. Repeat the steps for the following problem. Anna has 75¢ and Charles has 80¢. How much more money does Charles have? [5¢] Ask the child to imagine the abacus in her mind to find the answer. Ask her to write the equation [$80 - 75 = 5$] on the drawing board and also in her journal.

Problem 3. Jamie has read 13 pages and wants to read to the end of the chapter, which is 17 pages long. How many more pages does Jamie need to read? [4 pages]

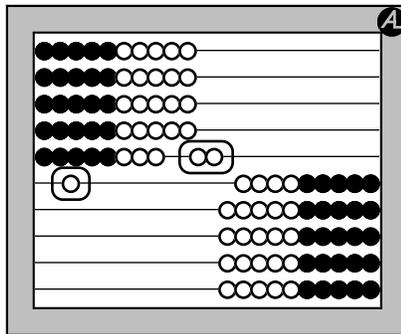
Again ask the child to solve the problem and to write the equation. [$17 - 13 = 4$]

Practice. Write the following equation

$$26 - 24 = [2]$$

and ask the child how she solved it. Emphasize going up from 24 to 26. Ask her to put the abacus into her mind, then to enter 24, and to see how many more she must enter to get to 26.

Repeat for 51-- 48. [3] Here emphasize going from 48 to 50, which is 2, and then going from 50 to 51, for a total of 3. See the figure below.



Visualizing what is needed with 48 to make 51. [2 to make 50 and 1 more to make 51]

Repeat for 62 – 59 [3] and 31 – 27 [4].

Worksheet. The worksheet is to be done without an abacus if possible. If she does use an abacus, be sure she uses the going up procedure.

The problems and solutions are as follows.

$10 - 8 = 2$	$13 - 10 = 3$
$11 - 9 = 2$	$60 - 56 = 4$
$31 - 29 = 2$	$42 - 38 = 4$
$95 - 90 = 5$	$19 - 15 = 4$
$76 - 72 = 4$	$12 - 9 = 3$
$49 - 47 = 2$	$52 - 49 = 3$
$100 - 99 = 1$	$90 - 80 = 10$
$88 - 85 = 3$	$70 - 62 = 8$
$29 - 25 = 4$	$30 - 24 = 6$
$9 - 7 = 2$	

Name _____

First subtract the ten and then the five.

$75 - 5 = \underline{\quad}$

$40 - 5 = \underline{\quad}$

$90 - 5 = \underline{\quad}$

$45 - 10 = \underline{\quad}$

$35 - 10 = \underline{\quad}$

$85 - 10 = \underline{\quad}$

$80 - 15 = \underline{\quad}$

$60 - 15 = \underline{\quad}$

$25 - 15 = \underline{\quad}$

$75 - 15 = \underline{\quad}$

$100 - 5 = \underline{\quad}$

$110 - 5 = \underline{\quad}$

$120 - 10 = \underline{\quad}$

$125 - 10 = \underline{\quad}$

$105 - 10 = \underline{\quad}$

$120 - 15 = \underline{\quad}$

$110 - 15 = \underline{\quad}$

$105 - 15 = \underline{\quad}$

$100 - 15 = \underline{\quad}$

Name _____

$10 - 8 = \underline{\quad}$

$11 - 9 = \underline{\quad}$

$31 - 29 = \underline{\quad}$

$95 - 90 = \underline{\quad}$

$76 - 72 = \underline{\quad}$

$49 - 47 = \underline{\quad}$

$100 - 99 = \underline{\quad}$

$88 - 85 = \underline{\quad}$

$29 - 25 = \underline{\quad}$

$9 - 7 = \underline{\quad}$

$13 - 10 = \underline{\quad}$

$60 - 56 = \underline{\quad}$

$42 - 38 = \underline{\quad}$

$19 - 15 = \underline{\quad}$

$12 - 9 = \underline{\quad}$

$52 - 49 = \underline{\quad}$

$90 - 80 = \underline{\quad}$

$70 - 62 = \underline{\quad}$

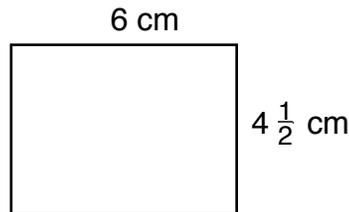
$30 - 24 = \underline{\quad}$

Lesson 97

Perimeter Problems in Centimeters

- OBJECTIVE** 1. To find perimeters with measurements involving $\frac{1}{2}$
- MATERIALS** Worksheet 64, Subtracting 4-Digit Numbers
Meter stick
The centimeter rulers from the previous lesson
Worksheet 68, Perimeter Problems in Centimeters
- WARM-UP** Ask the child to count by 8s. Then ask, What is $8 + 8$? [16] What is $16 + 8$? [24] What is $24 + 8$? [32] Continue to $72 + 8$. [80]
Ask the child to count by 9s.
Ask the child to show how much an inch is. _____
Ask the child to show how much a centimeter is. _____
Show the meter stick and ask, How many centimeters are in 1 meter? [100 centimeters]
- Subtraction practice.** Ask the child to take out Worksheet 64 and to solve the following problem in box d: $4672 - 3258$. [1414]
Ask her to write the solution and describe her method of finding the solution.
- ACTIVITIES** **Problem 1.** Draw the following rectangle with the measurements as shown below.

Note: A child needs activities to understand numbers like $2\frac{1}{2}$ and $3\frac{1}{2}$.



The rectangle for problem 1.

Point to the unmarked sides and ask how long they are. [6 cm and $4\frac{1}{2}$ cm] What is perimeter? [the distance around the rectangle]

Ask the child to draw the figure in her journal and to find the perimeter.

Ask her to explain her answer. Encourage writing the equation

$$P = 6 + 4\frac{1}{2} + 6 + 4\frac{1}{2}$$

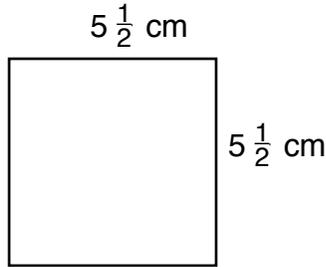
$$P = 21 \text{ cm}$$

She might choose to add the two 6s, followed by the 4s, and then the 2 halves. Or, she might see that $6 + 4 = 10$; two 10s is 20 and the 2 halves equal 1. So, the solution is 21 cm.

Ask if a bug walked around the edge of the rectangle, would it walk a meter. [no]

Problem 2. Draw the following figure and ask what it is called. [square, rectangle (parallelogram and quadrilateral)] Emphasize that a square is a special rectangle.

Ask if a bug walking around it would walk farther than the first rectangle. [yes, 22 cm] Ask the child to explain her work.



A rectangle for problem 2.

$$P = 5\frac{1}{2} + 5\frac{1}{2} + 5\frac{1}{2} + 5\frac{1}{2}$$

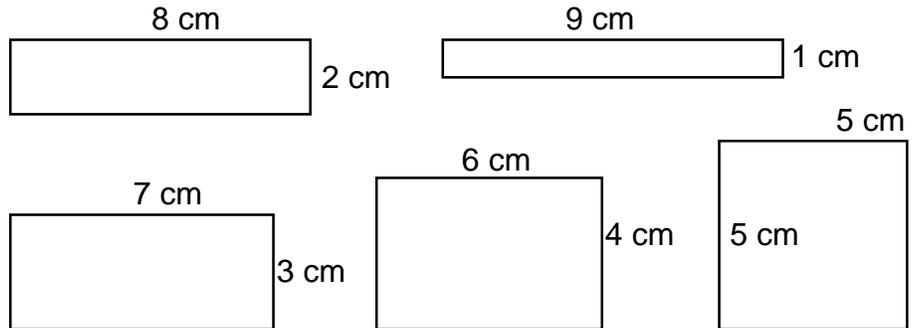
$$P = 22 \text{ cm}$$

Be sure she understands about adding the 1/2s, that two 1/2s make 1.

Problem 3. Draw a rectangle whose perimeter is 20 centimeters.

Ask the child to show her solution. There are 5 solutions, shown below, using whole numbers.

Note: Encourage an advanced student to find rectangles using halves of centimeters.



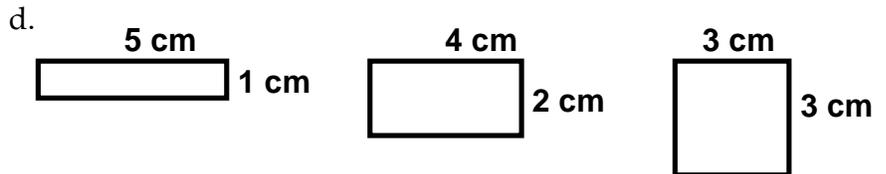
Rectangles having a perimeter of 20 cm.

Worksheet. Similar problems are on the worksheet. The solutions are as follows:

a. $P = 3 + 4 + 3 + 4$
 $P = 14 \text{ cm}$

b. $P = 5\frac{1}{2} + 3 + 5\frac{1}{2} + 3$
 $P = 17 \text{ cm}$

c. $P = 3\frac{1}{2} + 3\frac{1}{2} + 3\frac{1}{2} + 3\frac{1}{2}$
 $P = 14 \text{ cm}$



Name _____

a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

k.

l.

m.

n.

o.
