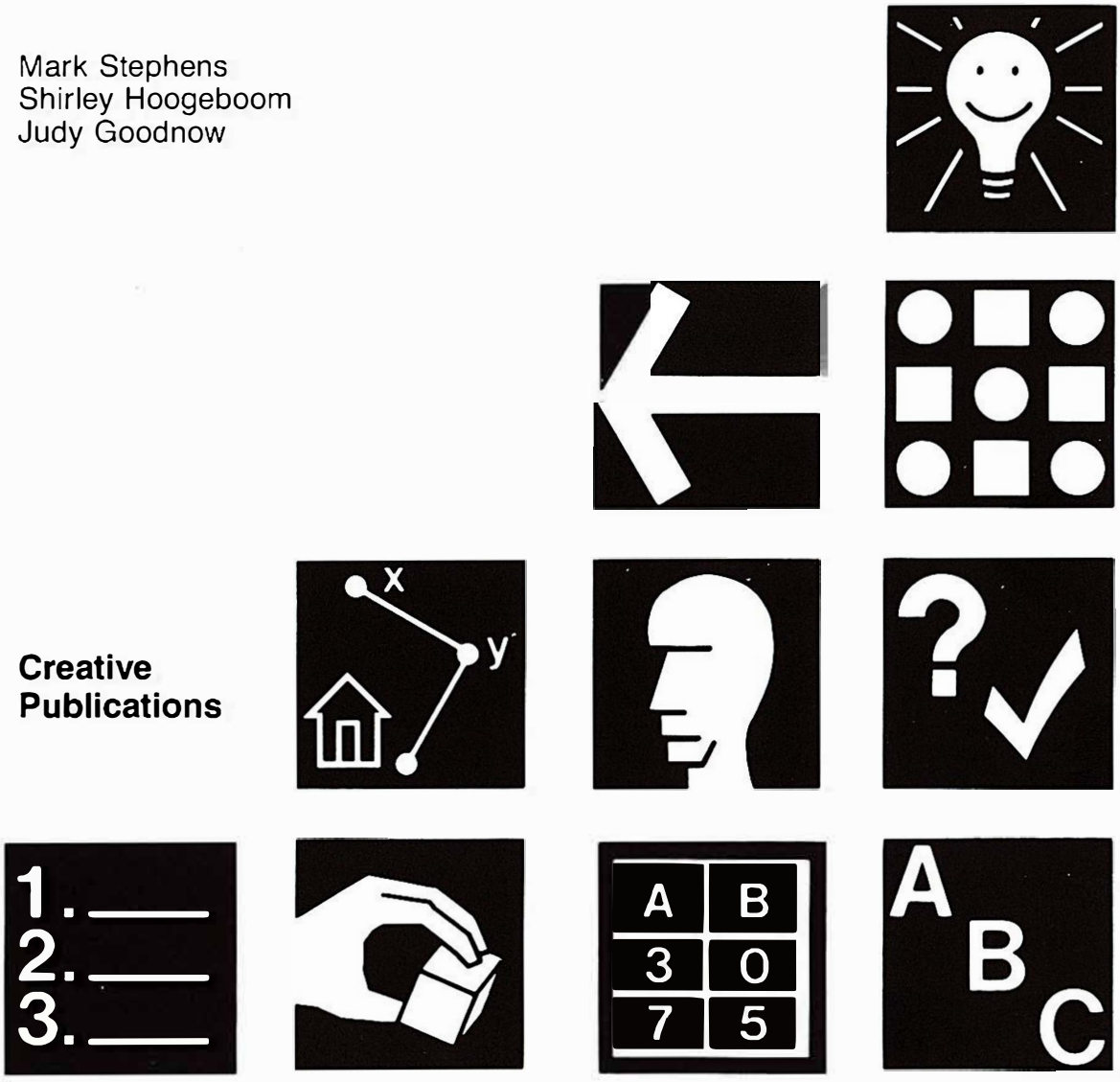
The Problem Solver 7

Activities for Learning Problem-Solving Strategies

Mark Stephens
Shirley Hoogeboom
Judy Goodnow



Creative Publications

Illustrated by Peter Stein
Cover design by JoAnne Hammer
Graphic symbols by Steve Reiling

1300 Villa Street
Mountain View, CA 94041
Printed U.S.A.

ISBN: 0-88488-685-9

9 10 11 12 13 14 15. 00 99 98 97

Contents

THE PROBLEM SOLVER PROGRAM

The Problem Solver is a step-by-step instructional program designed to help your students become competent and confident problem solvers. It utilizes an easy-to-learn, four-step method combined with ten useful problem-solving strategies. A wide range of reproducible problems are carefully sequenced to systematically expand your students' problem-solving abilities.

CONTENTS AND ORGANIZATION OF *THE PROBLEM SOLVER 7*

Section 1: Teaching the Strategies

The first part of this section describes the four-step method and the ten solution strategies. Sample problems are used to illustrate how the method and strategies can be implemented.

The second part of this section presents 48 teaching problems. For each problem there is a reproducible student page and a one-page teaching plan. The problems are organized in groups of two that focus on the same strategy. The symbol of that strategy is shown in the upper left-hand corner of both the student page and the teaching plan page.

Section 2: Practice Problems

This section presents 72 reproducible problems similar to those in Section 1. But here, no strategies are recommended. The students must decide which strategy to use. There are two problems on each page, and they have purposely been mixed up so that they do not follow the order of strategies presented in the teaching section. Students record their work and solutions on a separate recording sheet. All ten strategy symbols are shown at the bottom of the recording sheet, and the students circle the appropriate symbol(s) to indicate which strategy or strategies they used.

Section 3: Solutions

Here you will find a solution for every problem in Sections 1 and 2. For many problems, notes are also included describing the solution process. (Solutions for all the problems in Section 1 are also shown on their respective teaching plan pages.)

GENERAL TEACHING SUGGESTIONS

Presenting the Problems

Before you present any problems to the students, read through the descriptions of the four-step method and the ten solution strategies in Section 1. We recommend that you present the problems in the order they appear. The problems have been carefully sequenced so that they progress from easy to more challenging. The math skills required to solve even the most challenging problems are those which students have usually mastered by the end of the sixth grade.

Give each student a copy of the problem and a copy of the recording sheet. You may also want to make calculators available for them to use. Read the problem aloud to the students. Encourage the students to verbalize their thought processes as they choose strategies and find solutions. Develop an atmosphere in which the students feel comfortable expressing themselves. Let them know it's okay to make mistakes. In this setting, your students will become enthusiastic problem solvers and will begin to see problems as interesting challenges.

Use the teaching plans. The sequence of questions in each plan guides the students through the four-step method: FIND OUT, CHOOSE A STRATEGY, SOLVE IT, and LOOK BACK. You'll probably want to add some of your own questions to further clarify the process. The responses to the questions, shown in italics in the teaching plans, are only samples of the kinds of responses you want to draw from your students. Encourage them to risk giving incorrect answers. Remind them that it is more important for them to take an active role in solving the problem, and enjoy doing it, than it is to respond with the right answer.

Since students learn in different ways, some students may wish to use a strategy other than the focus strategy for solving a problem given in Section 1. Encourage students to use methods that are best for them, when they can demonstrate a legitimate solution process with another strategy. (The goal is to equip your students with techniques for approaching future problems, but you also want them to be flexible in applying them.) Some students may even discover additional strategies and use them to solve the problems. Encourage the students to design new symbols for those strategies.

Additional Practice

For additional practice, you can give students the problem extensions which appear on many teaching plans in Section 1, and the practice problems from Section 2. Since a problem extension restates a given problem with different data or a different question, you may wish to have students solve it immediately after solving the original problem. Each practice problem is similar to a group of two problems in Section 1. When students have solved both problems in that group, you can give them a similar problem from Section 2. However, you may wish to wait until the students have solved several groups of problems using different strategies before giving them the practice problems. That will make choosing a strategy more of a challenge.

The table below lists problems in *The Problem Solver 6* and *The Problem Solver 8* that are similar to the problems in *The Problem Solver 7*. The problems for sixth grade are less difficult and can be used with all students. The problems for eighth grade are more difficult, so you may wish to use them only with accelerated or gifted students.

The Problem Solver 7		Similar Problems in	
		The Problem Solver 6	*The Problem Solver 8*
Problems	***Strategy Focus***	***Problems***	***Problems***
1, 2	Use or make a table	1, 2, 49, 56, 91	1, 2, 50, 66, 76
3, 4	Make an organized list	3, 4, 60, 63, 113	3, 4, 49, 63, 80
5, 6	Act out or use objects	5, 6, 51, 64, 89	5, 6, 52, 62, 78
7, 8	Make an organized list	7, 8, 61, 76, 100	7, 8, 51, 60, 81
9, 10	Use or look for a pattern	9, 10, 58, 95, 117	9, 10, 53, 64, 77
11, 12	Use or make a table	11, 12, 50, 79, 105	11, 12, 56, 70, 88
13, 14	Make a picture or diagram	13, 14, 65, 78, 97	13, 14, 57, 75, 91
15, 16	Guess and check	15, 16, 71, 80, 104	15, 16, 54, 69, 93
17, 18	Work backwards	17, 18, 70, 90, 118	17, 18, 59, 65, 79
19, 20	Make a picture or diagram	19, 20, 59, 67, 92	19, 20, 55, 68, 95
21, 22	Use logical reasoning	21, 22, 83, 93, 119	21, 22, 58, 92, 101
23, 24	Use or make a table	23, 24, 53, 69, 115	23, 24, 61, 89, 103
25, 26	Make a picture or diagram	25, 26, 52, 62, 109	45, 46, 85, 109, 118
27, 28	Make an organized list	27, 28, 55, 82, 107	27, 28, 71, 96, 111
29, 30	Guess and check	29, 30, 66, 106, 111	29, 30, 74, 104, 115
31, 32	Make a picture or diagram	31, 32, 81, 96, 117	31, 32, 72, 102, 113
33, 34	Use or look for a pattern	33, 34, 68, 87, 112	33, 34, 82, 106, 116
35, 36	Use logical reasoning	35, 36, 57, 72, 85	35, 36, 73, 87, 100
37, 38	Act out or use objects	37, 38, 54, 77, 101	
39, 40	Use logical reasoning	39, 40, 99, 108, 114	39, 40, 86, 99, 114
41, 42	Make it simpler	41, 42, 73, 86, 120	37, 38, 83, 105, 117
43, 44	Work backwards	43, 44, 75, 94, 108	41, 42, 84, 108, 119
45, 46	Make it simpler	45, 46, 84, 98, 110	43, 44, 90, 98, 112
47, 48	Brainstorm	47, 48, 74, 88, 102	47, 48, 97, 110, 120

If you wish to provide more practice for your students, the following materials on problem solving are available from Creative Publications:

Brainstorming: Activities for Creative Thinking
Mathematics Contest Problems
The Problem Pocket: Logic Word Problems

TEACHING THE STRATEGIES

Part one of this section describes the four-step method and the ten solution strategies. Sample problems are used as examples to illustrate how the method and strategies can be implemented. Part two presents 48 teaching problems. For each problem there is a reproducible student page and a one-page teaching plan. The problems are organized in groups of two that focus on the same strategy. The symbol of that strategy is shown in the upper left-hand corner of both the student page and the teaching plan page. Please see pages vii-viii for some general teaching suggestions on presenting the problems to your students.

What Is the Four-Step Method?

The four-step method is a systematic approach to problem solving that can be used for solving any problem.

The first step is to FIND OUT what the problem means and what question you must answer to solve it. To find out what the problem means, you must understand the words and phrases used and what's happening in the problem. You must be able to identify the important information and the unimportant information, and determine if any necessary information is missing and what you must do to get that information. In some cases, the problem may have to be broken down into smaller problems before the larger problem can be solved. You should understand the problem well enough to say it in your own words. And finally, you must be able to state the question you have to answer to solve it.

The second step is to CHOOSE A STRATEGY that will help solve the problem. You will often find there is more than one strategy that can be used. The idea, however, is to find the strategy or strategies that will help you the most with a particular problem.

The third step is to SOLVE IT. Work through the problem until you find the answer to the question, using the strategy you selected. It is important that you record your work in a way that lets you see at a glance what you've completed. As you work to find the answer, you may find that the strategy you selected is not as helpful as you thought it might be. In that case, you will want to try a different strategy.

The fourth step is to LOOK BACK. Reread the problem and check the solution to see that it meets the conditions stated in the problem and that it answers the question. To review your solution and ask yourself if it's logical and reasonable is a very important step in problem solving.

What Are the Ten Solution Strategies?

ACT OUT OR USE OBJECTS

It can be very helpful to act out a problem or to move objects around while trying to solve a problem. It allows you to develop visual images of both the data in the problem and the solution process. By taking an active role in finding the solution, you are more likely to remember the process you used and be able to use it again for solving similar problems. The dramatizations and objects need not be elaborate: small scraps of paper and colored chips or counters will usually work quite well. This strategy is especially helpful when you want to visualize relationships. For example:

Problem 5: The Queen Bee was furious because several workers missed roll call again, and the clover in the field was in full bloom. "I bet they're hiding out in the T.V. room again," she said, as she set off to find them. Sure enough, there they were along with the youngest member of the hive, Bay Bee, watching "Days of Our Hives." Coming up next was "Miami Lice." Barna Bee was directly in front of the T.V. set; Spelling Bee was sitting between Vitamin Bee and Bar Bee and directly behind Barna Bee; Gats Bee was in front of Vitamin Bee; Toyn Bee was to the right of Honey Bee; and Walla Bee was in the back row, but not behind Bar Bee, because Bar was so tall that her exoskeleton hid the screen. Where was everyone sitting in the television room?

Solution:

Gats Bee	Barna Bee	Bay Bee
Vitamin Bee	Spelling Bee	Bar Bee
Walla Bee	Honey Bee	Toyn Bee

MAKE A PICTURE OR DIAGRAM

It may be helpful to use an available picture or make one when trying to solve certain problems. The pictures or diagrams need not be well drawn. It is most important that they help you understand and manipulate the data in the problem. Using pictures is almost a necessity for some problems, particularly those which involve mapping. For example:

Problem 25: Larry and his brother Brett are stranded in the desert. Their car has broken down in the middle of the hot day, and it is 36 miles to the nearest town. "Looks like we'll have to leave the car and take turns with the canteen and the skateboard," Larry said gloomily. The brothers want to leave at the same time and arrive in town at the same time. Both Larry and Brett know that they skateboard at the same speed, 6 miles per hour. Larry walks at 3 miles an hour and Brett walks at 4 miles an hour. They make a plan to exchange the skateboard along the way, when necessary. They will always leave the skateboard on the hour, but neither one can wait for the other. How long did it take them to get to the town and how many miles did each one walk and each one skateboard?

Solution: 8 hours; Larry skateboarding 24 miles and walking 12, Brett skateboarding 12 and walking 24

Hours	1	2	3	4	5	6	7	8
Larry	6 sk	12 sk ↓	15 wk	18 wk ↑	24 sk	30 sk ↓	33 wk	36 wk
Brett	4 wk	8 wk ↓	12 wk	18 sk ↑	22 wk	26 wk ↓	30 wk	36 sk

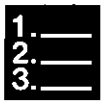
USE OR MAKE A TABLE

A table is an orderly arrangement of data, such as numbers. Making tables helps you keep track of data, spot missing data, and identify data that is asked for in the problem. Because patterns often become obvious when data is organized in a table, this strategy is often used in conjunction with other strategies. In the example below, the table is used to keep track of data and could also be used for identifying a number pattern.

Problem 23: Scientists are agog over the news that a herd of strange new animals has been discovered in the Plains of Abunk. Apparently the animals are a cross between a zebra and a giraffe. It seems that out of every 18 zegraffes, 3 have long necks and stripes; 4 have short necks and spots; 5 have short necks, stripes, and long legs; and 6 have long necks, spots, and short legs. Scientists from the University of Abunk corralled a group of zegraffes in order to study them. After a walk among the animals, the scientists reported that they had counted 45 zegraffes with long necks and stripes. How many zegraffes were in the group, and how many zegraffes were there of each kind?

Solution: 270 total; 45 with long necks, stripes; 60 with short necks, spots; 75 with short necks, stripes, long legs; 90 with long necks, spots, short legs

Total	18	36	54	72	90	108	126	144	162	180	. . .	270
Long necks, stripes	3	6	9	12	15	18	21	24	27	30	. . .	45
Short necks, spots	4	8	12	16	20	24	28	32	36	40	. . .	60
Short necks, stripes, long legs	5	10	15	20	25	30	35	40	45	50	. . .	75
Long necks, spots, short legs	6	12	18	24	30	36	42	48	54	60	. . .	90



MAKE AN ORGANIZED LIST

Making an organized list helps you organize your thinking about a problem. Recording work in an organized list makes it easy to review what you have done and to identify important steps that must yet be completed. It also provides a systematic way of recording computations made with given data or recording combinations of given items. For example:

Problem 27: Brenda was asked to purchase some live creatures for the science lab. She bought some salamanders, flatworms, and beetles. The salamanders cost $.25 each; the beetles cost $.15 each; and the flatworms cost $.10 each. Brenda purchased 60 creatures, and her total bill was $10.10. How many of each creature did Brenda purchase?

Solution: 19 salamanders, 25 beetles, 16 flatworms
(Other solutions are possible.)

Salamanders		Beetles		Flatworms	
1	.25	1	.15	1	.10
2	.50	2	.30	2	.20
⋮	⋮	⋮	⋮	⋮	⋮
16	4.00	16	2.40	16	1.60
17	4.25	17	2.55	17	1.70
18	4.50	18	2.70	18	1.80
19	4.75	19	2.85	19	1.90
20	5.00	20	3.00	20	2.00
21	5.25	21	3.15	21	2.10
22	5.50	22	3.30	22	2.20
23	5.75	23	3.45	23	2.30
24	6.00	24	3.60	24	2.40
25	6.25	25	3.75	25	2.50

16 + 19 + 25 = 60, and $4.75 + $3.75 + $1.60 = $10.10

GUESS AND CHECK

Guessing and checking is helpful when a problem presents large numbers or many pieces of data, or when the problem asks you to find one solution but not all possible solutions to a problem. When using this strategy, you guess the answer, test to see if it is correct, and make another guess if the previous one was incorrect. In this way, you gradually come closer and closer to a solution by making increasingly more reasonable guesses. You can also use this strategy to get started, and then find another strategy that can be used. Guessing and checking is particularly helpful when a problem presents so many pieces of data that making an organized list becomes a major task. For example:

Problem 15: The king's messengers are exhausted. It seems that the prince met an especially beautiful lady at the ball last week. After one dance with her, the royal clock chimed midnight and she ran off, leaving a small slipper behind. The prince wanted the messengers to find his mystery lady! For five full days the messengers went from door to door, trying to squeeze every female foot in the kingdom into the slipper. They tried twice as many feet on the first day as on the second day. On the third day they tried 25 more feet than the combined number of feet that they tried on the first two days. On the fourth day they tried 25% as many feet as on the third day. On the last day they tried 25% more feet than they had on the fourth day. On the 1000th try, they found the foot that fit. How many feet did they attempt to fit the shoe on each day?

Solution: 1st day—250, 2nd day—125, 3rd day—400, 4th day—100, 5th day—125

USE OR LOOK FOR A PATTERN

A pattern is a regular, systematic repetition. A pattern may be numerical, visual, or behavioral. By identifying the pattern, you can predict what will "come next" and what will happen again and again in the same way. Looking for patterns is a very important strategy for problem solving, and is used to solve many different kinds of problems. Sometimes you can solve a problem just by recognizing a pattern, but often you will have to extend a pattern to find a solution. Making a number table often reveals patterns, and for this reason is frequently used in conjunction with the "look for a pattern" strategy. For example:

Problem 9: The king's messengers, out of breath, arrived with terrible news. Penelope, the witch who lived in Black Castle, had cast a spell on the kingdom because the royal photograph developers were too slow! The witch wanted her pictures of the Annual Witch Reunion, and she had been waiting for days. Penelope believed her prints would be particularly handsome. Penelope had declared that each day, until she received her prints, a larger and larger number of the kingdom's subjects would fall asleep. On the first day of the spell 8 subjects fell asleep. On the second day 24 subjects fell asleep - three times as many as the day before. Every day, three times as many subjects fell asleep as on the previous day. On what day would the entire population of 150,000 subjects be asleep, if Penelope continued to wait for her handsome prints?

Solution: Day 10

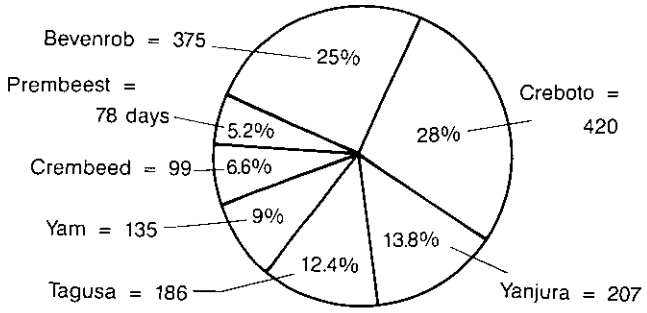
Day	1	2	3	4	5	6	7	8	9	10
Put to sleep	8	24	72	216	648	1,944	5,832	17,496	52,488	157,464
Total asleep	8	32	104	320	968	2,912	8,744	26,240	78,728	

WORK BACKWARDS

To solve certain problems you must make a series of computations, starting with data presented at the end of the problem and ending with data presented at the beginning of the problem. For example:

Problem 43: Bondar came home on the late space shuttle. "Pack your bags," he announced to his six-eyed family members. "We're being transferred to the planet Nebulosa." "Transferred to Nebulosa?" Junior Bondar cried. He ran to his bed chamber and got out a schoolbook. "We're studying Nebulosa in space science," he announced as he opened his book. "Listen to this: Nebulosa has the longest year in the Machinarxian Galaxy. It has 7 seasons. Yam lasts 9% of the year; Creboto lasts 28% of the year; Bevenrob lasts 25% of the year; Tagusa lasts 12.4% of the year; Yanjura lasts 13.8% of the year, and Crembeed lasts 6.6% of the year. Prembeest is 78 days long." Junior Bondar closed the book and sighed. "It's going to be a long wait between birthdays!" How many days will Junior have to wait between birthdays on Nebulosa?

Solution: 1500



USE LOGICAL REASONING

Logical reasoning is really used for all problem solving. However, there are types of problems that include or imply various conditional statements such as: "if. . .then," or "if. . .then. . .else," or "if something is true, then. . ." or "if something is not true, then. . . ." The data given in the problems can often be displayed in a chart or matrix. This kind of problem requires formal logical reasoning as you step your way through the statements given in the problem. For example:

Problem 40: Seven members of the school orchestra have been selected to participate in the All-City School Orchestra. Three of them are 13 years old, and four of them are 12 years old. Three play the trumpet, and four play the violin. Tomassi, Paul, and Ricky play the same instrument. Jesse and Miranda play different instruments. Jesse, Miranda, and Ann are the same age. Tomassi and Paul are not the same age. What is the name of the 13-year-old trumpeter who has been chosen to play First Chair?

Solution: Patty

Age 13	Age 12	Trumpet	Violin
1 Paul/Tomassi	1 Paul/Tomassi	1 Jesse/Miranda	1 Jesse/Miranda
(2 Patty)	2 Jesse	(2 Patty)	2 Tomassi
3 Ricky	3 Miranda	3 Ann	3 Paul
	4 Ann		4 Ricky

IF Paul and Tomassi are not the same age, THEN either Paul or Tomassi is age 13. IF Jesse, Miranda, and Ann are the same age, THEN they must be age 12, because only three of the orchestra members are age 13.

MAKE IT SIMPLER

You may find it helpful to make a problem simpler, especially when you begin to solve complex problems. Making a problem simpler may mean reducing large numbers to small numbers, or reducing the number of items given in a problem. The simpler representation of the problem, then, may suggest what operation or process you can use to solve the more complex problem. The simpler representation may even reveal a pattern that can be used to solve the problem. For example:

Problem 41: Most everyone knows about Ali Baba and the 40 thieves, but not everyone knows about Ali's younger brother, Bubba Baba. One night Bubba followed Ali and watched him enter the thieves' hideaway. Later, Bubba returned to the hideaway alone and spoke the magic words, "Open Sesame." The door opened and Bubba entered the cave. He was astonished to find 4,120 pounds of gold and silver nuggets. There were four times as many 1-pound gold nuggets as 3-pound gold nuggets. He found three times as many 3-pound silver nuggets as 6-pound silver nuggets. How many gold and silver nuggets of each size did Bubba discover in the thieves' hideaway?

Solution: 760 1-pound gold nuggets, 190 3-pound gold nuggets, 558 3-pound silver nuggets, 186 6-pound silver nuggets (Other solutions are possible.)

	Gold			Silver			Combined
Sets	3 lb	1 lb	Total lb	6 lb	3 lb	Total lb	**Total**
1	1	4	7	1	3	15	22
2	2	8	14	2	6	30	44

BRAINSTORM

This strategy is often used when all else fails. When you cannot think of a similar problem that you have solved before, and cannot think of another strategy to use, brainstorming is a good strategy to try. Brainstorming means looking at a problem in new and inventive ways. There are always problems that stretch people beyond their experience and expertise. When you encounter problems that you cannot solve, try to open up your mind, allow for inspiration, be creative, be flexible, and keep on trying until a light goes on! For example:

Problem 48: Winfred said to Darryl, "I bet you can't figure this out! Here are 6 straight lines. Add five more straight lines and make nine." Darryl said, "No problem." What did Darryl do?

Solution:

N I N E

How Can You Teach the Four-Step Method and Solution Strategies?

Use the teaching plans. Read the problem aloud. Then begin the sequence of questions given in the teaching plan for the problem. Name each step as you begin it. Encourage the students to exchange a variety of ideas and opinions after each question is raised. The questions will lead the students through the four steps and serve as a model for them to follow when they must develop their own questions for solving later problems. The four-step method is illustrated below by the teaching plan for problem 2. Italicized responses following the questions are examples of the kinds of responses you want to elicit from students.

USE OR MAKE A TABLE Teaching Plan

2 Poor Geppetto. After solving his problems with Pinocchio, he returns to his clock shop to find that his clocks are all off schedule. His clocks, some of which sound like train whistles, some like bells, some like cuckoos, and some like fire alarms, are all supposed to go off at the same time. However, the train whistle clocks are now going off every 9 minutes, the bell clocks every 3 minutes, the cuckoos every 6 minutes, and the fire alarm clocks every 4 minutes. If all the clocks have just gone off at the same time, how many times will one or more of the clocks go off before they all go off at the same time again?

FIND OUT

- What is the question you have to answer? *If all the clocks have just gone off at the same time, how many times will one or more of the clocks go off before they all go off at the same time again?*
- What is wrong with Geppetto's clocks? *They are off schedule.*
- When do the train whistle clocks go off? *Every 9 minutes* The cuckoo clocks? *Every 6 minutes* The fire alarm clocks? *Every 4 minutes* The bell clocks? *Every 3 minutes*

CHOOSE A STRATEGY

- Do you need to keep track of each minute and each time a clock goes off? *Yes, because we want to find each time one or more of the clocks go off, before they all go off at the same time.*
- Is there a way to organize and lay out the information, to see when the clocks go off? *Yes, we can make a table.*

SOLVE IT

- What do you think is the best way to set up the table, so that you can keep track of each clock that goes off? *Make a table and keep track of each minute.*
- What do you want to use for the column headings? *Minutes*
- What do you want to use for row labels? *Each kind of clock* How many rows do you need? *4*
- What are you looking for in your table? *We're looking for each time one or more of the clocks goes off, and when they go off at the same time.*
- What is the first clock that goes off? *The bell clock*
- Fill in the table until you find a time when the clocks all go off at the same time.

Solution: 17 times

Minutes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
fire				x				x				x				x		
bell			x			x			x			x			x			x
cuckoo						x						x						x
train									x									x

(continued)

Minutes	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
fire		x				x				x				x				x
bell			x			x			x			x			x			x
cuckoo						x						x						x
train									x									x

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

EXTEND IT

- If the fire alarm clocks go off every 7 minutes, instead of every 4 minutes, how many times would one or more of the clocks go off before the clocks all go off at the same time?

PRACTICE

- Similar Practice Problems: 50, 58, 67

When you have completed the four steps with the students, you can give them the problem extension to solve as further practice.

After your students have solved one or more groups of two problems, you can give them similar practice problems from Section 2. The practice problems related to a given group are identified in the teaching plan for the second problem in that group.

Recording Sheet

Name _____

Problem Number _____

FIND OUT

- What is the question you have to answer?
- What information does the problem give you?

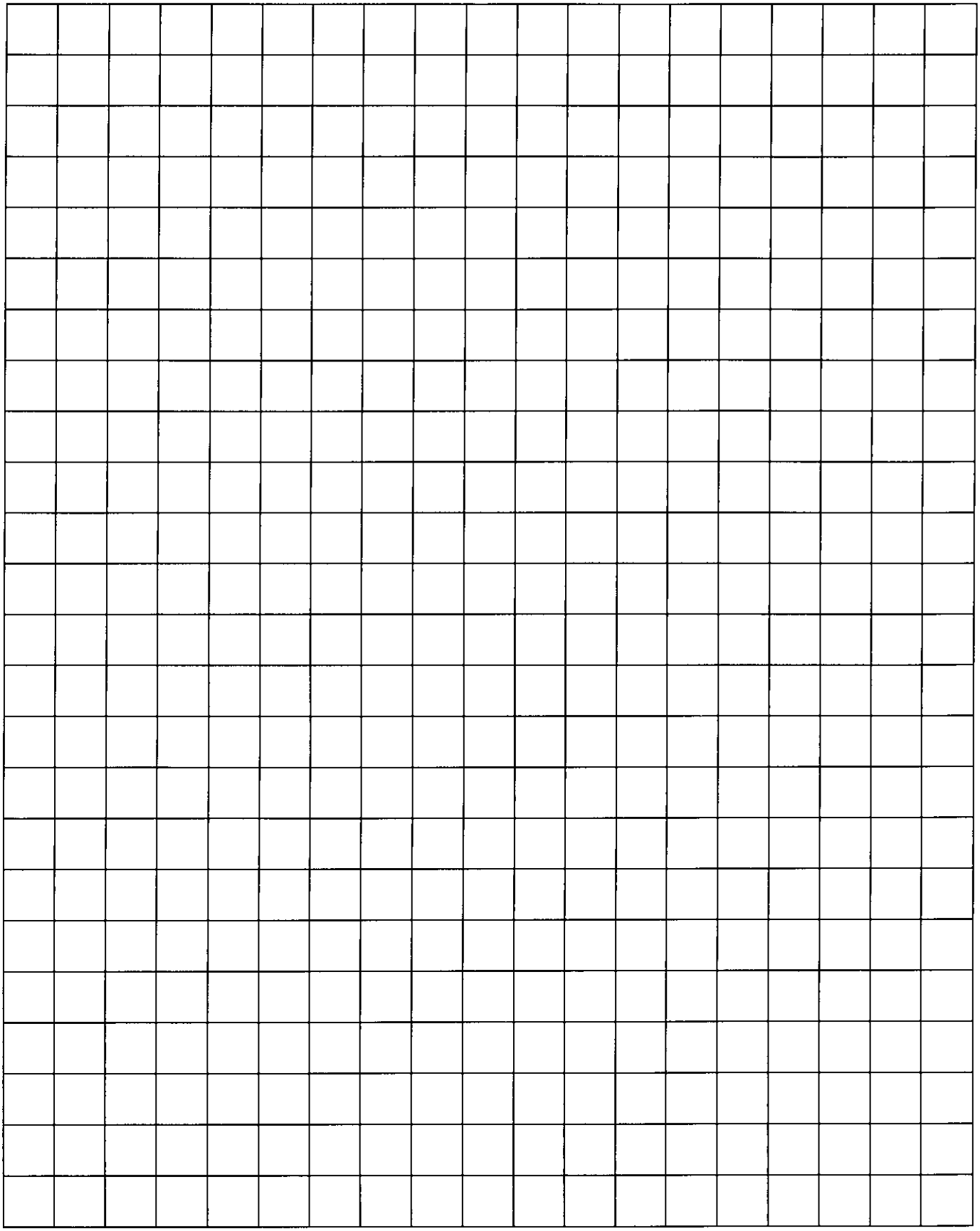
CHOOSE A STRATEGY

SOLVE IT

Solution

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?



T•x

USE OR MAKE A TABLE

Name

1 Lourdes is excited because her family is planning a reunion. Lourdes lives on a farm and hasn't seen her cousins for several years. Everyone is arriving on different trains: one cousin from San Francisco, an aunt and a cousin from Los Angeles, an uncle and two cousins from Nevada, her grandmother from Colorado, and a grandfather from Boston. Because Lourdes lives in a small town, the train schedule is as follows: A train arrives from San Francisco every four days, one arrives from Los Angeles every ten days, one from Nevada every three days, one from Colorado every eight days, and one from Boston every fifteen days. Lourdes' relatives are trying to all arrive on the same day, because it is a long way from the train station to the farm. If the trains all arrived together today, how many times in the next 20 weeks could the family members all arrive on the same day?

FIND OUT

- What is the question you have to answer?
- Where are Lourdes' relatives coming from?
- How often does the train come from San Francisco? From Los Angeles? From Nevada? From Colorado? From Boston?
- What is the family trying to do with their schedules?

CHOOSE A STRATEGY

- Do you need to keep track of each day and each train that comes in?
- Is there a way to organize and lay out the information, to see when all the trains will arrive together?

SOLVE IT

- What do you think is the best way to set up the table, so that you can cross reference the train schedules?
- If you put the train that comes the fewest times first, then how many times will that train come during the 20-week period?
- If you use the times that the Boston train will come as column headings, what do you want to use for row labels?
- How many rows do you need?
- What process will you use to check each train against the times that the train from Boston will arrive?
- If you find a train that does not come in on that day, then do you need to go through the rest of that column?
- What is the first time two or more trains will arrive on the same day?
- Continue to look for a time when all the trains come in at the same time.

Boston (15)	**15**	**30**	**45**	**60**	**75**	**90**	**105**	**120**	**135**	
LA (10)	N	Y	N							
Colorado (8)		N								
SF (4)										
Nevada (3)										

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

USE OR MAKE A TABLE — Teaching Plan

1 Lourdes is excited because her family is planning a reunion. Lourdes lives on a farm and hasn't seen her cousins for several years. Everyone is arriving on different trains: one cousin from San Francisco, an aunt and a cousin from Los Angeles, an uncle and two cousins from Nevada, her grandmother from Colorado, and a grandfather from Boston. Because Lourdes lives in a small town, the train schedule is as follows: A train arrives from San Francisco every four days, one arrives from Los Angeles every ten days, one from Nevada every three days, one from Colorado every eight days, and one from Boston every fifteen days. Lourdes' relatives are trying to all arrive on the same day, because it is a long way from the train station to the farm. If the trains all arrived together today, how many times in the next 20 weeks could the family members all arrive on the same day?

FIND OUT

- What is the question you have to answer? *If the trains all arrived together today, how many times in the next 20 weeks could the family members all arrive on the same day?*
- Where are Lourdes' relatives coming from? *San Francisco, Los Angeles, Colorado, Nevada, Boston*
- How often does the train come from San Francisco? *Every 4 days* From Los Angeles? *Every 10 days* From Nevada? *Every 3 days* From Colorado? *Every 8 days* From Boston? *Every 15 days*
- What is the family trying to do with their schedules? *Find a day when all their trains will come in*

CHOOSE A STRATEGY

- Do you need to keep track of each day and each train that comes in? *We could do that, or we could just use the times for the train that comes the fewest times.*
- Is there a way to organize and lay out the information, to see when all the trains will arrive together? *Yes, we can make a table.*

SOLVE IT

- What do you think is the best way to set up the table, so that you can cross reference the train schedules? *We can use the times for the train that comes the fewest times for the column headings.*
- If you put the train that comes the fewest times first, then how many times will that train come during the 20-week period? *9 times*
- If you use the times that the Boston train will come as column headings, then what do you want to use for row labels? *The other trains and the intervals at which they come.*
- How many rows do you need? *4 rows*
- What process will you use to check each train against the times that the train from Boston will arrive? *We can divide the number of days for each train into the number at the top of each column, to see if these two trains would arrive the same day.*
- If you find a train that does not come in on that day, then do you need to go through the rest of that column? *No, because we are looking for a day when all the trains come in together.*
- What is the first time two or more trains will arrive on the same day? *Day 30*
- Continue to look for a time when all the trains come in at the same time.

Solution: Only once, 120 days from today

Boston (15)	**15**	**30**	**45**	**60**	**75**	**90**	**105**	**120**	**135**		
LA (10)	N	Y	N	Y	N	Y	N	Y			
Colorado (8)		N		N		N		Y			
SF (4)								Y			
Nevada (3)								Y			

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

EXTEND IT

- If the train from Colorado comes every 9 days, instead of every 8 days, how many times in the next 30 weeks could all the family members arrive on the same day?

USE OR MAKE A TABLE

Name

2 Poor Geppetto. After solving his problems with Pinocchio, he returns to his clock shop to find that his clocks are all off schedule. His clocks, some of which sound like train whistles, some like bells, some like cuckoos, and some like fire alarms, are all supposed to go off at the same time. However, the train whistle clocks are now going off every 9 minutes, the bell clocks every 3 minutes, the cuckoos every 6 minutes, and the fire alarm clocks every 4 minutes. If all the clocks have just gone off at the same time, how many times will one or more of the clocks go off before they all go off at the same time again?

FIND OUT

- What is the question you have to answer?
- What is wrong with Geppetto's clocks?
- When do the train whistle clocks go off? The cuckoo clocks? The fire alarm clocks? The bell clocks?

CHOOSE A STRATEGY

- Do you need to keep track of each minute and each time a clock goes off?
- Is there a way to organize and lay out the information, to see when the clocks go off?

SOLVE IT

- What do you think is the best way to set up the table, so that you can keep track of each clock that goes off?
- What do you want to use for the column headings?
- What do you want to use for row labels? How many rows do you need?
- What are you looking for in your table?
- What is the first clock that goes off?
- Fill in the table until you find a time when all the clocks go off at the same time again.

Minutes	1	2	3	4	5	6	7	8	
fire				X				X	
bell			X			X			
cuckoo						X			
train									

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

2 Poor Geppetto. After solving his problems with Pinocchio, he returns to his clock shop to find that his clocks are all off schedule. His clocks, some of which sound like train whistles, some like bells, some like cuckoos, and some like fire alarms, are all supposed to go off at the same time. However, the train whistle clocks are now going off every 9 minutes, the bell clocks every 3 minutes, the cuckoos every 6 minutes, and the fire alarm clocks every 4 minutes. If all the clocks have just gone off at the same time, how many times will one or more of the clocks go off before they all go off at the same time again?

FIND OUT

- What is the question you have to answer? *If all the clocks have just gone off at the same time, how many times will one or more of the clocks go off before they all go off at the same time again?*
- What is wrong with Geppetto's clocks? *They are off schedule.*
- When do the train whistle clocks go off? *Every 9 minutes* The cuckoo clocks? *Every 6 minutes* The fire alarm clocks? *Every 4 minutes* The bell clocks? *Every 3 minutes*

CHOOSE A STRATEGY

- Do you need to keep track of each minute and each time a clock goes off? *Yes, because we want to find each time one or more of the clocks go off, before they all go off at the same time.*
- Is there a way to organize and lay out the information, to see when the clocks go off? *Yes, we can make a table.*

SOLVE IT

- What do you think is the best way to set up the table, so that you can keep track of each clock that goes off? *Make a table and keep track of each minute.*
- What do you want to use for the column headings? *Minutes*
- What do you want to use for row labels? *Each kind of clock* How many rows do you need? *4*
- What are you looking for in your table? *We're looking for each time one or more of the clocks goes off, and when they go off at the same time.*
- What is the first clock that goes off? *The bell clock*
- Fill in the table until you find a time when the clocks all go off at the same time.

Solution: 17 times

Minutes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
fire				x				x				x				x		
bell			x			x			x			x			x			x
cuckoo						x						x						x
train									x									x

(continued)

Minutes	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
fire		x				x				x				x				x
bell			x			x			x			x			x			x
cuckoo						x						x						x
train									x									x

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

EXTEND IT

- If the fire alarm clocks go off every 7 minutes, instead of every 4 minutes, how many times would one or more of the clocks go off before the clocks all go off at the same time?

PRACTICE

- Similar Practice Problems: 50, 58, 67

MAKE AN ORGANIZED LIST

Name

3 Sanjay spent a long time searching for just the right birthday card for his mother. He narrowed his choice down to two different cards, a humorous one and a serious one. He finally decided to buy both, for a total of $3.34. He gave the clerk $4.00. What are the possible combinations of coins that Sanjay could have received in change?

FIND OUT

- What is the question you have to answer?
- What did Sanjay give the clerk?
- What did the clerk give to Sanjay?

CHOOSE A STRATEGY

- What total amount of change did Sanjay receive? What is one possible combination of coins that totals this amount?
- How can you systematically record all the possible combinations of coins that Sanjay could have received?

SOLVE IT

- What are the different kinds of coins that could have been in Sanjay's change?
- Make a list. What do you want to keep track of in the first column of your list? Second column? Third column? Fourth column? Fifth column?
- Begin the list with 50 cents. In the first row of the list, 1 50-cent piece can be combined with 1 dime, 1 nickel and 1 penny to make the total amount of change Sanjay would receive. Can you make another combination beginning with a 50-cent piece?
- What is the largest number of quarters he could have received?
- Finish your list.

50	25	10	5	1
1	0	1	1	1
1	0	0	3	1
1				

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your organized list. Is your answer reasonable?

MAKE AN ORGANIZED LIST Teaching Plan

3 Sanjay spent a long time searching for just the right birthday card for his mother. He narrowed his choice down to two different cards, a humorous one and a serious one. He finally decided to buy both, for a total of $3.34. He gave the clerk $4.00. What are the possible combinations of coins that Sanjay could have received in change?

FIND OUT

- What is the question you have to answer? *What are the possible combinations of coins that Sanjay could have received in change?*
- What did Sanjay give the clerk? *$4.00*
- What did the clerk give to Sanjay? *The difference between the $3.34 and $4.00.*

CHOOSE A STRATEGY

- What total amount of change did Sanjay receive? *66 cents* What is one possible combination of coins that totals this amount? *One 50-cent piece, 1 dime, 1 nickel, and 1 penny*
- How can you systematically record all the possible combinations of coins that Sanjay could have received? *We can make an organized list.*

SOLVE IT

- What are the different kinds of coins that could have been in Sanjay's change? *50-cent piece, quarter, dime, nickel, penny*
- Make a list. What do you want to keep track of in the first column of your list? *50-cent pieces* Second column? *Quarters* Third column? *Dimes* Fourth column? *Nickels* Fifth column? *Pennies*
- Begin the list with 50 cents. In the first row of the list, 1 50-cent piece can be combined with 1 dime, 1 nickel and 1 penny to make the total amount of change Sanjay would receive. Can you make another combination beginning with a 50-cent piece? *Yes, with 3 nickels and 1 penny*
- What is the largest number of quarters he could have received? *2*
- Finish your list.

Solution: 93

50	25	10	5	1
1	0	1	1	1
1	0	0	3	1
1	0	0	0	16
	2	1	1	1
	2	0	3	1
	2	0	2	6
	2	0	1	11
	2	0	0	16

(See Solutions for complete answer)

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your organized list. Is your answer reasonable?

EXTEND IT

- If the cards cost $3.14, how many combinations of coins could Sanjay have received in change?

MAKE AN ORGANIZED LIST

Name

4 The community of gnomes in the Magic Forest is upset because their forest is being bulldozed for a shopping mall. The little people are moving far away, too far to walk. They are going in the boats they made from the bark of the trees. Each boat can hold up to and including 100 grams, and still stay afloat. The gnomes, as it happens, come in five different weights: 60 grams (senior citizens), 40 grams (adults), 20 grams (teenagers), 10 grams (children), and 5 grams (infants). What are the possible combinations of gnomes that can safely be put into a boat?

FIND OUT

- What is the question you have to answer?
- What are the gnomes doing?
- How many different kinds of gnomes are there? How much does each kind of gnome weigh?
- How much can a boat hold safely?

CHOOSE A STRATEGY

- If you begin with a 60-gram gnome, what can you add to this to make 100 grams? Are there other combinations, beginning with a 60-gram gnome?
- How can you systematically record all the possible combinations of gnomes that total 100 grams?

SOLVE IT

- Make a list. What do you want to keep track of in the first column of your list? Second column? Third column? Fourth column? Fifth column?
- If you begin with a 60-gram gnome, how many different combinations can you find that make 100 grams?
- What is the largest number of 40-gram gnomes you could use? How many combinations can you find using 40-gram gnomes with other gnomes?
- Finish your list.

60	40	20	10	5
1	1	0	0	0
1	0	2	0	0
1	0			

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your organized list. Is your answer reasonable?

4 The community of gnomes in the Magic Forest is upset because their forest is being bulldozed for a shopping mall. The little people are moving far away, too far to walk. They are going in the boats they made from the bark of the trees. Each boat can hold up to and including 100 grams, and still stay afloat. The gnomes, as it happens, come in five different weights: 60 grams (senior citizens), 40 grams (adults), 20 grams (teenagers), 10 grams (children), and 5 grams (infants). What are the possible combinations of gnomes that can safely be put into a boat?

FIND OUT

- What is the question you have to answer? *What are the possible combinations of gnomes that can safely be put into a boat?*
- What are the gnomes doing? *They are moving and traveling by boat.*
- How many different kinds of gnomes are there? *5* How much does each kind of gnome weigh? *senior citizens — 60 grams, adults — 40 grams, teenagers — 20 grams, children — 10 grams, infants — 5 grams*
- How much can a boat hold safely? *100 grams*

CHOOSE A STRATEGY

- If you begin with a 60-gram gnome, what can you add to this to make 100 grams? *One 40-gram* Are there other combinations, beginning with a 60-gram gnome? *Yes, one example is with one 20-gram gnome and two 10-gram gnomes.*
- How can you systematically record all the possible combinations of gnomes that total 100 grams? *We can make an organized list.*

SOLVE IT

- Make a list. What do you want to keep track of in the first column of your list? *60-gram gnomes* Second column? *40-gram gnomes* Third column? *20-gram gnomes* Fourth column? *10-gram gnomes* Fifth column? *5-gram gnomes*
- If you begin with a 60-gram gnome, how many different combinations can you find that make 100 grams? *10*
- What is the largest number of 40-gram gnomes you could use? *2* How many combinations can you find using 40-gram gnomes with other gnomes? *4*
- Finish your list.

Solution: 66

60	40	20	10	5
1	1	0	0	0
1	0	2	0	0
1	0	1	2	0
1	0	1	1	2
1	0	1	0	4

(See Solutions for complete answer)

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your organized list. Is your answer reasonable?

EXTEND IT

- If the gnomes had pet dogs that weighed 2 grams, how many combinations of gnomes and dogs could they put in a boat?

PRACTICE

- Similar Practice Problems: 49, 56, 72

ACT OUT OR USE OBJECTS

Name

5 The Queen Bee was furious because several workers missed roll call again, and the clover in the field was in full bloom. "I bet they're hiding out in the T.V. room again," she said, as she set off to find them. Sure enough, there they were along with the youngest member of the hive, Bay Bee, watching "Days of Our Hives." Coming up next was "Miami Lice." Barna Bee was directly in front of the T.V. set; Spelling Bee was sitting between Vitamin Bee and Bar Bee and directly behind Barna Bee; Gats Bee was in front of Vitamin Bee; Toyn Bee was to the right of Honey Bee; and Walla Bee was in the back row, but not behind Bar Bee, because Bar was so tall that her exoskeleton hid the screen. Where was everyone sitting in the television room?

FIND OUT

- What is the question you have to answer?
- How many bees were watching television?
- What do you know about the location of Barna Bee? Spelling Bee? Gats Bee? Toyn Bee? Walla Bee?

CHOOSE A STRATEGY

- Would it help to have pieces of paper, or something to represent each bee, and be able to move them around?

SOLVE IT

- If you use pieces of paper, how would you label them?
- What do you know about where Barna Bee is sitting?
- Who is sitting behind Barna Bee?
- Who can you put on either side of Spelling Bee?
- What do you know about where Gats Bee is sitting?
- Who is Toyn Bee sitting next to?
- Where is Walla Bee?
- Continue to move the bees around until you find a place for each one.

Barna Bee

Spelling Bee

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your set-up of the T.V. room. Is your answer reasonable?

5 The Queen Bee was furious because several workers missed roll call again, and the clover in the field was in full bloom. "I bet they're hiding out in the T.V. room again," she said, as she set off to find them. Sure enough, there they were along with the youngest member of the hive, Bay Bee, watching "Days of Our Hives." Coming up next was "Miami Lice.' Barna Bee was directly in front of the T.V. set; Spelling Bee was sitting between Vitamin Bee and Bar Bee and directly behind Barna Bee; Gats Bee was in front of Vitamin Bee; Toyn Bee was to the right of Honey Bee; and Walla Bee was in the back row, but not behind Bar Bee, because Bar was so tall that her exoskeleton hid the screen. Where was everyone sitting in the television room?

FIND OUT

- What is the question you have to answer? *Where was everyone sitting in the television room?*
- How many bees are watching television? *9*
- What do you know about the location of Barna Bee? *He is directly in front of the television.* Spelling Bee? *This bee is between Vitamin Bee and Bar Bee.* Gats Bee? *This one is in front of Vitamin Bee.* Toyn Bee? *He is to the right of Honey Bee.* Walla Bee? *This one is in the back row but not behind Bar Bee.*

CHOOSE A STRATEGY

- Would it help to have pieces of paper, or something to represent each bee, and be able to move them around? *Yes, using objects makes it easy to change positions when the arrangement doesn't match a clue.*

SOLVE IT

- If you use pieces of paper, how would you label them? *With the names of the 9 bees: Barna Bee, Spelling Bee, Gats Bee, Bar Bee, Toyn Bee, Walla Bee, Bay Bee, Vitamin Bee, Honey Bee*
- What do you know about where Barna Bee is sitting? *Directly in front of the television*
- Who is sitting behind Barna Bee? *Spelling Bee*
- Who can you put on either side of Spelling Bee? *Vitamin Bee and Bar Bee*
- What do you know about where Gats Bee is sitting? *In front of Vitamin Bee*
- Who is Toyn Bee sitting next to? *To the right of Honey Bee*
- Where is Walla Bee? *In the back but not behind Bar Bee*
- Continue to move the bees around until you find a place for each one.

Solution:

Gats Bee	Barna Bee	Bay Bee
Vitamin Bee	Spelling Bee	Bar Bee
Walla Bee	Honey Bee	Toyn Bee

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your set-up of the T.V. room. Is your answer reasonable?

EXTEND IT

- Make up a similar problem with 12 animals lined up in 3 rows.

ACT OUT OR USE OBJECTS

Name

6 When Lizzy came home from hockey practice, she asked her little sister, Malinda, if she had received any phone calls. "Yes, you got lots of calls," Malinda said. "Oh GREAT!" exclaimed Lizzy, who loved to talk on the phone. "Who called, and when did they call?" she asked. Malinda said, "Well, let me think — I didn't write it down, but I think I can remember. Paul called before Donna. Lani called next to last. Irene called between Marco and Lani. Allen called after Dave, and Peter called before Marco. Michelle called after Lani, and Donna called before Dave. And, oh yes, Allen called between Dave and Peter." What was the order in which Lizzy's friends called?

FIND OUT

- What is the question you have to answer?
- How many people called?
- What are the names of the friends who called?
- What does Malinda remember about the order in which everyone called?

CHOOSE A STRATEGY

- Would it help to have pieces of paper to represent different callers, which you could move around?

SOLVE IT

- If you use pieces of paper, how would you label them?
- How do you want to arrange the pieces of paper or objects?
- Who can you put after Paul?
- Who goes next to last?
- Who called before and after Irene?
- Who can go before Allen?
- Who called before Marco?
- Who called after Lani?
- Keep moving the objects around until your order of callers matches the clues.

Dave — Allen — Peter

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

6 When Lizzy came home from hockey practice, she asked her little sister, Malinda, if she had received any phone calls. "Yes, you got lots of calls," Malinda said. "Oh GREAT!" exclaimed Lizzy, who loved to talk on the phone. "Who called, and when did they call?" she asked. Malinda said, "Well, let me think — I didn't write it down, but I think I can remember. Paul called before Donna. Lani called next to last. Irene called between Marco and Lani. Allen called after Dave, and Peter called before Marco. Michelle called after Lani, and Donna called before Dave. And, oh yes, Allen called between Dave and Peter." What was the order in which Lizzy's friends called?

FIND OUT

- What is the question you have to answer? *What was the order in which Lizzy's friends called?*
- How many people called? *9*
- What are the names of the friends who called? *Paul, Donna, Lani, Irene, Marco, Allen, Dave, Peter, Michelle*
- What does Malinda remember about the order in which everyone called? *Paul before Donna, Lani next to last, Irene between Marco and Lani, Allen after Dave, Peter before Marco, Michelle after Lani, Donna before Dave, Allen between Dave and Peter*

CHOOSE A STRATEGY

- Would it help to have pieces of paper to represent different callers, which you could move around? *Yes, then we can easily change the order when a clue doesn't match our arrangement.*

SOLVE IT

- If you use pieces of paper, how would you label them? *Paul, Donna, Lani, Irene, Marco, Allen, Dave, Peter, Michelle*
- How do you want to arrange the pieces of paper or objects? *In a straight line*
- Who can you put after Paul? *Donna*
- Who goes next to last? *Lani*
- Who called before and after Irene? *Irene called between Marco and Lani.*
- Who can go before Allen? *Dave, and we also know that Allen is beween Dave and Peter, so Peter must come after Allen.*
- Who called before Marco? *Peter*
- Who called after Lani? *Michelle*
- Keep moving the objects around until your order of callers matches the clues.

Solution:

Paul — Donna — Dave — Allen — Peter — Marco — Irene — Lani — Michelle

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

EXTEND IT

- Make up a similar problem with 12 callers.

PRACTICE

- Similar Practice Problems: 52, 69, 75

MAKE AN ORGANIZED LIST

Name

7 The Four Bomber Brothers are the most popular act at the Dingaling Brothers' Circus. In shining helmets and padded vests, they climb a 50-foot ladder and take turns jumping into one of five buckets of water. Each bucket is labeled with a number: 1, 3, 5, 7, and 9. In each performance their four jumps must total 16 points. If the score doesn't equal 16 points, each brother gets a pie in the face. Assuming they never miss the buckets, how many different ways can the Bomber Brothers get a total of 16 points in four jumps?

FIND OUT

- What is the question you have to answer?
- How many brothers are in the act?
- How many buckets are there? How are the buckets labeled?
- How many jumps do the brothers take?
- What are the possible scores for a jump?
- How many points do the brothers try to get in each performance?

CHOOSE A STRATEGY

- If the brothers get 5 on the first jump, 5 on the second, 1 on the third, and 5 on the fourth; is this the same as getting 1 on the first, 5 on the second, 5 on the third, and 5 on the fourth? If not, what is another way to score 16 with these numbers?
- Is there a systematic way to record all the possible ways the brothers can score 16 points?

SOLVE IT

- What are the possible scores for one jump?
- What are the possible combinations of four numbers that equal 16 points?
- One way to set up an organized list is to have four columns labeled Jump 1, Jump 2, Jump 3, Jump 4. Begin with 5 for Jump 1, 5 for Jump 2, 5 for Jump 3, and 1 for Jump 4. Is there another way to arrange these numbers, using 5 for Jump 1 again?
- Now use 1 for Jump 1. How many ways can you list these same numbers, using 1 for Jump 1?
- Continue your list, until you have found all the possible ways the brothers could score 16 points.

Combinations of 16
5 + 5 + 5 + 1
7 + 7 + 1 + 1

Jump 1	Jump 2	Jump 3	Jump 4
5	5	5	1
5	5	1	5
5	1	5	5

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your list. Is your answer reasonable?

MAKE AN ORGANIZED LIST Teaching Plan

7 The Four Bomber Brothers are the most popular act at the Dingaling Brothers' Circus. In shining helmets and padded vests, they climb a 50-foot ladder and take turns jumping into one of five buckets of water. Each bucket is labeled with a number: 1, 3, 5, 7, and 9. In each performance their four jumps must total 16 points. If the score doesn't equal 16 points, each brother gets a pie in the face. Assuming they never miss the buckets, how many different ways can the Bomber Brothers get a total of 16 points in four jumps?

FIND OUT

- What is the question you have to answer? *How many different ways can the Bomber Brothers get a total of 16 points in four jumps?*
- How many brothers are in the act? *4*
- How many buckets are there? *5* How are the buckets labeled? *1, 3, 5, 7, 9*
- How many jumps do the brothers take? *4*
- What are the possible scores for a jump? *1, 3, 5, 7, 9*
- How many points do the brothers try to get in each performance? *16*

CHOOSE A STRATEGY

- If the brothers get 5 on the first jump, 5 on the second, 1 on the third, and 5 on the fourth; is this the same as getting 1 on the first, 5 on the second, 5 on the third, and 5 on the fourth? *No* If not, is there another way for the brothers to score 16 with these numbers? *Yes, 5, 1, 5, 5 or 5, 5, 5, 1*
- Is there a systematic way to record all the possible ways the brothers can score 16 points? *Yes, we can make an organized list.*

SOLVE IT

- What are the possible scores for one jump? *1, 3, 5, 7, or 9*
- What are the possible combinations of four numbers that equal 16 points? *5+5+5+1, 7+7+1+1, 7+3+5+1, 9+5+1+1, 3+3+3+7, 5+5+3+3, 9+3+3+1*
- One way to set up an organized list is to have four columns labeled Jump 1, Jump 2, Jump 3, Jump 4. Begin with 5 for Jump 1, 5 for Jump 2, 5 for Jump 3, and 1 for Jump 4. Is there another way to arrange these numbers, using 5 for Jump 1 again? *Yes, 5-5-1-5, 5-1-5-5*
- Now use 1 for Jump 1. How many ways can you list these same numbers, using 1 for Jump 1? *Only one: 1-5-5-5*
- Continue your list, until you have found all the possible ways the brothers could score 16 points.

Solution: 68 different ways

Combinations of 16	Jump 1	Jump 2	Jump 3	Jump 4
5 + 5 + 5 + 1	5	5	5	1
7 + 7 + 1 + 1	5	5	1	5
7 + 3 + 5 + 1	5	1	5	5
9 + 5 + 1 + 1	1	5	5	5
3 + 3 + 3 + 7	7	7	1	1
5 + 5 + 3 + 3	7	1	7	1
9 + 3 + 3 + 1	7	1	1	7

(See Solutions for complete answer)

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your list. Is your answer reasonable?

EXTEND IT

- If there are six buckets, labeled 1, 3, 4, 5, 7, and 8, how many different ways can the brothers score 16 points?

MAKE AN ORGANIZED LIST

Name

8 After waiting in line for hours, Mercedes and her cousin have gotten tickets to the hottest game show on television, "Wheel of Fortune Cookies." The cousins love the part of the game where a contestant spins the wheel four times and after each spin takes a fortune cookie from inside the wheel. Concealed in each fortune cookie is one of these numbers: 0, 1, 6, 7, 9, or 11. The contestant draws out four cookies, and if the total of the numbers inside the cookies is exactly 20, the contestant wins a big prize! How many different ways can a contestant win the big prize?

FIND OUT

- What is the question you have to answer?
- What does each contestant get to do?
- How many cookies does a contestant get to take from the bin?
- How are the cookies marked?
- How many points does the contestant need to win?

CHOOSE A STRATEGY

- If a contestant gets a 7 on Spin 1, a 7 on Spin 2, 6 on Spin 3, and 0 on Spin 4, is it the same as getting 7 on Spin 1, 7 on Spin 2, 0 on Spin 3, and 6 on Spin 4? Is there another way to score 20 points with the numbers 7, 7, 6, and 0? If not, is there another way to win with these numbers?
- Is there a systematic way to record all the possible ways a contestant can score 20 points?

SOLVE IT

- What are the possible scores for one spin?
- What are the possible combinations of numbers that equal 20 points?
- One way to set up an organized list is to have four columns labeled Spin 1, Spin 2, Spin 3, and Spin 4. Begin with 7 for Spin 1, 7 for Spin 2, 6 for Spin 3, and 0 for Spin 4. Is there another way to arrange these numbers, using 7 for Spin 1?
- Now use 6 for Spin 1. How many ways can you list these same numbers, using 6 for Roll 1?
- Now use 0 for Spin 1, 6 for Spin 2, 7 for Spin 3, and 7 for Spin 4. How many different ways can you list these four numbers?
- Continue to fill in your list, to find all the possible ways a contestant can score 20 points.

Combinations of 20	Spin 1	Spin 2	Spin 3	Spin 4
7 + 7 + 6 + 0	7	7	6	0
11 + 9 + 0 + 0	7	7	0	6
9 + 9 + 1 + 1	7	0	7	6
	7	0	6	7

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your list. Is your answer reasonable?

MAKE AN ORGANIZED LIST — Teaching Plan

8 After waiting in line for hours, Mercedes and her cousin have gotten tickets to the hottest game show on television, "Wheel of Fortune Cookies." The cousins love the part of the game where a contestant spins the wheel four times and after each spin takes a fortune cookie from inside the wheel. Concealed in each fortune cookie is one of these numbers: 0, 1, 6, 7, 9, or 11. The contestant draws out four cookies, and if the total of the numbers inside the cookies is exactly 20, the contestant wins a big prize! How many different ways can a contestant win the big prize?

FIND OUT

- What is the question you have to answer? *How many different ways can a contestant win the big prize?*
- What does each contestant get to do? *Spin the wheel and pick out fortune cookies.*
- How many cookies does a contestant get to take from the bin? *4*
- How are the cookies marked? *0, 1, 6, 7, 9, or 11*
- How many points does the contestant need to win? *20*

CHOOSE A STRATEGY

- If a contestant gets a 7 on Spin 1, a 7 on Spin 2, 6 on Spin 3, and 0 on Spin 4, is it the same as getting 7 on Spin 1, 7 on Spin 2, 0 on Spin 3, and 6 on Spin 4? *No* If not, is there another way to win with these numbers? *Yes, 7-6-0-7, 7-6-7-0, 7-0-7-6, 7-0-6-7*
- Is there a systematic way to record all the possible ways a contestant can score 20 points? *Yes, we can make an organized list.*

SOLVE IT

- What are the possible scores for one spin? *0, 1, 6, 7, 9, or 11*
- What are the possible combinations of numbers that equal 20 points? *7+7+6+0, 11+9+0+0, 9+9+1+1, 6+6+7+1, 11+1+7+1*
- One way to set up an organized list is to have four columns labeled Spin 1, Spin 2, Spin 3, and Spin 4. Begin with 7 for Spin 1, 7 for Spin 2, 6 for Spin 3, and 0 for Spin 4. Is there another way to arrange these numbers, using 7 for Spin 1? *7-7-0-6, 7-6-0-7, 7-6-7-0, 7-0-7-6, 7-0-6-7*
- Now use 6 for Spin 1. How many ways can you list these same numbers, using 6 for Roll 1? *6-7-7-0, 6-7-0-7, 6-0-7-7*
- Now use 0 for Spin 1. How many ways can you list these same numbers, using 0 for Roll 1? *0-6-7-7, 0-7-6-7, 0-7-7-6*
- Continue to fill in your list, to find all the possible ways a contestant can score 20 points.

Solution: 54 different ways

Combinations of 20
7 + 7 + 6 + 0
11 + 9 + 0 + 0
9 + 9 + 1 + 1
6 + 6 + 7 + 1
11 + 1 + 7 + 1

Spin 1	Spin 2	Spin 3	Spin 4
7	7	6	0
7	7	0	6
7	6	0	7
7	6	7	0
7	0	7	6
7	0	6	7

(See Solutions for complete answer)

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your list. Is your answer reasonable?

EXTEND IT

- If they can spin 4 times and the cookies are labeled 0, 1, 5, 6, 7, 9, or 11, how many different ways can a contestant score 20 points?

PRACTICE

- Similar Practice Problems: 51, 65, 78

USE OR LOOK FOR A PATTERN

Name

9 The king's messengers, out of breath, arrived with terrible news. Penelope, the witch who lived in Black Castle, had cast a spell on the kingdom because the royal photograph developers were too slow! The witch wanted her pictures of the Annual Witch Reunion, and she had been waiting for days. Penelope believed her prints would be particularly handsome. Penelope had declared that each day, until she received her prints, a larger and larger number of the kingdom's subjects would fall asleep. On the first day of the spell 8 subjects fell asleep. On the second day 24 subjects fell asleep — three times as many as the day before. Every day, three times as many subjects fell asleep as on the previous day. On what day would the entire population of 150,000 subjects be asleep, if Penelope continued to wait for her handsome prints?

FIND OUT

- What is the question you have to answer?
- What was Penelope's spell?
- How many subjects fell asleep the first day? The second day?
- Does the rate of increase stay the same from day to day?

CHOOSE A STRATEGY

- How does the number of subjects falling asleep change each day?
- Can you use this rate of increase to help you solve the problem?
- Is there a systematic way to record the information?

SOLVE IT

- If you set up a table, what are you keeping track of in the top row?
- What are you keeping track of in the second row?
- What are you keeping track of in the third row?
- If the number of subjects falling asleep tripled, how many fell asleep on the second day?
- How many subjects fell asleep on the third day?
- After the third day, what was the total number of subjects asleep?
- Continue filling in your table until you find a day when all the subjects would be asleep.

Day	1	2	3	4	5	6	
Put to sleep	8	24					
Total asleep	8	32					

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table and pattern of increase. Is your answer reasonable?

9 The king's messengers, out of breath, arrived with terrible news. Penelope, the witch who lived in Black Castle, had cast a spell on the kingdom because the royal photograph developers were too slow! The witch wanted her pictures of the Annual Witch Reunion, and she had been waiting for days. Penelope believed her prints would be particularly handsome. Penelope had declared that each day, until she received her prints, a larger and larger number of the kingdom's subjects would fall asleep. On the first day of the spell 8 subjects fell asleep. On the second day 24 subjects fell asleep — three times as many as the day before. Every day, three times as many subjects fell asleep as on the previous day. On what day would the entire population of 150,000 subjects be asleep, if Penelope continued to wait for her handsome prints?

FIND OUT

- What is the question you have to answer? *On what day would the entire population of 150,000 subjects be asleep, if Penelope continued to wait for her handsome prints?*
- What was Penelope's spell? *She was putting her subjects to sleep.*
- How many subjects fell asleep the first day? *8* The second day? *24*
- Does the rate of increase stay the same from day to day? *Yes, each day the number is triple the number of the day before.*

CHOOSE A STRATEGY

- How does the number of subjects falling asleep change each day? *It is triple the number of the day before.*
- Can you use this rate of increase to help you solve the problem? *Yes, we can use the pattern to find out when all the subjects would be asleep.*
- Is there a systematic way to record the information? *We can make a table.*

SOLVE IT

- If you set up a table, what are you keeping track of in the top row? *The number of days*
- What are you keeping track of in the second row? *The number of subjects put to sleep*
- What are you keeping track of in the third row? *The total number of subjects asleep as of that day*
- If the number of subjects falling asleep tripled, how many fell asleep on the second day? *24*
- How many subjects fell asleep on the third day? *72*
- After the third day, what was the total number of subjects asleep? *104*
- Continue filling in your table until you find a day when all the subjects would be asleep.

Solution: Day 10

Day	1	2	3	4	5	6	7	8	9	10	
Put to sleep	8	24	72	216	648	1,944	5,832	17,496	52,488	157,464	
Total asleep	8	32	104	320	968	2,912	8,744	26,240	78,728		

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table and pattern of increase. Is your answer reasonable?

EXTEND IT

- If each day 2¼ times more subjects are put to sleep than the day before, how long will it take before the entire population is asleep?

USE OR LOOK FOR A PATTERN Name

10 As you may remember, Pinocchio had a rather nasty habit of lying, which caused his nose to grow each time he told a lie. One morning, while working at his father's clock shop, Pinocchio decided to try an experiment. He wanted to see how long he could get his nose to grow. He measured his nose in its natural state and found it was 2 inches long. He shouted, "Cows make the best brain surgeons!" His nose grew 1.5 times longer than the original 2 inches. Now his nose was 5 inches long. "Jellybeans are an excellent source of protein!" he screamed, and again his nose increased 1.5 times the previous amount of growth. His nose was now 9.5 inches long. This is fun, he thought, and yelled, "Chocolate prevents cavities!" If Geppetto's clock shop was 32 feet long, and Pinocchio's nose continued to grow 1.5 times the amount of the previous growth, how many lies did Pinocchio have to tell before his nose reached the opposite wall?

FIND OUT

- What is the question you have to answer?
- What was Pinocchio doing?
- How long was Pinocchio's nose in its natural state?
- How much did Pinocchio's nose grow after his first lie?
- How much did Pinocchio's nose grow after his second lie?
- How long is Geppetto's shop?

CHOOSE A STRATEGY

- How did Pinocchio's nose increase ?
- Can you use this rate of increase to help you solve the problem?
- How can you organize and record the information?

SOLVE IT

- When you set up your table, what are you keeping track of in the first row? In the second row? In the third row?
- What is the pattern of increase in Pinocchio's nose?
- How long is his nose after the first lie?
- How long is his nose after the second lie?
- Continue to use the pattern to fill in the table, until his nose is as long as Geppetto's shop.

Lie	1	2	3	4	5	
Inches of growth	3	4.5				
Total inches	5					

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table and pattern of increase. Is your answer reasonable?

10 As you may remember, Pinocchio had a rather nasty habit of lying, which caused his nose to grow each time he told a lie. One morning, while working at his father's clock shop, Pinocchio decided to try an experiment. He wanted to see how long he could get his nose to grow. He measured his nose in its natural state and found it was 2 inches long. He shouted, "Cows make the best brain surgeons!" His nose grew 1.5 times longer than the original 2 inches. Now his nose was 5 inches long. "Jellybeans are an excellent source of protein!" he screamed, and again his nose increased 1.5 times the previous amount of growth. His nose was now 9.5 inches long. This is fun, he thought, and yelled, "Chocolate prevents cavities!" If Geppetto's clock shop was 32 feet long, and Pinocchio's nose continued to grow 1.5 times the amount of the previous growth, how many lies did Pinocchio have to tell before his nose reached the opposite wall?

FIND OUT

- What is the question you have to answer? *How many lies did Pinocchio have to tell before his nose reached the opposite wall?*
- What was Pinocchio doing? *Trying to see how long he could get his nose*
- How long was Pinocchio's nose in its natural state? *2 inches*
- How much did Pinocchio's nose grow after his first lie? *3 inches*
- How much did Pinocchio's nose grow after his second lie? *4.5 inches*
- How long is Geppetto's shop? *32 feet*

CHOOSE A STRATEGY

- How did Pinocchio's nose increase? *It increased 1.5 times the previous growth each time it grew.*
- Can you use this rate of increase to help you solve the problem? *Yes, we can use this pattern to figure out how much his nose grows.*
- How can you organize and record the information? *We can use a table.*

SOLVE IT

- When you set up your table, what are you keeping track of in the first row? *The number of lies* In the second row? *The amount of growth after each lie* In the third row? *The new length of his nose*
- What is the pattern of increase in Pinocchio's nose? *1.5 times greater than the previous growth*
- How long is his nose after the first lie? *5 inches*
- How long is his nose after the second lie? *9.5 inches*
- Continue to use the pattern to fill in the table, until his nose is as long as Geppetto's shop.

Solution: 11 lies

Lie	1	2	3	4	5	6	7	8	9	10	11	
Inches of growth	3	4.5	6.75	10.13	15.2	22.8	34.2	51.3	76.95	115.43	173.15	
Total inches	5	9.5	16.25	26.38	41.58	64.38	98.58	149.88	226.83	342.26	515.41	

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table and pattern of change. Is your answer reasonable?

EXTEND IT

- If Pinocchio's nose grew 1¼ times more than the previous growth each time, how long would it take his nose to reach the opposite wall of Geppetto's shop?

PRACTICE

- Similar Practice Problems: 54, 71, 83

USE OR MAKE A TABLE

Name

11 It is a very hot summer in the desert, and there is a shortage of water. The sheiks began lining up their camels at 3:00 this morning for a fill-up at the self-serve water station, which opens at 6:00 A.M. There are two lines of camels: one for dromedary (one-hump) camels and one for Bactrian (two-hump) camels. At 3:00 A.M. there were 4 camels in the dromedary line and 6 in the Bactrian line; by 3:15 there were 5 in the dromedary and 7 in the Bactrian; by 3:30 there were 7 in the dromedary and 9 in the Bactrian; by 3:45 there were 10 in the dromedary and 12 in the Bactrian. It is now 4:00, and there are 14 camels in the dromedary line and 16 in the Bactrian. At that rate, how many camels will be waiting at the water station when the attendants open it at 6:00 A.M.?

FIND OUT

- What is the question you have to answer?
- What time did the camels start lining up?
- How many camels were in the dromedary line at 3:00? At 3:15? At 3:30? At 3:45? At 4:00? How many camels were in the Bactrian line at 3:00? At 3:15? At 3:30? At 3:45? At 4:00?
- What time will the station open?

CHOOSE A STRATEGY

- Would it help to keep track of every fifteen minutes and how many camels are in each line?
- What strategy can help you figure out how the number of camels in each line is changing?

SOLVE IT

- When you set up a table, what will you use as labels for the columns? For the rows?
- What is the difference between the number of camels in the dromedary line at 3:00 and at 3:15? At 3:15 and at 3:30? At 3:30 and at 3:45? At 3:45 and at 4:00?
- Do you see a pattern in the way the numbers change?
- Continue to fill in your table to find out how many camels will be waiting in the station when it opens at 6:00.

Time	3:00	3:15	3:30	3:45	4:00	
Dromedary						
Bactrian						
Total						

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

11 It is a very hot summer in the desert, and there is a shortage of water. The sheiks began lining up their camels, at 3:00 this morning for a fill-up at the self-serve water station, which opens at 6:00 A.M. There are two lines of camels: one for dromedary (one-hump) camels and one for Bactrian (two-hump) camels. At 3:00 A.M. there were 4 camels in the dromedary line and 6 in the Bactrian line; by 3:15 there were 5 in the dromedary and 7 in the Bactrian; by 3:30 there were 7 in the dromedary and 9 in the Bactrian; by 3:45 there were 10 in the dromedary and 12 in the Bactrian. It is now 4:00, and there are 14 camels in the dromedary line and 16 in the Bactrian. At that rate, how many camels will be waiting at the water station when the attendants open it at 6:00 A.M.?

FIND OUT

- What is the question you have to answer? *How many camels will be waiting at the water station when the attendants open it at 6:00 A.M.?*
- What time did the camels start lining up? *3:00 A.M.*
- How many camels were in the dromedary line at 3:00? *4* At 3:15? *5* At 3:30? *7* At 3:45? *10* At 4:00? *14* How many camels were in the Bactrian line at 3:00? *6* At 3:15? *7* At 3:30? *9* At 3:45? *12* At 4:00? *16*
- What time will the station open? *6:00 A.M.*

CHOOSE A STRATEGY

- Would it help to keep track of every fifteen minutes and how many camels are in each line? *Yes, we can make a table.*
- What strategy can help you figure out how the number of camels in each line is changing? *Look for a pattern in the way the numbers change in each line.*

SOLVE IT

- When you set up a table, what will you use as labels for the columns? *The 15-minute time intervals* For the rows? *Dromedary, Bactrian, and Total*
- What is the difference between the number of camels in the dromedary line at 3:00 and at 3:15? *+1* At 3:15 and at 3:30? *+2* At 3:30 and at 3:45? *+3* At 3:45 and at 4:00? *+4*
- Do you see a pattern in the way the numbers change? *Yes, the differences keep increasing by 1.*
- (Have students continue to fill in their tables.) How many camels will be waiting in the station when it opens at 6:00?

Solution: 166

Time	3:00	3:15	3:30	3:45	4:00	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00
Dromedary	4	5	7	10	14	19	25	32	40	49	59	70	82
Bactrian	6	7	9	12	16	21	27	34	42	51	61	72	84
Total	10	12	16	22	30	40	52	66	82	100	120	142	166

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

EXTEND IT

- If there were 3 dromedaries in line at 3:00, 4 at 3:15, 7 at 3:30, 12 at 3:45, and 19 at 4:00, how many camels would there be in the station when it opened at 6:00?

USE OR MAKE A TABLE

Name

12 It is nearing curtain time at the Opera House. The two greatest classical singers in the world, Viola Voice and Lily Larynx, are in their dressing rooms getting ready for their first concert together. Sam, the stage manager, has his hands full receiving flowers from the singers' adoring fans and delivering them to the two prima donnas. At 6:05 he brought 3 bouquets to each singer. At 6:10 he delivered 7 bouquets to Viola and 9 to Lily; five minutes later he delivered 6 bouquets to Viola and 7 to Lily; five minutes later he brought 10 to Viola and 13 to Lily; and five minutes later he delivered 9 to Viola and 11 to Lily. If the flowers keep arriving in this way every five minutes, how many bouquets will each of the opera stars have when the curtain goes up at 8:00?

FIND OUT

- What is the question you have to answer?
- What time did Sam start delivering flowers to the singers?
- How many bouquets did Sam deliver to Viola at 6:05? At 6:10? At 6:15? At 6:20? At 6:25? How many bouquets did Sam deliver to Lily at 6:05? At 6:10? At 6:15? At 6:20? At 6:25?
- What time will the curtain go up?

CHOOSE A STRATEGY

- Would it help to keep track of every five minutes and how many bouquets each singer receives?
- What strategy can help you figure out how the number of bouquets for each singer is changing?

SOLVE IT

- When you set up a table, what will you use as labels for the columns? For the rows?
- What is the difference between the number of bouquets Viola received at 6:05 and at 6:10? At 6:10 and at 6:15? At 6:15 and at 6:20? At 6:20 and at 6:25?
- Do you see a pattern of change?
- Continue to fill in your table to find out how many bouquets each singer will have when the curtain goes up at 8:00.

Time	6:05	6:10	6:15	6:20	6:25	
Viola						
Lily						

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

12 It is nearing curtain time at the Opera House. The two greatest classical singers in the world, Viola Voice and Lily Larynx, are in their dressing rooms getting ready for their first concert together. Sam, the stage manager, has his hands full receiving flowers from the singers' adoring fans and delivering them to the two prima donnas. At 6:05 he brought 3 bouquets to each singer. At 6:10 he delivered 7 bouquets to Viola and 9 to Lily; five minutes later he delivered 6 bouquets to Viola and 7 to Lily; five minutes later he brought 10 to Viola and 13 to Lily; and five minutes later he delivered 9 to Viola and 11 to Lily. If the flowers keep arriving in this way every five minutes, how many bouquets will each of the opera stars have when the curtain goes up at 8:00?

FIND OUT

- What is the question you have to answer? *How many bouquets will each of the opera stars have when the curtain goes up at 8:00?*
- What time did Sam start delivering flowers to the singers? *6:05*
- How many bouquets did Sam deliver to Viola at 6:05? *3* At 6:10? *7* At 6:15? *6* At 6:20? *10* At 6:25? *9* How many bouquets did Sam deliver to Lily at 6:05? *3* At 6:10? *9* At 6:15? *7* At 6:20? *13* At 6:25? *11*
- What time will the curtain go up? *8:00*

CHOOSE A STRATEGY

- Would it help to keep track of every five minutes and how many bouquets each singer receives? *Yes, we can make a table.*
- What strategy can help you figure out how the number of bouquets for each singer is changing? *We can look for a pattern in the numbers.*

SOLVE IT

- When you set up a table, what will you use as labels for the columns? *The 5-minute time intervals* For the rows? *Viola, and Lily*
- What is the difference between the number of bouquets Viola received at 6:05 and at 6:10? *+4* At 6:10 and at 6:15? *−1* At 6:15 and at 6:20? *+4* At 6:20 and at 6:25? *−1*
- Do you see a pattern of change? *Yes, +4, −1*
- (Have students continue to fill in their tables.) How many bouquets will each singer have when the curtain goes up at 8:00?

Solution: Viola Voice—516; Lily Larynx—672

Time	6:05	6:10	6:15	6:20	6:25	6:30	6:35	6:40	6:45	6:50	6:55	7:00
Viola	3	7	6	10	9	13	12	16	15	19	18	22
Lily	3	9	7	13	11	17	15	21	19	25	23	29

(continued)

Time	7:05	7:10	7:15	7:20	7:25	7:30	7:35	7:40	7:45	7:50	7:55	8:00
Viola	21	25	24	28	27	31	30	34	33	37	36	40
Lily	27	33	31	37	35	41	39	45	43	49	47	53

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

EXTEND IT

- After the concert Sam loaded Viola's bouquets into vans, and his son loaded Lily's flowers into vans. Sam loaded 19 bouquets into the first van in his line, 17 in the second one, 22 into the third, 20 into the fourth, 25 into the fifth, and so on. Sam's son loaded 29 bouquets into the first van in his line, 26 into the second, 33 into the third, 30 into the fourth, 37 into the fifth, and so on. How many vans were needed to carry away all of the singers' bouquets?

PRACTICE

- Similar Practice Problems: 53, 70, 84

MAKE A PICTURE OR DIAGRAM Name

13 Venski is fascinated by the ice-cleaning machine as it scrapes the ice between periods at the hockey game. The hockey rink is a rectangle, 120 feet by 60 feet. The scraper cleans a 4-foot-wide strip. If the machine starts at one corner and moves around and around the rink toward the center, on which trip around will it have half the area of the rink clean?

FIND OUT

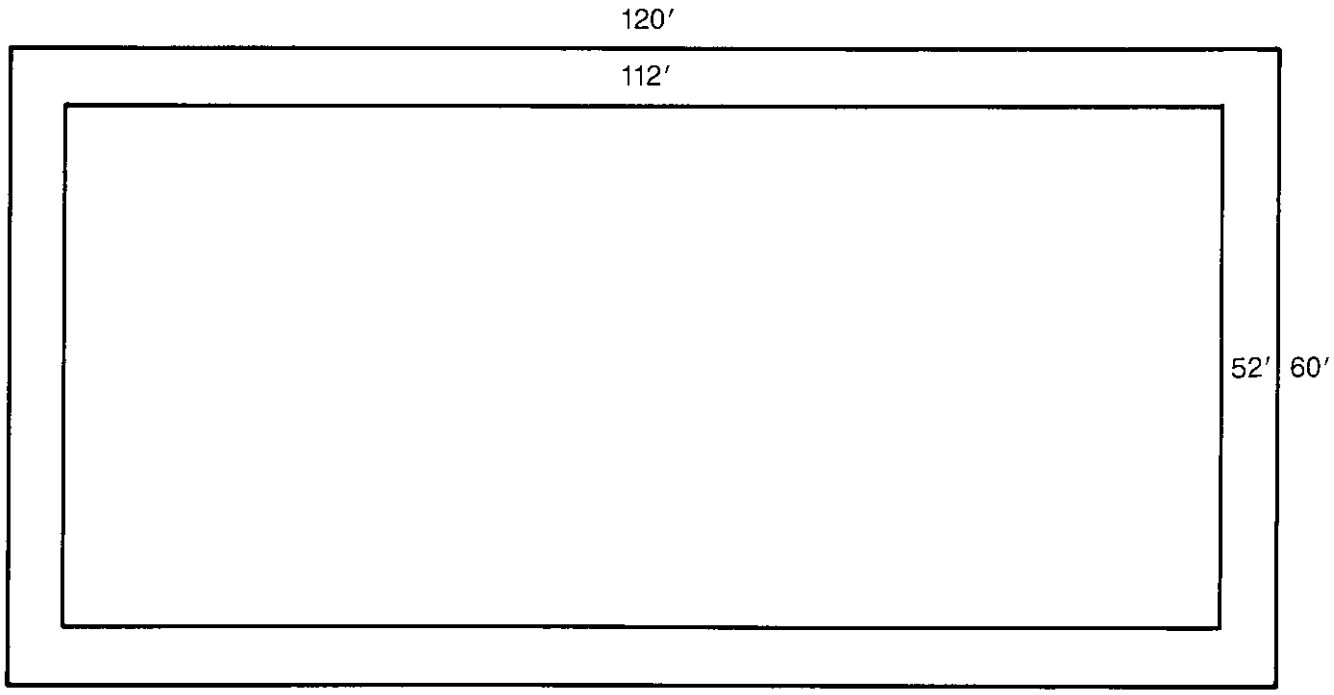
- What is the question you have to answer?
- What are the shape and dimensions of the hockey rink?
- How wide is the strip of ice that the machine cleans as it moves?
- Where does the machine start cleaning the rink? How does it move as it cleans?

CHOOSE A STRATEGY

- Would it help to draw a diagram so that you can see how the machine moves on the rink?

SOLVE IT

- Begin by drawing the rink. Write the dimensions on the sides.
- What is the area of the rink? What is half the area?
- How wide is the strip cleaned by the machine? On your diagram, show the strip that will be cleaned the first trip around the rink.
- What are the dimensions of the part still to be cleaned? What is the area of the part still to be cleaned? Is it more, or less, than half?
- Continue showing strips on your diagram and recording the dimensions and area of the part to be cleaned. On which trip around will the machine have half the area of the rink clean?



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

13 Venski is fascinated by the ice-cleaning machine as it scrapes the ice between periods at the hockey game. The hockey rink is a rectangle, 120 feet by 60 feet. The scraper cleans a 4-foot-wide strip. If the machine starts at one corner and moves around and around the rink toward the center, on which trip around will it have half the area of the rink clean?

FIND OUT

- What is the question you have to answer? *On which trip around will the machine have half the area of the rink clean?*
- What are the shape and dimensions of the hockey rink? *Rectangle, 120 feet by 60 feet.*
- How wide is the strip of ice that the machine cleans as it moves? *4 feet*
- Where does the machine start cleaning the rink? *At one corner* How does it move as it cleans? *Around and around, from the outside edge toward the center.*

CHOOSE A STRATEGY

- Would it help to draw a diagram so that you can see how the machine moves on the rink? *Yes.*

SOLVE IT

- Begin by drawing the rink. Write the dimensions on the sides.
- What is the area of the rink? *7200 square feet* What is half the area? *3600 square feet*
- How wide is the strip cleaned by the machine? *4 feet* On your diagram, show the strip that will be cleaned the first trip around the rink.
- What are the dimensions of the part still to be cleaned? *112 feet by 52 feet* What is the area of the part still to be cleaned? *5824 square feet* Is it more, or less, than half? *More*
- (Have students continue to show strips on their diagrams, until the area of the part to be cleaned is less than half.) On which trip around will the machine have half the area of the rink clean?

Solution: 3rd trip

$60 \times 120 = 7200$ sq ft

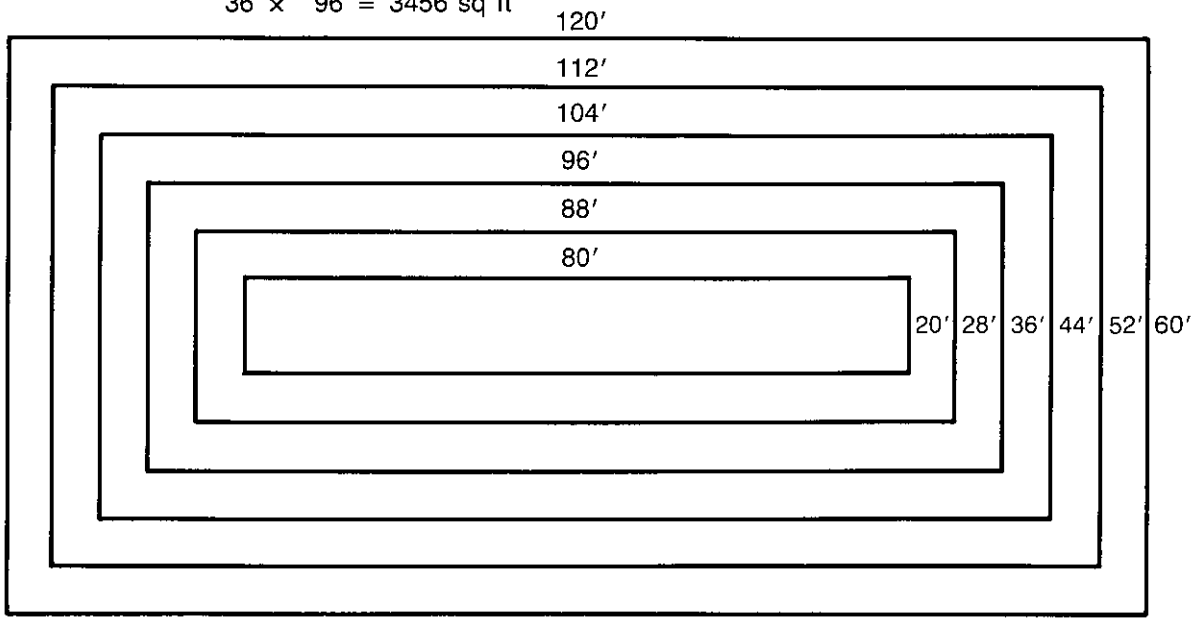
$\frac{1}{2} \times 7200 = 3600$ sq ft

1st time $<$ $60 \times 120 = 7200$ sq ft

2nd time $<$ $52 \times 112 = 5824$ sq ft

3rd time $<$ $44 \times 104 = 4576$ sq ft

$36 \times 96 = 3456$ sq ft



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

EXTEND IT

- On which trip around will the machine have two-thirds of the area of the rink clean?

MAKE A PICTURE OR DIAGRAM Name

14 Holly and Harlan took a shortcut home through the park. It was a warm day, so they parked their bikes and took a drink from the water fountain. While resting, they watched workmen putting in a huge flower bed around a statue of George Washington. The flower bed consisted of a series of rectangular borders surrounding the statue, with a different type of flower in each border. The base of the statue in the center was 12 feet by 2 feet, and each border was 3 feet wide. "Where do we plant the jonquils?" one of the workers shouted. The supervisor stuck his head around the base of the statue and responded, "In the border that has 8 times the area of this base." Holly looked at Harlan, puzzled. "Do you know what he's talking about?" she asked. "I'm not sure," answered Harlan, "but let's figure it out." What are the dimensions of that border?

FIND OUT

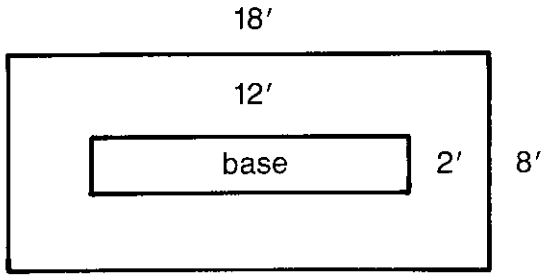
- What is the question you have to answer?
- What is the design of the flower bed?
- What is the shape of the base of the statue? What are the dimensions of the base?
- How wide is each border surrounding the statue?
- What do you know about the area of the border in which the jonquils will be planted?

CHOOSE A STRATEGY

- Would it help to draw a diagram so that you can see how the borders are laid out around the statue?

SOLVE IT

- Begin by drawing the base of the statue. Write the dimensions on the sides.
- What is the area of the base? What would 8 times that area be?
- How wide is each border? On your diagram, show the first border surrounding the base of the statue. Write the dimensions on the outer edges.
- What is the area of the base plus the first border? Then what is the area of the first border? Is it 8 times the area of the base?
- Continue drawing your diagram until you find out what the dimensions are of the border in which the jonquils will be planted.



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

14 Holly and Harlan took a shortcut home through the park. It was a warm day, so they parked their bikes and took a drink from the water fountain. While resting, they watched workmen putting in a huge flower bed around a statue of George Washington. The flower bed consisted of a series of rectangular borders surrounding the statue, with a different type of flower in each border. The base of the statue in the center was 12 feet by 2 feet, and each border was 3 feet wide. "Where do we plant the jonquils?" one of the workers shouted. The supervisor stuck his head around the base of the statue and responded, "In the border that has 8 times the area of this base." Holly looked at Harlan, puzzled. "Do you know what he's talking about?" she asked. "I'm not sure," answered Harlan, "but let's figure it out." What are the dimensions of that border?

FIND OUT

- What is the question you have to answer? *What are the dimensions of the border in which the jonquils will be planted?*
- What is the design of the flower bed? *It is a series of rectangular borders surrounding the statue.*
- What is the shape of the base of the statue? *Rectangle* What are the dimensions of the base? *12 feet by 2 feet*
- How wide is each border surrounding the statue? *3 feet*
- What do you know about the area of the border in which the jonquils will be planted? *It is 8 times the area of the base of the statue.*

CHOOSE A STRATEGY

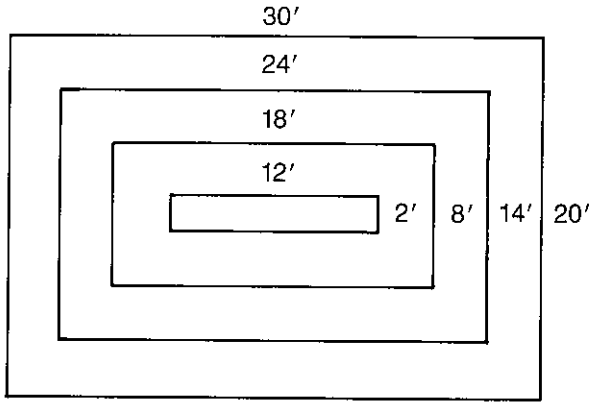
- Would it help to draw a diagram so that you can see how the borders are laid out around the statue? *Yes.*

SOLVE IT

- Begin by drawing the base of the statue. Write the dimensions on the outside edges.
- What is the area of the base? *24 square feet* What would 8 times that area be? *192 square feet*
- How wide is each border? *3 feet* On your diagram, show the first border surrounding the base of the statue. Write the dimensions on the outer edges.
- What is the area of the base plus the first border? *144 square feet* Then what is the area of the first border? *144 – 24 = 120 square feet* Is it 8 times the area of the base? *No.*
- (Have students continue drawing their diagrams.) What are the dimensions of the border in which the jonquils will be planted?

Solution: 14 feet by 24 feet

$2' \times 12' = 24$ sq ft $\times$ 8 = 192 sq ft
$8' \times 18' = 144 - 24 = 120$ sq ft (border 1)
$14' \times 24' = 336 - 144 = 192$ sq ft (border 2)



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

EXTEND IT

- The area of the border in which the workers will plant daffodils is 17 times the area of the base. What are the dimensions of that border?

PRACTICE

- Similar Practice Problems: 55, 79, 88

GUESS AND CHECK

Name

15 The king's messengers are exhausted. It seems that the prince met an especially beautiful lady at the ball last week. After one dance with her, the royal clock chimed midnight and she ran off, leaving a small slipper behind. The prince wanted the messengers to find his mystery lady! For five full days the messengers went from door to door, trying to squeeze every female foot in the kingdom into the slipper. They tried twice as many feet on the first day as on the second day. On the third day they tried 25 more feet than the combined number of feet that they tried on the first two days. On the fourth day they tried 25% as many feet as on the third day. On the last day they tried 25% more feet than they had on the fourth day. On the 1000th try, they found the foot that fit. How many feet did they attempt to fit the shoe on each day?

FIND OUT

- What is the question you have to answer?
- How many feet were tried in all?
- What do you know about the number of feet tried on the first day? On the second day? On the third day? On the fourth day? On the fifth day?

CHOOSE A STRATEGY

- Can guessing an answer help you solve this problem?
- How can you use the information from an incorrect guess?

SOLVE IT

- What was the total number of tries made by the messengers?
- Would you start by guessing a number for the first, second, third, fourth, or fifth day? Why?
- What is your guess?
- If you guess the number of attempts for one day, can you figure out the number of attempts for the other days?
- How can you check your guess?
- How was your guess? If your first guess was wrong, how can you use the information to make your next guess better?
- Continue to make guesses and check them until you solve the problem. How many feet did the king's messengers attempt to fit the shoe on each day?

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

15 The king's messengers are exhausted. It seems that the prince met an especially beautiful lady at the ball last week. After one dance with her, the royal clock chimed midnight and she ran off, leaving a small slipper behind. The prince wanted the messengers to find his mystery lady! For five full days the messengers went from door to door, trying to squeeze every female foot in the kingdom into the slipper. They tried twice as many feet on the first day as on the second day. On the third day they tried 25 more feet than the combined number of feet that they tried on the first two days. On the fourth day they tried 25% as many feet as on the third day. On the last day they tried 25% more feet than they had on the fourth day. On the 1000th try, they found the foot that fit. How many feet did they attempt to fit the shoe on each day?

FIND OUT

- What is the question you have to answer? *How many feet did the messengers attempt to fit the shoe on each day?*
- How many feet were tried in all? *1,000*
- What do you know about the number of feet tried on the first day? *Twice as many as on the second day* On the second day? *We don't know very much.* On the third day? *25 more feet than on the first and second days together.* On the fourth day? *25% of the number of feet tried on the third day.* On the fifth day? *25% more than the number of feet on the fourth day.*

CHOOSE A STRATEGY

- Can guessing an answer help you to solve this problem? *Yes, because we don't have a definite number of feet for any day.*
- How can you use the information from an incorrect guess? *We can determine whether it is too high or too low and then make another guess based on that.*

SOLVE IT

- What was the total number of tries made by the messengers? *1,000*
- Would you start by guessing a number for the first, second, third, fourth, or fifth day? *Second* Why? *We know the least about the number for that day.*
- What is your guess? *100* (This is an example of one possible guess.)
- If you guess the number of attempts for one day, can you figure out the number of attempts for the other days? *Yes, if the second day is 100, then the first day is twice 100, or 200; the third day is 200 + 100 + 25, or 325. The fourth day is 25% of the third day, or 81.25. The fifth day is 25% more than the fourth day, or 101.56.*
- How can you check your guess? *Add up the number of tries for the five days and see if the sum is 1,000. Tries: 200 + 100 + 325 + 81.25 + 101.56 = 807.81*
- How was your guess? *Too low.* If your first guess was wrong, how can you use the information to make your next guess better? *Make the guess for the second day higher.*
- (Have students continue to make guesses until they solve the problem.) How many feet did they attempt to fit the shoe on each day?

  Solution: 1st day—250, 2nd day—125, 3rd day—400, 4th day—100, 5th day—125

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

EXTEND IT

- Ladies began sending shoes to the castle. When the total reached 995, the Queen put a stop to it. She sent back 7 times as many shoes on Tuesday as on Monday; 45% as many on Wednesday as on Tuesday; 25% as many on Thursday as on Wednesday; and 50% as many on Friday as on Monday. How many shoes did the Queen send back each day?

GUESS AND CHECK

Name

16 It's feeding time in the jungle, and the Flytrap children are hungry. Their mother, Venus, has been gathering flies for her children's upturned mouths. "Remember, children, you must eat all your dinner, or no dessert." She needn't worry! Yesterday, the six Flytrap brothers and sisters ate 115 flies altogether. Farley ate four times the number of flies that Franny ate. Fiona managed to snap up half the number of flies that Farley ate. Frank gulped down as many flies as Fiona and Floyd together. Franny ate twice as many as Floyd. Festus ate five fewer flies than Fiona, and Floyd ate one-eighth as many as Farley. (Floyd is a picky eater.) How many flies did each child eat?

FIND OUT

- What is the question you have to answer?
- How many Flytrap children are there?
- How many flies did they eat in all?
- What do you know about the number of flies that Farley ate? That Franny ate? That Fiona ate? That Frank ate? That Floyd ate? That Festus ate?

CHOOSE A STRATEGY

- Can guessing an answer help you solve this problem?
- How can you use the information from an incorrect guess?

SOLVE IT

- How many flies in all did the children eat?
- Would you start by guessing a number for Farley, Franny, Fiona, Frank, Floyd, or Festus? Why?
- What is your guess?
- If you guess the number of flies for one child, can you figure out the number of flies for each brother or sister?
- How can you check your guess?
- How was your guess? If your first guess was wrong, how can you use the information to make your next guess better?
- Continue to make guesses and check them until you find out how many flies each child ate.

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

16 It's feeding time in the jungle, and the Flytrap children are hungry. Their mother, Venus, has been gathering flies for her children's upturned mouths. "Remember, children, you must eat all your dinner, or no dessert." She needn't worry! Yesterday, the six Flytrap brothers and sisters ate 115 flies altogether. Farley ate four times the number of flies that Franny ate. Fiona managed to snap up half the number of flies that Farley ate. Frank gulped down as many flies as Fiona and Floyd together. Franny ate twice as many as Floyd. Festus ate five fewer flies than Fiona, and Floyd ate one-eighth as many as Farley. (Floyd is a picky eater.) How many flies did each child eat?

FIND OUT

- What is the question you have to answer? *How many flies did each child eat?*
- How many Flytrap children are there? *6*
- How many flies did they eat in all? *115*
- What do you know about the number of flies that Farley ate? *4 times as many as Franny ate* That Franny ate? *2 times as many as Floyd* That Fiona ate? *Half as many as Farley* That Frank ate? *As many as Fiona and Floyd together* That Floyd ate? *One-eighth as many as Farley* That Festus ate? *5 fewer than Fiona*

CHOOSE A STRATEGY

- Can guessing an answer help you solve this problem? *Yes, because we don't have a definite number for any child.*
- How can you use the information from an incorrect guess? *We can determine whether it is too high or too low and then make another guess based on that.*

SOLVE IT

- How many flies in all did the children eat? *115*
- Would you start by guessing a number for Farley, Franny, Fiona, Frank, Floyd, or Festus? *Farley* Why? *If we know the number for Farley, we can figure out the numbers for Fiona, Franny, and Floyd.*
- What is your guess? *24* (This is an example of one possible guess.)
- If you guess the number of flies for one child, can you figure out the number of flies for each brother or sister? *Yes, if Farley ate 24 flies, then Fiona ate ½ × 24, or 12 flies; and Franny ate ¼ × 24, or 6 flies; and Floyd ate ⅛ × 24, or 3 flies. Then Frank ate 12 + 3, or 15 flies. Festus ate 12 − 5, or 7 flies. The total number of flies is 24 + 12 + 6 + 3 + 15 + 7, or 67.*
- How can you check your guess? *Compare 67 with 115.*
- How was your guess? *Too low.* If your first guess was wrong, how can you use the information to make your next guess better? *We can start with a higher number for Farley.*
- (Have students continue making guesses until they find the solution.) How many flies did each child eat?

  Solution: Farley—40, Floyd—5, Franny—10, Frank—25, Fiona—20, Festus—15

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

EXTEND IT

- Today the Flytraps ate 172 flies in all. Franny ate 5 times as many as Farley; Fiona ate ¼ as many as Farley; Frank ate as much as Fiona and Farley together; Festus ate 6 more flies than Floyd, who ate ¼ as many as Franny. How many did each child eat?

PRACTICE

- Similar Practice Problems: 57, 68, 82

WORK BACKWARDS

Name

17 In order to graduate from the Easter Bunny University and be an official egg-delivering rabbit, Riley Rabbit has to pass a final "eggsamination." He has to hop ten miles through the heart of downtown traffic (at rush hour) with a basketful of decorated eggs. At three stations along the way a judge will match each uncracked egg with a decorated egg and remove the cracked eggs. To pass the exam, Riley must arrive at the fourth station with at least twice the number of uncracked eggs that he began with. Here is what happened: Riley arrived at Station 1 with no cracked eggs. His eggs were matched with decorated ones. On the way to Station 2, however, he cracked 10 eggs. At Station 2 the uncracked eggs were matched and the cracked ones removed. On the way to Station 3 Riley cracked 14 eggs, which were removed and the uncracked ones matched. On the way to Station 4 he cracked 2 eggs. Riley arrived at Station 4 with 90 uncracked eggs. Did Riley graduate?

FIND OUT

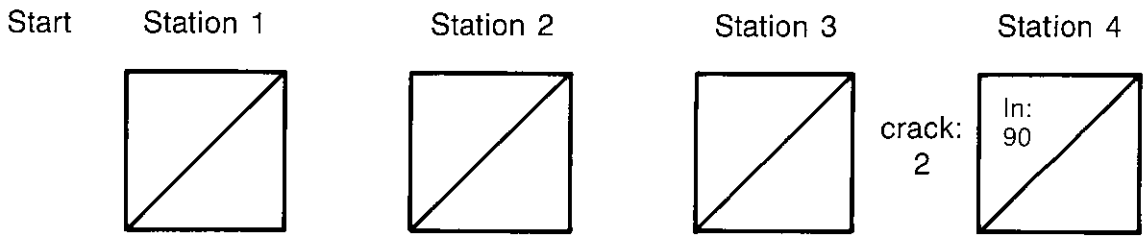
- What is the question you have to answer?
- What is Riley doing?
- What happened at the first 3 stations Riley stopped at?
- What happened at the last station?
- How many eggs were cracked between Station 1 and Station 2?
- How many eggs were cracked between Station 2 and Station 3?
- How many eggs were cracked between Station 3 and Station 4?
- How many uncracked eggs did he have when he got to Station 4?

CHOOSE A STRATEGY

- Think about the best way to begin solving this problem. The only total given for uncracked eggs is for the last stop, Station 4. Therefore you need to work backwards from Station 4 to Station 1.
- Is there another strategy that would be helpful?

SOLVE IT

- If you begin with Station 4, how many uncracked eggs did he arrive there with?
- How many did he crack on the way to Station 4?
- Working backwards to Station 3, if you add 2 to 90, then 92 eggs represents the amount he had after the uncracked ones were matched. How many uncracked eggs did he have when he arrived at Station 3?
- Working backwards to Station 2, how many eggs were cracked between Station 2 and 3? How many eggs did he leave Station 2 with? How many uncracked eggs did he arrive at Station 2 with?
- Continue working backwards in this way until you find out how many eggs Riley started with.



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your picture and work. Is your answer reasonable?

17 In order to graduate from the Easter Bunny University and be an official egg-delivering rabbit, Riley Rabbit has to pass a final "eggsamination." He has to hop ten miles through the heart of downtown traffic (at rush hour) with a basketful of decorated eggs. At three stations along the way a judge will match each uncracked egg with a decorated egg and remove the cracked eggs. To pass the exam, Riley must arrive at the fourth station with at least twice the number of uncracked eggs that he began with. Here is what happened: Riley arrived at Station 1 with no cracked eggs. His eggs were matched with decorated ones. On the way to Station 2, however, he cracked 10 eggs. At Station 2 the uncracked eggs were matched and the cracked ones removed. On the way to Station 3 Riley cracked 14 eggs, which were removed and the uncracked ones matched. On the way to Station 4 he cracked 2 eggs. Riley arrived at Station 4 with 90 uncracked eggs. Did Riley graduate?

FIND OUT

- What is the question you have to answer? *Did Riley graduate?*
- What is Riley doing? *Trying to carry eggs through downtown, cracking as few as possible.*
- What happened at the first 3 stations Riley stopped at? *Each uncracked egg was matched with another one and the cracked ones were removed.*
- What happened at the last station? *They checked to see how many uncracked eggs he had left.*
- How many eggs were cracked between Station 1 and Station 2? *10*
- How many eggs were cracked between Station 2 and Station 3? *14*
- How many eggs were cracked between Station 3 and Station 4? *2*
- How many uncracked eggs did he have when he got to Station 4? *90*

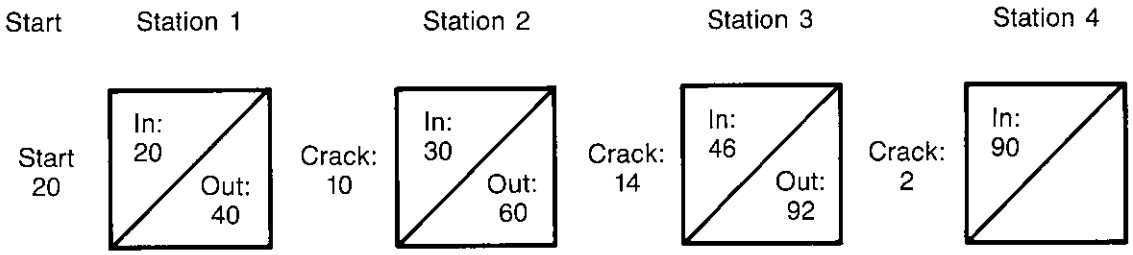
CHOOSE A STRATEGY

- Think about the best way to begin solving this problem. The only total given for uncracked eggs is for the last stop, Station 4. Therefore you need to work backwards from Station 4 to Station 1.
- Is there another strategy that would be helpful? *We can make a diagram.*

SOLVE IT

- If you begin with the Station 4, how many uncracked eggs did he arrive there with? *90*
- How many did he crack on the way to Station 4? *2*
- Working backwards to Station 3, if you add 2 to 90, then 92 eggs represents the amount he had after the uncracked ones were matched. How many uncracked eggs did he have when he arrived at Station 3? *46, taking half of 92*
- Working backwards to Station 2, how many eggs were cracked between Station 2 and 3? *14* How many eggs did he leave Station 2 with? *46+14=60* How many uncracked eggs did he arrive at Station 2 with? *½ of 60=30*
- (Have students continue working backwards in this way.) How many eggs did Riley start with?

Solution: Yes, because he began with 20 eggs.



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your picture and work. Is your answer reasonable?

EXTEND IT

- Does Riley pass the test if instead of matching each uncracked egg, they only match ½ of the uncracked eggs?

18 Ramon has a summer job as a bike messenger, delivering packages to businesses and offices downtown. Ramon feels totally cool getting his instructions from the dispatcher over a two-way radio. This morning his first stop was an insurance office where he picked up some packages. His instructions were to drop off $\frac{1}{2}$ of those packages at a second building and pick up two more packages. His third stop was a medical building. He dropped off $\frac{1}{2}$ of his packages and picked up seven. At his fourth stop, city hall, he dropped off $\frac{1}{4}$ of his packages and picked up one. The fifth delivery was to law offices where he left $\frac{1}{2}$ of his packages and picked up one. On his sixth stop, Ramon left 6 packages, all that he had left. Then he took a lunch break. How many packages did Ramon deliver before lunch?

FIND OUT

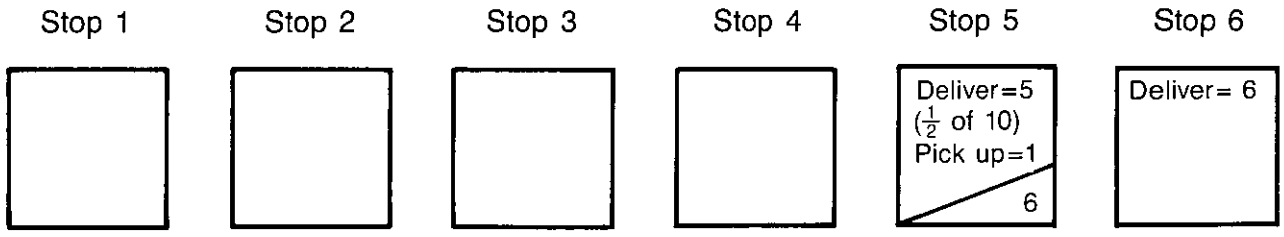
- What is the question you have to answer?
- What was Ramon doing?
- What do you know about Ramon's first stop?
- What do you know about the number of packages he picked up and delivered at his second stop?
- What do you know about the number of packages he picked up and delivered at his third stop?
- What do you know about the number of packages he picked up and delivered at his fourth stop?
- What did Ramon pick up and deliver at his fifth stop?
- What did Ramon do on his sixth stop?

CHOOSE A STRATEGY

- You have very little specific information. If you begin with the number of packages he delivered on his sixth stop, what can you do?
- Is there a way to show your work that will help?

SOLVE IT

- Begin with Ramon's sixth stop. How many packages did he deliver here? Did he pick up any?
- If you work back to his fifth stop, you know he left with 6 packages after picking up 1, so that he had to have 5 after he made his delivery. How many did he arrive at stop 5 with?
- Work backwards to stop 4. Go through the same process of subtracting the number that he picked up and then figure out the number he arrived with. How many did he deliver and pick up at this stop? How many did he arrive with?
- Continue to work backwards in this way, until you reach the number of packages that he started with.



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

18 Ramon has a summer job as a bike messenger, delivering packages to businesses and offices downtown. Ramon feels totally cool getting his instructions from the dispatcher over a two-way radio. This morning his first stop was an insurance office where he picked up some packages. His instructions were to drop off ½ of those packages at a second building and pick up two more packages. His third stop was a medical building. He dropped off ½ of his packages and picked up seven. At his fourth stop, city hall, he dropped off ¼ of his packages and picked up one. The fifth delivery was to law offices where he left ½ of his packages and picked up one. On his sixth stop, Ramon left 6 packages, all that he had left. Then he took a lunch break. How many packages did Ramon deliver before lunch?

FIND OUT

- What is the question you have to answer? *How many packages did Ramon deliver before lunch?*
- What was Ramon doing? *Delivering packages and picking up packages at different buildings*
- What do you know about Ramon's first stop? *He picked up some packages*
- What do you know about the number of packages he picked up and delivered at his second stop? *He delivered ½ the number he had and picked up 2.*
- What do you know about the number of packages he picked up and delivered at his third stop? *He delivered ½ the number he had and picked up 7.*
- What do you know about the number of packages he picked up and delivered at his fourth stop? *He delivered ¼ the total number he had and picked up 1.*
- What did Ramon pick up and deliver at his fifth stop? *He delivered ½ the total number he had and then picked up 1.*
- What did Ramon do on his sixth stop? *He left 6 packages, all that he had.*

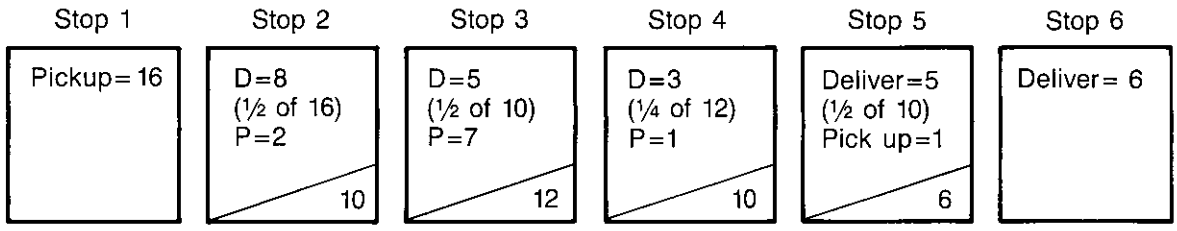
CHOOSE A STRATEGY

- You have very little specific information. If you begin with the number of packages he delivered on his sixth stop, what can you do? *Work backwards to his first stop*
- Is there a way to show your work that will help? *We can make a diagram.*

SOLVE IT

- Begin with Ramon's sixth stop. How many packages did he deliver here? *6* Did he pick up any? *No*
- If you work back to his fifth stop, you know he left with 6 packages after picking up 1, so that he had to have 5 before he picked up 1. How many did he arrive at stop 5 with? *10, if 5 is ½ the amount he had after making his delivery.*
- Work backwards to stop 4. Go through the same process of subtracting the number that he picked up and then figure out the number he arrived with. How many did he deliver and pick up at this stop? *Deliver ¼ total and pick up 1* How many did he arrive with? *10−1=9, then if 9 is ¾ the number delivered, he must have arrived with 12.*
- (Have students continue to work backwards in this way.) How many packages did Ramon deliver before lunch?

Solution: 27



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your picture and work. Is your answer reasonable?

EXTEND IT

- If Ramon delivered 10 packages at the second stop, 3 packages at the fourth stop, and 10 packages at the sixth stop, and otherwise followed the same instructions, how many packages would he have started with?

PRACTICE

- Similar Practice Problems: 60, 81, 91

MAKE A PICTURE OR DIAGRAM Name

19 "Mercy!" exclaims Gertie Giraffe as she looks at her yards and yards of yarn. "What did I get myself into?" Winter is coming on, and Gertie is knitting neck-warmers for Geraldine and Geronimo and their cousins. Of all the neck-warmers that she plans to knit, 61 will be purple, 83 will be extra long, and 59 will be striped. Five of the warmers will be purple and extra long; 22 will be striped and extra long, and 10 will be purple and striped. There will be 11 purple, extra long, striped warmers. How many neck-warmers does Gertie plan to knit?

FIND OUT

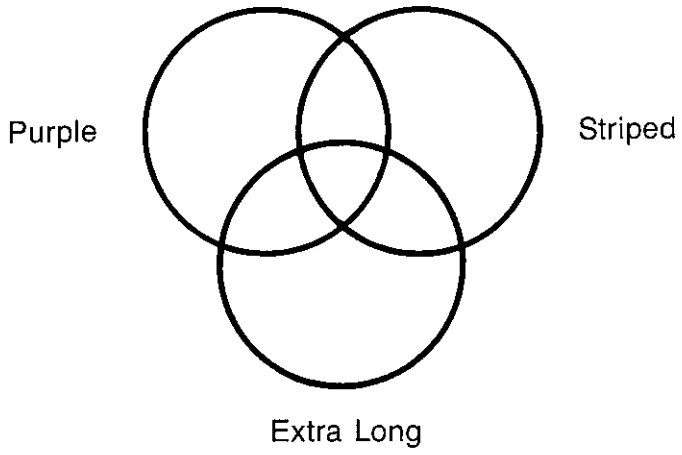
- What is the question you have to answer?
- How many of the neck-warmers will be purple? Extra long? Striped?
- How many will be purple and extra long? Striped and extra long? Purple and striped? Purple, extra long, and striped?

CHOOSE A STRATEGY

- Is there a kind of diagram that can help you organize the information in this problem?

SOLVE IT

- If you make a Venn diagram, how many circles will you have to draw? What will you label each circle? Must the circles intersect? Why or why not?
- How many neck-warmers in all will be purple? Where will you place that number? How many will be purple and striped? Where will you place that number? How many will be purple and extra long? Where will you place that number? How many will be purple, striped, and extra long? Where will you place that number? Then how many will be purple, but not striped or extra long? Where will you place that number?
- Keep filling in your diagram until you find out how many neck-warmers Gertie plans to knit.



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

19 "Mercy!" exclaims Gertie Giraffe as she looks at her yards and yards of yarn. "What did I get myself into?" Winter is coming on, and Gertie is knitting neck-warmers for Geraldine and Geronimo and their cousins. Of all the neck-warmers that she plans to knit, 61 will be purple, 83 will be extra long, and 59 will be striped. Five of the warmers will be purple and extra long; 22 will be striped and extra long, and 10 will be purple and striped. There will be 11 purple, extra long, striped warmers. How many neck-warmers does Gertie plan to knit?

FIND OUT

- What is the question you have to answer? *How many neck-warmers does Gertie plan to knit?*
- How many of the neck-warmers will be purple? *61* Extra long? *83* Striped? *59*
- How many will be purple and extra long? *5* Striped and extra long? *22* Purple and striped? *10* Purple, extra long, and striped? *11*

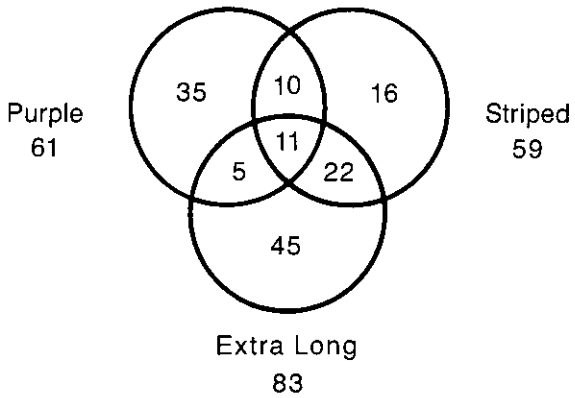
CHOOSE A STRATEGY

- Is there a kind of diagram that can help you organize the information in this problem? *Yes, a Venn diagram.*

SOLVE IT

- If you make a Venn diagram, how many circles will you have to draw? 3 What will you label each circle? *Label one circle Purple, another one Striped, and the other one Extra Long.* Must the circles intersect? *Yes.* Why or why not? *To show the neck-warmers that are both purple and striped; purple and extra long; striped and extra long; or purple, striped, and extra long.*
- How many neck-warmers in all will be purple? *61* Where will you place that number? *Next to the label outside the circle.* How many will be purple and extra long? *5* Where will you place that number? *In the intersection of Purple and Extra Long.* How many will be purple and striped? *10* Where will you place that number? *In the intersection of Purple and Striped.* How many will be purple, striped, and extra long? *11* Where will you place that number? *In the intersection of Purple, Extra Long, and Striped.* Then how many will be purple, but not striped or extra long? *35* Where will you place that number? *In the Purple circle.*
- (Have students complete their diagrams.) How many neck-warmers does Gertie plan to knit? *35 + 45 + 16 + 5 + 10 + 22 + 11*

Solution: 144



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

EXTEND IT

- Gerard Giraffe makes backpacks for students. Of the packs he made, 27 are canvas, 37 are blue, and 30 are waterproof. He made 7 of blue canvas, and 4 of waterproofed canvas. Twelve packs are blue and waterproof. Five are made of waterproofed blue canvas. How many backpacks did Gerard make?

MAKE A PICTURE OR DIAGRAM Name

20 It is the first annual Fretters' Convention, and musicians from all over the country have assembled to play their instruments. There will be concerts, contests, and jam sessions. Lizzy has come with her father, who is an amateur musician. Lizzy is milling about, looking at the musicians' plastic name tags, which are shaped like guitars, banjos, and ukeleles. She notices that 170 people at the convention play the guitar, 185 play the banjo, and 97 play the ukelele. Nineteen play no instrument at all, but are there just for the fun, like her. She observes that 87 people play guitar and banjo, 42 play ukelele and guitar, 48 play banjo and ukelele, and 36 people play all three instruments. How many people in all are attending the Fretters' Convention?

FIND OUT

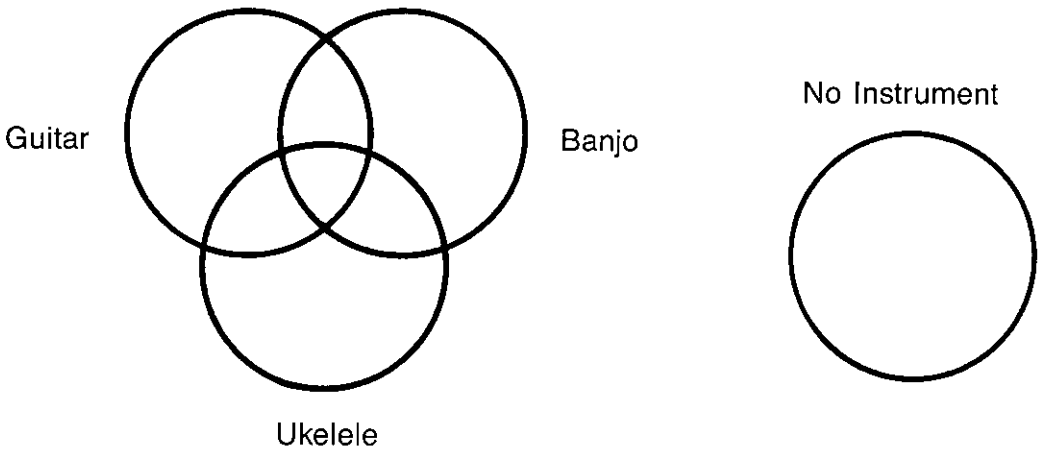
- What is the question you have to answer?
- How many of the people play guitar? Banjo? Ukelele?
- How many play guitar and banjo? How many play guitar and ukelele? How many play banjo and ukelele? How many play no instrument? How many play all three?

CHOOSE A STRATEGY

- Is there a kind of diagram that can help you organize the information in this problem?

SOLVE IT

- If you make a Venn diagram, how many circles will you have to draw? What will you label each circle? Must they intersect? Why or why not?
- How many people play guitar? Where will you place that number? How many play guitar, banjo, and ukelele? Where will you place that number? How many play just guitar and banjo? Where will you place that number? How many play just guitar and ukelele? Where will you place that number? Then how many play just the guitar? Where will you place that number?
- Keep filling in your diagram to find out how many people are attending the Fretters' Convention.



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

20 It is the first annual Fretters' Convention, and musicians from all over the country have assembled to play their instruments. There will be concerts, contests, and jam sessions. Lizzy has come with her father, who is an amateur musician. Lizzy is milling about, looking at the musicians' plastic name tags, which are shaped like guitars, banjos, and ukeleles. She notices that 170 people at the convention play the guitar, 185 play the banjo, and 97 play the ukelele. Nineteen play no instrument at all, but are there just for the fun, like her. She observes that 87 people play guitar and banjo, 42 play ukelele and guitar, 48 play banjo and ukelele, and 36 people play all three instruments. How many people in all are attending the Fretters' Convention?

FIND OUT

- What is the question you have to answer? *How many people in all are attending the Fretters' Convention?*
- How many of the people play guitar? *170* Banjo? *185* Ukelele? *97*
- How many play guitar and banjo? *87* How many play guitar and ukelele? *42* How many play banjo and ukelele? *48* How many play no instrument? *19* How many play all three? *36*

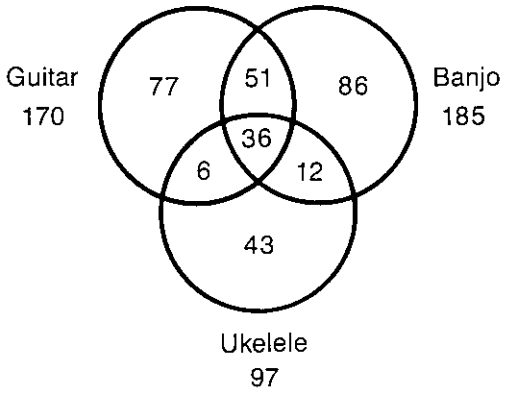
CHOOSE A STRATEGY

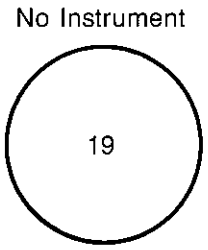
- Is there a kind of diagram that can help you organize the information in this problem? *Yes, a Venn diagram.*

SOLVE IT

- If you make a Venn diagram, how many circles will you have to draw? 4 What will you label each circle? *Label one circle Guitar, one circle Banjo, one circle Ukelele, and one circle No Instrument.* Must the circles intersect? *3 of them must intersect.* Why or why not? *To show the people who play more than one instrument.*
- How many people play guitar? *170* Where will you place that number? *Next to the label, outside the Guitar circle.* How many play guitar, banjo, and ukelele? *36* Where will you place that number? *In the intersection of the three circles.* How many play just guitar and banjo? *87 – 36, or 51* Where will you place that number? *In the intersection of Guitar and Banjo* How many play just guitar and ukelele? *42 – 6, or 36* Where will you place that number? *In the intersection of Guitar and Ukelele* Then how many play just the guitar? *77* Where will you place that number? *In the Guitar circle*
- (Have students complete their diagrams.) How many people are attending the Fretters' Convention?

Solution: 330





LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

EXTEND IT

- It's the last day of the convention, and some students have joined the Fretters for a jam session. Fifteen of the students play guitar and banjo, 21 play ukelele and banjo, and 4 play all three instruments. How many people in all are at the jam session?

PRACTICE

- Similar Practice Problems: 61, 93, 101

21 Gnome-Dome, Inc., is giving thrilling rides in a hot-air balloon. Gnomes from all over the forest are watching the pilot inflate the balloon. The gnomes are eager to climb on board and begin the 60-minute flight. The pilot, however, is concerned about the weight of her passengers. The balloon will only support the weight of 24 gnome-babies. As everyone knows, the weight of 12 baby gnomes is equal to the weight of 4 teenage gnomes; the weight of 6 gnome children is equal to the weight of 3 adults; and the weight of 4 children equals the weight of 8 babies. How many adult gnomes will the balloon support, and how many gnome children will it support?

FIND OUT

- What is the question you have to answer?
- How much weight will the balloon support?
- What is the weight of 12 baby gnomes equal to? What is the weight of 6 gnome children equal to? What is the weight of 4 gnome children equal to?

CHOOSE A STRATEGY

- You can use a series of "If this is true, then this is true" statements to help you solve this problem. What kind of thinking is that called?
- How can you record your "If. . .then" statements?

SOLVE IT

- You can begin by writing as equations the information given in the problem.
- If the weight of 12 babies equals the weight of 4 teenage gnomes, then how many teens together would equal the weight of 24 babies?
- If the weight of 4 gnome children equals the weight of 8 babies, then how many children together would equal the weight of 24 babies?
- If the weight of 6 children equals the weight of 3 adults, then how many adults together would equal the weight of 12 children? Then how many adults together would equal the weight of 24 babies?
- How many adult gnomes will the balloon support, and how many gnome children will the balloon support?

If 12 babies = 4 teens
6 children =
4 children =

Then

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

21 Gnome-Dome, Inc., is giving thrilling rides in a hot-air balloon. Gnomes from all over the forest are watching the pilot inflate the balloon. The gnomes are eager to climb on board and begin the 60-minute flight. The pilot, however, is concerned about the weight of her passengers. The balloon will only support the weight of 24 gnome-babies. As everyone knows, the weight of 12 baby gnomes is equal to the weight of 4 teenage gnomes; the weight of 6 gnome children is equal to the weight of 3 adults; and the weight of 4 children equals the weight of 8 babies. How many adult gnomes will the balloon support, and how many gnome children will it support?

FIND OUT

- What is the question you have to answer? *How many adult gnomes will the balloon support, and how many gnome children will it support?*
- How much weight will the balloon support? *The weight of 24 gnome-babies*
- What is the weight of 12 baby gnomes equal to? *4 teenage gnomes* What is the weight of 6 gnome children equal to? *3 adults* What is the weight of 4 gnome children equal to? *8 babies*

CHOOSE A STRATEGY

- You can use a series of "If this is true, then this is true" statements to help you solve this problem. What kind of thinking is that called? *Logical reasoning*
- How can you record your "If. . .then" statements? *As a series of equations*

SOLVE IT

- You can begin by writing as equations the information given in the problem.
- If the weight of 12 babies equals the weight of 4 teenage gnomes, then how many teens together would equal the weight of 24 babies? *8*
- If the weight of 4 gnome children equals the weight of 8 babies, then how many children together would equal the weight of 24 babies? *12*
- If the weight of 6 children equals the weight of 3 adults, then how many adults together would equal the weight of 12 children? *6* Then how many adults together would equal the weight of 24 babies? *6*
- How many adult gnomes will the balloon support, and how many gnome children will the balloon support?

Solution: 12 children or 6 adults

If
12 babies = 4 teens
6 children = 3 adults
4 children = 8 babies

Then
24 babies = 8 teens (12 × 2 and 4 × 2)
12 children = 24 babies (4 × 3 and 8 × 3)
12 children = 6 adults (6 × 2 and 3 × 2)
6 adults = 24 babies

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

EXTEND IT

- A group of gnomes took a ride in the balloon on a warm day. They took exactly 1 bottle of Gnome Cola for each gnome in the group. The weight of 5 bottles of Cola equals the weight of 1 gnome baby. The total weight of gnomes and bottles was equal to the weight of 24 babies. How many and what kind of gnomes were on the ride?

22 Luisa and her family are spending the day at Grand America Amusement Park. Each family member has a book of tickets for the rides. Eight gray tickets have the same value as 2 blue tickets, 4 pink tickets have the same value as 3 yellow tickets, and 5 pink tickets have the same value as 6 gray tickets. Luisa and Nicolas really want to go on the Wacky Whirlygig, which costs 24 gray tickets. However, Luisa has only blue tickets left, and her brother Nicolas has only yellow tickets left. How many tickets must each of them use for the Wacky Whirlygig ride?

FIND OUT

- What is the question you have to answer?
- How many gray tickets does the ride cost?
- What is the value of 8 gray tickets equal to? What is the value of 4 pink tickets equal to? What is the value of 5 pink tickets equal to?

CHOOSE A STRATEGY

- You can use a series of "If this is true, then this is true" statements to help you solve this problem. What kind of thinking is that called?
- How can you record your "If. . .then" statements?

SOLVE IT

- You can begin by writing as equations the information given in the problem.
- If the value of 8 gray tickets equals the value of 2 blue tickets, then how many gray tickets together would equal the value of 6 blue tickets?
- Continue writing equations to find out how many tickets Luisa and Nicolas will each have to use for the Wacky Whirlygig ride.

If

Then

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

22 Luisa and her family are spending the day at Grand America Amusement Park. Each family member has a book of tickets for the rides. Eight gray tickets have the same value as 2 blue tickets, 4 pink tickets have the same value as 3 yellow tickets, and 5 pink tickets have the same value as 6 gray tickets. Luisa and Nicolas really want to go on the Wacky Whirlygig, which costs 24 gray tickets. However, Luisa has only blue tickets left, and her brother Nicolas has only yellow tickets left. How many tickets must each of them use for the Wacky Whirlygig ride?

FIND OUT

- What is the question you have to answer? *How many tickets must Luisa and Nicolas each use for the Wacky Whirlygig ride?*
- How many gray tickets does the ride cost? *24*
- What is the value of 8 gray tickets equal to? *2 blue tickets* What is the value of 4 pink tickets equal to? *3 yellow tickets* What is the value of 5 pink tickets equal to? *6 gray tickets*

CHOOSE A STRATEGY

- You can use a series of "If this is true, then this is true" statements to help you solve this problem. What kind of thinking is that called? *Logical reasoning*
- How can you record your "If. . .then" statements? *As a series of equations*

SOLVE IT

- You can begin by writing as equations the information given in the problem.
- If the value of 8 gray tickets equals the value of 2 blue tickets, then how many gray tickets together would equal the value of 6 blue tickets? *24*
- (Have students continue writing equations.) How many tickets will Luisa and Nicolas each have to use for the Wacky Whirlygig ride?

Solution: Luisa—6 blue tickets; Nicolas—15 yellow tickets

If	8 gray	= 2 blue
	4 pink	= 3 yellow
	5 pink	= 6 gray
Then	24 gray	= 6 blue
	20 pink	= 15 yellow
	20 pink	= 24 gray
	15 yellow	= 24 gray

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

EXTEND IT

- Gilberto has 3 blue, 15 pink, 10 yellow, and 2 gray tickets. How many rides can he take on the Wacky Whirlygig?

PRACTICE

- Similar Practice Problems: 59, 80, 96

USE OR MAKE A TABLE

Name

23 Scientists are agog over the news that a herd of strange new animals has been discovered in the Plains of Abunk. Apparently the animals are a cross between a zebra and a giraffe. It seems that out of every 18 zegraffes, 3 have long necks and stripes; 4 have short necks and spots; 5 have short necks, stripes, and long legs; and 6 have long necks, spots, and short legs. Scientists from the University of Abunk corralled a group of zegraffes in order to study them. After a walk among the animals, the scientists reported that they had counted 45 zegraffes with long necks and stripes. How many zegraffes were in the group, and how many zegraffes were there of each kind?

FIND OUT

- What is the question you have to answer?
- Out of every 18 zegraffes, how many have long necks and stripes? How many have short necks and spots? How many have short necks, stripes, and long legs? How many have long necks, spots, and short legs?
- Out of all the zegraffes that the scientists counted, how many of them had long necks and stripes?

CHOOSE A STRATEGY

- What strategy can help you keep track of the different kinds of zegraffes?

SOLVE IT

- When you set up a table, what will you use as labels for the columns? For the rows?
- Out of the first group of 18, how many zegraffes had long necks and stripes? Will you have to add a second group of 18?
- What number will you be watching for in the first row?
- Continue to fill in your table until you find out how many zegraffes in all were in the group, and how many there were of each kind.

Total	**18**	**36**	
Long necks, stripes	3		
Short necks, spots	4		
Short necks, stripes, long legs	5		
Long necks, spots, short legs	6		

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

23 Scientists are agog over the news that a herd of strange new animals has been discovered in the Plains of Abunk. Apparently the animals are a cross between a zebra and a giraffe. It seems that out of every 18 zegraffes, 3 have long necks and stripes; 4 have short necks and spots; 5 have short necks, stripes, and long legs; and 6 have long necks, spots, and short legs. Scientists from the University of Abunk corralled a group of zegraffes in order to study them. After a walk among the animals, the scientists reported that they had counted 45 zegraffes with long necks and stripes. How many zegraffes were in the group, and how many zegraffes were there of each kind?

FIND OUT

- What is the question you have to answer? *How many zegraffes were in the group, and how many zegraffes were there of each kind?*
- Out of every 18 zegraffes, how many have long necks and stripes? *3* How many have short necks and spots? *4* How many have short necks, stripes, and long legs? *5* How many have long necks, spots, and short legs? *6*
- Out of all the zegraffes that the scientists counted, how many of them had long necks and stripes? *45*

CHOOSE A STRATEGY

- What strategy can help you keep track of the different kinds of zegraffes? *A table*

SOLVE IT

- When you set up a table, what will you use as labels for the columns? *The total number of zegraffes, as groups of 18 are added* For the rows? *Descriptions of the different kinds of zegraffes*
- Out of the first group of 18, how many zegraffes had long necks and stripes? *3* Will you have to add a second group of 18? *Yes*
- What number will you be watching for in the first row? *45*
- (Have students continue filling in their tables.) How many zegraffes in all were in the group, and how many were there of each kind?

Solution: 270 total; 45 with long necks, stripes; 60 with short necks, spots; 75 with short necks, stripes, long legs; 90 with long necks, spots, short legs

Total	18	36	54	72	90	108	126	144	162	180	. . .	270
Long necks, stripes	3	6	9	12	15	18	21	24	27	30	. . .	45
Short necks, spots	4	8	12	16	20	24	28	32	36	40	. . .	60
Short necks, stripes, long legs	5	10	15	20	25	30	35	40	45	50	. . .	75
Long necks, spots, short legs	6	12	18	24	30	36	42	48	54	60	. . .	90

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

EXTEND IT

- Skubbits, a cross between a skunk and a rabbit, have been found in the hills of Abunk. Out of every 23 skubbits, 4 have long tails and brown spots; 9 have short tails and white stripes; 3 have short ears, short tails, and brown spots; and 7 have long ears, long tails, and white stripes. If the scientists have counted 189 skubbits with short tails and white stripes, how many skubbits are there in the hills of Abunk?

USE OR MAKE A TABLE

Name

24 Donald was having a hard time getting to sleep, so he began to count sheep in his imagination. As he watched the sheep jumping over a fence, he noticed that they had a rather unusual appearance. The problem was, he had eaten too much pizza for dinner. For every 9 sheep with tomato-colored wool that Donald counted, 6 sheep had onion rings through their noses, 4 sheep had bell peppers for ears, 12 had mushrooms for eyes, 11 had pepperoni sausages for legs, and 8 were munching on mozzarella cheese. When Donald counted the 56th sheep with bell pepper ears, he got up and took an antacid. How many sheep in all had he counted, and how many of them had red wool, how many had onion rings, and how many were munching on cheese?

FIND OUT

- What is the question you have to answer?
- For every 9 sheep that had tomato-colored wool, how many sheep had onion rings through their noses? How many had bell peppers for ears? How many had mushrooms for eyes? How many had pepperoni sausages for legs? How many were munching on cheese?
- How many sheep with bell pepper ears did Donald count?

CHOOSE A STRATEGY

- What strategy can help you keep track of the different kinds of sheep as Donald counts them?

SOLVE IT

- When you set up a table, what will you use as labels for the columns? For the rows?
- What number will you fill in as the first total?
- What number will you be watching for in the bell pepper sheep row?
- Continue filling in your table until you find out how many sheep had Donald counted, and how many had red wool, how many had onion rings, and how many were munching on cheese.

Total			
Red wool	9		
Onion rings	6		
Bell peppers	4		
Mushrooms	12		
Pepperoni	11		
Cheese	8		

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

24 Donald was having a hard time getting to sleep, so he began to count sheep in his imagination. As he watched the sheep jumping over a fence, he noticed that they had a rather unusual appearance. The problem was, he had eaten too much pizza for dinner. For every 9 sheep with tomato-colored wool that Donald counted, 6 sheep had onion rings through their noses, 4 sheep had bell peppers for ears, 12 had mushrooms for eyes, 11 had pepperoni sausages for legs, and 8 were munching on mozzarella cheese. When Donald counted the 56th sheep with bell pepper ears, he got up and took an antacid. How many sheep in all had he counted, and how many of them had red wool, how many had onion rings, and how many were munching on cheese?

FIND OUT

- What is the question you have to answer? *How many sheep in all had he counted, and how many of them had red wool, how many had onion rings, and how many were munching on cheese?*
- For every 9 sheep that had tomato-colored wool, how many sheep had onion rings through their noses? *6* How many had bell peppers for ears? *4* How many had mushrooms for eyes? *12* How many had pepperoni sausages for legs? *11* How many were munching on cheese? *8*
- How many sheep with bell pepper ears did Donald count? *56*

CHOOSE A STRATEGY

- What strategy can help you keep track of the different kinds of sheep as Donald counts them? *A table*

SOLVE IT

- When you set up a table, what will you use as labels for the columns? *The total number of sheep, as new groups are added* For the rows? *Descriptions of the different kinds of sheep*
- What number will you fill in as the first total? *50*
- What number will you be watching for in the bell pepper sheep row? *56*
- (Have students continue filling in their tables.) How many sheep in all had Donald counted, and how many of them had red wool, how many had onion rings, and how many were munching on cheese?

Solution: 700 total; 126 red wool, 84 onion rings, 112 cheese

Total	50	100	150	200	250	300	350	400	450	500	550	600	650	700
Red wool	9	18	27	36	45	54	63	72	81	90	99	108	117	126
Onion rings	6	12	18	24	30	36	42	48	54	60	66	72	78	84
Bell peppers	4	8	12	16	20	24	28	32	36	40	44	48	52	56
Mushrooms	12	24	36	48	60	72	84	96	108	120	132	144	156	168
Pepperoni	11	22	33	44	55	66	77	88	99	110	121	132	143	154
Cheese	8	16	24	32	40	48	56	64	72	80	88	96	104	112

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

EXTEND IT

- Donald fell asleep and dreamed about sheep. For every 5 sheep with black olive eyes that he saw in his dream, 10 had onion ring wool, 8 had bell pepper rings in their noses, 7 had anchovy tails, and 18 were munching on cheese. If Donald counted 128 sheep with bell pepper rings in their noses, how many sheep did he count in all?

PRACTICE

- Similar Practice Problems: 62, 90, 106

MAKE A PICTURE OR DIAGRAM Name

25 Larry and his brother Brett are stranded in the desert. Their car has broken down in the middle of the hot day, and it is 36 miles to the nearest town. "Looks like we'll have to leave the car and take turns with the canteen and the skateboard," Larry said gloomily. The brothers want to leave at the same time and arrive in town at the same time. Both Larry and Brett know that they skateboard at the same speed, 6 miles per hour. Larry walks at 3 miles an hour and Brett walks at 4 miles an hour. They make a plan to exchange the skateboard along the way, when necessary. They will always leave the skateboard on the hour, but neither one can wait for the other. How long did it take them to get to the town and how many miles did each one walk and each one skateboard?

FIND OUT

- What is the question you have to answer?
- What are Larry and Brett doing?
- How far is it to the nearest town?
- How are they traveling?
- When do they want to arrive in town?
- How fast do Larry and Brett go by skateboard? When walking?
- What are the rules for exchanging the skateboard?

CHOOSE A STRATEGY

- Is there a good way to keep track of their progress to "see" how many miles they have traveled after each hour and how they can exchange the skateboard?

SOLVE IT

- What do you want to keep track of in your diagram?
- If Larry is the slower walker, then maybe he could start on the skateboard. After one hour where will each one be?
- If they can only change their means of travel on the hour, then when does Larry need to leave the skateboard so that Brett can pick it up?
- Continue to mark the hours on the diagram, and where each brother is after each hour. Remember that they have to arrive at the same time.

Hour	1	2	3	4
Larry	6 sk	12 sk		
Brett	4 wk	8 wk	12 wk	sk

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

MAKE A PICTURE OR DIAGRAM Teaching Plan

25 Larry and his brother Brett are stranded in the desert. Their car has broken down in the middle of the hot day, and it is 36 miles to the nearest town. "Looks like we'll have to leave the car and take turns with the canteen and the skateboard," Larry said gloomily. The brothers want to leave at the same time and arrive in town at the same time. Both Larry and Brett know that they skateboard at the same speed, 6 miles per hour. Larry walks at 3 miles an hour and Brett walks at 4 miles an hour. They make a plan to exchange the skateboard along the way, when necessary. They will always leave the skateboard on the hour, but neither one can wait for the other. How long did it take them to get to the town and how many miles did each one walk and each one skateboard?

FIND OUT

- What is the question you have to answer? *How long did it take them to get to the town and how many miles did each one walk and each one skateboard?*
- What are Larry and Brett doing? *They are stranded in the desert and they are trying to get to the nearest town.*
- How far is it to the nearest town? *36 miles*
- How are they traveling? *By walking and with a skateboard*
- When do they want to arrive in town? *At the same time*
- How fast do Larry and Brett go by skateboard? *6 miles per hour* When walking? *Larry 3 miles per hour, Brett 4 miles per hour*
- What are the rules for exchanging the skateboard? *They must always exchange on the hour or leave the skateboard for the other, but neither one must ever wait for the other.*

CHOOSE A STRATEGY

- Is there a good way to keep track of their progress to "see" how many miles they have traveled after each hour and how they can exchange the skateboard? *Yes, we can make a diagram.*

SOLVE IT

- What do you want to keep track of in your diagram? *Each hour and how many miles each one has gone. Also we need to keep track of when the skateboard is left or exchanged.*
- If Larry is the slower walker, then maybe he could start on the skateboard. After one hour where will each one be? *Larry will be at 6 miles and Brett at 4 miles.*
- If they can only change their means of travel on the hour, then when does Larry need to leave the skateboard so that Brett can pick it up? *If Larry uses the skateboard for another hour he will be at 12 miles. If he leaves the skateboard, then Brett can pick it up at the end of hour 3, when he will be at the 12 mile mark.*
- (Have students complete their diagrams.) How long did it take the brothers to get to the town and how many miles did each one walk and each one skateboard?

Solution: 8 hours; Larry skateboarding 24 miles and walking 12, Brett skateboarding 12 and walking 24

Hours	1	2	3	4	5	6	7	8
Larry	6 sk	12 sk	15 wk	18 wk	24 sk	30 sk	33 wk	36 wk
Brett	4 wk	8 wk	12 wk	18 sk	22 wk	26 wk	30 wk	36 sk

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

EXTEND IT

- Make up another similar problem. Have the two brothers walking at different speeds and have the town further away.

MAKE A PICTURE OR DIAGRAM Name

26 On the planet of Orx, three friends were traveling to a nearby village that was 32 hiccaps away. (A hiccap is an Orxian unit of measurement.) People traveling together on Orx had to arrive at their destination at exactly the same time. The friends took turns riding an orxicus and a boricon, and they ran. The orxicus was an animal frequently used for transportation on Orx, and it traveled at 8 hiccaps an hour. The boricon was a spaceboard that could be ridden at 6 hiccaps an hour, or carried. The friends could each run 4 hiccaps an hour. They could change their means of transportation, but only on the hour. They could exchange the boricon and the orxicus, but only if no one had to wait for anyone else. They could also leave the boricon or the orxicus for one of the others to pick up. How long did it take them to get to the village and how far did each one ride the orxicus, ride the boricon, or run?

FIND OUT

- What is the question you have to answer?
- What are the three friends doing?
- How are they traveling?
- How far is the nearby village?
- What is an orxicus? How fast can it go?
- What is a boricon? How fast can they go on it?
- How fast can they run?
- What are the conditions for exchanging the orxicus or boricon?

CHOOSE A STRATEGY

- What is the best way to keep track of where each friend is after each hour, what they are traveling on, and how they should exchange the orxicus or boricon?

SOLVE IT

- What do you need to keep track of on your diagram?
- If each friend starts off using a different means of transportation, where will they each be in one hour?
- Can they make an exchange at the end of the first hour, or should someone leave the orxicus or boricon for someone to pick up later?
- At the end of the second hour should they pick up something, leave something, or make an exchange?
- Continue to fill in the diagram until you figure out a way to get them to the village at the same time.

Hour	1	2	3	4	5	6
A	8 o	12				
B	6 b					
C	4 r					

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

26 On the planet of Orx, three friends were traveling to a nearby village that was 32 hiccaps away. (A hiccap is an Orxian unit of measurement.) People traveling together on Orx had to arrive at their destination at exactly the same time. The friends took turns riding an orxicus and a boricon, and they ran. The orxicus was an animal frequently used for transportation on Orx, and it traveled at 8 hiccaps an hour. The boricon was a spaceboard that could be ridden at 6 hiccaps an hour, or carried. The friends could each run 4 hiccaps an hour. They could change their means of transportation, but only on the hour. They could exchange the boricon and the orxicus, but only if no one had to wait for anyone else. They could also leave the boricon or the orxicus for one of the others to pick up. How long did it take them to get to the village and how far did each one ride the orxicus, ride the boricon, or run?

FIND OUT

- What is the question you have to answer? *How long did it take them to get to the village and how far did each one ride the orxicus, ride the boricon, or run?*
- What are the three friends doing? *Going to a nearby village*
- How are they traveling? *By orxicus, boricon, and by running*
- How far is the nearby village? *32 hiccaps away*
- What is an orxicus? *An animal that can be ridden* How fast can it go? *8 hiccaps an hour*
- What is a boricon? *A spaceboard that can be ridden* How fast can they go on it? *6 hiccaps an hour*
- How fast can they run? *4 hiccaps an hour*
- What are the conditions for exchanging the orxicus or boricon? *It should always be on the hour, and only if no one had to wait for anyone else.*

CHOOSE A STRATEGY

- What is the best way to keep track of where each friend is after each hour, what they are traveling on, and how they should exchange the orxicus or boricon? *We can make a diagram.*

SOLVE IT

- What do you need to keep track of on your diagram? *The hours, how far each friend goes, and how each one is traveling*
- If each friend starts off using a different means of transportation, where will they each be in one hour? *After hour 1 they will be 8 hiccaps, 6 hiccaps, and 4 hiccaps along the way.*
- Can they make an exchange at the end of the first hour, or should someone leave the orxicus or boricon for someone to pick up later? *If someone leaves the orxicus, then someone who runs for 2 hours will be 8 hiccaps along and can pick up the orxicus.*
- At the end of the second hour should they pick up something, leave something, or make an exchange? *If A rides the orxicus 1 hour and then leaves it and runs, A will be at 12 hiccaps. If B rides the boricon for 2 hours, B will be at 12 hiccaps. If C runs for 2 hours, then C will be at 8 hiccaps and can pick up the orxicus. B could give A the boricon.*
- (Have students complete their diagrams.) How long did it take the friends to get to the village and how far did each one ride the orxicus, ride the boricon, or run?

Solution: 6 hours; A = 8 hiccaps on the orxicus, 12 on boricon, 12 running; B = 8 hiccaps on orxicus, 12 on boricon, 12 running; C = 16 on orxicus, 16 running, 0 on boricon

Hour	1		2		3		4		5		6	
A	8	o	12	r	18	b	24	b	28	r	32	r
B	6	b	12	b	16	r	24	o	28	r	32	r
C	4	r	8	r	16	o	20	r	24	r	32	o

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

EXTEND IT

- Make up another problem with the three friends, but have a different speed for the orxicus, boricon, and have each friend run at a different speed from the other.

PRACTICE

- Similar Practice Problems: 64, 92, 116

MAKE AN ORGANIZED LIST

Name

27 Brenda was asked to purchase some live creatures for the science lab. She bought some salamanders, flatworms, and beetles. The salamanders cost $.25 each; the beetles cost $.15 each; and the flatworms cost $.10 each. Brenda purchased 60 creatures, and her total bill was $10.10. How many of each creature did Brenda purchase?

FIND OUT

- What is the question you have to answer?
- How much did one salamander cost? One beetle? One flatworm?
- How many creatures did Brenda buy?
- How much did Brenda pay for all the creatures?

CHOOSE A STRATEGY

- How can you systematically display the information for this problem?

SOLVE IT

- When you make an organized list, how many columns will you need? What will you use as labels for the columns?
- What will you record in the first row of your list? In the second row?
- Fill in several rows of your list until you can find a combination of 3 numbers (one from each column) that has a sum of 60.
- When you find three numbers that combine to make 60, what does the combined cost of those 60 creatures have to be?
- Continue to fill in your list and test combinations of numbers that make a total of 60.

Salamanders		Beetles		Flatworms	
1	.25	1	.15	1	.10
2	.50	2	.30	2	.20
3	1.50	3	.45	3	.30

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your list. Is your answer reasonable?

MAKE AN ORGANIZED LIST Teaching Plan

27 Brenda was asked to purchase some live creatures for the science lab. She bought some salamanders, flatworms, and beetles. The salamanders cost $.25 each; the beetles cost $.15 each; and the flatworms cost $.10 each. Brenda purchased 60 creatures, and her total bill was $10.10. How many of each creature did Brenda purchase?

FIND OUT

- What is the question you have to answer? *How many of each creature did Brenda purchase?*
- How much did one salamander cost? *$.25* One beetle? *$.15* One flatworm? *$.10*
- How many creatures did Brenda buy? *60*
- How much did Brenda pay for all the creatures? *$10.10*

CHOOSE A STRATEGY

- How can you systematically display the information for this problem? *We can make an organized list.*

SOLVE IT

- When you make an organized list, how many columns will you need? *3* What will you use as labels for the columns? *The names of the 3 kinds of creatures*
- What will you record in the first row of your list? *The cost for 1 salamander, for 1 beetle, and for 1 flatworm* What will you record in the second row of your list? *The cost for 2 of each kind of creature*
- Fill in several rows of your list until you can find a combination of 3 numbers (one from each column) that has a sum of 60.
- When you find three sets of creatures that combine to make 60, what does the combined cost of those 60 creatures have to be? *$10.10*
- (Have students continue to fill in their lists and test combinations of numbers that sum to 60.) How many salamanders, beetles, and flatworms did Brenda buy?

Solution: 19 salamanders, 25 beetles, 16 flatworms (Other solutions are possible.)

Salamanders		Beetles		Flatworms	
1	.25	1	.15	1	.10
2	.50	2	.30	2	.20
3	.75	3	.45	3	.30
4	1.00	4	.60	4	.40
5	1.25	5	.75	5	.50
6	1.50	6	.90	6	.60
7	1.75	7	1.05	7	.70
8	2.00	8	1.20	8	.80
⋮	⋮	⋮	⋮	⋮	⋮
15	3.75	15	2.25	15	1.50

(continued)

Salamanders		Beetles		Flatworms	
16	4.00	16	2.40	16	1.60
17	4.25	17	2.55	17	1.70
18	4.50	18	2.70	18	1.80
19	4.75	19	2.85	19	1.90
20	5.00	20	3.00	20	2.00
21	5.25	21	3.15	21	2.10
22	5.50	22	3.30	22	2.20
23	5.75	23	3.45	23	2.30
24	6.00	24	3.60	24	2.40
25	6.25	25	3.75	25	2.50

16 + 19 + 25 = 60, and $4.75 + $3.75 + $1.60 = $10.10

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your list. Is your answer reasonable?

EXTEND IT

- For the next semester, Brenda bought 37 creatures for $6.30. How many did she buy of each kind of creature?

MAKE AN ORGANIZED LIST Name

28 Everyone knows that Johnny Appleseed went about the countryside planting apple seeds, from which grew beautiful apple trees. But not everyone knows about his two cousins, Penelope Peachpit and Orville Orangeseed, who also planted seeds. In one season these three hard-working cousins all planted industriously. Each of the seeds Johnny planted became an apple tree that yielded exactly 150 apples that season. Each peach pit that Penelope planted became a tree that yielded exactly 275 peaches. Each of the seeds that Orville planted became a tree that yielded exactly 310 oranges. That season, the cousins planted a total of 66 seeds, which yielded a total of 16,255 fruits. How many seeds of each type did the cousins plant?

FIND OUT

- What is the question you have to answer?
- How many trees grew from each seed or pit planted?
- How many apples did each apple tree yield? How many peaches did each peach tree yield? How many oranges did each orange tree yield?
- How many seeds did the three cousins plant in all?
- How many fruits did the trees yield altogether that season?

CHOOSE A STRATEGY

- How can you systematically display the information for this problem?

SOLVE IT

- When you make an organized list, how many columns will you need?
- What will you use as labels for the columns?
- What will you record in the first row of your list?
- Fill in several rows of your list until you can find a combination of 3 numbers (one for each column) that has a sum of 66.
- When you find three numbers that combine to make 66, what does the combined yield of fruit have to be from those trees?
- Continue to fill in your list and test combinations of numbers that make a total of 66.

Apple		Peach		Orange	
1	150	1	275	1	310
2	300	2	550	2	620

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your list. Is your answer reasonable?

MAKE AN ORGANIZED LIST Teaching Plan

28 Everyone knows that Johnny Appleseed went about the countryside planting apple seeds, from which grew beautiful apple trees. But not everyone knows about his two cousins, Penelope Peachpit and Orville Orangeseed, who also planted seeds. In one season these three hard-working cousins all planted industriously. Each of the seeds Johnny planted became an apple tree that yielded exactly 150 apples that season. Each peach pit that Penelope planted became a tree that yielded exactly 275 peaches. Each of the seeds that Orville planted became a tree that yielded exactly 310 oranges. That season, the cousins planted a total of 66 seeds, which yielded a total of 16,255 fruits. How many seeds of each type did the cousins plant?

FIND OUT

- What is the question you have to answer? *How many seeds of each type did the cousins plant?*
- How many trees grew from each seed or pit planted? *1*
- How many apples did each apple tree yield? *150* How many peaches did each peach tree yield? *275* How many oranges did each orange tree yield? *310*
- How many seeds did the three cousins plant in all? *66*
- How many fruits did the trees yield altogether that season? *16,255*

CHOOSE A STRATEGY

- How can you systematically display the information for this problem? *We can make an organized list.*

SOLVE IT

- When you make an organized list, how many columns will you need? *3*
- What will you use as labels for the columns? *The names of the 3 kinds of fruit*
- What will you record in the first row of your list? *The yield for 1 apple tree, 1 peach tree, and 1 orange tree*
- Fill in several rows of your list until you can find a combination of 3 numbers (one for each column) that has a sum of 66.
- When you find three numbers that combine to make 66, what does the combined yield of fruit have to be from those trees? *16,255*
- (Have students continue to fill in their lists and test combinations of numbers that make a total of 66.) How many apple seeds, peach pits, and orange seeds did the cousins plant?

Solution: 23 apple seeds, 15 peach pits, 28 orange seeds

(continued)

Apple	Peach	Orange
1 150	1 275	1 310
2 300	2 550	2 620
3 450	3 825	3 930
4 600	4 1100	4 1240
5 750	5 1375	5 1550
6 900	6 1650	6 1860
7 1050	7 1925	7 2170
8 1200	8 2200	8 2480
9 1350	9 2475	9 2790
10 1500	10 2750	10 3100
11 1650	11 3025	11 3410
12 1800	12 3300	12 3720
13 1950	13 3575	13 4030
14 2100	14 3250	14 4340

Apple	Peach	Orange
15 2250	15 4125	15 4650
16 2400	16 4400	16 4960
17 2550	17 4675	17 5270
18 2700	18 4950	18 5580
19 2850	19 5225	19 5890
20 3000	20 5500	20 6200
21 3150	21 5775	21 6510
22 3300	22 6050	22 6820
23 3450	23 6325	23 7130
24 3600	24 6600	24 7440
25 3750	25 6875	25 7750
26 3900	26 7150	26 8060
27 4050	27 7425	27 8370
28 4200	28 7700	28 8680

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your list. Is your answer reasonable?

EXTEND IT

- The next season the three cousins planted 70 seeds, which yielded 16,860 fruits. How many seeds of each type did the cousins plant?

PRACTICE

- Similar Practice Problems: 63, 87, 111

GUESS AND CHECK

Name

29 It was time for the Fourth of July parade. Marty was helping to put helium in the balloons. When he was finished he had inflated 1147 balloons. There were 255 more white balloons than red ones. There were 116 fewer blue balloons than white ones. How many balloons of each color did Marty inflate?

FIND OUT

- What is the question you have to answer?
- What is Marty doing?
- How many balloons did he inflate?
- What do you know about the number of white balloons and red balloons?
- What do you know about the number of blue balloons ?

CHOOSE A STRATEGY

- Will guessing the answer help you to solve this problem?
- How can you use the information from an incorrect guess?

SOLVE IT

- What is the total number of balloons that Marty inflated?
- How many more white balloons than red balloons are there?
- How many fewer blue balloons than white balloons are there?
- Which color balloon do you want to make a guess for?
- Then how do you guess a number for the other colors?
- Make your guess, keeping in mind the total number of balloons, and the difference between the white and red and white and blue. What is your guess? Why?
- How can you check your guess? How did you do?
- If your guess was wrong, how can you use the information to make your next guess?
- Keep making guesses and checking them until you get the right answer.

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

29 It was time for the Fourth of July parade. Marty was helping to put helium in the balloons. When he was finished he had inflated 1147 balloons. There were 255 more white balloons than red ones. There were 116 fewer blue balloons than white ones. How many balloons of each color did Marty inflate?

FIND OUT

- What is the question you have to answer? *How many balloons were there of each color?*
- What is Marty doing? *Putting helium in balloons*
- How many balloons did he inflate? *1147*
- What do you know about the number of white balloons and red balloons? *There are 255 more white than red balloons.*
- What do you know about the number of blue balloons ? *There are 116 fewer blue balloons than white balloons.*

CHOOSE A STRATEGY

- Will guessing the answer help you to solve this problem? *Yes, because we're not really sure what to do.*
- How can you use the information from an incorrect guess? *The incorrect guess can help us decide if the next guess should be higher or lower.*

SOLVE IT

- What is the total number of balloons that Marty inflated? *1147*
- How many more white balloons than red balloons are there? *255*
- How many fewer blue balloons than white balloons are there? *116*
- Which color balloon do you want to make a guess for? *The white balloons*
- Then how do you guess a number for the other colors? *We can subtract the 255 and 116 from our guess, to get the number for blue and red.*
- Make your guess, keeping in mind the total number of balloons, and the difference between the white and red and white and blue. What is your guess? (This is an example of a guess.) *500 for white* Why? *If we guess for the white, then we can subtract 255 to find the number of red and 116 to find the number of blue.*
- How can you check your guess? *We can get a number for red and a number for blue and then add those two numbers to 500.* How did you do? *The total is 1129, too low.*
- If your guess was wrong, how can you use the information to make your next guess? *Our next guess should be higher, based on the 1129.*
- (Have students continue guessing and checking until they find a solution.) How many balloons of each color did Marty inflate?

  Solution: white—506, red—251, blue—390

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

EXTEND IT

- What if there were a total of 1350 balloons and there were 131 fewer red than blue and 316 more white than red, how many balloons of each color would there be?

30 Remember the princess and the pea? She had problems sleeping because of a pea under her mattress. Well, her problem was tiny compared with that of her cousin, the duchess. The duchess bought a radio, got it back to the castle, and discovered that it played only rock music. "Horrors!" she gasped. "Where is Bach? Where is Beethoven? What's all this screaming?" She took the radio back and exchanged it, only to have the same thing happen again. The duchess exchanged quite a few radios, until she finally found one that would pick up a classical station at the castle. She was glad the radio was on her Chopin Liszt, and she would be sure to Handel it with care, so that she wouldn't have to take this one Bach. You might be wondering how many radios the duchess took back before she found the right one. Here is a clue. The total number of radios, divided in half, added to 9, equals $\frac{3}{4}$ the number. How many radios did she return?

FIND OUT
- What is the question you have to answer?
- What was happening to the duchess?
- What is the clue?

CHOOSE A STRATEGY
- Will guessing the answer help you to solve this problem?
- How can you use the information from an incorrect guess?

SOLVE IT
- Is there anything in the clue to help you make your guess?
- What is your guess?
- How can you check your guess? How did you do?
- If your guess was wrong, how can you use this information to make your next guess?
- Keep making guesses and checking them until you find the right number.

LOOK BACK
- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

30 Remember the princess and the pea? She had problems sleeping because of a pea under her mattress. Well, her problem was tiny compared with that of her cousin, the duchess. The duchess bought a radio, got it back to the castle, and discovered that it played only rock music. "Horrors!" she gasped. "Where is Bach? Where is Beethoven? What's all this screaming?" She took the radio back and exchanged it, only to have the same thing happen again. The duchess exchanged quite a few radios, until she finally found one that would pick up a classical station at the castle. She was glad the radio was on her Chopin Liszt, and she would be sure to Handel it with care, so that she wouldn't have to take this one Bach. You might be wondering how many radios the duchess took back before she found the right one. Here is a clue. The total number of radios, divided in half, added to 9, equals ¾ the number. How many radios did she return?

FIND OUT

- What is the question you have to answer? *How many radios did she return?*
- What was happening to the duchess? *She couldn't get the music she wanted on the radios she bought.*
- What is the clue? *The number divided in half, added to 9, equals ¾ the number.*

CHOOSE A STRATEGY

- Will guessing the answer help you to solve this problem? *Yes, because we don't really know what else to do.*
- How can you use the information from an incorrect guess? *We can figure out whether the next guess should be higher or lower.*

SOLVE IT

- Is there anything in the clue to help you make your guess? *The number is probably divisible by 3.*
- What is your guess? *30* (Sample guess)
- How can you check your guess? *Divide by 2, add 9, and then add another fourth* How did you do? *32, too low*
- If your guess was wrong, how can you use this information to make your next guess? *We can guess a higher number next.*
- (Have students continue guessing and checking until they find the solution.) How many radios did she return?

Solution: 36 ÷ 2 = 18 + 9 = 27, which is ¾ of 36

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

EXTEND IT

- The duchess had a cousin who had the same problem, but she took back a different number of radios. Here's a clue for her total: One-half the number, divided by 3 and added to 5, equals ¼ of the number.

PRACTICE

- Similar Practice Problems: 73, 95, 118

MAKE A PICTURE OR DIAGRAM Name

31 Meredith Mouse was giving her cousin Morris a tour of the old Harvey mansion, recently converted into the White Rabbit Inn. Meredith knew where all the furnace pipes connected the rooms. The rooms formed a square around a central hall with an elevator. There were 16 rooms on each floor, 5 rooms on each side. The innkeeeper left snacks of cheese and crackers in each room, much to the delight of the mice. Meredith and Morris began their tour on the first floor in the room at the northwest corner. Finding the cheese all eaten, they headed up a pipe one floor, then east 4 rooms, and south 2 rooms. Once again the cheese was all gone, so they headed up a pipe 3 floors, where Morris slipped in the pipe and fell down 1 floor. Meredith joined him and they went south 2 rooms, west 4, north 3, and then directly to the room across the hall on the east side of the hotel, where they found some nice aged cheddar. Where did Meredith and Morris find cheese? Draw a diagram to show the location.

FIND OUT

- What is the question you have to answer?
- What is Meredith doing?
- How are the rooms arranged on each floor? How many rooms are on each side?
- Where do Meredith and Morris begin their tour?
- Where do they go on the first floor?
- Which floor do they go to next? Where do they go on this floor?
- Then which floor do they go to? Where do they go on this floor?

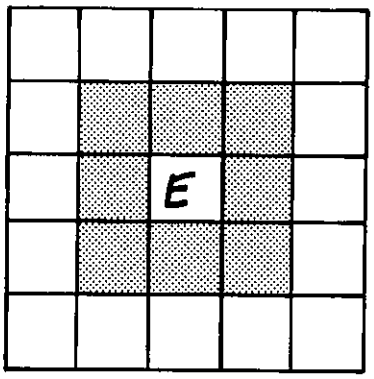
CHOOSE A STRATEGY

- Would it be helpful to try and "see" this problem by making a picture or diagram?

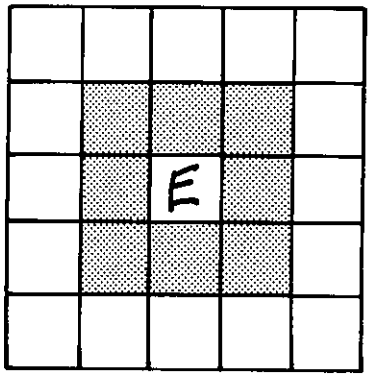
SOLVE IT

- Use graph paper or make a diagram of the first floor of the hotel. How many rooms will be on the floor altogether?
- Now follow the directions for that floor. Where do Meredith and Morris end up?
- Now make a diagram of the next floor that they go to. Follow the directions for that floor. Where do they end up?
- Continue to make a picture of each floor that they go to, and the directions that they follow on each one, until you find out where they found cheese.

Floor 1



Floor 2



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

31 Meredith Mouse was giving her cousin Morris a tour of the old Harvey mansion, recently converted into the White Rabbit Inn. Meredith knew where all the furnace pipes connected the rooms. The rooms formed a square around a central hall with an elevator. There were 16 rooms on each floor, 5 rooms on each side. The innkeeeper left snacks of cheese and crackers in each room, much to the delight of the mice. Meredith and Morris began their tour on the first floor in the room at the northwest corner. Finding the cheese all eaten, they headed up a pipe one floor, then east 4 rooms, and south 2 rooms. Once again the cheese was all gone, so they headed up a pipe 3 floors, where Morris slipped in the pipe and fell down 1 floor. Meredith joined him and they went south 2 rooms, west 4, north 3, and then directly to the room across the hall on the east side of the hotel, where they found some nice aged cheddar. Where did Meredith and Morris find cheese? Draw a diagram to show the location.

FIND OUT

- What is the question you have to answer? *Where did Meredith and Morris find cheese?*
- What is Meredith doing? *Giving her cousin a tour of the old mansion and looking for cheese*
- How are the rooms arranged on each floor? *They are in a square around a central hall with an elevator.* How many rooms are on each side? *5*
- Where do Meredith and Morris begin their tour? *On the first floor in the northwest corner*
- Where do they go on the first floor? *Up one of the furnace pipes*
- Which floor do they go to next? *The second floor* Where do they go on this floor? *East 4, south 2*
- Then which floor do they go to? *Fourth floor* Where do they go on this floor? *South 2, west 4, north 3, directly across hall to east side of the building*

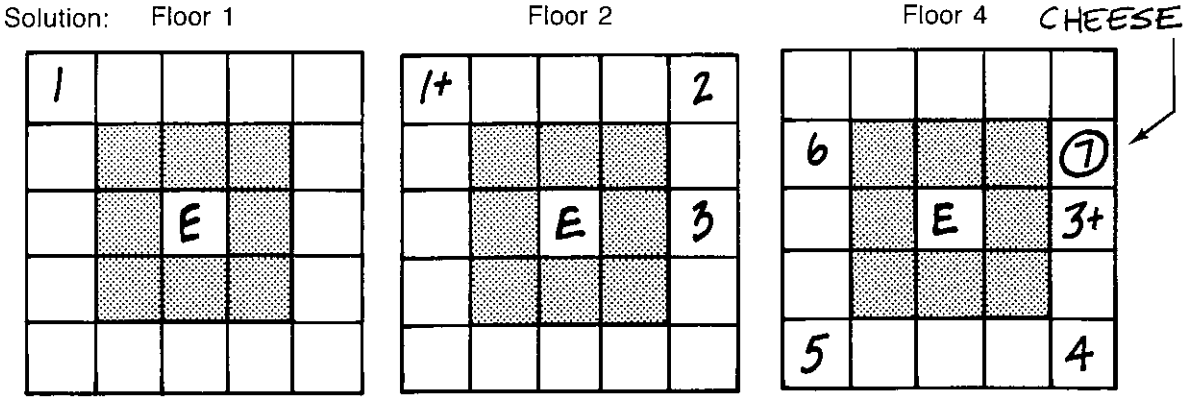
CHOOSE A STRATEGY

- Would it be helpful to try and "see" this problem by making a picture or diagram? *Yes, it would be much easier to plot this out on graph paper, or make a diagram of each floor.*

SOLVE IT

- Use graph paper or make a diagram of the first floor of the hotel. How many rooms will be on the floor altogether? *16*
- Now follow the directions for that floor. Where do Meredith and Morris end up? *On the second floor*
- Now make a diagram of the next floor that they go to. Follow the directions for that floor. Where do they end up? *2 rooms down from northeast corner*
- (Have students finish their diagrams.) Where did Meredith and Morris find cheese?

Solution:



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

EXTEND IT

- What if the mice continue to look for more cheese and go up a pipe 2 floors, go south 2 rooms, go directly across the hall to the west side, go north 3; then go down a pipe 3 floors, go diagonally across the hall to the southeast corner, then north 3; go down a pipe 2 floors, go directly across the hall to the west and south 3, to a big chunk of Swiss cheese. Where will they find the Swiss cheese?

MAKE A PICTURE OR DIAGRAM Name

32 Professor Picken Brush holds the map in her hand as she steps inside the northwest corner entrance to the ancient tomb. Her mission is to find the gold-inlaid throne of King Aru III. Each level of the tomb is square and is divided into rooms of equal size. The entrance level or first level has 36 rooms, and is centered directly above the second level below, which has 64 rooms. Each level down has one more row of rooms on each side than the level above it. Professor Brush follows the map, going south 3 rooms, then continuing east 5 rooms. She suddenly finds herself sliding down 2 levels through a trap door. She gets up and walks north 3 rooms, then west 6 rooms, where she finds a pole. Climbing up the pole to the room directly above, she walks south 5 rooms. She turns and goes east 7 rooms where a rope ladder appears. She lowers herself two levels on the rope ladder. From here she moves west 9 rooms and then south 2 rooms. There is the throne of King Aru III! Where does Professor Brush find the throne? Draw a diagram to show the location.

FIND OUT

- What is the question you have to answer?
- What is Professor Picken Brush doing?
- Where does she enter the tomb?
- What do you know about the first level? The second level?
- How is each level down different from the previous level?
- Where does she go on the first level?
- What level does she go to next? Where does she go on this level?
- What level does she go to next? Where does she go on this level?
- Which level is the last level she goes to? Where does she go on this level?

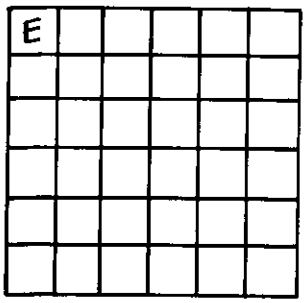
CHOOSE A STRATEGY

- Would it help to draw a picture or diagram of the different levels of the tomb?

SOLVE IT

- Use graph paper or draw level 1 of the tomb. How large is it?
- Follow the directions for this level. Where does Professor Brush end up?
- Draw the next level. How many rooms are on this level? Would it help to cut out the first level and put it on top, to make sure it is the right size and you begin in the right room?
- Follow the directions for this level. Where does she end up?
- Continue to make a diagram of each level, and follow the directions until you locate the throne.

Level 1



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

32 Professor Picken Brush holds the map in her hand as she steps inside the northwest corner entrance to the ancient tomb. Her mission is to find the gold-inlaid throne of King Aru III. Each level of the tomb is square and is divided into rooms of equal size. The entrance level or first level has 36 rooms, and is centered directly above the second level below, which has 64 rooms. Each level down has one more row of rooms on each side than the level above it. Professor Brush follows the map, going south 3 rooms, then continuing east 5 rooms. She suddenly finds herself sliding down 2 levels through a trap door. She gets up and walks north 3 rooms, then west 6 rooms, where she finds a pole. Climbing up the pole to the room directly above, she walks south 5 rooms. She turns and goes east 7 rooms where a rope ladder appears. She lowers herself two levels on the rope ladder. From here she moves west 9 rooms and then south 2 rooms. There is the throne of King Aru III! Where does Professor Brush find the throne? Draw a diagram to show the location.

FIND OUT

- What is the question you have to answer? *Where does Professor Brush find the throne?*
- What is Professor Picken Brush doing? *She is searching through an ancient tomb for a gold-inlaid throne.*
- Where does she enter the tomb? *At the northwest corner*
- What do you know about the first level? *There are 36 rooms* The second level? *64 rooms*
- How is each level down different from the previous level? *Each level is centered directly above the level below it and has one more row of rooms on each side than the previous level.*
- Where does she go on the first level? *South 3 rooms, east 5*
- What level does she go to next? *She slides through a trap door down 2 levels to 3rd level* Where does she go on this level? *North 3, west 6*
- What level does she go to next? *She climbs a pole up 1 floor to the 2nd level* Where does she go on this level? *South 5, east 7*
- Which level is the last level she goes to? *Down 2 levels on a rope ladder to the 4th level* Where does she go on this level? *She goes west 9 and south 2*

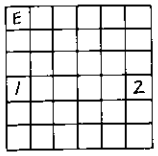
CHOOSE A STRATEGY

- Would it help to draw a picture or diagram of the different levels of the tomb? *Yes, then we can see how the levels change and where she goes on each level.*

SOLVE IT

- Use graph paper or draw level 1 of the tomb. How large is it? *36 rooms*
- Follow the directions for this level. Where does Professor Brush end up? *3 rooms south from the northeast corner*
- Draw the next level. How many rooms are on this level? *64 rooms* Would it help to cut out the first level and put it on top, to make sure it is the right size and you begin in the right room? *Yes*
- Follow the directions for this level. Where does she end up? *South 2 and east 1 from the northwest corner*
- (Have students finish their diagrams.) Where does Prof. Brush find the throne?

Solution: Level 1



(See Solutions for complete answer)

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your diagram. Is your answer reasonable?

EXTEND IT

- Make up a similar problem. Create a building with more levels. Give directions for a search party to locate a gold dog. Can someone else locate the dog from your directions?

PRACTICE

- Similar Practice Problems: 66, 89, 114

USE OR LOOK FOR A PATTERN

Name

33 Mele is designing a tree for her 7th grade holiday play. Since the play takes place in a futuristic society, Mele is designing a futuristic tree made entirely of stars. The first, or top, branch will have just one star; the second branch will have two stars; the third branch will have three stars, and so on. Mele will make the stars herself from foil. If her tree has 15 branches, how many stars will Mele need to make?

FIND OUT

- What is the question you have to answer?
- How many stars are on the first branch? On the second branch? On the third branch?
- How many branches will Mele's tree have?

CHOOSE A STRATEGY

- How can you organize the information in the problem?
- Is there a pattern in the way the numbers of stars on the branches change?

SOLVE IT

- Continue to fill in the table until you get to 15 branches.
- What happens if you add the stars on the 1st branch to the stars on the 15th branch? What happens if you add the stars on the 2nd branch to the stars on the 14th branch? If you continue in this way, how many pairs of star sets give a total of 16? Is there a set of stars that you can not pair with another set?
- How many stars will Mele have to make?

Branches	1	2	3	
Stars	1	2	3	

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

33 Mele is designing a tree for her 7th grade holiday play. Since the play takes place in a futuristic society, Mele is designing a futuristic tree made entirely of stars. The first, or top, branch will have just one star; the second branch will have two stars; the third branch will have three stars, and so on. Mele will make the stars herself from foil. If her tree has 15 branches, how many stars will Mele need to make?

FIND OUT

- What is the question you have to answer? *How many stars will Mele need to make?*
- How many stars are on the first branch? *1* On the second branch? *2* On the third branch? *3*
- How many branches will Mele's tree have? *15*

CHOOSE A STRATEGY

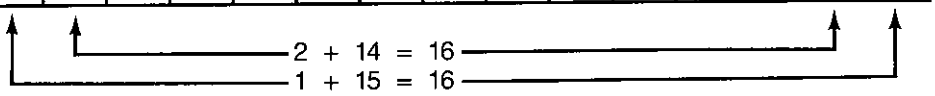
- How can you organize the information in the problem? *We can make a table.*
- Is there a pattern in the way the numbers of stars on the branches change? *Yes, + 1.*

SOLVE IT

- Continue to fill in the table until you get to branch 15.
- What happens if you add the stars on the 1st branch to the stars on the 15th branch? *The sum is 16 stars.* What happens if you add the stars on the 2nd branch to the stars on the 14th branch? *The sum is 16 stars.* If you continue in this way, how many pairs of star sets give a total of 16? *7* Is there a set of stars that you can not pair with another set? *Yes, 8 stars.*
- How many stars will Mele have to make? *7 × 16 + 8*

Solution: 120

Branches	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Stars	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

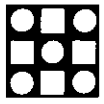


LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

EXTEND IT

- If Mele decided to add 5 more branches to the tree, how many stars would she have to make in all?



USE OR LOOK FOR A PATTERN Name

34 Astronomers all over the world are stunned by a remarkable discovery of a new galaxy deep in the farthest reaches of space. This galaxy, which can only be viewed by the most powerful, computerized telescopes, has a unique arrangement. It is composed of many suns, each with its own system of planets revolving around it in a most interesting way. The nearest sun in the new galaxy, called S-1, has just one planet revolving around it. The next closest sun, S-2, has two planets revolving around it. The third sun has three planets, and so on. So far, the information coming back from the new galaxy indicates that there are 23 suns, each farther and farther away from Earth. How many planets are there in the new galaxy?

FIND OUT

- What is the question you have to answer?
- How many planets does the first sun have? The second sun? The third sun?
- How many suns are there in the new galaxy?

CHOOSE A STRATEGY

- How can you organize the information in the problem?
- Is there a pattern in the way the numbers of planets revolving around the suns change?

SOLVE IT

- Continue to fill in the table until you get to the 23rd sun.
- What happens if you add the planets of the 1st sun to the planets of the 23rd sun? What happens if you add the planets of the 2nd sun to the planets of the 22nd sun? If you continue in this way, how many sums of 24 do you get? Is there a set of planets that you can not pair with another set?
- How many planets are there in the new galaxy?

Suns	1	2	3	
Planets	1	2	3	

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

34 Astronomers all over the world are stunned by a remarkable discovery of a new galaxy deep in the farthest reaches of space. This galaxy, which can only be viewed by the most powerful, computerized telescopes, has a unique arrangement. It is composed of many suns, each with its own system of planets revolving around it in a most interesting way. The nearest sun in the new galaxy, called S-1, has just one planet revolving around it. The next closest sun, S-2, has two planets revolving around it. The third sun has three planets, and so on. So far, the information coming back from the new galaxy indicates that there are 23 suns, each farther and farther away from Earth. How many planets are there in the new galaxy?

FIND OUT

- What is the question you have to answer? *How many planets are there in the new galaxy?*
- How many planets does the first sun have? *1* The second sun? *2* The third sun? *3*
- How many suns are there in the new galaxy? *23*

CHOOSE A STRATEGY

- How can you organize the information in the problem? *We can make a table.*
- Is there a pattern in the way the numbers of planets revolving around the suns change? *Yes, + 1.*

SOLVE IT

- Continue to fill in the table until you get to the 23rd sun.
- What happens if you add the planets of the 1st sun to the planets of the 23rd sun? *The sum is 24.* What happens if you add the planets of the 2nd sun to the planets of the 22nd sun? *The sum is 24.* If you continue in this way, how many sums of 24 do you get? *11* Is there a set of planets that you can not pair with another set? *Yes, one.*
- How many planets are there in the new galaxy? *11 × 24 + 12*

Solution: 276

(You may wish to show students an algorithm that can be used for solving this type of problem.) Multiply the number of suns in the galaxy (23) by the sum of the first and last sets of planets (24), and divide by 2. *23 × 24 ÷ 2*

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

EXTEND IT

- If 9 more suns were found in the galaxy, how many planets would there be in the galaxy?

PRACTICE

- Similar Practice Problems: 76, 104, 109

35 As everyone leaves the table after lunch, Steven chuckles and says, "I can't believe we're all brothers and sisters. We sure have different interests! Everyone laughs and agrees. Their favorite sports are football, surfing, skateboarding, softball, ice skating, and swimming; and each person participates in a different sport. Arnie, Renee, and Jack have an excellent sense of balance. Neither Jack nor Renee likes contact sports. Enid and Arnie love the water, but Enid is allergic to salt water. Jack likes cold weather sports best. Renee wears kneepads, and Paula always wears her cap backwards. Can you match each person with a sport?

FIND OUT

- What is the question you have to answer?
- Who are the brothers and sisters?
- What sports do they participate in?
- What do you know about Arnie, Renee, and Jack? What else do you know about Renee and Jack? What else do you know about Renee? What else do you know about Arnie? What do you know about Enid? What do you know about Paula?

CHOOSE A STRATEGY

- The information in this problem is given in a set of clues. If you use a series of "If. . .then" statements to solve this problem, what kind of thinking will you be using?
- Is there another strategy you can use to organize the information?

SOLVE IT

- When you make a table, how many columns will you need? How many rows?
- What will you label the columns? The rows?
- If Arnie, Renee, and Jack have an excellent sense of balance, in which sports do they probably participate?
- If Enid and Arnie love water, in which sports do they probably participate? If Enid is allergic to salt water, in which of the water sports does she participate? In which box of the table could you write Yes for Enid? If you match Enid with one sport, you can write No for all of the other sports in Enid's row. In which other boxes can you write No? Which sport is Arnie's? Then in which boxes can you write No?
- Use the remaining clues and continue to fill in the table until every box has Yes or No in it.

	Football	Surfing	Skate-board	Softball	Ice Skating	Swimming
Steven						
Arnie						
Renee						
Paula						
Jack						
Enid						

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

35 As everyone leaves the table after lunch, Steven chuckles and says, "I can't believe we're all brothers and sisters. We sure have different interests! Everyone laughs and agrees. Their favorite sports are football, surfing, skateboarding, softball, ice skating, and swimming; and each person participates in a different sport. Arnie, Renee, and Jack have an excellent sense of balance. Neither Jack nor Renee likes contact sports. Enid and Arnie love the water, but Enid is allergic to salt water. Jack likes cold weather sports best. Renee wears kneepads, and Paula always wears her cap backwards. Can you match each person with a sport?

FIND OUT

- What is the question you have to answer? *Can you match each person with a sport?*
- Who are the brothers and sisters? *Steven, Arnie, Renee, Jack, Enid, Paula*
- What sports do they participate in? *Football, surfing, skateboarding, softball, ice skating, swimming*
- What do you know about Arnie, Renee, and Jack? *They have an excellent sense of balance.* What else do you know about Renee and Jack? *They don't like contact sports.* What else do you know about Renee? *She wears kneepads.* What else do you know about Arnie? *He loves the water.* What do you know about Enid? *She loves the water but is allergic to salt water.* What do you know about Paula? *She always wears her cap backwards.*

CHOOSE A STRATEGY

- The information in this problem is given in a set of clues. If you use a series of "If. . .then" statements to solve this problem, what kind of thinking will you be using? *Logical reasoning*
- Is there another strategy you can use to organize the information? *Yes, we can make a table.*

SOLVE IT

- When you make a table, how many columns will you need? *6* How many rows? *6*
- What will you label the columns? *Football, surfing, skateboarding, softball, ice skating, swimming* The rows? *Steven, Arnie, Renee, Jack, Enid, Paula*
- If Arnie, Renee, and Jack have an excellent sense of balance, in which sports do they probably participate? *Surfing, skateboarding, and ice skating*
- If Enid and Arnie love water, in which sports do they probably participate? *Surfing and swimming* If Enid is allergic to salt water, in which of the water sports does she participate? *Swimming* In which box of the table could you write Yes for Enid? *Swimming* If you match Enid with one sport, you can write No for all of the other sports in Enid's row. In which other boxes can you write No? *All of the other boxes in the Swimming column.* Which sport is Arnie's? *Surfing* Then in which boxes can you write No? *All of the other boxes in Arnie's row, and all of the other boxes in the Surfing column.*
- (Have students use the remaining clues and continue to fill in the table until every box has Yes or No in it.) Can you match each person with a sport?

Solution: Steven—football; Arnie—surfing; Renee—skateboarding; Paula—softball; Jack— ice skating; Enid—swimming

	Football	Surfing	Skate-board	Softball	Ice Skating	Swimming
Steven	Y	N	N	N	N	N
Arnie	N	Y	N	N	N	N
Renee	N	N	Y	N	N	N
Paula	N	N	N	Y	N	N
Jack	N	N	N	N	Y	N
Enid	N	N	N	N	N	Y

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

36 Allen, Carrie, John, and Gloria hold these jobs in their city: veterinarian, mail carrier, police officer, and zoo keeper. Allen and Gloria work with animals. Carrie and John wear uniforms. John refuses to touch a gun. Gloria does not like dogs. The veterinarian is 5 years older than the mail carrier. Carrie, 24 years old, is 3 years younger than the zoo keeper. The 20-year-old delivers letters. Can you match each person with an age and a job?

FIND OUT

- What is the question you have to answer?
- Who are the people?
- What jobs do they have?
- What do you know about their ages?
- What do you know about Allen and Gloria? What else do you know about Gloria? What do you know about Carrie and John? What else do you know about John?

CHOOSE A STRATEGY

- The information in this problem is given in a set of clues. If you use a series of "If. . .then" statements to solve this problem, what kind of thinking will you be using?
- Is there another strategy you can use to organize the information?

SOLVE IT

- When you make a table, how many rows will you need? How many columns?
- What will you label the rows? The columns?
- If Allen and Gloria work with animals, which jobs do they have? If Gloria does not like dogs, which job doesn't she have? Then which job does she have? In which box of the table could you write Yes for Gloria? If you match Gloria with one job, you can write No for all of the other jobs in Gloria's row. In which other boxes can you write No? What do you know about the zoo keeper's age? Then what can you label the column after 24? Where can you write Yes in Carrie's row? Then in what other boxes can you write No?
- Use the remaining clues and continue to fill in the table until every box has Yes or No in it.

	Veterinarian	Police Officer	Zoo Keeper	Mail Carrier	20	24	27	25
Allen								
Carrie								
John								
Gloria								

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

36 Allen, Carrie, John, and Gloria hold these jobs in their city: veterinarian, mail carrier, police officer, and zoo keeper. Allen and Gloria work with animals. Carrie and John wear uniforms. John refuses to touch a gun. Gloria does not like dogs. The veterinarian is 5 years older than the mail carrier. Carrie, 24 years old, is 3 years younger than the zoo keeper. The 20-year-old delivers letters. Can you match each person with an age and a job?

FIND OUT

- What is the question you have to answer? *Can you match each person with an age and a job?*
- Who are the people? *Allen, Carrie, John, and Gloria*
- What jobs do they have? *Veterinarian, mail carrier, police officer, and zoo keeper*
- What do you know about their ages? *The mail carrier is 20 years old; the veterinarian is 5 years older than the mail carrier; Carrie is 24 years old and is 3 years younger than the zoo keeper.*
- What do you know about Allen and Gloria? *They work with animals.*
- What else do you know about Gloria? *She doesn't like dogs.*
- What do you know about Carrie and John? *They wear uniforms.*
- What do you know about John? *He refuses to touch a gun.*

CHOOSE A STRATEGY

- The information in this problem is given in a set of clues. If you use a series of "If. . .then" statements to solve this problem, what kind of thinking will you be using? *Logical reasoning*
- Is there another strategy you can use to organize the information? *Yes, we can make a table.*

SOLVE IT

- When you make a table, how many rows will you need? *4* How many columns? *8; 4 for the jobs and 4 for the ages*
- What will you label the rows? *Allen, Carrie, John, Gloria* The columns? *Veterinarian, Police Officer, Zoo Keeper, Mail Carrier; age 20, 24, and we have to find out what the other two numbers should be.*
- If Allen and Gloria work with animals, which jobs do they have? *Veterinarian and zoo keeper* If Gloria does not like dogs, which job doesn't she have? *Veterinarian* Then which job does she have? *Zoo keeper* In which box of the table could you write Yes for Gloria? *Zoo Keeper* If you match Gloria with one job, you can write No for all of the other jobs in Gloria's row. In which other boxes can you write No? *All of the other boxes in the Zoo Keeper column* What do you know about the zoo keeper's age? *3 years older than Carrie, who is 24 years old; so 27* Then what can you label the column after 24? *27* Where can you write Yes in Carrie's row? *In the 24 box* Then in what other boxes can you write No? *The boxes for other ages in Carrie's row; and boxes for other people in the 24 column.*
- (Have students use the remaining clues and continue to fill in the table.) Can you match each person with an age and a job?

Solution: Allen, 25, veterinarian; Carrie, 24, police officer; John, 20, mail carrier; Gloria, 27, zoo keeper

	Veterinarian	Police Officer	Zoo Keeper	Mail Carrier	20	24	27	25
Allen	Y	N	N	N	N	N	N	Y
Carrie	N	Y	N	N	N	Y	N	N
John	N	N	N	Y	Y	N	N	N
Gloria	N	N	Y	N	N	N	Y	N

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your table. Is your answer reasonable?

PRACTICE

- Similar Practice Problems: 74, 100, 112

37 Lily tosses and turns, too excited to go to sleep. Tomorrow is the Rose Bowl parade, and Lily, her sister Lulu, Lily's boyfriend Lee, and his brother Louis will be riding on a huge float made up of hundreds of flowers. One person will be on the north side, one on the east, one on the south, and one on the west, each one facing away from the center of the float. Lulu will be to the left of Lee's girlfriend. Lee's brother will be to the right of Lily's boyfriend. Each member of the Jones family will be across from a member of the Anderson family. There will not be an Anderson on the west side and Louis will be riding on the north side. What is the name and position of each person who will be riding on the float?

FIND OUT

- What is the question you have to answer?
- What is Lily thinking about?
- Who is riding on the float?
- How are they sitting on the float?
- What do you know about where Louis is sitting? Lulu? Lee's brother?
- What do you know about the Jones family members? The Andersons?

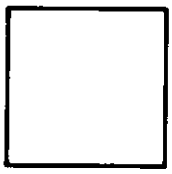
CHOOSE A STRATEGY

- Would it be helpful to have a piece of paper or other object to represent each person and move it around until you find the right location?
- Is there another strategy that would be helpful to use with this problem?

SOLVE IT

- If you use pieces of paper to represent the people sitting on the float, how many pieces do you need? Do you need separate pieces for the first names and the last names?
- How do you want to label each piece of paper?
- Draw a square to represent the float. What else do you need by the square?
- Begin with Louis. What do you know about where he is sitting?
- Now what do you know about where Lulu is sitting? Place her in one of the empty places. Who has to be on her right?
- What clue do you have about the Andersons and the Jones?
- Continue to move the papers or objects around until you have arranged everyone and their placement matches the clues.

Louis



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your arrangement. Is your answer reasonable?

37 Lily tosses and turns, too excited to go to sleep. Tomorrow is the Rose Bowl parade, and Lily, her sister Lulu, Lily's boyfriend Lee, and his brother Louis will be riding on a huge float made up of hundreds of flowers. One person will be on the north side, one on the east, one on the south, and one on the west, each one facing away from the center of the float. Lulu will be to the left of Lee's girlfriend. Lee's brother will be to the right of Lily's boyfriend. Each member of the Jones family will be across from a member of the Anderson family. There will not be an Anderson on the west side and Louis will be riding on the north side. What is the name and position of each person who will be riding on the float?

FIND OUT

- What is the question you have to answer? *What is the name and position of each person on the float?*
- What is Lily thinking about? *The parade and who is riding on one of the floats*
- Who is riding on the float? *Lily, Lulu, Louis, and Lee*
- How are they sitting on the float? *North, south, east, and west, each one away from the center of the float*
- What do you know about where Louis is sitting? *He is on the north side* Lulu? *She is to the left of Lee's girlfriend* Lee's brother? *To the right of Lily's boyfriend*
- What do you know about the Jones family members? *They are not across from each other* The Andersons? *There is not an Anderson on the west side*

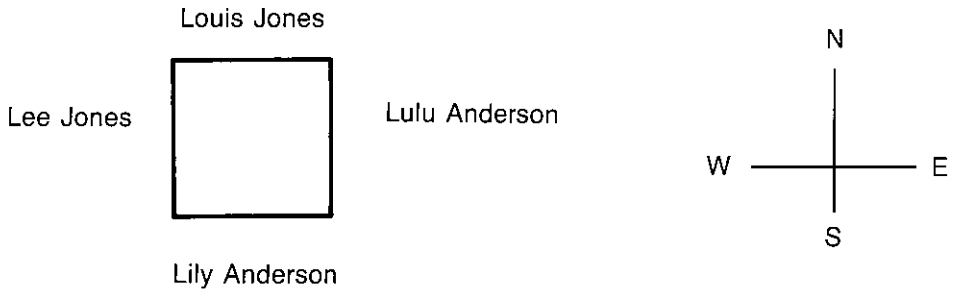
CHOOSE A STRATEGY

- Would it be helpful to have a piece of paper or other object to represent each person and move it around until you find the right location? *Yes, because this will make it easier to experiment with possible solutions.*
- Is there another strategy that would be helpful to use with this problem? *Yes, we can also make a diagram of the float.*

SOLVE IT

- If you use pieces of paper to represent the people sitting at the float, how many pieces do you need? *8* Do you need separate pieces for the first names and the last names? *Yes, so we need 4 for first names and 4 for last names*
- How do you want to label each piece of paper? *Lily, Lulu, Louis, Lee, Anderson, Anderson, Jones, Jones*
- Draw a square to represent the float. What else do you need by the square? *N, S, E, W*
- Begin with Louis. What do you know about where he is sitting? *He is on the north side.*
- Now what do you know about where Lulu is sitting? *She is to the left of Lee's girlfriend, so she is probably to the left of Lily .* Place her in one of the empty places. Who has to be on her right? *Lily*
- What clue do you have about the Andersons and the Jones? *There are two of each, if Lulu and Lily are sisters and Louis and Lee are brothers. We also know there must be a Jones on the west because there is not an Anderson.*
- (Have students continue to move objects around until they find a solution.) What is the name and position of each person who will be riding on the float?

Solution:



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your arrangement. Is your answer reasonable?

EXTEND IT

- Make up a similar problem, but this time have four people with different last names.

38 The Blacks, the Browns, the Whites, and the Greens, four married couples, are playing a card game. If they are arranged at two separate tables, where is each one sitting?

- No Black is across from a Green or a Brown.
- Married couples are not at the same table.
- Mary is across from Jennifer's husband.
- John's wife is to Mary's left and across from Arlene's husband.
- John is opposite Allen's wife.
- Paul's wife is on John's left and across from Mary's husband.
- John's partner is a Brown.
- Peter's wife is on Suzanne's right.
- Mary's partner is not a Black.

FIND OUT

- What is the question you have to answer?
- How many tables are there? How many people?
- What do you know about the Blacks? About married couples?
- What do you know about Mary? John's wife? John's partner? Paul's wife? Peter's wife? Mary's partner?

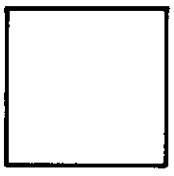
CHOOSE A STRATEGY

- Would it be helpful to have a piece of paper or other object to represent each person and move it around until you find the right location?
- Is there another strategy that would be helpful to use with this problem?

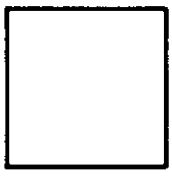
SOLVE IT

- If you use pieces of paper to represent the people sitting at the tables, how many pieces do you need? Do you need separate pieces for the first names and the last names?
- How do you want to label each piece of paper?
- Draw squares to represent the tables. Begin with John. Place him at one of the tables. What are all the things you know about John?
- If John is at one table, then where is John's wife? What do you know about her?
- Continue placing people and trying to match the placement with the clues.

Mary



John



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your arrangement. Is your answer reasonable?

38 The Blacks, the Browns, the Whites, and the Greens, four married couples, are playing a card game. If they are arranged at two separate tables, where is each one sitting?

- No Black is across from a Green or a Brown.
- Married couples are not at the same table.
- Mary is across from Jennifer's husband.
- John's wife is to Mary's left and across from Arlene's husband.
- John is opposite Allen's wife.
- Paul's wife is on John's left and across from Mary's husband.
- John's partner is a Brown.
- Peter's wife is on Suzanne's right.
- Mary's partner is not a Black.

FIND OUT

- What is the question you have to answer? *Can you seat each person at the tables?*
- How many tables are there? *2* How many people? *8*
- What do you know about the Blacks? *No Black is across from a Brown or Green.* About married couples ? *No married couple is at the same table.*
- What do you know about Mary? *She is across from Jennifer's husband.* John's wife? *She is to Mary's left and across from Arlene's husband.* John's partner? *The partner is a Brown.* Paul's wife? *She is on John's left and across from Mary's husband.* Peter's wife? *She is on Suzanne's right.* Mary's partner? *He is Jennifer's husband and not a Black.*

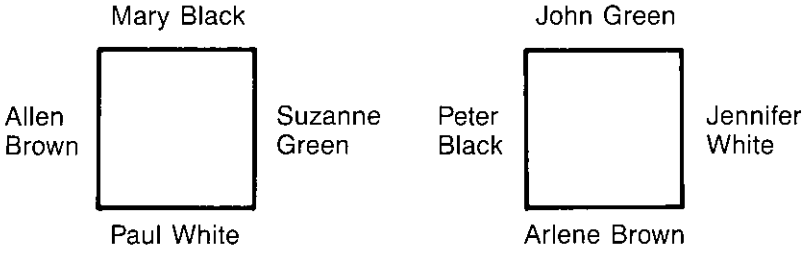
CHOOSE A STRATEGY

- Would it be helpful to have a piece of paper or other object to represent each person and move it around until you find the right location? *Yes, this would allow for more experimentation.*
- Is there another strategy that would be helpful to use with this problem? *We should make a diagram of the tables.*

SOLVE IT

- If you use pieces of paper to represent the people sitting at the tables, how many pieces do you need? *16* Do you need separate pieces for the first names and the last names? *Yes, 8 and 8*
- How do you want to label each piece of paper? *2 Browns, 2 Whites, 2 Greens, 2 Blacks, Mary, Jennifer, Arlene, Suzanne, John, Peter, Paul, Allen*
- Draw squares to represent the tables. Begin with John. Place him at one of the tables. What are all the things you know about John? *He is across from Allen's wife, and his partner is a Brown.*
- If John is at one table, then where is John's wife? *At the other table.* What do you know about her? *She is to Mary's left and across from Arlene's husband.*
- (Have students continue to move objects, placing people and trying to match the placement with the clues.) Where is each person sitting?

Solution:



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your arrangement. Is your answer reasonable?

EXTEND IT

- Make up a similar problem. Try to do this with each of the 8 people having a different last name.

PRACTICE

- Similar Practice Problems: 86, 102, 117

39 Five cousins are camping together in the mountains. Two of the cousins are Pattersons and three are Andersons. Two of them are from Montana, and three are from Wyoming. Irene and Yvonne are from the same state. Michael and Emily are from different states. Leo and Michael have the same last name. Emily and Yvonne do not have the same last name. The Patterson from Montana awakes in the middle of the night to discover a raccoon rummaging through the food pack. What is that cousin's first name?

FIND OUT

- What is the question you have to answer?
- How many cousins are camping together? What are their names?
- How many are Pattersons? How many are Andersons?
- How many are from Montana? How many are from Wyoming?
- What do you know about where Irene and Yvonne live? Where Michael and Emily live?
- What do you know about Leo's and Michael's last names? About Emily's and Yvonne's last names?

CHOOSE A STRATEGY

- Would using "if. . .then" statements help you work through this problem? What kind of thinking is this called?
- How can you organize the information in the problem?

SOLVE IT

- How many names will you have to write under Montana? Under Wyoming? How many names will you have to write under Patterson? Under Anderson?
- If Leo and Michael have the same last name, and Emily and Yvonne have different last names, then under which last name would you write each of their first names? Under which last name would you write Irene's name?
- If Irene and Yvonne are from the same state, and Michael and Emily are from different states, then under what state would you write each of their first names? Under what state would you write Leo's name?
- What is the first name of the Patterson from Montana who discovered the raccoon?

Patterson	Anderson	Montana	Wyoming
1 Emily/Yvonne	1 Emily/Yvonne		
2	2		
	3		

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

39 Five cousins are camping together in the mountains. Two of the cousins are Pattersons and three are Andersons. Two of them are from Montana, and three are from Wyoming. Irene and Yvonne are from the same state. Michael and Emily are from different states. Leo and Michael have the same last name. Emily and Yvonne do not have the same last name. The Patterson from Montana awakes in the middle of the night to discover a raccoon rummaging through the food pack. What is that cousin's first name?

FIND OUT

- What is the question you have to answer? *What is the first name of the Patterson from Montana who discovered the raccoon?*
- How many cousins are camping together? *5* What are their names? *Irene, Yvonne, Michael, Emily, Leo*
- How many are Pattersons? *2* How many are Andersons? *3*
- How many are from Montana? *2* How many are from Wyoming? *3*
- What do you know about where Irene and Yvonne live? *They are from the same state.* Where Michael and Emily live? *They are from different states.*
- What do you know about Leo's and Michael's last names? *They have the same last name.* About Emily's and Yvonne's last names? *They have different last names.*

CHOOSE A STRATEGY

- Would using "if. . .then" statements help you work through this problem? *Yes* What kind of thinking is this called? *Logical reasoning*
- How can you organize the information in the problem? *We can write the two last names and the names of the two states, and then list the cousins' names under them as we work through the problem.*

SOLVE IT

- How many names will you have to write under Montana? *2* Under Wyoming? *3* How many names will you have to write under Patterson? *2* Under Anderson? *3*
- If Leo and Michael have the same last name, and Emily and Yvonne have different last names, then under which last name would you write each of their first names? *Write Emily/Yvonne under both last names. Then we have to write Leo and Michael under Anderson.* Under which last name would you write Irene's name? *Patterson*
- If Irene and Yvonne are from the same state, and Michael and Emily are from different states, then under what state would you write each of their first names? *Write Michael/Emily under both states. Then we have to write Irene and Yvonne under Wyoming.* Under what state would you write Leo's name? *Montana*
- What is the first name of the Patterson from Montana who discovered the raccoon? *Emily is the only cousin whose name appears under both Patterson and Montana.*

Solution: Emily

Patterson	Anderson	Montana	Wyoming
1 Emily/Yvonne	1 Emily/Yvonne	1 Michael/Emily	1 Michael/Emily
2 Irene	2 Leo	2 Leo	2 Irene
	3 Michael		3 Yvonne

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

EXTEND IT

- Write a similar problem about 5 people. Use different names and different states.

40 Seven members of the school orchestra have been selected to participate in the All-City School Orchestra. Three of them are 13 years old, and four of them are 12 years old. Three play the trumpet, and four play the violin. Tomassi, Paul, and Ricky play the same instrument. Jesse and Miranda play different instruments. Jesse, Miranda, and Ann are the same age. Tomassi and Paul are not the same age. What is the name of the 13-year-old trumpeter who has been chosen to play First Chair?

FIND OUT

- What is the question you have to answer?
- How many members of the orchestra have been selected to play in the All-City School Orchestra? What are their names?
- How many are 13 years old? How many are 12 years old?
- How many play the trumpet? How many play the violin?
- What do you know about what Tomassi, Paul, and Ricky play? About what Jesse and Miranda play?
- What do you know about the ages of Jesse, Miranda, and Ann? About the ages of Tomassi and Paul?

CHOOSE A STRATEGY

- What kind of thinking can you use to help you solve this problem?
- How can you organize the information in the problem?

SOLVE IT

- How many names will you have to write under Age 13? Under Age 12?
- How many names will you have to write under Trumpet? Under Violin?
- If Tomassi, Paul, and Ricky play the same instrument, and Miranda and Jesse play different instruments, then under what instrument would you write each of their names? Then under what instrument would you write Ann's and Patty's names?
- Continue to work through the problem until you find the name of the 13-year-old trumpet player.

Age 13	Age 12	Trumpet	Violin
1 Paul/Tomassi	1 Paul/Tomassi	1	1
2	2	2	2
3	3	3	3
	4		4

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

40 Seven members of the school orchestra have been selected to participate in the All-City School Orchestra. Three of them are 13 years old, and four of them are 12 years old. Three play the trumpet, and four play the violin. Tomassi, Paul, and Ricky play the same instrument. Jesse and Miranda play different instruments. Jesse, Miranda, and Ann are the same age. Tomassi and Paul are not the same age. What is the name of the 13-year-old trumpeter who has been chosen to play First Chair?

FIND OUT

- What is the question you have to answer? *What is the name of the 13-year-old trumpeter who has been chosen to play First Chair?*
- How many members of the orchestra have been selected to play in the All-City School Orchestra? *7* What are their names? *Paul, Ricky, Ann, Patty, Jesse, Tomassi, and Miranda*
- How many are 13 years old? *3* How many are 12 years old? *4*
- How many play the trumpet? *3* How many play the violin? *4*
- What do you know about what Tomassi, Paul, and Ricky play? *They play the same instrument.* About what Jesse and Miranda play? *They play different instruments.*
- What do you know about the ages of Jesse, Miranda, and Ann? *They are the same age.* About the ages of Tomassi and Paul? *They are different ages.*

CHOOSE A STRATEGY

- What kind of thinking can you use to help you solve this problem? *Logical reasoning*
- How can you organize the information in the problem? *We can write the names of the two instruments and the two ages, and then record the players' names under them as we work through the problem.*

SOLVE IT

- How many names will you have to write under Age 13? *3* Under Age 12? *4*
- How many names will you have to write under Trumpet? *3* Under Violin? *4*
- If Tomassi, Paul, and Ricky play the same instrument, and Miranda and Jesse play different instruments, then under what instrument would you write each of their names? *Write Jesse/Miranda under both instruments, and Tomassi, Paul, and Ricky under Violin.* Then under what instrument would you write Ann's and Patty's names? *Trumpet*
- (Have students continue to work through the problem.) What is the name of the 13-year-old trumpet player? *Patty's name is the only one that appears under both 13 and Trumpet.*

Solution: Patty

Age 13	Age 12	Trumpet	Violin
1 Paul/Tomassi	1 Paul/Tomassi	1 Jesse/Miranda	1 Jesse/Miranda
2 Patty	2 Jesse	2 Patty	2 Tomassi
3 Ricky	3 Miranda	3 Ann	3 Paul
	4 Ann		4 Ricky

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

PRACTICE

- Similar Practice Problems: 77, 105, 113

41 Most everyone knows about Ali Baba and the 40 thieves, but not everyone knows about Ali's younger brother, Bubba Baba. One night Bubba followed Ali and watched him enter the thieves' hideaway. Later, Bubba returned to the hideaway alone and spoke the magic words, "Open Sesame." The door opened and Bubba entered the cave. He was astonished to find 4,120 pounds of gold and silver nuggets. There were four times as many 1-pound gold nuggets as 3-pound gold nuggets. He found three times as many 3-pound silver nuggets as 6-pound silver nuggets. How many gold and silver nuggets of each size did Bubba discover in the thieves' hideaway?

FIND OUT

- What is the question you have to answer?
- How many pounds of gold and silver did Bubba find?
- What do you know about the number of 1-pound gold nuggets Bubba found?
- What do you know about the number of 3-pound silver nuggets Bubba found?

CHOOSE A STRATEGY

- Might it be helpful to begin with a smaller number than 4,120 to help solve the problem?

SOLVE IT

- Try the number 50 in place of 4,120.
- If Bubba found 4 times as many 1-pound gold nuggets as 3-pound gold nuggets, what is the least number of pounds of gold he could have found?
- If Bubba found 3 times as many 3-pound silver nuggets as 6-pound silver nuggets, what is the least number of pounds of silver he could have found?
- If you combine the gold and silver nuggets in the first set, how many pounds do you have? How many sets of 22 are there in 50 pounds? How many gold nuggets of each size would there be in those sets? How many pounds would they weigh together? How many silver nuggets of each size would there be? How many pounds would they weigh together? How many pounds would 2 sets of gold and silver nuggets weigh together?
- Now try 4,120. How can you begin? How many sets do you get? Can the remaining pounds be divided evenly by 7 or 15? What can you do?

	Gold			Silver			Combined
Sets	3 lb	1 lb	Total lb	6 lb	3 lb	Total lb	**Total**
1	1	4	7	1	3	15	22
2	2	8	14	2	6	30	44

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

41

Most everyone knows about Ali Baba and the 40 thieves, but not everyone knows about Ali's younger brother, Bubba Baba. One night Bubba followed Ali and watched him enter the thieves' hideaway. Later, Bubba returned to the hideaway alone and spoke the magic words, "Open Sesame." The door opened and Bubba entered the cave. He was astonished to find 4,120 pounds of gold and silver nuggets. There were four times as many 1-pound gold nuggets as 3-pound gold nuggets. He found three times as many 3-pound silver nuggets as 6-pound silver nuggets. How many gold and silver nuggets of each size did Bubba discover in the thieves' hideaway?

FIND OUT

- What is the question you have to answer? *How many gold and silver nuggets of each size did Bubba discover in the thieves' hideaway?*
- How many pounds of gold and silver did Bubba find? *4,120*
- What do you know about the number of 1-pound gold nuggets Bubba found? *It was 4 times the number of 3-pound gold nuggets he found.*
- What do you know about the number of 3-pound silver nuggets Bubba found? *It was 3 times the number of 6-pound silver nuggets he found.*

CHOOSE A STRATEGY

- Might it be helpful to begin with a smaller number than 4,120 to help solve the problem? *Yes, it would help to make the problem simpler.*

SOLVE IT

- Try the number 50 in place of 4,120.
- If Bubba found 4 times as many 1-pound gold nuggets as 3-pound gold nuggets, what is the least number of pounds of gold he could have found? *One 3-pound nugget plus four 1-pound nuggets, or 7 pounds*
- If Bubba found 3 times as many 3-pound silver nuggets as 6-pound silver nuggets, what is the least number of pounds of silver he could have found? *One 6-pound nugget plus three 3-pound nuggets, or 15 pounds.*
- If you combine the gold and silver nuggets in the first set, how many pounds do you have? *22* How many sets of 22 are there in 50 pounds? *2* How many gold nuggets of each size would there be in those sets? *Two 3-pound nuggets and eight 1-pound gold nuggets* How many pounds would they weigh together? *14* How many silver nuggets of each size would there be? *Two 6-pound silver nuggets and six 3-pound silver nuggets* How many pounds would they weigh together? *30* How many pounds would 2 sets of gold and silver nuggets weigh together? *44*
- Now try 4,120. How can you begin? *Divide it into sets of 22 pounds.* How many sets do you get? *187* Can the remaining pounds be divided evenly by 7 or 15? *No.* What can you do? *Reduce the number of sets until the remainder can be evenly divided by 7 or 15.*

Solution: 760 1-pound gold nuggets, 190 3-pound gold nuggets, 558 3-pound silver nuggets, 186 6-pound silver nuggets
(Other solutions are possible.)

	Gold			Silver			Combined
Sets	3 lb	1 lb	Total lb	6 lb	3 lb	Total lb	Total
1	1	4	7	1	3	15	22
2	2	8	14	2	6	30	44

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

EXTEND IT

- Bubba entered the cave another time and found 768 pounds of gold and silver bars. He saw 4 times as many 1-pound gold bars as 3-pound gold bars, and 8 times as many 2-pound gold bars as 3-pound gold bars. He counted 3 times as many 3-pound silver bars as 6-pound silver bars. How many bars of each kind and weight did he find?

42 P.G. Andee takes her science class on a field trip to the local hydroelectric plant. After an interesting tour of the facilities, the guide explains to the class that there are four such plants in the northern part of the state. Power Plant A converts one half as many gallons of water per hour into electricity as Power Plant B, which converts one half as many per hour as Plant C, which converts one half as many per hour as Plant D. Last year all four plants together converted 262,800,000 gallons of water into electric power. The company made a profit of $25 per gallon of water converted. How much profit was made per hour at each power plant?

FIND OUT

- What is the question you have to answer?
- What do you know about the number of gallons converted at Plant A?
- What do you know about the number of gallons converted at Plant B?
- What do you know about the number of gallons converted at Plant C?
- How many gallons of water were converted in one year by all four plants?
- How much profit did the company make per gallon of water converted?

CHOOSE A STRATEGY

- Might it be helpful to begin with a smaller number than 262,800,000?

SOLVE IT

- Try 262,800 in place of 262,800,000. If 262,800 gallons were converted per year, how many gallons did the plants convert per hour?
- Which plant converted the most gallons of water?
- If you make a guess about the gallons converted by one plant, can you figure out how many gallons the other plants converted? If the four plants together converted 30 gallons per hour, how many did each plant convert?
- Now try 262,800,000. How many gallons of water were converted per hour by each plant? How much profit was made per hour at each power plant?

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

42 P.G. Andee takes her science class on a field trip to the local hydroelectric plant. After an interesting tour of the facilities, the guide explains to the class that there are four such plants in the northern part of the state. Power Plant A converts one half as many gallons of water per hour into electricity as Power Plant B, which converts one half as many per hour as Plant C, which converts one half as many per hour as Plant D. Last year all four plants together converted 262,800,000 gallons of water into electric power. The company made a profit of $25 per gallon of water converted. How much profit was made per hour at each power plant?

FIND OUT

- What is the question you have to answer? *How much profit was made per hour at each power plant?*
- What do you know about the number of gallons converted at Plant A? *It was half the number of gallons converted at Plant B.*
- What do you know about the number of gallons converted at Plant B? *It was half the number of gallons converted at Plant C.*
- What do you know about the number of gallons converted at Plant C? *It was half the number of gallons converted at Plant D.*
- How many gallons of water were converted in one year by all four plants? *262,800,000*
- How much profit did the company make per gallon of water converted? *$25*

CHOOSE A STRATEGY

- Might it be helpful to begin with a smaller number than 262,800,000? *Yes, it would help to make the problem simpler.*

SOLVE IT

- Try 262,800 in place of 262,800,000. If 262,800 gallons were converted per year, how many gallons did the plants convert per hour? *262,800 ÷ 365, or 720 gallons per day; 720 ÷ 24, or 30 gallons per hour*
- Which plant converted the most gallons of water? *Plant D*
- If you make a guess about the gallons converted by one plant, can you figure out how many gallons the other plants converted? *Yes.* (Have students make a guess for Plant A or D, then determine the number of gallons for the other plants.) If the four plants together converted 30 gallons per hour, how many did each plant convert? *Plant D converted 16, Plant C converted 8, Plant B converted 4, Plant A converted 2.*
- Now try 262,800,000. How many gallons of water were converted per hour by each plant? *Plant A converted 2,000; Plant B converted 4,000; Plant C converted 8,000; Plant D converted 16,000.* How much profit was made per hour at each power plant?

  Solution: Plant A—$50,000; Plant B—$100,000; Plant C—$200,000; Plant D—$400,000

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

EXTEND IT

- One year the plants converted 376,680,000 gallons of water. Plant A converted one sixth as many gallons as Plant B, which converted half as many as Plant C, which converted half as many as Plant D. At $25 profit per gallon, how much profit did each plant make per hour?

PRACTICE

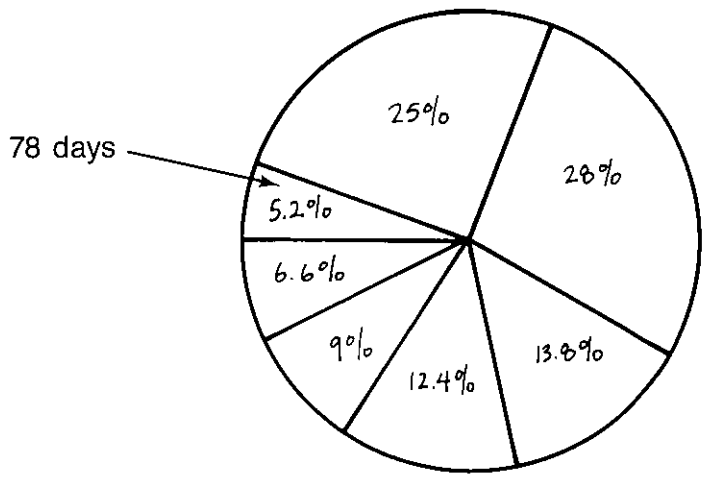
- Similar Practice Problems: 85, 99, 115

43 Bondar came home on the late space shuttle. "Pack your bags," he announced to his six-eyed family members. "We're being transferred to the planet Nebulosa." "Transferred to Nebulosa?" Junior Bondar cried. He ran to his bed chamber and got out a schoolbook. "We're studying Nebulosa in space science," he announced as he opened his book. "Listen to this: Nebulosa has the longest year in the Machinarxian Galaxy. It has 7 seasons. Yam lasts 9% of the year; Creboto lasts 28% of the year; Bevenrob lasts 25% of the year; Tagusa lasts 12.4% of the year; Yanjura lasts 13.8% of the year, and Crembeed lasts 6.6% of the year. Prembeest is 78 days long." Junior Bondar closed the book and sighed. "It's going to be a long wait between birthdays!" How many days will Junior have to wait between birthdays on Nebulosa?

FIND OUT
- What is the question you have to answer?
- How many seasons does Nebulosa have?
- What part of the year is Yam? Creboto? Bevenrob? Tagusa? Yanjura? Crembeed? Prembeest?

CHOOSE A STRATEGY
- To solve this problem you have to start with the number of days given for Prembeest. How can you organize and use the rest of the information given?
- What kind of diagram could you use to help solve the problem?

SOLVE IT
- When you draw a circle graph, how will you divide and label it?
- What is the sum of all the parts except Prembeest? Then what part of the year is Prembeest? How many days long is Prembeest?
- How long is Tagusa? How long is Crembeed?
- Continue to work backwards and fill in each part of the circle graph. How many days are there in the Nebulosan year?



LOOK BACK
- Read the problem again. Look at the data, conditions, and the main question. Review your circle graph. Is your answer reasonable?

43 Bondar came home on the late space shuttle. "Pack your bags," he announced to his six-eyed family members. "We're being transferred to the planet Nebulosa." "Transferred to Nebulosa?" Junior Bondar cried. He ran to his bed chamber and got out a schoolbook. "We're studying Nebulosa in space science," he announced as he opened his book. "Listen to this: Nebulosa has the longest year in the Machinarxian Galaxy. It has 7 seasons. Yam lasts 9% of the year; Creboto lasts 28% of the year; Bevenrob lasts 25% of the year; Tagusa lasts 12.4% of the year; Yanjura lasts 13.8% of the year, and Crembeed lasts 6.6% of the year. Prembeest is 78 days long." Junior Bondar closed the book and sighed. "It's going to be a long wait between birthdays!" How many days will Junior have to wait between birthdays on Nebulosa?

FIND OUT

- What is the question you have to answer? *How many days will Junior have to wait between birthdays on Nebulosa?*
- How many seasons does Nebulosa have? *7*
- What part of the year is Yam? *9%* Creboto? *28%* Bevenrob? *25%* Tagusa? *12.4%* Yanjura? *13.8%* Crembeed? *6.6%* How long is Prembeest? *78 days*

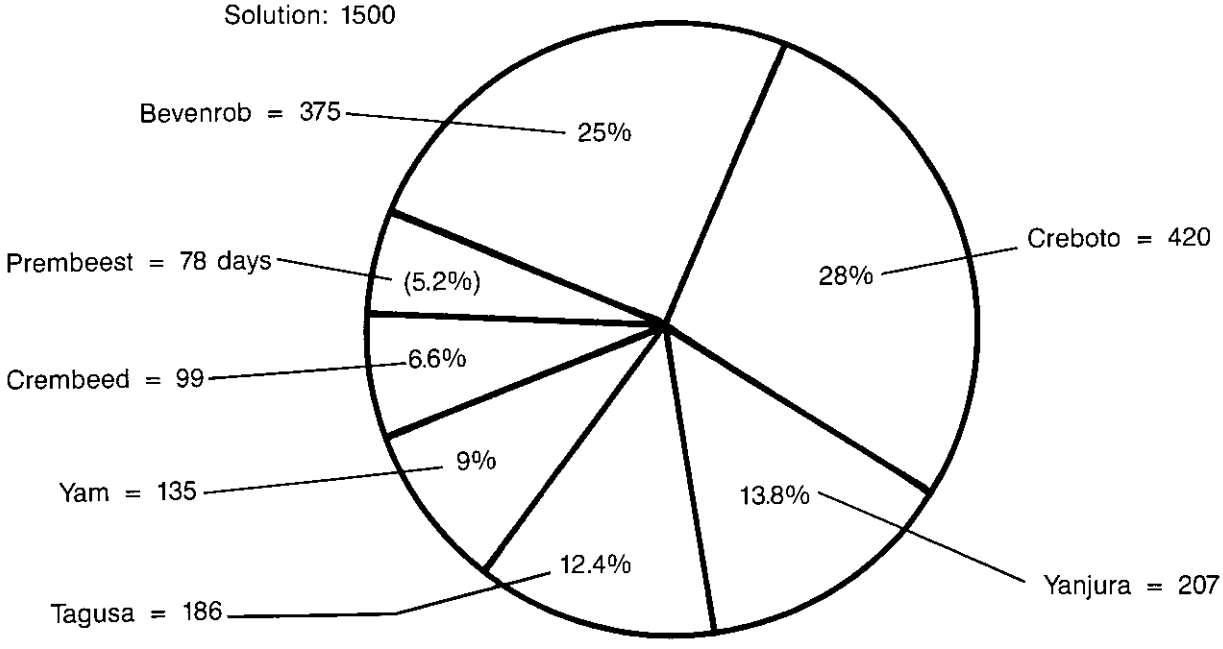
CHOOSE A STRATEGY

- To solve this problem you have to start with the number of days given for Prembeest. How can you organize and use the rest of the information given? *We can begin with the 78 days and work backwards through the problem.*
- What kind of diagram could you use to help solve the problem? *A circle graph*

SOLVE IT

- When you draw a circle graph, how will you divide and label it?
- What is the sum of all the parts except Prembeest? *94.8%* Then what part of the year is Prembeest? *5.2%* How many days long is Prembeest? *78*
- How long is Tagusa? *78 ÷ 5.2 = 15 days or 1%, so Tagusa is 186 days long* How long is Crembeed? *6.6 × 15 = 99 days*
- (Have students continue to work backwards and fill in each part of the circle graph.) How many days will Junior have to wait between birthdays on Nebulosa?

Solution: 1500



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your circle graph. Is your answer reasonable?

EXTEND IT

- Make up a similar problem for a planet that has a different number of seasons.

44 The students at Xynxo Middle School, on the planet Droxnerd, are looking for a new mascot. The student council conducted a poll, asking the students to choose one of the Droxnerdian animals for a mascot. The council found that $\frac{2}{7}$ of the student body voted for the three-tailed mambano; $\frac{1}{7}$ voted for the pointed plynx; $\frac{1}{7}$ voted for the twelve-headed stroob; $\frac{1}{14}$ voted for the half-horned rhynopotamus; $\frac{1}{14}$ voted for the reversible mirnk; $\frac{1}{7}$ voted for the laughing lulubeak; $\frac{1}{28}$ voted for the flat-footed duxter; $\frac{1}{28}$ voted for the singing snydeblinker; $\frac{1}{28}$ voted for the louvered brankomoose; $\frac{1}{56}$ voted for the blue-toothed dinkelwink; $\frac{1}{112}$ voted for the short-haired shrift; and 16 students were absent. How many students attend Xynxo Middle School, and how many of them voted for each animal?

FIND OUT

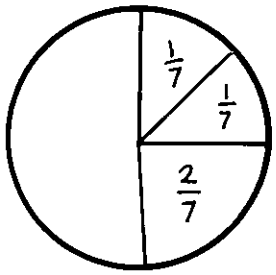
- What is the question you have to answer?
- How many different animals could the students vote for?
- What fractional part of the student body voted for the mambano? For the plynx? For the stroob? For the rhynopotamus? For the mirnk? For the lulubeak? For the duxter? For the snydeblinker? For the brankomoose? For the dinkelwink? For the shrift?
- How many students were absent?

CHOOSE A STRATEGY

- To solve this problem you have to start with the number of absent students. How can you organize and use the rest of the information given?
- What kind of diagram could you use to help solve the problem?

SOLVE IT

- If you draw a circle graph, how will you divide and label it?
- What is the sum of all the parts except the absent students? Then what part of the whole student body is absent? How many students make up that part?
- How many students voted for the shrift? How many students voted for the dinkelwink?
- Continue to work backwards and fill in each part of the circle graph.



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your circle graph. Is your answer reasonable?

44

The students at Xynxo Middle School, on the planet Droxnerd, are looking for a new mascot. The student council conducted a poll, asking the students to choose one of the Droxnerdian animals for a mascot. The council found that 2/7 of the student body voted for the three-tailed mambano; 1/7 voted for the pointed plynx; 1/7 voted for the twelve-headed stroob; 1/14 voted for the half-horned rhynopotamus; 1/14 voted for the reversible mirnk; 1/7 voted for the laughing lulubeak; 1/28 voted for the flat-footed duxter; 1/28 voted for the singing snydeblinker; 1/28 voted for the louvered brankomoose; 1/56 voted for the blue-toothed dinkelwink; 1/112 voted for the short-haired shrift; and 16 students were absent. How many students attend Xynxo Middle School, and how many of them voted for each animal?

FIND OUT

- What is the question you have to answer? *How many students attend Xynxo Middle School, and how many of them voted for each animal?*
- How many different animals could the students vote for? *11*
- What fractional part of the student body voted for the mambano? *2/7* For the plynx? *1/7* For the stroob? *1/7* For the rhynopotamus? *1/14* For the mirnk? *1/14* For the lulubeak? *1/7* For the duxter? *1/28* For the snydeblinker? *1/28* For the brankomoose? *1/28* For the dinkelwink? *1/56* For the shrift? *1/112*
- How many students were absent? *16*

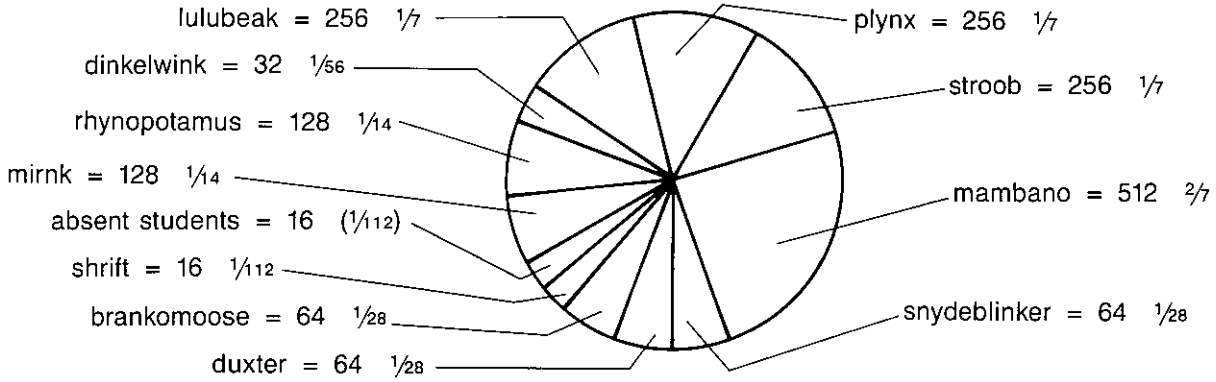
CHOOSE A STRATEGY

- To solve this problem you have to start with the number of absent students. How can you organize and use the rest of the information given? *We can begin with the 16 students and work backwards through the problem.*
- What kind of diagram could you use to help solve the problem? *A circle graph*

SOLVE IT

- If you draw a circle graph, how will you divide and label it? *2/7—mambano, 1/7—plynx, 1/7—stroob, 1/7—lulubeak, 1/14—rhynopotamus, 1/14—mirnk, 1/28—duxter, 1/28—snydeblinker, 1/28—brankomoose, 1/56—dinkelwink, 1/112—shrift, 1/112—(16) absent students*
- What is the sum of all the parts except the absent students? *111/112* Then what part of the whole student body is absent? *1/112* How many students make up that part? *16*
- How many students voted for the shrift? *16* How many students voted for the dinkelwink? *32*
- (Have students continue to work backwards and fill in each part of the circle graph.) How many students attend Xynxo Middle School, and how many of them voted for each animal?

Solution: Total—1792; mambano—512; plynx—256; stroob—256; mirnk—128; rhynopotamus—128; lulubeak—256; duxter—64; snydeblinker—64; brankomoose—64; dinkelwink—32; shrift—16; (absent—16)



LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your circle graph. Is your answer reasonable?

EXTEND IT

- Write a similar problem about animals from another planet. Use different fractional parts.

PRACTICE

- Similar Practice Problems: 94, 107, 119

45 Major Milton Mosquito, commanding officer of the Institute of Invading Insects, is preparing his troops for their first assault of the summer: an annual company picnic on the shores of Lake Oingo-Boingo. "This will be your finest hour," the Major shouts at the troops. "We will meet them at the barbecue pits! We will meet them at the dessert table! We will meet them at the lagoon! We will meet them at the parking lot! It is now 9:00 A.M. Saturday, March 24. Be ready to attack in 99,180 seconds from now." When will the insect invaders first attack the unsuspecting picnickers?

FIND OUT

- What is the question you have to answer?
- What is the time and date right now?
- When does the Major tell them to be ready to attack?

CHOOSE A STRATEGY

- Would it be easier to solve this problem with fewer seconds?

SOLVE IT

- Begin with 4,000 seconds. How could you make the seconds easier to handle?
- If you change the seconds into minutes, then what is the next way to simplify the minutes?
- After you have simplified 4,000 seconds, and have an idea of the process, try going back to 99,180 seconds. What is the first step?
- Continue to work through the steps until you translate the number of seconds into days and add that to Saturday at 9:00 A.M.

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

45

Major Milton Mosquito, commanding officer of the Institute of Invading Insects, is preparing his troops for their first assault of the summer: an annual company picnic on the shores of Lake Oingo-Boingo. "This will be your finest hour," the Major shouts at the troops. "We will meet them at the barbecue pits! We will meet them at the dessert table! We will meet them at the lagoon! We will meet them at the parking lot! It is now 9:00 A.M. Saturday, March 24. Be ready to attack in 99,180 seconds from now." When will the insect invaders first attack the unsuspecting picnickers?

FIND OUT

- What is the question you have to answer? *When will the insect invaders first attack the unsuspecting picnickers?*
- What is the time and date right now? *Saturday, March 24, 9:00 A.M.*
- When does the Major tell them to be ready to attack? *In 99,180 seconds*

CHOOSE A STRATEGY

- Would it be easier to solve this problem with fewer seconds? *Yes, it would help to make the problem simpler.*

SOLVE IT

- Begin with 4,000 seconds. How could you make the seconds easier to handle? *First we could change that into minutes, by dividing by 60, making 66 minutes and 40 seconds*
- If you change the seconds into minutes, then what is the next way to simplify the minutes? *Change these into hours, dividing again by 60, making 1 hour, 6 minutes and 40 seconds*
- After you have simplified 4,000 seconds, and have an idea of the process, try going back to 99,180 seconds. What is the first step? *Dividing by 60 to get the number of minutes, which comes out to 1,653 minutes*
- (Have students continue to work through the steps.) When will the insect invaders first attack the unsuspecting picnickers?

Solution: Sunday, March 25, 12:33 P.M.

99180 ÷ 60 = 1653 minutes, ÷ 60 = 27 hours and 33 minutes,
÷ 24 = 1 day, 3 hours, 33 minutes,
added to 9:00 A.M. on March 24 = March 25, 12:33 P.M.

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

EXTEND IT

- If the Major told them to be ready in 550,000 minutes, what hour and day of what month would this be?

46 Morxian Movie Productions, a studio on the Planet Morx, is searching for someone to play the title role in their upcoming epic "The Creation of the Entire Universe." Starlet Marjorie Minkelmonx read for the part as the universe and the studio executives liked her reading, but unfortunately she weighs only $67\frac{1}{2}$ Morxian pounds. The part calls for someone weighing 879 Morxian pounds. Marjorie has agreed to eat Morxian ice cream non-stop until she weighs enough to play the part. Planet physicians have told her that the ice cream is so rich that she will gain 4 ounces for every minute that she eats it. There are 8 ounces in a Morxian pound, 12 hours in a Morxian day, and 30 minutes in a Morxian hour. Marjorie took her first spoonful of ice cream at 2:15 P.M. on Thursday. If she eats ice cream continuously, when will she be ready to step in front of the cameras?

FIND OUT

- What is the question you have to answer?
- What is Marjorie doing?
- What does Marjorie weigh? What does she need to weigh in order to get the part?
- What is she going to do in order to gain weight?
- How many ounces will she gain a minute?
- How many ounces are in a Morxian pound?
- How many minutes are in a Morxian hour? Hours in a Morxian day?
- When does Marjorie start eating ice cream?

CHOOSE A STRATEGY

- Would it be easier to try to solve the problem if you begin by figuring out how many pounds Marjorie would gain in an hour?

SOLVE IT

- Begin with the smallest piece of information you have. How much does she gain in a minute?
- How many minutes are in a Morxian hour? How much does she gain in an hour?
- How many ounces are in a Morxian pound? How many pounds does Marjorie gain in a Morxian hour?
- How many pounds does Marjorie have to gain?
- If you know how much she gains in an hour then you can divide the total amount she needs to gain by this amount. Then add the time it will take to the present time.

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

46 Morxian Movie Productions, a studio on the Planet Morx, is searching for someone to play the title role in their upcoming epic "The Creation of the Entire Universe." Starlet Marjorie Minkelmonx read for the part as the universe and the studio executives liked her reading, but unfortunately she weighs only 67½ Morxian pounds. The part calls for someone weighing 879 Morxian pounds. Marjorie has agreed to eat Morxian ice cream non-stop until she weighs enough to play the part. Planet physicians have told her that the ice cream is so rich that she will gain 4 ounces for every minute that she eats it. There are 8 ounces in a Morxian pound, 12 hours in a Morxian day, and 30 minutes in a Morxian hour. Marjorie took her first spoonful of ice cream at 2:15 P.M. on Thursday. If she eats ice cream continuously, when will she be ready to step in front of the cameras?

FIND OUT

- What is the question you have to answer? *If she eats ice cream continuously, when will she be ready to step in front of the cameras?*
- What is Marjorie doing? *Trying to gain weight*
- What does Marjorie weigh? *67½* pounds What does she need to weigh in order to get the part? *879 Morxian pounds*
- What is she going to do in order to gain weight? *Eat Morxian ice cream*
- How many ounces will she gain a minute? *4 ounces*
- How many ounces are in a Morxian pound? *8 ounces to 1 pound*
- How many minutes are in a Morxian hour? *30 minutes* Hours in a Morxian day? *12 hours*
- When does Marjorie start eating ice cream? *2:15 P.M. on a Thursday*

CHOOSE A STRATEGY

- Would it be easier to try to solve the problem if you begin by figuring out how many pounds Marjorie would gain in an hour? *Yes, it would help to make the problem simpler.*

SOLVE IT

- Begin with the smallest and simplest piece of information you have. How much does she gain in a minute? *4 ounces*
- How many minutes are in a Morxian hour? *30 minutes* How much does she gain in an hour? *30 × 4 = 120 ounces*
- How many ounces are in a Morxian pound? *8 ounces* How many pounds does Marjorie gain in a Morxian hour? *120 ÷ 8 = 15 pounds*
- How many pounds does Marjorie have to gain? *811½ pounds*
- If you know how much she gains in an hour then you can divide the total amount she needs to gain by this amount. Then add the time it will take to the present time. Don't forget to consider the number of hours in a Morxian day.
- (Have students continue to work through the steps.) When will Marjorie be ready to step in front of the cameras?

  Solution: Monday, 8:18 P.M.

  811½ × 8 = 6492 ounces, ÷ 4 = 1623, ÷ 30 = 54 hours 3 minutes, ÷ 12 = 4.5 days 3 minutes

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

EXTEND IT

- If the part called for someone weighing 1412 Morxian pounds, when would Marjorie be ready to begin filming?

PRACTICE

- Similar Practice Problems: 98, 103, 108

BRAINSTORM Name

47 Anita said to Martha: "Wait a minute, I'll be right there. I'm working on a problem. I started with 22 and I divided it in half. Then I divided the answer in half. I'm going to keep dividing each number until I get to zero." How long did Martha have to wait?

FIND OUT

- What is the question you have to answer?
- What is Anita doing?
- What number does she begin with? What does she do with the answer?

CHOOSE A STRATEGY

- When the strategies you know about don't apply to a problem, and you don't know where to begin, . . . relax, and open up your mind to any and all possibilities. Explore anything you think of; reasonable or unreasonable. We call this "brainstorming."

SOLVE IT

- What is your first reaction to this problem?
- Do you think this is a straightforward math problem?
- Do you think it is possible to get to zero?
- Do you think this might be impossible?

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

47 Anita said to Martha: "Wait a minute, I'll be right there. I'm working on a problem. I started with 22 and I divided it in half. Then I divided the answer in half. I'm going to keep dividing each number until I get to zero." How long did Martha have to wait?

FIND OUT

- What is the question you have to answer? *How long did Martha have to wait?*
- What is Anita doing? *She is dividing 22 in half and then continuing to divide each answer in half until she gets to zero.*
- What number does she begin with? *22* What does she do with the answer? *Divide it in half*

CHOOSE A STRATEGY

- When the strategies you know about don't apply to a problem, and you don't know where to begin. . . relax and open up your mind to any and all possibilities. Explore anything you think of; reasonable or unreasonable. We call this "brainstorming."

SOLVE IT

- What is your first reaction to this problem? *Easy!*
- Do you think this is a straightforward math problem? *Yes, we just divide.*
- Do you think it is possible to get to zero? *Yes*
- Do you think this might be impossible? *No — well, maybe it will take a while.*

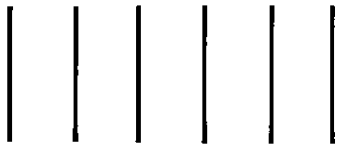
Solution: She would have to wait forever because mathematically it is possible to keep dividing a number in half to infinity.

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

BRAINSTORM Name

48 Winfred said to Darryl, "I bet you can't figure this out! Here are 6 straight lines. Add five more straight lines and make nine." Darryl said, "No problem." What did Darryl do?



FIND OUT
- What is the question you have to answer?
- What is Winfred's problem?
- What is Darryl's response?

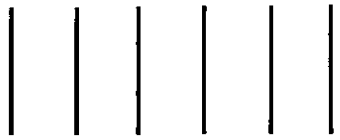
CHOOSE A STRATEGY
- When the strategies you know about don't apply to the problem, what can you do?

SOLVE IT
- What is your first reaction to Winfred's problem?
- Can you try to visualize different ways to solve this problem?
- Can you try to move objects around to help you?

LOOK BACK
- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

48

Winfred said to Darryl, "I bet you can't figure this out! Here are 6 straight lines. Add five more straight lines and make nine." Darryl said, "No problem." What did Darryl do?



FIND OUT

- What is the question you have to answer? *What did Darryl do?*
- What is Winfred's problem? *Here are 6 straight lines. Add five more straight lines and make nine.*
- What is Darryl's response? *No problem.*

CHOOSE A STRATEGY

- When the strategies you know about don't apply to the problem, what can you do? *We can brainstorm.*

SOLVE IT

- What is your first reaction to Winfred's problem? *Really hard, and don't know what to do, or how to solve it*
- Can you try to visualize different ways to solve this problem? *Yes, although I'm not quite sure how to do this. Would the lines need to be the same length? Do they need to be touching?*
- Can you try to move objects around to help you? *This might help.*

Solution: N I N E

LOOK BACK

- Read the problem again. Look at the data, conditions, and the main question. Review your work. Is your answer reasonable?

PRACTICE

- Similar Practice Problems: 97, 110, 120

Name

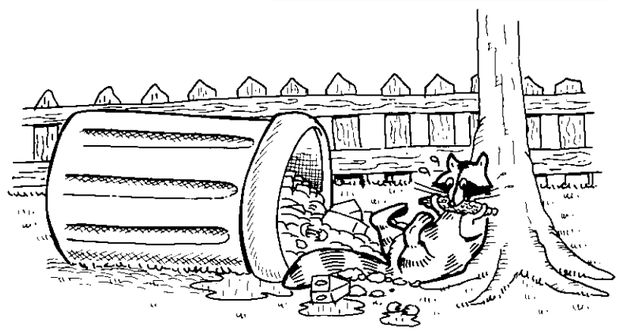
49 Aida was buying decorations for the Halloween Haunt. When she realized that she only had $1.15 in her pocket, she headed for the sale table. She found large rubber tarantulas for 60¢, small rubber black widows for 25¢, paper bats for 10¢, cardboard monsters for 80¢, and tiny black cats for 5¢. What are all the possible combinations of decorations from the sale table that she could buy?

Name

50 For the next 144 days, Earth's newest space colony will be floating through the area between Mars and Jupiter known as the asteroid belt. Most of the asteroids, which will be constantly bombarding the colony, are no larger than a baseball. But there are five huge asteroids, which scientists have named Alpha, Beta, Cephalon, Delta, and Erthon, that will occasionally orbit the colony. The scientists are advising everyone to stay inside during any time that more than one of these huge asteroids orbits the colony at the same time. Alpha will orbit the colony every 6 days, Beta every 4 days, Cephalon every 9 days, Delta every 12 days, and Erthon every 18 days. How many days will the inhabitants of the space colony have to spend inside in the next 144 days?

Name

51 "Well," says Mrs. Garcia, "raccoons got into the garbage can again last night, and now there is trash all over the yard!" Antonio and Maria look at each other and quickly say in the same breath, "I cleaned it up last time!" Mrs. Garcia proposes a game to decide who will clean up the yard. She hands Antonio a special die from one of the family board games. The six sides of the die are marked 11, 10, 9, 8, 7, and 6. The object of the game is to roll the die four times. The first person to make a total of 30 in four rolls of the die does NOT have to clean the yard. How many different ways can the die be rolled four times and make a total of 30 points?



Name

52 Blanca dreams of traveling all over the world. She collects travel posters and tacks them up to the ceiling above her bed so she can lie in bed and look at them. For her last birthday Blanca's aunt, a travel agent, gave her a poster of Italy. Blanca rearranged the posters to make room for the new one. She put Japan between Spain and Germany as well as between England and France. She put Italy above Spain and to the left of England. She did not put Ireland next to Germany, or Russia next to France. Austria was the last poster she put up. How did Blanca arrange the posters on the ceiling?

Name

53 Pizza-making is a family affair at Lucca Pizza Parlor. Angelo, Paoli, and Lucia Lucca are helping their parents make pizzas for an especially busy day of orders. Angelo makes the cheese pizzas, Paoli makes the pepperoni pizzas, and Lucia makes the vegetarian pizzas. During the first hour Angelo made 6 pizzas, Paoli made 5, and Lucia made 2. The next hour Angelo made 12, Paoli made 2, and Lucia made 8. The third hour Angelo made 8, Paoli made 7, and Lucia made 4. The next hour Angelo made 16, Paoli made 4, and Lucia made 16. The fifth hour Angelo made 12, Paoli made 9, and Lucia made 8. During the last hour of their very long day, they made a total of 210 pizzas. After 10 hours, how many of the pizzas were cheese, how many were pepperoni, and how many were veggie?

Name

54 Rats had always been a problem in the little town of Hamlin, but when the mayor found nibbles out of his favorite cheese, he knew enough was enough! Since the exterminator was on vacation, the mayor sent out a plea for help. A flute player with the municipal orchestra volunteered his assistance. "By doing what?" asked the mayor. "By playing my flute," the flutist responded, and he played for the mayor who was very impressed. The mayor agreed to let the piper try to lure the rats out of town by playing his flute. There were 1500 rats in the town of Hamlin. On the first day of tooting, 10% of the rats followed the flutist out of town and into the sea. Each day 10% more rats left town than had left the previous day. At this rate, what day would be the final day that the flutist would have to toot?

Name

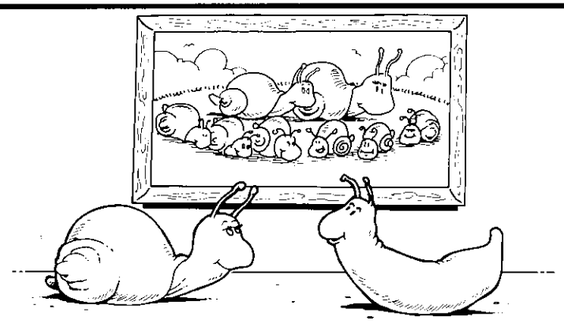
55 Sue is watching her Uncle George lay down sod in Carver Park. He must cover an area 40 feet square, but he wants to leave a square in the center of the lawn, equaling one fourth of the total area. Sue gets to plant that central area with marigolds, her favorite flowers. The sod that Uncle George is laying down comes in widths of 2 feet. If he starts unrolling the sod at one corner of the square and continues unrolling it around the edge, working his way toward the center, how many trips around the square will he make with the sod?

Name

56 Jacob's home town is celebrating its 100th anniversary. Jacob's father, who is an electrician, is preparing to wire the belltower in the town square with lights. Jacob's father decides he will need 90 feet of lights to dramatically light up the tower. The lights come in strings with lengths of 60 feet, 50 feet, 30 feet, 20 feet, 10 feet, and 5 feet. What are the possible combinations of lights that Jacob's father could use for the tower?

Name

57 ''My goodness, what a lovely family!'' exclaimed Bonnie Banana Slug. She was admiring a family portrait in the house of her new neighbor, Susanna Snail. ''Yes, I'm very proud of my little ones,'' replied Mrs. Snail, beaming. ''How old are they?'' asked Bonnie. ''Let's see,'' sighed Mrs. Snail. ''Sara is half as old as Sondra. Sol is 3 days younger than Sal and one sixth as old as Sigmund. Sherry is 12 days older than Sigmund and twice as old as the combined ages of Sal and Sara. And the total of the children's ages is twice my age.'' Bonnie scolded, ''That doesn't tell me very much. How old are YOU?'' Mrs. Snail whispered, ''72 days.'' Then she quickly changed the subject by offering her new neighbor a look at the garden. How many days old is each Snail child?



Name

58 If you go to the airport early in November and look very closely, you can see hundreds of turkeys cleverly disguised as tourists. They are fleeing the country, to avoid becoming someone's Thanksgiving meal. Most of them head for the islands, until the holidays are over. An airline ticket agent, familiar with this annual event, kept track last year of the disguises used by the clever turkeys. The agent noticed every eighth turkey wearing sunglasses, every sixth one with a blond wig, every twelfth in a Hawaiian shirt, every fifth carrying a camera, and every third was hiding behind a copy of *Gobble*. How many turkeys, out of the first 200 that the agent noticed, wore sunglasses, a blonde wig, a flowered shirt, carried a camera, and were reading *Gobble*?

Name

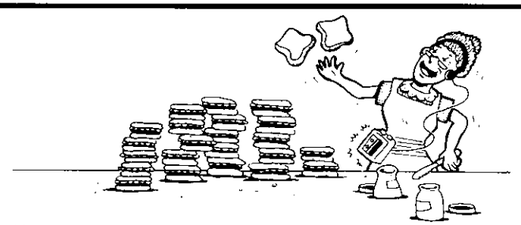
59 Maxine, Patti, and Laverne belong to a sticker-trading club, which meets once a month. They collect stickers during the week, and then at the meeting they trade stickers with each other to try to complete their collections. They have agreed that they may trade 16 insect stickers for 5 bird stickers, 2 flower stickers for 1 rainbow sticker, or 7 flower stickers for 12 insect stickers. Maxine wants to trade some of her 20 rainbow stickers for a fair number of Patti's bird stickers. How can they make a fair trade?

Name

60 The Sea-City shuttle is making the last run of the day. The bus leaves the terminal with some passengers already on board. At the city park, the first stop, the bus picks up the same number of passengers as the number on board before it stops. Seven passengers get off here. At the second stop, the zoo, the bus picks up the same number of passengers as the number on board before the bus stops. Nine passengers get off. At the football stadium, the last stop, no one gets on and 21 passengers get off. The bus returns empty to the terminal. How many passengers were on board when the bus left the terminal?

Name

61 The old woman who lived in a shoe with her many children awoke one morning and set out the bread, salami, cheese, and tomatoes for her children's sandwiches, as she always did. She put on an aerobics workout tape and began making the sandwiches in time to the music, as she always did. But then she did something she never did. She got so caught up in the music that she lost track of the number of sandwiches she was making. When the tape finished 45 minutes later, she found herself surrounded by stacks and stacks and stacks of sandwiches. "RATS!" she said. "What shall I do now?" She found that 294 of the sandwiches had salami, 294 had cheese, and 368 had tomatoes; 87 had salami and cheese, 65 had salami and tomatoes, 152 had cheese and tomatoes; and 50 had salami, cheese, and tomatoes. The woman decided to freeze the sandwiches and thaw some out each school day. If she had 18 children, and each child ate one sandwich a day, how many days did the sandwiches last?



Name

62 Canine City is typical of any large city, with one rather remarkable exception: The city is made up entirely of dogs who own humans, rather than human residents who own dogs. It is a rather fitting turn of the table, and the dog residents seem to like it just fine. Once a year the dogs get together and have a Human Show. Ribbons are awarded for the best-groomed, the best-behaved, and the most-alert humans, and for the humans who can do the most tricks. This year Spot, the dalmation, and Prince, the collie, have entered their own humans—Sid and Gladys. While grooming their humans at intermission, Prince observed how unruly the batch of humans seemed this year. Spot agreed and noted that out of every 31 humans in the show, 2 bore an alarming resemblance to their dog owners; 3 fell asleep right on the show tables; 5 simply refused to obey commands; 6 were uncombed; 7 growled constantly; and 8 performed perfectly. Out of 682 humans entered in the show, how many were there in each of the categories that Spot and Prince observed?

Name

63 The ugly duckling grew up to become a beautiful swan, and his brothers and sisters grew up to be ordinary ducks. Everyone got married and raised ducklings and baby swans. One day the swans and ducks decided to have a reunion for old times' sake. They rented a hall next to a pond, and everyone had a great time. There were four sizes of swans and ducks at the reunion. The adult swans each weighed 35 pounds; the young swans each weighed 8 pounds; the adult ducks each weighed 16 pounds; and the ducklings each weighed 4 pounds. After the birds had eaten and were getting ready to go swimming, the photographer they had hired for the event got everyone together for a family photograph. There were 84 birds in the picture, with a combined weight of 1,323 pounds. How many adult swans, young swans, adult ducks, and ducklings were in the family photo?

Name

64 "Amadeo! Hey, Amadeo! Aren't you coming for practice?" Amadeo put down the newspaper and looked out the window. Raul was outside, his softball and bat in hand. "Be there in a minute!" Amadeo shouted, "I'm reading this incredible story." In the paper was a story about three friends, all marathon swimmers, who had tried to go around the world in a boat they built together. When they were 120 kilometers from their first shore stop for provisions, the boat sank. They rescued two one-man rafts and a wetsuit. After trying to put two men on a raft and having it sink, they made a plan: They would take turns riding on the rafts and swimming with the wetsuit. The rafters would keep pace alongside the swimmer. The agreement was that each man would swim as short a distance as possible (while trying to keep their swimming distances equal) and each man would raft as long a distance as possible (while rafting equal distances) until they reached shore. How did they work this out and how far did each one raft and each one swim?

Name

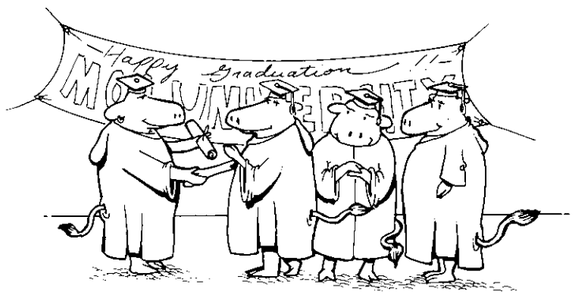
65 Pablo spent the entire day on the roller coaster at Four Flags Amusement Park. As he finally left the park, just before closing time, he saw a huge, lime-green dinosaur at the Ring-Toss Booth. He knew it would be the perfect birthday present for his little sister. "Wait a minute," he said to his friends, "I have to win this for Oriana." His friends watched as Pablo was given four rings to toss. He aimed each ring at six pins labeled 25, 20, 10, 8, 5, and 0. The person in the booth explained, "You must toss all four rings, and your total must be 40 points to take the prize dinosaur." How many different ways could Pablo toss the rings and win the dinosaur?

Name

66 Sir Galloplad is entering the castle to look for Princess Elaine, who is being held captive. A spy within the castle has given Sir Galloplad a crude map of the castle interior. There are 72 rooms on each floor, all of identical size. Each floor is 6 rooms wide by 12 rooms long. There is a dungeon beneath the castle with chambers the same size as the rooms above. Following the map, Sir Galloplad enters through a window high on the southeast corner of the top floor. He stealthily moves 3 rooms north and 7 rooms west. There a chute drops him down 2 floors. He advances 2 rooms north and 4 rooms east. He climbs a ladder to the floor above, moves 3 rooms south and finds a secret staircase that takes him 2 floors down. The map indicates that the princess should be here, but instead there is a note from his spy saying she has been moved. Sir Galloplad follows a new map from the spy, climbing the same secret stairway one floor up. He goes west 8 rooms, where he finds yet another note with this message: GO 1 ROOM SOUTH AND 2 ROOMS EAST. TAKE THE SECRET PASSAGE 1 FLOOR DOWN. THE PRINCESS IS 2 ROOMS WEST. Where does Sir Galloplad find the captive princess?

Name

67 It is graduation day at Moo U., and the cows are waiting patiently to receive their degrees. The university clerk is watching as each graduate shakes hoofs with the university president. The clerk notices that every third candidate receives a BBA (Bachelor of Bovine Arts), every seventh graduate receives a CCD (Doctorate of Cud-Chewing) degree, every fourteenth a BS (Beef Science) degree, every ninth an HHA (Honorary Hoof Award), and every twenty-first an MA (Moo Award). Any cow who receives all five degrees and awards will win the coveted UB (Udderly Brilliant) award. How many cows out of the 260 graduating class will receive the UB award?

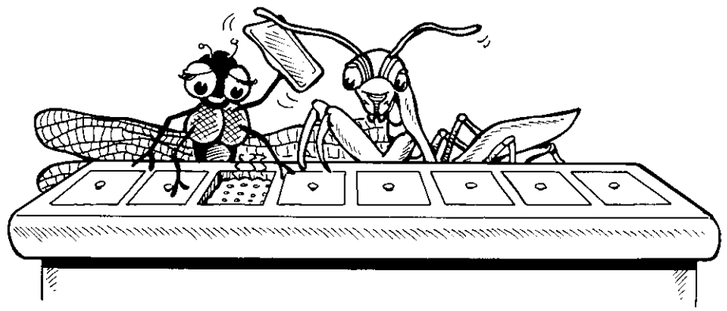


Name

68 Jasmine and Jasper share a paper route. Their route manager is having a new subscription contest. The carrier who gets the most new subscriptions will win a trip to Disneyland, so Jasper and Jasmine have been competing to see who can get the most. The contest lasts four weeks. During the first week, Jasmine got half as many new subscriptions as Jasper, but during the second week she got three times as many as he did. During the third week Jasmine got half as many subscriptions as Jasper did during the same week. This is the last week of the contest, and Jasmine has signed up five times as many new subscriptions as her brother has this week. In total, Jasmine has 30 more than Jasper has, and together they have 162 new subscriptions. How many new subscriptions did each of them get each week of the contest?

Name

69 "Oh, I just LOVE cafeterias," sighed Doris Dragonfly, as she looks at the steam table. It is her first date with Martin Mantis, who has taken her to the local bug-a-teria that has all you can eat for 50 cents. They advertise "Over 2 Billion Bugs Served!" A tempting array is displayed: the Lady Bug Fingers are between the Potato Bug Salad and the Bumbleburgers and next to the Honeybee Melon; the Shoo Fly Pie is above the Potato Bug Salad; the Ant-ipasto is to the right of the Honeybee Melon; the Roach Rounds are to the right of the Caterpillar Cookies, which are not next to the Shoo Fly Pie. Moth Muffins are another item offered. Where are all the foods in the display?



Name

70 Remember the old woman who lived in a shoe and had so many children she didn't know what to do? Well, a freeway was built right next to the shoe, so she and the children opened shop at the off-ramp. The children made lawn ornaments, sugar bowls, hats, and sunglasses—all looking like pink flamingos. The first week they made 4 lawn ornaments, 9 sugar bowls, 3 hats, and 2 pairs of sunglasses. The second week they made 8 lawn ornaments, 16 sugar bowls, 9 hats, and 8 pairs of sunglasses. The next week they made 7 lawn ornaments, 17 sugar bowls, 6 hats, and 7 pairs of sunglasses. The fourth week they made 14 lawn ornaments, 24 sugar bowls, 18 hats, and 13 pairs of sunglasses. The next week they made 13 lawn ornaments, 25 sugar bowls, 15 hats, and 12 pairs of sunglasses. If the children continue to make the products at that rate, and the woman sells the items at $1.00 each, how much money will they make the 15th week?

Name

71 Tillie the tuna is giving her first concert. The underwater amphitheater is full and waiting for Tillie, Sharleen Shark, and the Fluke Wellington Orchestra. The concert will end with the choir of Angelfish. Molly Marlin is behind the curtain, peeking out at the audience, as Tillie begins singing. Molly notices that in the first five minutes of Tillie's performance, the entire front row of 60 fish get up, swim off, and demand their money back! Molly doesn't want to carp, but she is afraid that if this continues, the concert will flounder. To Molly's horror, 114 fish leave in the next five minutes, 90% more than the number of fish that left in the first five minutes. If this same rate of departure continues, how long will it take before all 2,200 patrons are gone?

Name

72 Ninette was on the last leg of her bike trip. The temperature seemed like 105 degrees, and the humidity was terrible. As Ninette entered town she saw a drink stand. She stopped to buy the biggest, coolest drink they had. Ninette reached in her pocket for all the change she had, which was just the right amount—76¢. What are all the possible combinations of coins she could have had?

Name

73 Carl's hands trembled as he stood in front of the safe and unfolded the crumpled piece of paper holding the combination that would open the safe. "Rats!" he moaned. The combination was written in the form of a riddle. The last number was described in the following way: Find $\frac{2}{3}$ of the final number, add 16, and this number will be equal to two times the mystery number. What was the final number of the combination?

Name

74 Deep in the farthest reaches of space there is another solar system. There are six planets in the system, all with very different climates. Mariponia, the planet nearest to the sun, is very hot and dry. It is surrounded by thick gases and has no plant life of any kind. Xerxos is covered with the exotic vegetation of a rain forest. Vornal is three-fourths swampland and one-fourth ocean. Temperatures on mountainous Breepus never exceed 5 degrees Fahrenheit, because Breepus is so far from the sun. Because of its rotational pattern, Jonyxia has daylight one day of the year, and is in total darkness the rest of the time. Ilianos is a rocky, desert-like planet surrounded by such noxious gases that life can only survive underground. This solar system also has some unusual animal life. The web-footed orthalon is an amphibian with fur that is impervious to water. The ginkark is a small, furless creature that cannot survive in climates below 30 degrees Fahrenheit. The mulchwort has no eyes, but it has powerful antennae all over its body, and a darting tongue that acts as a kind of radar. The pirulean arx is a reptile that, while appearing to be ferocious, is actually a vegetarian. The spotted rumtumper has a snout for burrowing. The three-horned swilkie has hoofs, thick fur, and an excellent sense of balance. Can you match each animal with its home planet?

Name

75 The audience can scarcely believe what it has heard. Can it be? Prehistoric animals in a CIRCUS? And, unbelievably, there they are. Marconi the Magnificent has somehow captured the only known survivors from prehistoric times and put them together in the Center Ring. The saber-toothed tiger is across from the brontosaurus. The diplodocus is to the left of the brontosaurus and across from the iguanadon. The stegosaurus is across from the plesiosaurus but not next to the pterodactyl. The woolly mammoth is between the iguanadon and the stegosaurus and directly across from the pterodactyl. The terrifying tyrannosaurus rex takes center stage. Where are all the prehistoric creatures located in the ring?

Name

76 It is a little-known fact that when Snow White first arrived at the home of the dwarfs, there were actually 37 of the little fellows in residence—far too many for her to remember their names. So Snow numbered them, Dwarf #1 through Dwarf #37, and that helped. She had been there only a day or so when the dwarfs asked her if she would mind making sandwiches for their lunches at the mines. Thirty-seven sandwiches seemed like a lot to Snow, but the rent was free, so she agreed. She had just whipped out her butter knife when the dwarf with the big nose announced that 37 sandwiches would not be enough. It seems that Dwarf #1 ate one sandwich, Dwarf #2 ate two sandwiches, Dwarf #3 ate three sandwiches, and so on. Snow turned white. "You have GOT to be kidding!" she gasped. She began packing her bags, figuring that she would rather take her chances with the Queen. Then Dwarfs #8 through #37 revealed that they would be moving out the next day, so would Snow mind making all those sandwiches just for one day? Snow agreed and everyone lived happily ever after. How many sandwiches did Snow make for all 37 dwarfs that day?

Name

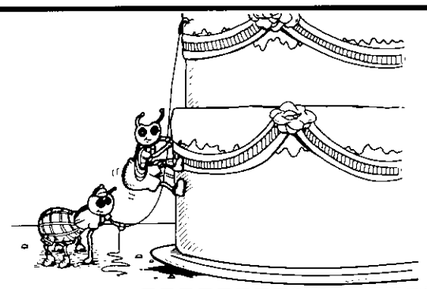
77 Lavinia and six of her friends want to go to the movies together. They can't decide what to see, so they are going to a theater complex that is showing several movies and they will break up into smaller groups. Four of the friends live in Windy City, and three are from Mill City. Four of them want to see "Out of Asparagus," and three want to see "Chili Revenge." Paul, Aaron, and Desiree are from the same city. Lavinia and Jennifer are from different cities. Xavier, Lavinia, and Sparky want to see the same movie. Aaron and Jennifer do not want to see the same movie. Which of the friends is from Mill City and wants to see "Chili Revenge"?

Name

78 Angel designed a game for the children to play at her younger brother's birthday party. She filled six small bowls with water and placed them on a table. The bowls were labeled 12, 10, 9, 8, 6, and 2. Each player gets four Ping-Pong balls and four throws at the bowls from a distance of 8 feet. The player gets the points marked on the bowl if the ball goes in the water. The winner has to get 36 points in four throws. What are the possible ways a winner can score 36 points in four tosses of the Ping-Pong balls?

Name

79 Finally, after days of hiking with their mountain-climbing supplies on their backs, they saw it rising tall and white and glistening. It was the ultimate challenge of their climbing careers, and the worker ants were ready for it. ''Go for it!'' shouted their leader Colonel Andrew Ant. The climbers looked up in awe at the layered wedding cake. Their goal was the white rose on the very top layer. The bottom layer of the cake was 20 inches by 40 inches, and each of the other layers was 2 inches shorter and 2 inches narrower than the layer on which it rested. The climbers scaled the side of each layer, then devoured every square inch of frosting on the top of it to prepare them for the climb up the next layer. When they had consumed 78% of the frosting from the tops of the layers, they were too stuffed to go forward! On what layer did they stop?

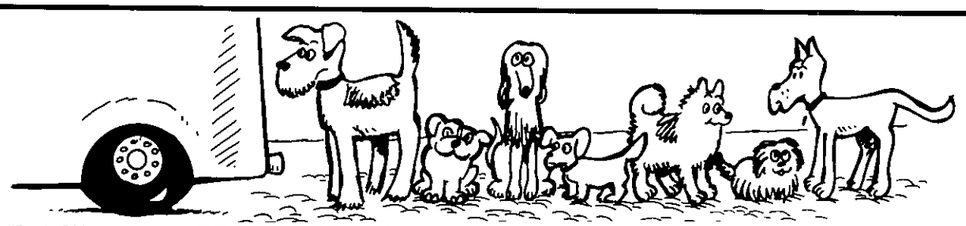


Name

80 The first interstellar tourist shuttle is ready for departure to the planets Zerbo, Yorx, Greebe, and Blinko. Tourists from all over Earth are waiting to board. They are eager to shop in the stores on the different planets. As they shop they will have to remember that 9 Zerbo dollars have the same value as 3 Yorx dollars; 6 Blinko dollars have the same value as 5 Greebe dollars; and 10 Blinko dollars have the same value as 2 Zerbo dollars. A solar-powered dog polisher on Blinko costs 90 Blinko dollars. How much would it cost in Yorx dollars and in Greebe dollars?

Name

81 Hector the Collector is dog tired. Every day he sets out early to collect stray dogs before the dog catcher finds them. During each hour he collects dogs first, and then tries to deliver some to their owners, to make more room in his van. On Tuesday, for instance, during the first hour Hector found a number of dogs but wasn't able to return any. During the second hour he picked up 10 dogs and was able to return $\frac{1}{2}$ of the total number he had. In the third hour he picked up 4 more dogs, and was able to return $\frac{1}{5}$ the number that he had. During the fourth hour he picked up 6, and then returned $\frac{1}{9}$ of the total number. In the fifth hour he picked up 10 and then returned 6. During the sixth hour he found 2 but wasn't able to return any. In the next hour, he found 14 dogs and was able to return $\frac{5}{6}$ of the number he had. During the eighth hour he didn't find any dogs, but was able to return 4 to their owners. Exhausted, Hector returned home with only 2 dogs. How many dogs did he collect altogether on Tuesday?

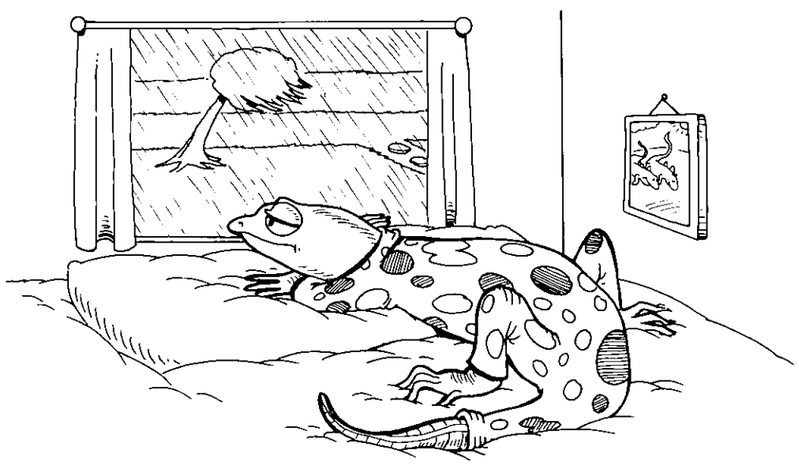


Name

82 It is the last day of the 7th grade car wash. Aya, Jessica, Oliver, Hal, Lou, Pam, and Roger are competing with each other to see who can wash the most cars. Jessica cleaned one more than twice as many cars as Aya. Oliver did 5 more cars than Jessica. Hal washed half as many cars as Lou, and Pam washed one-third more cars than Aya did. Roger, who came late, washed one-ninth as many cars as Oliver did. All together the 7th-graders washed 157 cars. How many did each person wash?

Name

83 Neville Newt said, "Generally I like rain, but this is ridiculous. If this continues, we'll have to get the beavers to build an ark!" During the first storm, they got .5 inches of rain. Each day after that, they got 50% more rain than on the previous day. At that rate, how long would it be before they had 25 inches of rain?



Name

84 Everyone knows that the swallows return to Mission San Juan Capistrano every year. What they don't know, however, is that Appletown, Boomtown, and Cocoontown also receive annual visits from the animal kingdom, beginning on January 1 of each year. Last year, on the first day 6 armadillos returned to Appletown, 10 bats returned to Boomtown, and 21 caterpillars returned to Cocoontown. On the second day 12 armadillos, 20 bats, and 16 caterpillars returned. The next day 8 armadillos, 18 bats, and 28 caterpillars returned. On the fourth day 16 armadillos, 28 bats, and 23 caterpillars returned. On the fifth day 12 armadillos, 26 bats, and 35 caterpillars returned. This rate of return continued until the 21st day, when 2,233 creatures returned. How many of them were armadillos, how many were bats, and how many were caterpillars?

Name

85 "Look," complained Trixie Troll. "I'm getting tired of hanging out under the bridge and shouting 'Trip-trap, trip-trap, who is tripping on my bridge?' a zillion times a day. I've been doing it for centuries, and enough is enough! Let's build toll booths on our bridges. We'll post the tolls and have no more fairy tale nonsense about it!" Trixie's sister, Trina, and her brothers, Troy and Trevor, agreed. Each Troll took charge of a separate bridge and built his or her own toll booth. Troy charged $.64 toll; Trina made each traveler pay $5; Trixie set her toll at $1.25; Trevor charged $2.10. During the first month, Troy collected tolls from 700 travelers; Trina collected from 473 travelers; Trixie collected tolls from half as many travelers as Troy did; and Trevor collected tolls from three times as many travelers as Troy did. After they paid taxes to the bridge commissioner, each of the four trolls had $100.00 profit. How much tax did the trolls pay together?

Name

86 Rhea Butler has invited 9 neighborhood friends in for dinner. How has she seated them around her dining room table?

- Arthur and Alan are at either ends of the table.
- Grace is Miss McIntyre's houseguest for the weekend.
- The Defoes are good friends of Lionel's.
- Mr. Anderson does not hear well.
- Sue does not sit next to Rachel.
- Lionel and Rhea are next to each other.
- Alan and Betty are husband and wife.
- Rachel sits next to Mrs. Franklin.
- Arthur sits next to Betty.
- Carl Brown sits between two ladies.
- Jerome Smoot sits to the right of Rhea and also next to Betty.
- Miss McIntyre sits across from the Williams gentleman.
- Miss French sits to the right of Arthur.

Name

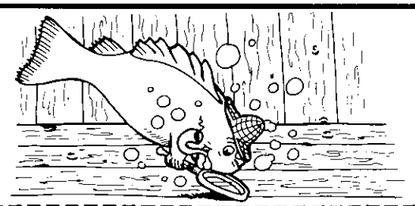
87 "Dad, look! What a beauty!" Veronica exclaims as she pulls a plastic bag out of the box marked LIVE FISH: HANDLE WITH CARE. Her father's new tropical fish store will open in another two weeks and her whole family has been working to get it ready. Veronica has just opened a box containing *Betta Splenden*, the Siamese fighting fish. She floats the bag carefully on top of the water in a 2-gallon tank. Veronica looks at all the brand-new, glistening tanks, some of which already have fish in them. There are 99 tanks, and they hold varying amounts of water. Some, like the tank into which Veronica put the fighting fish, hold only 2 gallons. Others hold 5, 10, 15, 26, or 43 gallons. It took Veronica's father 5 hours and 6 minutes, at a water flow rate of 5 gallons per minute, to fill all the tanks to capacity. How many of each size tank are there in the store?

Name

88 Lin Po is watching his friend Chun make a dart board. Chun has drawn a series of concentric circles around a central circle. The diameter of the outer circle is 30 inches, the diameter of the next smaller circle is 24 inches, the diameter of the next smaller circle is 18 inches, and so on. "Hey, Chun," challenges Lin Po. "Can you figure out the area of each of the rings?" "Sure," Chun answers smartly. "I'll use 3.14 for pi." "Good," challenges Lin Po again. "Can you figure out which ring has an area equal to one-fifth the area of the whole board?" Chun has to think about that. Can you help him?

Name

89 J. Coddington Carp, mayor of Finville, has been fishnapped from his stateroom at the Waterview Hotel. The hotel was a sunken luxury liner that was converted into a hotel by resident fish. Detective Bernie Bass is on his way now to dust the mayor's stateroom for finprints. The staterooms, all of identical size, are on several levels. The top level has 24 rooms arranged in a 4-by-6 rectangle. Each successive level down has 2 more rows of rooms on each side than the level above. Bass enters through the most southwestern stateroom of the top level. He swims 3 rooms northeast and goes through a hole in the floor to the next level down. Then he swims northwest for 2 rooms where he goes through floor holes down 2 levels. He swims south 4 rooms and then southwest 5 rooms, and through a ceiling hole to the room above. He swims 2 rooms northeast, then through a hole to the room above. Family pictures on the wall tell him that he is in the mayor's stateroom. Panting from exhaustion, Detective Bass wipes his brow and wishes the pictures had been more obvious. Why? Where is Carp's stateroom?



Name

90 Princess Rosalinda is to be married next week. The royal bakers have been working around the clock for a week, preparing the cakes for the wedding. Since the princess loves butterflies, each cake will be decorated with a butterfly made of icing. For every 26 cakes decorated with monarch butterflies, 14 cakes will be decorated with tiger swallowtails, 34 will be decorated with painted ladies, and 7 will be decorated with frittilary butterflies. The royal bakers already have 390 cakes decorated with monarch butterflies. How many cakes have they made in all, and how many cakes are there with each kind of decoration on them?

Name

91 It is the maiden voyage of SpacExpress I, the first interstellar commute shuttle. The shuttle will leave planet Earth, make five stops to refuel at satellites along the way, land on planet Zeron, and then return to Earth. After taking off with a full tank of fuel, SpacExpress I burns $\frac{1}{2}$ of its fuel before arriving at Satellite I. The shuttle takes on 50 gallons of fuel. The shuttle burns $\frac{1}{3}$ of its fuel before arriving at Satellite II, where it takes on 100 gallons. The shuttle burns $\frac{1}{4}$ of its fuel on the way to Satellite III, where it takes on only 10 gallons. Before arriving at Satellite IV the shuttle uses up $\frac{1}{2}$ its fuel, and then takes on 100 gallons. On the way to Satellite V, $\frac{1}{4}$ of the fuel supply is consumed, and 15 gallons are taken on when the shuttle stops. On the last leg of the journey to Zeron the shuttle burns $\frac{7}{8}$ of its fuel supply, landing on Zeron with 18.75 gallons left. What is the capacity of the SpacExpress I fuel tank?

Name

92 Marlo and Min were delivering mail in the mountains. On their route, which covered 36 miles, they traveled by pony, by skates, and by walking. They shared the pony named Pete, who traveled at 12 miles an hour. They could each skate 8 miles an hour and they walked 4 miles an hour. They each finished their rounds in the same amount of time. They could only exchange Pete or the skates on the hour, and no one had time to wait for the other. They agreed to share Pete. If one of them wasn't using the skates, they could just carry them, but they had to arrive at the same time. How long did it take them and how far did each one walk, ride, and skate?

Name

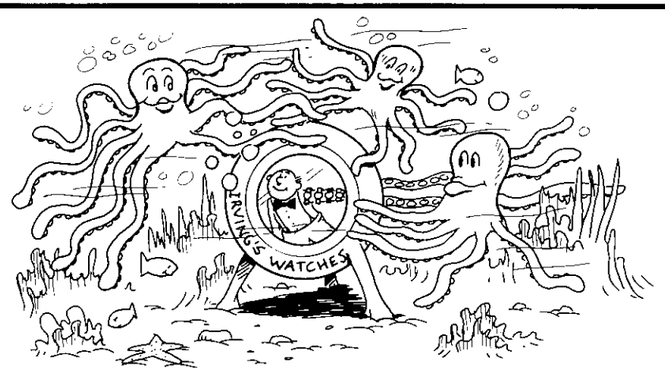
93 It was the last week of summer vacation, and Mr. and Mrs. Centipede wanted to buy new school shoes for the children. Fortunately they knew of a special shoe store that sold one-size-fits-all shoes for centipedes. So they all piled into the family bus and went downtown. They bought 540 shoes made of leather; two-thirds that many were high-tops, and 477 had buckles. Carlotta did not like having her feet constricted, so they bought 30 clogs for her. Two hundred of the shoes were leather high-tops with buckles; 269 were leather and had buckles; 218 were high-tops with buckles; and 246 were leather high-tops. How many items of footwear in all did the Centipede family buy?

Name

94 Ms. Dixie Drinkwater, chairperson of the Parch City Beverage Advisory Board, calls the annual meeting of the members to order. The citizens of Parch City pride themselves on the number of gallons of healthful beverages they consume every year. It is the Board's job to verify the figures before the report is published in the newspaper. Everyone is waiting effervescently. "Well," begins Ms. Drinkwater dryly, "16% of the total amount of beverages consumed was orange juice; 5% was mineral water; 11% was mango juice; 8% was cactus milk; 24% was broth; 7% was carrot juice; 13% was celery juice; 3% was banana shake; 9% was prune juice, and 3740 gallons of milk were consumed. End of report. Let's break for tea." How many total gallons of beverages were consumed by the thirsty residents of Parch City that year?

Name

95 Everyone knows that octopi have 8 tentacles. But the only human being on earth who knows that there are other kinds of octopi is a watch salesman named Irving. Every five years Irving hires a diving bell and goes to the bottom of the sea, where there is a community of octopi, nonopi (with 9 tentacles), and decapi (with 10 tentacles). Irving sells waterproof watches for several days. He knows that the total population of the three types of creatures is 377. In order for each creature to wear a watch on each tentacle, Irving will have to bring 3,364 watches. How many of the creatures are octopi, how many are nonopi, and how many are decapi?



Name

96 Anastasia of the Magic Forest is a bit absent-minded. Once a week she makes a batch of magic potion. But every week she seems to be out of something that she needs for her recipe, so she has to refer to her chart of equivalencies and try to substitute as best she can. Her chart lists these equivalencies: 7 ounces of powdered snail shell may be substituted for 12 ounces of dried spider; 3 ounces of bats' wings may be substituted for 5 ounces of frog toes; and 24 ounces of cactus root may be substituted for 9 ounces of powdered snail shell. Today she is fresh out of powdered snail shell and dried spider. What can she substitute for dried spider and in what amount?

Name

97 Milo's age is the same as his grandfather's with the digits reversed. The product of their ages gives a year during World War II. If Milo's mother is twice as old as Milo, then how old is Milo, his mother, and his grandfather?

Name

98 Twisted Tuba is a heavy metal rock group, featuring tuba players. The group's only recording, "Material Tuba," was #99 on the charts. The Twisted Tuba's manager, Harry Hornblower, is concerned because the group's concerts have been largely unattended. To raise money, Harry has decided to have a marathon tuba-tooting session, for which sponsors agree to pay 9 cents for each minute the group can continually play their tubas. In order to make up the money they lost on their concerts, they need to make $288,977.40. Harry scheduled the marathon to begin on January 1 at noon. If the group gets 10 sponsers for each minute and reaches their goal, when will they finish tooting their tubas?

Name

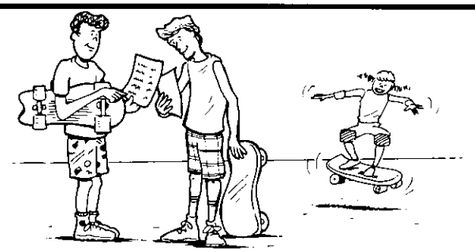
99 The Duke of Yolk is "eggstatic." His kingdom, which produces only pigs, eggs, and green onions, has been invited to display its products at the World Food Fair. The Duke asked his cook, Julia, to prepare ham and onion omelettes for the visitors at the fair. She thought the idea was a bit cracked, but the Duke kept egging her on, so she agreed to do it. The attendance at the fair is expected to be 3,207,672 people, but the recipe in the royal cookbook only feeds 3,427 people. It calls for 856.75 dozen eggs, 72 pounds of ham, and 136 pounds of onion. (Tabasco is optional.) Each mature pig yields 36 pounds of ham and each bunch of onions from the royal farms weighs 2 pounds. How many eggs, how many pigs, and how many bunches of onions will Julia need in order to feed the visitors at the fair?

Name

100 Six friends are enjoying a day in the city together. They stop to look around in a shop that sells a large variety of T-shirts with different decorations and logos on them. The friends decide to buy T-shirts that are decorated to show their favorite pastimes. One T-shirt has a picture of a book on it; one has a picture of a tennis racket; one has a movie poster; one has the cover of a recipe book; one has a piano; and one has a record with the label of a famous rock band on it. Can you match the friend with the T-shirt he or she selects? Skeeter does not go anywhere without her earphones and cassette player. Alex does not want to get out of shape. Randy cleans up any mess he makes when he makes it, so he doesn't have a lot of stuff to wash at one time. Wink likes a quiet, well-lighted place and his favorite chair. Lynn spends lots of time in front of the mirror, pretending that she is a famous star. And Bev does not spend less than an hour a day at her pastime.

Name

101 Nathaniel and Daniel are attending the local skateboard competition. They think it is a "totally rad" event, but they chuckle to themselves, sure that many of the adult spectators do not know what most of the skateboard maneuvers are called. To find out, they handed out questionnaires at the beginning of the freestyle competition. Now, just before the street style competition begins, they are tallying the results. They discover that 410 spectators know what an "ollie" is, 462 know what a "copergrind" is, and 552 know what a "rail slide" is. Ninety-one spectators can identify both an "ollie" and a "copergrind"; 105 can identify both a "copergrind" and a "rail slide"; and 42 can identify a "rail slide" and an "ollie". Only 25 spectators know what all three maneuvers are called, and 192 cannot identify any of the three maneuvers. How many spectators filled in a questionnaire for Nathaniel and Daniel?



Name

102 The United Planetary Peace Council is having its second meeting. Each month the member planets take turns hosting the meets, and since Winxnerd I was the host planet last month, Winxnerd II is host planet this month. Can you seat the ambassadors at the table on either side of the host ambassador, and tell which planet each one represents?

- Bondar and General Proink sit next to each other.
- Madame Larknoz sits next to the ambassador from Lalo.
- Grandorf, who did not host the last meeting, sits to the right of Mme. Riarmo.
- Nambo sits to the right of General Proink and next to Madame Riarmo.
- The ambassador from Yinx sits to the right of Grandorf.
- Grink sits between two ladies.
- Madame Larknoz is across from the ambassador from Nod.
- Mme. Protorp does not sit next to Mme. Larknoz.
- General Proink and Grandorf are from twin planets.
- The ambassador from Syrontium sits to the right of the ambassador from Lalo.
- The ambassador from Krinko is here for the first time.
- Mme. Riarmo and the ambassador from Yinx are mother and daughter.
- The ambassador from Lunk sits next to Mme. Protorp's mother.
- Mme. Oinxoinx sits across from General Proink.
- Grink is not from the planet Nebulosa.

Name

103 William Tremblesword was a tall poet who had been trying unsuccessfully to get his poems published. He was puzzled by all the rejection slips he received, because he knew he had written some lovely poems, like "Ode on a Forklift," and "Rime of the Ancient Metal Detector." One day William met a publisher who offered to pay $\frac{1}{4}$ of 1 cent for each word. The longer the poem, the better for William. He took the phone off the hook and put a DO NOT DISTURB sign on the door. He figured he could crank out 26 words per minute. Armed with a thesaurus of very short words, he sat down at his typewriter and looked at his watch. It was 7:30 P.M. on October 14. He took a deep breath, repeating softly "I before E except after C," and began typing. He went nonstop right through Halloween, Thanksgiving, Christmas, New Year's (which would be a leap year), and the Presidents' birthdays. At midnight on the last day of February, he typed the words THE END, and slumped across his keyboard, exhausted. He called his poem "My Love is Like a Red, Red Convertible," and he knew it was his finest work. It was a long poem, but then, he was a long fellow. How much money were William's words worth?

Name

104 There is, in some deserts of the world, a cactus that many people believe does not exist at all. Others, who believe it exists, have given it a name: the Night-Blooming, or Starlight, Cactus. It blooms only by the clear, soft light of the stars, and only on cloudless nights. It produces small, white, star-shaped blossoms in five-minute intervals: one blossom in the first five minutes of exposure to starlight, two blossoms in the next five minutes, three blossoms in the third five minutes, and so on until sunrise, when all the blossoms evaporate in the light of the sun. If you had been lucky enough to watch this cactus throughout 6 hours of starlight one evening last summer, how many blossoms would you have seen on the Starlight Cactus?

Name

105 When Snow White married the prince and moved into his castle, the seven dwarfs sold their cottage and scattered to different parts of the country. Four of the dwarfs moved to the West Coast and opened a store selling diamonds. Three of the dwarfs moved to the East Coast and bought a chain of clothing stores that sold half-sizes. Four of the dwarfs bought condos on the beach, and three purchased houses in the city. Grouchy, Joyful, and Wheezy moved to the same coast. Silly and Nosey moved to different coasts. Silly, Snoozy, and Shy bought the same kind of home, but Joyful and Nosey purchased different kinds of homes. One day a royal messenger brought Snow White the wonderful news that one of the dwarfs, who lived in a house on the East Coast, was going to get married. Snow sat right down and sent the dwarf a letter offering the use of the castle for the wedding. To which dwarf did she address the letter?

Name

106 Ronelle's seventh-grade class went on a field trip to a bottle factory. The class enjoyed moving from room to room, watching the machines put out the glistening, brand-new bottles. The guide explained that out of every 144 bottles coming off the lines in the factory, 29 would be used by ketchup manufacturers, 18 would be used by soda factories, 33 would become medicine bottles, 41 would become salad dressing bottles, 15 would be used for vinegar, and only 8 would be used for milk, since most milk comes in cartons. On one shift, 2304 bottles came off the lines. How many bottles belonged to each category?

Name

107 An elderly woman, claiming to be Goldilocks, has been making the rounds on the talk shows. She is advertising her just-published book, *Too Hot, Too Cold, Just Right: My Life as a Drop-In*. It is the story of how her chance visit to the home of a family of bears, and their rejection, led her to a lifetime of compulsive "dropping-in" on total strangers. "Oh, yes," she reminisces, "once I got started, there was no stopping me. I dropped in on many lovely people in my nearly eighty years on the road." She smiles and settles back in her chair. "One third were eating dinner when I arrived; $\frac{1}{6}$ were watching television; $\frac{1}{12}$ were away on vacation; $\frac{1}{24}$ refused to answer the door; $\frac{1}{48}$ had never heard of me (Imagine that!); $\frac{2}{96}$ invited me back; $\frac{2}{9}$ pretended to be asleep; $\frac{1}{18}$ sent me a bill; $\frac{1}{36}$ gave me a teddy bear; $\frac{1}{72}$ called the police (Mercy, what a fuss!) and 576 asked me if I did windows. I assured them I didn't." *Too Hot, Too Cold, Just Right* leaves the reader with two burning questions: Just how many people did Goldilocks drop in on, and how many people were in each category?

Name

108 The government is sending a fly up on the next space shuttle, to study the effects of weightlessness on flies. Sherman Shadfly wants to be the first fly in space, but as everyone knows, the life span of the adult shadfly is only 3 hours, and Sherman is afraid he won't last until the launch. His friend Sharkey knows a fly who makes a secret potion that is guaranteed to extend the life span for 3 minutes for each ounce of potion consumed. Sherman suspects that this is a fly-by-night operation, but he is willing to try anything to make the launch. The potion is expensive: $5.75 for a 4-ounce bottle and $11.00 for the 8-ounce economy size. Sherman believes in being frugal, so he has purchased the potion in 8-ounce bottles. He takes his first sip at 11:00 P.M., Tuesday the 4th. The shuttle is scheduled for launch on Saturday the 22nd at 5:00 A.M. How much money did Sherman save by buying the economy-size bottles?

Name

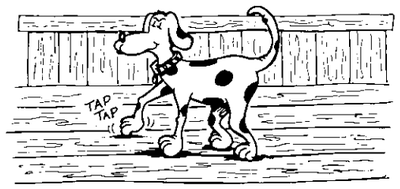
109 It is the Tenth Anniversary of the opening of Grand America Amusement Park. In celebration of the event, the park is giving away free passes for five minutes after the gates open. The first person through the gate will receive one free pass, the second person will receive two free passes, the third will receive three, and so on. Hirotomo wants very much to get enough free passes for everyone in his church, which means he will need 820 passes. If Hirotomo is first in line and gets others from his group to stand in line behind him, how many others will he need to help him in order to get enough tickets for the whole church?

Name

110 You are the manager of a rock band. You hire a drummer who is half your age. The guitarist is three years older than the drummer. The lead singer is 6 years older than the guitarist. The pianist is 27 years old. The total ages of the members of the band is 64. How old is the guitarist?

Name

111 "What?" gasped Old Mother Hubbard when she opened her cupboard to get her poor doggie a bone. "STILL bare? I'm going to the butcher." Off she went, and the dog could not have agreed more. Mother Hubbard made the mistake of taking the dog with her. The dog, you see, had saved Mother Hubbard's daughter from an oncoming train many years earlier, and he had learned to use that act of bravery to his every advantage. So when Mother Hubbard started to walk out of the butcher shop with bones that cost only $.57 each, the dog began tapping his claws on the floor. Mother Hubbard returned to the counter and bought more bones, some at $.98 each and some at $1.06 each. This time, the dog began making sounds like a train, just as a reminder. This so unnerved Mother Hubbard that she bought more bones, some at $1.33 each and some at $2.78 each. She gave the butcher a $100-bill for her package of 68 bones, and she received 3 pennies, 1 dime, and a $5-bill for change. How many bones at each price had the dog persuaded Old Mother Hubbard to buy?



Name

112 The five Couch Potatoes are sitting around in their living room, enjoying their two favorite activities—eating and watching television. Each has put out his or her favorite snack: pizza, popcorn, peanuts, diet soda, or beef jerky. And each has circled his or her favorite T.V. program in the television guide: "Dance Party," a Laurel and Hardy comedy movie, a movie about the life of Abraham Lincoln, a Giants-Dodgers game, and the Potato Broadcasting Network News Hour. Spud does not like any butter with his snack. Idaho eats only meat. Russet, who likes to laugh, is concerned about his weight. Small Fry does not like to clean up the mess he makes when he tries to catch his snack in his mouth and misses. Chip likes to have her snack delivered. The Couch Potato who likes peanuts jumps up and down during his or her program, shouting at the screen. The one who likes pizza also likes to move rhythmically when his or her program is on. The Potato who likes beef jerky is also a history buff, and the one who likes popcorn is also very interested in world events. Can you match each Couch Potato with his or her favorite snack and television program?

Name

113 The king narrowed his eyes, leaned forward, and pointed his bejeweled finger at the young man before him. "SO," bellowed the king. "You want my daughter's hand in marriage?" "Yes, Your Highness," the young man responded, his voice trembling. "We are in love and wish to spend our lives together." The king glared menacingly as he scrutinized the young man before him. "Very well," he answered at last. "You and my daughter may marry if you can pass this test." At the snap of his royal fingers, five doors appeared—three of them red, two of them blue. The king smiled smugly. "Behind three of these doors are fire-belching dragons. Behind the other two are gentle deer. The second and third doors conceal the same kind of animal. The first and fourth doors conceal different kinds of animals. You may select any door you wish. If you select a door that conceals a deer, you may marry my daughter. AND. . .," he said triumphantly, "if you select a door that conceals a dragon, you will be consumed by flame. Now, choose." The young man noticed that the first and fifth doors were the same color, while the third and fourth doors were different colors. He paused, his heart pounding. Then he opened the fifth door. What was his fate?

Name

114 Deep inside an iceberg archaeologists have discovered the lost continent of Alopecia. The Alopecians were hairless creatures who left behind a magnificent temple of ice with 1-foot thick floors and walls. Buried beneath the floor of the third and bottom level is the statue of the goddess Henna, sculpted of ice and set with diamonds. A diving team will try to remove the statue. However, the only access is by drilling through the 1-foot thick layers of ice that divide the levels, so the statue will have to be pulled out by cable. Each level is 16 chambers wide by 32 long, running west to east. The 512 identical chambers on each level are 3 feet square by 3 feet high. Because each chamber has four walls, a ceiling, and floor; divers will drill holes in the middle of a chamber roof, pull the cable along the center of each chamber right under the ceiling, and drill through the wall into the next chamber. They will follow this plan: Drill hole through the center of the roof above the most southeastern chamber; go 2 chambers west, 4 chambers north; drop to next level; go 4 chambers northwest, 8 chambers west; drop to bottom level. The statue is buried 3 feet deep beneath the floor of this chamber. What is the shortest length of cable the divers will need to remove the statue?

Name

115 Professor Nonsense has a theory about how flowers grow. He believes that every night bugs tug at flowers to get them to grow and then open them carefully just before sunrise. He says that the dewdrops on flowers are actually drops of bug sweat. The professor tells about a small county in which dragonflies each open 6 roses, 4 daisies, and 6 daffodils per night; ladybugs each open 1 petunia, 2 pansies, and 1 tulip; moths each open 3 chrysanthemums and 5 violets; and bees each open 17 tiger lilies and 3 iris. Dragonflies deposit 10 sweat drops on each flower they open; ladybugs leave 5 drops, moths deposit 40 drops, and bees leave 15 drops. One morning last summer the professor counted 74,360 sweat drops on the flowers. He noticed four times as many 10-drop flowers as 5-drop flowers, and 3 times as many 15-drop flowers as 40-drop flowers. How many of each kind of insect had been working on the flowers the night before?

Name

116 Three friends decided to make a trip to a state park 42 miles away. None of them walked very fast, so they decided to take a bike and a skateboard to share. They knew that each one walked 3 miles per hour, biked 9 miles per hour, and skateboarded 6 miles per hour. They worked out a plan to exchange the skateboard and bike on the hour, but only so that nobody had to wait for anyone else. They could also leave the skateboard or the bike for someone coming along, who could pick it up on the hour. The bike could also be locked to a tree and left for the trip home, if necessary. Draw a diagram to show how they made their exchanges, in order to all arrive at the park at the same time. How long did it take them and how far did each one bike, skateboard, and walk?

Name

117 Paula is having a potluck at her home with several of her friends. Can you place them around the table and tell what each person brought?

- Beatrice is on Steve's left.
- Cheryl is on the right of the man who brought ice cream.
- Paula is on Laverne's right.
- Mr. Davenport is on the left of the person who brought chips and dip.
- Mrs. Bradshaw is to the right of Mrs. Rappaport who brought tomato soup.
- Ms. DuBois brought an appetizer.
- Michael is on the right of the person who brought macaroni casserole.
- Michael, Brian, Beatrice, and Cheryl came with their spouses.
- Mr. Melendez brought salad.
- Cheryl is between Mr. Adams and his wife.
- Cecily brought macaroni casserole.
- Brian's specialty is apple pie.
- The person who brought homemade bread is not married to the person who brought ice cream.
- The Davenports both like to bake.
- Cheryl is on the left of the person who brought pot roast.

Name

118 Allison Wonderland and her family were vacationing in a very peculiar city. Everyone in the city spoke in equations. Mr. Wonderland pulled into a gas station and asked the attendant how many miles they were from Diamond City, Heart City, and Club City. The attendant, a strange-looking man in a tall hat, pointed north and said, "$\frac{2}{5}$ of the number of miles to Diamond City, plus 32, is equal to 2 times the number of miles to Diamond City." Then he pointed south and said, "$\frac{1}{3}$ the number of miles to Heart City, plus 35, is equal to 2 times the number of miles to Heart City." Then he poured himself some tea, and pointed to the east and said, "$\frac{1}{2}$ the number of miles to Club City, plus 40, is equal to 3 times the number of miles to Club City." As they left the gas station, Mrs. Wonderland pulled out her calculator, but Allison said they didn't need it. How far were they from each city?

Name

119 "Good grief!" moaned the desk manager of the Igloo Hotel as he examined the reservations list. "Someone has made a mistake!" Penguins from all over the world were in town for the Nonconformists' Convention. One of the clerks at the hotel had added a zero to the number of available rooms, and now penguins by the hundreds were pouring through the revolving doors into the lobby. There were penguins on foot, penguins in cabs, penguins waddling everywhere, all wearing plastic badges that said, DARE TO BE DIFFERENT. The first wave of penguins approached the desk and began clamoring for rooms. They truly were from all over the world: $\frac{1}{4}$ of them were Emperor penguins; $\frac{2}{6}$ were Chinstrap penguins; $\frac{1}{8}$ were Kings; $\frac{1}{12}$ were Rock Hoppers; $\frac{1}{32}$ were Galapagos penguins; $\frac{1}{24}$ were Peruvians; $\frac{1}{16}$ were Little Blues; $\frac{1}{64}$ were Gentoos; $\frac{1}{64}$ were Magellans; $\frac{1}{48}$ were Macaroni penguins, and 240 were Blackfoot. When the desk manager finished registering the guests, he wailed, "That's TEN times the number of available rooms we have!" If each room could be occupied by just one penguin, what was the actual number of available rooms at the Igloo Hotel?

Name

120 Four fathers and four sons go fishing. They catch an 8-pound bass, a 12-pound catfish, and a 15-pound salmon. It is a long drive home and they are afraid the fish will spoil, so they sell them to a local butcher for $2.00 per pound. The only currency the butcher has in his cash drawer is in the form of $1.00 bills. The men do not know the butcher, so they will not accept a check as payment. How can the butcher divide the money between the men evenly, without using coins?

Solutions

1 Only once, 120 days from today

2 17 times

3 93

50	25	10	5	1
1	0	1	1	1
1	0	1	0	6
1	0	0	3	1
1	0	0	2	6
1	0	0	1	11
1	0	0	0	16
	2	1	1	1
	2	1	0	6
	2	0	3	1
	2	0	2	6
	2	0	1	11
	2	0	0	16
	1	4	0	1
	1	3	2	1
	1	3	1	6
	1	3	0	11

50	25	10	5	1
	1	2	4	1
	1	2	3	6
	1	2	2	11
	1	2	1	16
	1	2	0	21
	1	1	6	1
	1	1	5	6
	1	1	4	11
	1	1	3	16
	1	1	2	21
	1	1	1	26
	1	1	0	31
	1	0	8	1
	1	0	7	6
	1	0	6	11
	1	0	5	16

50	25	10	5	1
	1	0	4	21
	1	0	3	26
	1	0	2	31
	1	0	1	36
	1	0	0	41
		6	1	1
		6	0	6
		5	3	1
		5	2	6
		5	1	11
		5	0	16
		4	5	1
		4	4	6
		4	3	11
		4	2	16
		4	1	21

50	25	10	5	1
		4	0	26
		3	7	1
		3	6	6
		3	5	11
		3	4	16
		3	3	21
		3	2	26
		3	1	31
		3	0	36
		2	9	1
		2	8	6
		2	7	11
		2	6	16
		2	5	21
		2	4	26
		2	3	31

50	25	10	5	1
		2	2	36
		2	1	41
		2	0	46
		1	11	1
		1	10	6
		1	9	11
		1	8	16
		1	7	21
		1	6	26
		1	5	31
		1	4	36
		1	3	41
		1	2	46
		1	1	51
		1	0	56
			13	1

50	25	10	5	1
			12	6
			11	11
			10	16
			9	21
			8	26
			7	31
			6	36
			5	41
			4	46
			3	51
			2	56
			1	61
			0	66

4 66

60	40	20	10	5
1	1	0	0	0
1	0	2	0	0
1	0	1	2	0
1	0	1	1	2
1	0	1	0	4
1	0	0	4	0
1	0	0	3	2
1	0	0	2	4
1	0	0	1	6
1	0	0	0	8
	2	1	0	0

60	40	20	10	5
	2	0	2	0
	2	0	1	2
	2	0	0	4
	1	3	0	0
	1	2	2	0
	1	2	1	2
	1	2	0	4
	1	1	4	0
	1	1	3	2
	1	1	2	4
	1	1	1	6

60	40	20	10	5
	1	1	0	8
	1	0	6	0
	1	0	5	2
	1	0	4	4
	1	0	3	6
	1	0	2	8
	1	0	1	10
	1	0	0	12
		5	0	0
		4	2	0
		4	1	2

60	40	20	10	5
		4	0	4
		3	4	0
		3	3	2
		3	2	4
		3	1	6
		3	0	8
		2	6	0
		2	5	2
		2	4	4
		2	3	6
		2	2	8

60	40	20	10	5
		2	1	10
		2	0	12
		1	8	0
		1	7	2
		1	6	4
		1	5	6
		1	4	8
		1	3	10
		1	2	12
		1	1	14
		1	0	16

60	40	20	10	5
			10	0
			9	2
			8	4
			7	6
			6	8
			5	10
			4	12
			3	14
			2	16
			1	18
			0	20

5

Gats Bee	Barna Bee	Bay Bee
Vitamin Bee	Spelling Bee	Bar Bee
Walla Bee	Honey Bee	Toyn Bee

6 Paul - Donna - Dave - Allen - Peter - Marco - Irene - Lani - Michelle

7 68 different ways

1	2	3	4
5	5	5	1
5	5	1	5
5	11	5	5
1	5	5	5
7	7	1	1
7	1	7	1
7	1	1	7
1	7	1	7
1	7	7	1
1	1	7	7
7	3	5	1
7	3	1	5

1	2	3	4
7	1	3	5
7	1	5	3
7	5	3	1
7	5	1	3
3	7	1	5
3	7	5	1
3	5	1	7
3	5	7	1
3	1	7	5
3	1	5	7
5	7	1	3
5	7	3	1

1	2	3	4
5	3	7	1
5	3	1	7
5	1	7	3
5	1	3	7
1	7	5	3
1	7	3	5
1	5	3	7
1	5	7	3
1	3	7	5
1	3	5	7
5	5	3	3
5	3	5	3

(CONT.)

7 (CONT.)

1	2	3	4
5	3	3	5
3	5	3	5
3	3	5	5
3	5	5	3
9	3	3	1
9	1	3	3
9	3	1	3
3	3	9	1
3	9	3	1
3	1	9	3
3	1	3	9
3	3	1	9

1	2	3	4
1	9	3	3
1	3	9	3
1	3	3	9
3	9	1	3
9	5	1	1
9	1	5	1
9	1	1	5
1	9	1	5
1	9	5	1
1	5	9	1
1	5	1	9
1	1	5	9

1	2	3	4
1	1	9	5
5	9	1	1
5	1	1	9
5	1	9	1
3	3	3	7
3	3	7	3
3	7	3	3
7	3	3	3

8 54 different ways

SPIN 1	2	3	4
7	7	6	0
7	7	0	6
7	6	0	7
7	6	7	0
7	0	7	6
7	0	6	7
6	7	7	0
6	7	0	7
6	0	7	7

SPIN 1	2	3	4
0	6	7	7
0	7	6	7
0	7	7	6
11	9	0	0
11	0	0	9
11	0	9	0
9	0	0	11
9	0	11	0
9	11	0	0

SPIN 1	2	3	4
0	0	9	11
0	0	11	9
0	11	9	0
0	9	11	0
0	11	0	9
0	9	0	11
9	9	1	1
9	1	9	1
9	1	1	9

SPIN 1	2	3	4
1	9	1	9
1	9	9	1
1	1	9	9
6	6	7	1
6	6	1	7
6	7	1	6
6	7	6	1
6	1	7	6
6	1	6	7

SPIN 1	2	3	4
7	6	6	1
7	6	1	6
7	1	6	6
1	7	6	6
1	6	7	6
1	6	6	7
11	1	7	1
11	1	1	7
11	7	1	1

SPIN 1	2	3	4
7	11	1	1
7	1	11	1
7	1	1	11
1	7	1	11
1	7	11	1
1	11	1	7
1	11	7	1
1	1	7	11
1	1	11	7

9 Day 10

10 11 lies

11 166

12 Viola Voice—516; Lily Larynx—672

13 3rd trip

14 14 feet by 24 feet

15 1st day—250; 2nd day—125; 3rd day—400; 4th day—100; 5th day—125

16 Farley—40; Floyd—5, Franny—10; Frank—25; Fiona—20; Festus—15

17 20

18 16

19 144

20 330

21 12 children or 6 adults

22 Luisa—6 blue tickets; Nicolas—15 yellow tickets

23 270 total; 45 with long necks and stripes; 60 with short necks and spots; 75 with short necks, stripes, and long legs; 90 with long necks, spots, and short legs

24 700 total; 126 red wool, 84 onion rings; 112 cheese

25 8 hours; Larry skateboarding 24 miles and walking 12; Brett skateboarding 12 and walking 24

26 6 hours; A—18 hiccaps on the orxicus, 12 on boricon, 12 running; B—8 hiccaps on orxicus, 12 on boricon, 12 running; C—16 on orxicus, 16 running, 0 on boricon

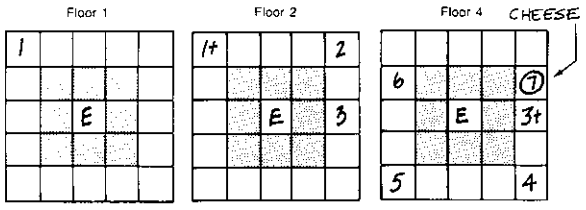
27 19 salamanders, 25 beetles, 16 flatworms (Other solutions are possible.)

28 23 apple seeds, 15 peach pits, 28 orange seeds (Other solutions are possible.)

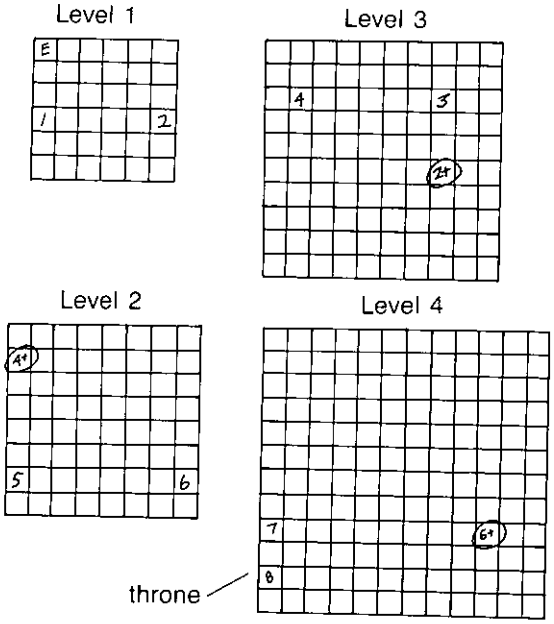
29 White—506, red—251, blue—390

30 36 (36 ÷ 2 = 18 + 9 = 27, which is ¾ of 36)

31



32



33 120

34 276

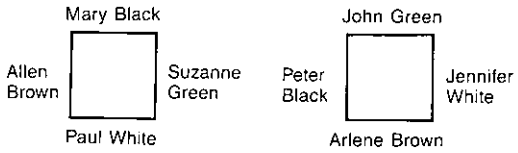
35 Steven—football; Arnie—surfing; Renee—skateboarding; Paula—softball; Jack—ice skating; Enid—swimming

36 Allen, 25, veterinarian; Carrie, 24, police officer; John, 20, mail carrier; Gloria, 27, zoo keeper

37

Lily Anderson
Lulu Anderson Lee Jones
Louis Jones

38



39 Emily

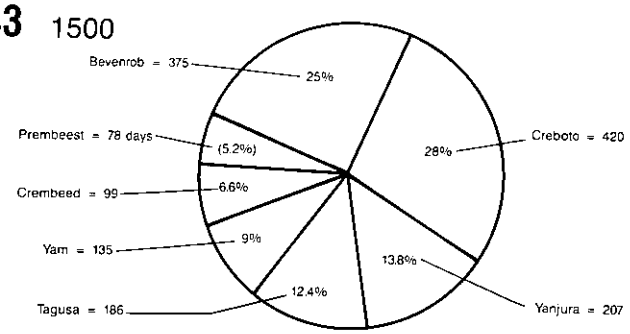
40 Patty

41 760 1-lb gold nuggets; 190 3-lb gold nuggets; 558 3-lb silver nuggets; 186 6-lb silver nuggets (Other solutions are possible.)

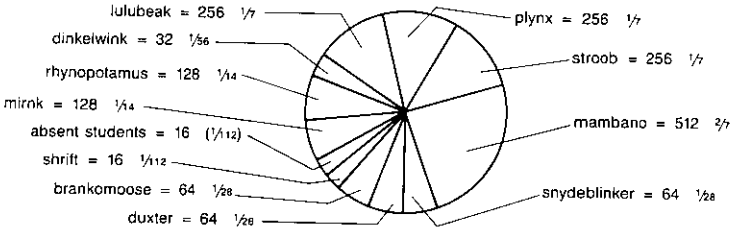
	Gold			Silver			Combined
Sets	3 lb	1 lb	Total lb	6 lb	3 lb	Total lb	Total
1	1	4	7	1	3	15	22
2	2	8	14	2	6	30	44

42 Plant A—$50,000; Plant B—$100,000; Plant C—$200,000; Plant D—$400,000

43 1500



44 Total—1792; mambano—512; plynx—256; stroob—256; mirnk—128; rhynopotamus—128; lulubeak—256; duxter—64; snydeblinker—64; brankomoose—64; dinkelwink—32; shrift—16



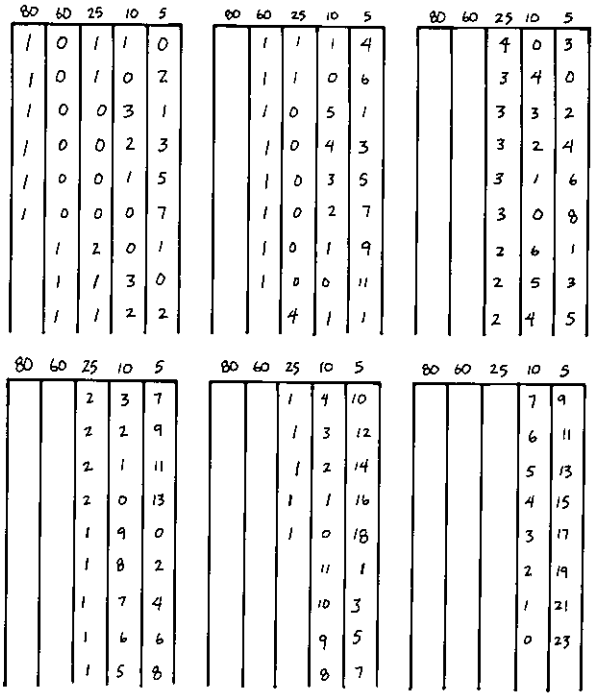
45 Sunday, March 25, 12:33 P.M.

46 Monday, 8:18 P.M.

47 She would have to wait forever because mathematically it is impossible to keep dividing a number in half to infinity.

48 N I N E

49 53



50 16 days

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A						X						X						X
B				X				X				X				X		
C									X									X
D												X						
E																		X

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A						X						X						X
B		X				X				X				X				X
C									X									X
D						X												X
E																		X

CYCLE IS 144 DAYS - THIS CYCLE REPEATS FOUR TIMES IN 144, SO SOLUTION IS $4 \times 4 = 16$ DAYS

51 56

ROLL

1	2	3	4
6	7	8	9
6	7	9	8
6	8	7	9
6	8	9	7
6	9	7	8
6	9	8	7
7	6	8	9
7	6	9	8
7	8	6	9
7	8	9	6
7	9	6	8
7	9	8	6

ROLL

1	2	3	4
8	6	7	9
8	6	9	7
8	7	6	9
8	7	9	6
8	9	6	7
8	9	7	6
9	6	7	8
9	6	8	7
9	7	6	8
9	7	8	6
9	8	6	7
9	8	7	6

ROLL

1	2	3	4
7	7	7	9
7	7	9	7
7	9	7	7
9	7	7	7
8	8	8	6
8	8	6	8
8	6	8	8
6	8	8	8
9	9	6	6
9	6	9	6
9	6	6	9
6	6	9	9

ROLL

1	2	3	4
6	9	6	9
6	9	9	6
8	8	7	7
8	7	8	7
8	7	7	8
7	7	8	8
7	8	7	8
7	8	8	7
7	6	6	11
7	6	11	6
7	11	6	6
6	6	7	11

ROLL

1	2	3	4
6	6	11	7
6	7	6	11
6	7	11	6
6	11	6	7
6	11	7	6
11	6	6	7
11	6	7	6
11	7	6	6

52

ITALY	ENGLAND	RUSSIA
SPAIN	JAPAN	GERMANY
IRELAND	FRANCE	AUSTRIA

53 Cheese—72; pepperoni—10; vegetarian—128

	HOURS 1	2	3	4	5	6	7	8	9	10
CHEESE	6	12	8	16	12	24	20	40	36	72
PEPPERONI	5	2	7	4	9	6	11	8	13	10
VEGGIES	2	8	4	16	8	32	16	64	32	128

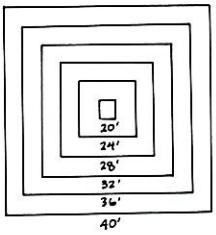
TOTAL: 210

54 In 8 days

	1	2	3	4	5	6	7	8
NO. OF RATS LEAVING	150	165	182	200	210	231	254	GONE!
RATS LEFT	1350	1185	1003	803	593	362	108	

220 242 266 293

55 5 times around the square



$40' \times 40' = 1600$ SQ. FT.
$\frac{1}{4} \times 1600 = 400$ SQ. FT.

$36' \times 36' = 1296$ SQ. FT.
$32' \times 32' = 1024$ SQ. FT.

$28' \times 28' = 784$ SQ. FT.
$24' \times 24' = 576$ SQ. FT.
$20' \times 20' = 400$ SQ. FT.

56 70

60	50	30	20	10	5
1	0	1	0	0	0
1	0	0	1	1	0
1	0	0	1	0	2
1	0	0	0	3	0
1	0	0	0	2	2
1	0	0	0	1	4
1	0	0	0	0	6
		1	1	0	1	0
		1	1	0	0	2
		1	0	2	0	0
		1	0	1	2	0
		1	0	1	1	2
		1	0	1	0	4

13

60	50	30	20	10	5
		1	0	0	4	0
		1	0	0	3	2
		1	0	0	2	4
		1	0	0	1	6
		1	0	0	0	8
			3	0	0	0
			2	1	1	0
			2	1	0	2
			2	0	3	0
			2	0	2	2
			2	0	1	4
			2	0	0	6

17

60	50	30	20	10	5
			1	3	0	0
			1	2	2	0
			1	2	1	2
			1	2	0	4
			1	1	4	0
			1	1	3	2
			1	1	2	4
			1	1	1	6
			1	1	0	8
			1	0	6	0
			1	0	5	2
			1	0	4	4

17

60	50	30	20	10	5
		1	0	3	6
		1	0	2	8
		1	0	1	10
		1	0	0	12
			4	1	0
			4	0	2
			3	3	0
			3	2	2
			3	1	4
			3	0	6
			2	5	0
			2	4	2

12

60	50	30	20	10	5
			2	3	4
			2	2	6
			2	1	8
			2	0	10
			1	7	0
			1	6	2
			1	5	4
			1	4	6
			1	3	8
			1	2	10
			1	1	12
			1	0	14

17

60	50	30	20	10	5
				9	0
				8	2
				7	4
				6	6
				5	8
				4	10
				3	12
				2	14
				1	16
				0	18

10

57 Sol—6 days; Sal—9 days; Sherry—48 days; Sondra—30 days; Sara—15 days; Sigmund—36 days

58 Only 1, number 120

	12	24	36	48	60	72	84	96	100	120
8	N	Y	N	Y	N	Y	N	Y	N	Y
6		Y		Y		Y		Y		Y
5		N		N		N		N		Y
3										Y

59 14 rainbows = 15 birds

IF:

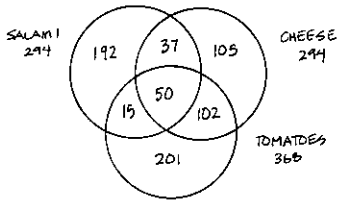
16 INSECTS = 5 BIRDS
2 FLOWERS = 1 RAINBOW
7 FLOWERS = 12 INSECTS

THEN:

48 INSECTS = 15 BIRDS
28 FLOWERS = 14 RAINBOWS (16×3, 5×3)
28 FLOWERS = 48 INSECTS (14×2, 4×1)
14 RAINBOWS = 48 INSECTS (7×4, 12×4)
14 RAINBOWS = 15 BIRDS

60 11 people

61 39 days



192 + 37 + 105 + 15 + 50 + 102 + 201 = 702 SANDWICHES

702 ÷ 18 = 39 DAYS

62 44 resembled owners; 66 fell asleep; 110 refused to obey; 132 were uncombed; 154 growled; 176 performed perfectly

TOTAL HUMANS

	31	62	93	124	155	186	217	248	279	310	341
RESEMBLED DOGS	2	4	6	8	10	12	14	16	18	20	22
WERE ASLEEP	3	6	9	12	15	18	21	24	27	30	33
REFUSED TO OBEY	5	10	15	20	25	30	35	40	45	50	55
UNCOMBED	6	12	18	24	30	36	42	48	54	60	66
GROWLED	7	14	21	28	35	42	49	56	63	70	77
PERFECT	8	16	24	32	40	48	56	64	72	80	88

(CONT.)

TOTAL HUMANS

	372	403	434	465	496	527	558	589	620	651	682
RESEMBLED DOGS	24	26	28	30	32	34	36	38	40	42	44
WERE ASLEEP	36	39	42	45	48	51	54	57	60	63	66
REFUSED TO OBEY	60	65	70	75	80	85	90	95	100	105	110
UNCOMBED	72	78	84	90	96	102	108	114	120	126	132
GROWLED	84	91	98	105	112	119	126	133	140	147	154
PERFECT	96	104	112	120	128	136	144	152	160	168	176

63 21 adult swans, 21 young swans, 21 adult ducks, 21 ducklings

	35 lbs	16 lbs	8 lbs	4 lbs
1	35	16	8	4
2	70	32	16	8
3	105	48	24	12
4	140	64	32	16
5	175	80	40	20
6	210	96	48	24
7	245	112	56	28
8	280	128	64	32
9	315	144	72	36
10	350	160	80	40
11	385	176	88	44

	35 lbs	16 lbs	8 lbs	4 lbs
12	420	192	96	48
13	455	208	104	52
14	490	224	112	56
15	525	240	120	60
16	560	256	128	64
17	595	272	136	68
18	630	288	144	72
19	665	304	152	76
20	700	320	160	80
21	735	336	168	84

64 Swim 40 kilometers, raft 80 kilometers

65 89

1	2	3	4
25	5	5	5
5	25	5	5
5	5	25	5
5	5	5	25
25	10	5	0
25	10	0	5
25	5	10	0
25	5	0	10
25	0	5	10
25	0	10	5
10	25	5	0
10	25	0	5
10	5	25	0
10	5	0	25
10	0	25	5

1	2	3	4
10	0	5	25
5	25	10	0
5	25	0	10
5	10	25	0
5	10	0	25
5	0	25	10
5	0	10	25
0	25	10	5
0	25	5	10
0	10	25	5
0	10	5	25
0	5	25	10
0	5	10	25
20	20	0	0
20	0	20	0

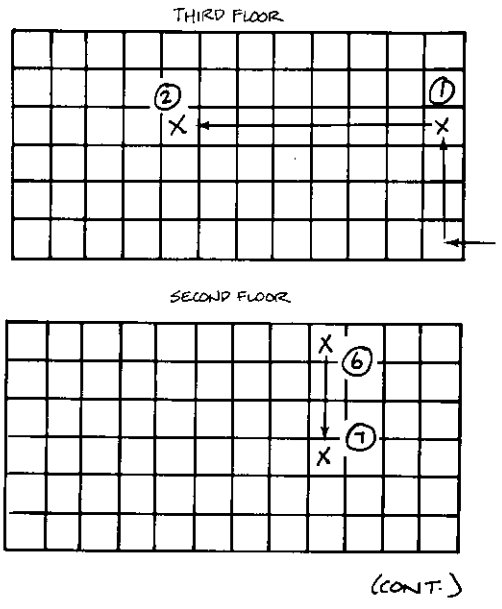
1	2	3	4
20	0	0	20
0	20	0	20
0	20	20	0
0	0	20	20
20	12	8	0
20	12	0	8
20	8	12	0
20	8	0	12
20	0	12	8
20	0	8	12
12	20	8	0
12	20	0	8
12	8	20	0
12	8	0	20
12	0	20	8

1	2	3	4
12	0	8	20
8	20	12	0
8	20	0	12
8	12	20	0
8	12	0	20
8	0	20	12
8	0	12	20
0	20	12	8
0	20	8	12
0	12	8	20
0	12	20	8
0	8	20	12
0	8	12	20
10	10	10	10
20	10	5	5

1	2	3	4
20	5	10	5
20	5	5	10
10	20	5	5
10	5	20	5
10	5	5	20
5	20	10	5
5	20	5	10
5	10	20	5
5	10	5	20
5	5	20	10
5	5	10	20
12	12	8	8
12	8	12	8
12	8	8	12
8	12	12	8

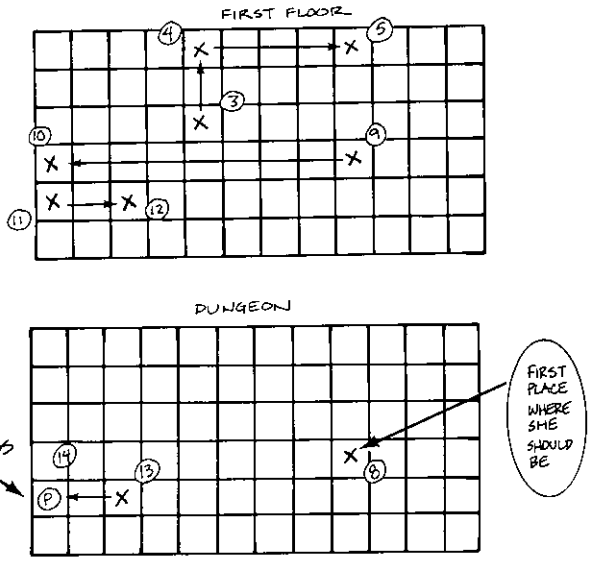
1	2	3	4
8	12	8	12
8	8	12	12
20	10	10	0
20	10	0	10
20	0	10	10
10	20	10	0
10	20	0	10
10	10	20	0
10	10	0	20
10	0	20	10
10	0	10	20
0	20	10	10
0	10	20	10
0	10	10	20

66



(CONT.)

66 (CONT.)



67 2 cows

	21	42	63	84	105	126
14	N	Y	N	Y	N	Y
9		N		N		Y
7						Y
3						Y

68 Jasmine: 1st week—11; 2nd week—27; 3rd week—13; 4th week—45; total—96. Jasper: 1st week—22; 2nd week—9; 3rd week—26; 4th week—9; total—66

69

SHOOFLY PIE	HONEY BEE MELON	ANT-IPASTO
POTATO BUG SALAD	LADY BUG FINGERS	BUMBLE BURGERS
MOTH MUFFINS	CATERPILLAR COOKIES	ROACH ROUNDS

70 $3,769

	WEEKS														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LAWN ORNAMENTS	4	8	7	14	13	26	25	50	49	98	97	194	193	386	385
SUGAR BOWLS	9	16	17	24	25	32	33	40	41	48	49	56	57	64	65
HATS	3	9	6	18	15	45	42	126	123	369	366	10_{98}	10_{95}	3_{28_5}	3_{28_2}
SUNGLASSES	2	8	7	13	12	18	17	23	22	28	27	33	32	38	37

TOTAL: 3,769

71 30 minutes

	1	2	3	4	5	6
FISH LEAVING	60	114	216.65	411.54	781.9	EMPTY!
FISH LEFT	2140	2026	1809.4	1397.86	615.96	

72 134

50	25	10	5	1
1	1	0	0	1
1	0	2	1	1
1	0	2	0	6
1	0	1	3	1
1	0	1	2	6
1	0	1	1	11
1	0	1	0	16
1	0	0	5	1
1	0	0	4	6
1	0	0	3	11
1	0	0	2	16
1	0	0	1	21
1	0	0	0	26
	3	0	0	1
	2	2	1	1

50	25	10	5	1
	2	2	0	6
	2	1	3	1
	2	1	2	6
	2	1	1	11
	2	1	0	16
	2	0	5	1
	2	0	4	6
	2	0	3	11
	2	0	2	16
	2	0	1	21
	2	0	0	26
	1	5	0	1
	1	4	2	1
	1	4	1	6
	1	4	0	11

50	25	10	5	1
	1	3	4	1
	1	3	3	6
	1	3	2	11
	1	3	1	16
	1	3	0	21
	1	2	6	1
	1	2	5	6
	1	2	4	11
	1	2	3	16
	1	2	2	21
	1	2	1	26
	1	2	0	31
	1	1	8	1
	1	1	7	6
	1	1	6	11

50	25	10	5	1
	1	1	5	16
	1	1	4	21
	1	1	3	26
	1	1	2	31
	1	1	1	36
	1	1	0	41
	1	0	10	1
	1	0	9	6
	1	0	8	11
	1	0	7	16
	1	0	6	21
	1	0	5	26
	1	0	4	31
	1	0	3	36
	1	0	2	41

50	25	10	5	1
	1	0	1	46
	1	0	0	51
		7	1	1
		7	0	6
		6	3	1
		6	2	6
		6	1	11
		6	0	16
		5	5	1
		5	4	6
		5	3	11
		5	2	16
		5	1	21
		5	0	26
		4	7	1

50	25	10	5	1
		4	6	6
		4	5	11
		4	4	16
		4	3	21
		4	2	26
		4	1	31
		4	0	36
		3	9	1
		3	8	6
		3	7	11
		3	6	16
		3	5	21
		3	4	26
		3	3	31
		3	2	36

50	25	10	5	1
		3	1	41
		3	0	46
		2	11	1
		2	10	6
		2	9	11
		2	8	16
		2	7	21
		2	6	26
		2	5	31
		2	4	36
		2	3	41
		2	2	46
		2	1	51
		2	0	56
		1	13	1

50	25	10	5	1
		1	12	6
		1	11	11
		1	10	16
		1	9	21
		1	8	26
		1	7	31
		1	6	36
		1	5	41
		1	4	46
		1	3	51
		1	2	56
		1	1	61
		1	0	66
			15	1
			14	6

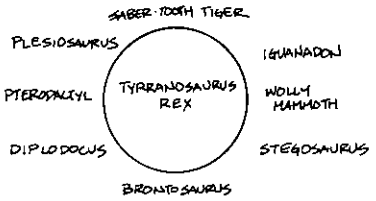
50	25	10	5	1
			13	11
			12	16
			11	21
			10	26
			9	31
			8	36
			7	41
			6	46
			5	51
			4	56
			3	61
			2	66
			1	71
			0	76

73 12

74 Web-footed orthalon—Vornal; ginkark—Mariponia; mulchwort—Jonyxia; pirulean arx—Xerxos; spotted rumtumper—Ilianos; swilkie—Breepus

	MARIPONIA	XERXOS	VORNAL	BREEPUS	JONYXIA	ILIANOS
WEB-FOOTED ORTHALON	N	N	Y	N	N	N
GINKARK	Y	N	N	N	N	N
MULCHWORT	N	N	N	N	Y	N
PIRULEAN ARX	N	Y	N	N	N	N
SPOTTED RUMTUMPER	N	N	N	N	N	Y
THREE HORNED SWILKIE	N	N	N	Y	N	N

75



76 703 (37 × 38 ÷ 2 = 703)

77 Jennifer

WINDY CITY	MILL CITY
1. LAVINIA/JENNIFER	1. LAVINIA/JENNIFER
2. PAUL	2. XAVIER
3. AARON	3. SPARKY
4. DESIREE	

"CHILI REVENGE"	"OUT OF ASPARAGUS"
1. AARON/JENNIFER	1. AARON/JENNIFER
2. PAUL	2. XAVIER
3. DESIREE	3. LAVINIA
	4. SPARKY

78 85

1	2	3	4
12	12	10	2
12	12	2	10
12	10	12	2
12	10	2	12
12	2	12	10
12	2	10	12
10	12	12	2
10	12	2	12
10	2	12	12
2	12	12	10
2	12	10	12

1	2	3	4
2	10	12	12
12	12	6	6
12	6	12	6
12	6	6	12
6	12	12	6
6	12	6	12
6	6	12	12
12	9	9	6
12	9	6	9
12	6	9	9
9	12	9	6

1	2	3	4
9	12	6	9
9	9	12	6
9	9	6	12
9	6	9	12
9	6	12	9
6	12	9	9
6	9	12	9
6	9	9	12
12	10	6	6
12	10	6	6
12	8	10	6

(CONT.)

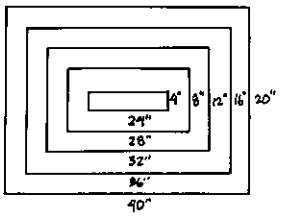
78 (CONT.)

1	2	3	4
12	8	6	10
12	6	10	8
12	6	8	10
10	12	8	6
10	12	6	8
10	8	12	6
10	8	6	12
10	6	12	8
10	6	8	12
8	12	10	6
8	12	6	10
8	10	12	6
8	10	6	12
8	6	12	10
8	6	10	12
6	8	12	10

1	2	3	4
6	8	10	12
6	12	10	8
6	12	8	10
6	10	12	8
6	10	8	12
12	8	8	8
8	12	8	8
8	8	12	8
8	8	8	12
10	10	10	6
10	6	10	10
10	10	6	10
6	10	10	10
10	10	8	8
10	8	10	8
10	8	8	10

1	2	3	4
8	10	10	8
8	10	8	10
8	8	10	10
10	8	9	9
10	9	8	9
10	9	9	8
9	10	9	8
9	10	8	9
9	9	10	8
9	9	8	10
9	8	9	10
9	8	10	9
8	10	9	9
8	9	10	9
8	9	9	10
9	9	9	9

79 4th layer from bottom



40" × 20" = 800 sq. in.
78% × 800 = 624 sq. in.

40" × 20" = 800 sq. in.
36" × 16" = 576 sq. in.
32" × 12" = 384 sq. in.
28" × 8" = 224 sq. in.
24" × 4" = 96 sq. in.

800 − 576 = 224 < 624 sq. in.
800 − 384 = 416 < 624 sq. in.
800 − 224 = 576 < 624 sq. in.
800 − 96 = 704 > 624 sq. in.

80 6 Yorx dollars, 75 Greebe dollars

IF:	THEN:
9 ZERBO $ = 3 YORX $	18 ZERBO $ = 6 YORX $ (9×2 AND 3×2)
6 BLINKO $ = 5 GREEBE $	90 BLINKO $ = 75 GREEBE $ (6×15 AND 5×15)
10 BLINKO $ = 2 ZERBO $	90 BLINKO $ = 18 ZERBO $ (10×9 AND 2×9)
	90 BLINKO $ = 6 YORX $

81 58 dogs

82 Jesse—4; Aya—15; Jessica—31; Oliver—36; Hal—17; Lou—34; Pam—20

83 9 days

	1	2	3	4	5	6	7	8	9
AMT MORE	.5	.75	1.125	1.6875	2.53	3.795	5.693	8.535	9TH DAY
TOTAL	.5	1.25	2.375	4.0625	6.594	10.389	16.08	24.615	

84 Armadillos—2052; bats—90; caterpillars—91

	1	2	3	4	5	6	7	8	9	10	11
ARMADILLOS	6	12	8	16	12	24	20	40	36	72	68
BATS	10	20	18	28	26	36	34	44	42	52	50
CATERPILLARS	21	16	28	23	35	30	42	37	49	44	56

	12	13	14	15	16	17	18	19	20	21
ARMADILLOS	136	132	264	260	520	516	10_{32}	10_{28}	20_{56}	20_{52}
BATS	60	58	68	66	76	74	84	82	92	90
CATERPILLARS	51	63	58	70	69	77	72	84	79	91

TOTAL: 2,233

85 $7,260.50

TROY : $ .64 TOLL × 700 = $ 448.00
TRINA : $5.00 TOLL × 473 = $2365.00
TRIXIE : $ 1.25 TOLL × 360 = $ 937.50
TREVOR : $2.10 TOLL × 2100 = $4410.00
7,660.50 TOTAL
- 400.00 PROFIT
$7,260.50 TAXES

86

ALAN DEFOE

LIONEL WILLIAMS — RACHEL MCINTYRE
RHEA BUTLER — GRACE FRANKLIN
JEROME SMOOT — CARL BROWN
BETTY DEFOE — SUE FRENCH

ARTHUR ANDERSON

87 19 2-gallon tanks; 18 5-gallon tanks; 17 10-gallon tanks; 16 15-gallon tanks; 15 26-gallon tanks; 14 43-gallon tanks

CAPACITY OF TANKS (GAL)

	2	5	10	15	26	43
1	2	5	10	15	26	43
2	4	10	20	30	52	86
3	6	15	30	45	78	129
4	8	20	40	60	104	172
5	10	25	50	75	130	215
6	12	30	60	90	156	258
7	14	35	70	105	182	301
8	16	40	80	120	208	344
9	18	45	90	135	234	387
10	20	50	100	150	260	430

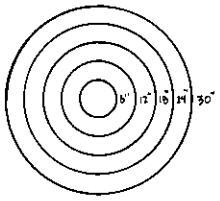
CAPACITY OF TANKS (GAL.)

	2	5	10	15	26	43
11	22	55	110	165	286	473
12	24	60	120	180	312	516
13	26	65	130	195	338	559
14	28	70	140	210	364	(602)
15	30	75	150	225	(390)	645
16	32	80	160	(240)	416	688
17	34	85	(170)	255	442	731
18	36	(90)	180	270	468	774
19	(38)	95	190	285	494	817
20	40	100	200	300	520	860

5 HOURS, 6 MINUTES = 306 MINUTES

306 × 5 GALLONS = 1530 GALLONS

88 18" ring

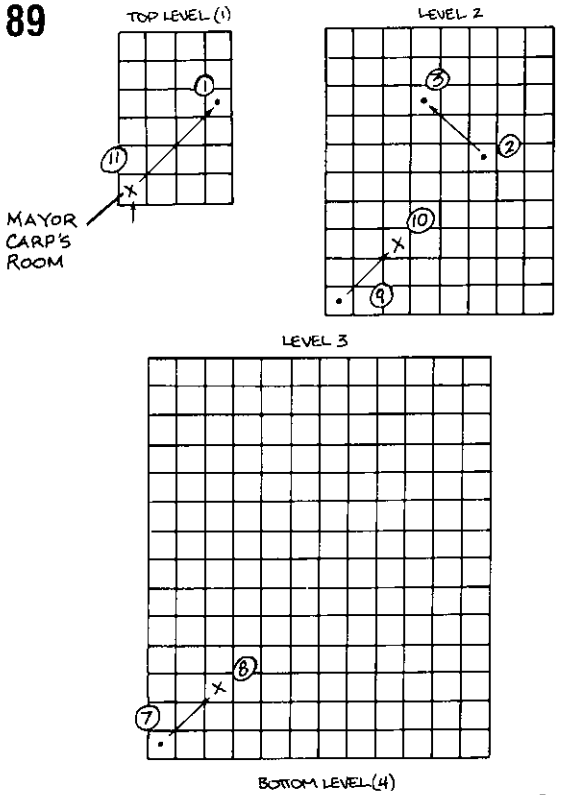


AREA OF BOARD
30" DIAMETER, 15" RADIUS
15 × 3.14 = 47.1
47.1² = 2218.41 SQ. IN.
1/5 × 2218.41 = 443.682 SQ. IN.

AREA OF CIRCLES
30" DIAMETER, 15" RADIUS
15 × 3.14 = 47.1 47.1² = 2218.41 SQ. IN.
24" DIAMETER, 12" RADIUS
12 × 3.14 = 37.68 37.68² = 1419.7824 SQ. IN.
18" DIAMETER, 9" RADIUS
9 × 3.14 = 28.26 28.26² = 798.6276 SQ. IN.
12" DIAMETER, 6" RADIUS
6 × 3.14 = 18.84 18.84² = 354.9456 SQ. IN.

AREA OF RINGS
30" RING
2218.41 - 1419.7824 = 798.6276 SQ. IN.
24" RING
1419.7824 - 798.6276 = 621.1548 SQ. IN.
18" RING
798.6276 - 354.9456 = 443.682 SQ. IN.

89



90 1215 total; 390 monarch; 210 tiger swallowtail; 510 painted lady; 105 fritillary

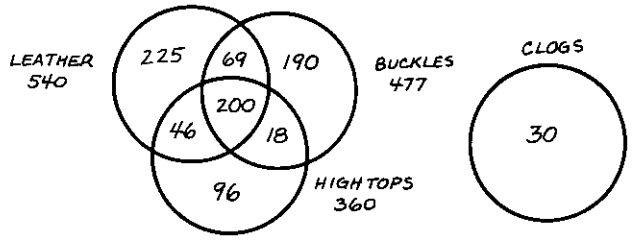
TOTALS

	81	162	243	324	405	486	567	648	729	810	891	972	1053	1134	1215
MONARCH	26	52	78	104	130	156	182	208	234	260	286	312	338	364	390
TIGER SWALLOWTAIL	14	28	42	56	70	84	98	112	126	140	154	168	182	196	210
PAINTED LADY	34	68	102	136	170	204	238	272	306	340	374	408	442	476	510
FRITILLARY	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105

91 200 gallons

92 5 hours; 1—ride 24 miles, walk 12 ; 2—ride 12 miles, skate 16, walk 8

93 874



225+69+190+46+200+18+96+30=874 TOTAL

94 93,500 gallons (list of %)

MILK	= 4%	= 3,740 GALLONS
ORANGE JUICE	= 16%	= 14,960
MINERAL WATER	= 5%	= 4,675
MANGO JUICE	= 11%	= 10,285
CACTUS MILK	= 8%	= 7,480
BROTH	= 24%	= 22,440
CARROT JUICE	= 7%	= 6,545
CELERY JUICE	= 13%	= 12,155
BANANA SHAKE	= 3%	= 2,805
PRUNE JUICE	= 9%	= 8,415
	100%	93,500 GALLONS

95 150 octopi, 106 nonopi, 121 decapi

96 168 oz cactus root = 108 oz dried spiders

IF: 7 oz. SNAIL SHELLS = 12 oz. DRIED SPIDERS
3 oz. BAT WINGS = 5 oz. FROG TOES
24 oz. CACTUS ROOT = 9 oz. SNAIL SHELLS
THEN:
63 oz. SNAIL SHELLS = 108 oz. DRIED SPIDERS
168 oz. CACTUS ROOT = 63 oz. SNAIL SHELLS

97 Milo is 27, mother is 54, grandfather is 72.

98 August 11, 11:26 P.M.

99 1872 pigs; 63,648 bunches of onions; 9,623,016 eggs

3,207,672 ÷ 3,427 = 936

936 × 72 lb. HAM =
67,392 lb. HAM ÷ 36 = 1,872 PIGS

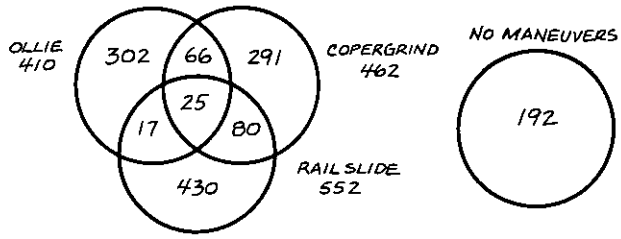
936 × 136 lb. ONION =
127,296 lb. ONION ÷ 2 = 63,648 BUNCHES

856.75 DOZ. EGGS =
10,281 EGGS × 936 = 9,636,016 EGGS

100 Wink—book; Alex—racket; Lynn—poster; Randy—recipe book; Bev—piano; Skeeter—record album

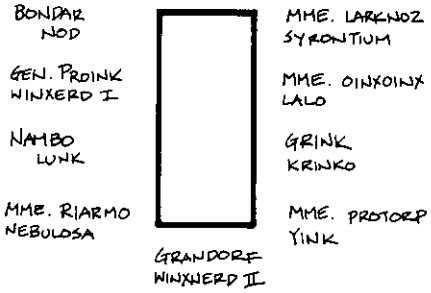
	BOOK	RACKET	POSTER	RECIPE BOOK	PIANO	RECORD ALBUM
WINK	Y	N	N	N	N	N
ALEX	N	Y	N	N	N	N
LYNN	N	N	Y	N	N	N
RANDY	N	N	N	Y	N	N
BEV	N	N	N	N	Y	N
SKEETER	N	N	N	N	N	Y

101 1,403



302+66+291+17+25+80+430+192=1,403

102



103 $12,934.35

104 2628 (72 × 73 ÷ 2 = 2628)

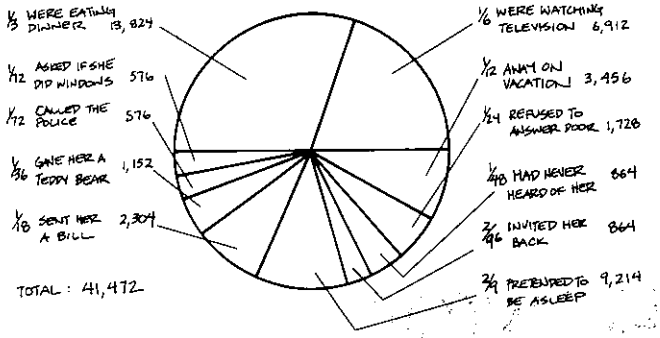
105 Nosey

WEST COAST	EAST COAST	CONDOS ON THE BEACH	HOUSES IN THE CITY
1. GROUCHY	1. SILLY/NOSEY	1. SILLY	1. JOYFUL/NOSEY
2. JOYFUL	2. SNOOZY	2. SNOOZY	2. WHEEZY
3. WHEEZY	3. SHY	3. SHY	3. GROUCHY
4. SILLY/NOSEY		4. JOYFUL/NOSEY	

106 2,304 total; 464 ketchup; 288 soda; 528 medicine; 656 salad dressing; 240 vinegar; 128 milk

	TOTALS															
	144	288	432	576	720	864	1008	1152	1296	1440	1584	1728	1872	2016	2160	2304
KETCHUP	29	58	87	116	145	174	203	232	261	290	319	348	377	406	435	464
SODA	18	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288
MEDICINE	33	66	99	132	165	198	231	264	297	330	363	396	429	462	495	528
SALAD DRESSING	41	82	123	164	205	246	287	328	369	410	451	492	533	574	615	656
VINEGAR	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240
MILK	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128

107 Total—41,472; eating dinner—13,824; watching television—6,912; on vacation—3,456; refused to answer door—1,728; never heard of Goldilocks—864; invited her to dinner—864; pretended to be asleep—9,216; sent bill—2,304; gave teddy bear—1,152; called police—576; asked if she did windows—576



108 $517.50

109 39 (40 people altogether; 40 × 41 ÷ 2 = 820)

110 It depends on your age!

111 13 at $.57, 12 at $.98, 12 at $1.06, 16 at $1.33, 15 at $2.78

	.57	.98	1.06	1.33	2.78
1	.57	.98	1.06	1.33	2.78
2	1.14	1.96	2.12	2.66	5.56
3	1.71	2.94	3.18	3.99	8.34
4	2.28	3.92	4.24	5.32	11.12
5	2.85	4.90	5.30	6.65	13.90
6	3.42	5.88	6.36	7.98	16.68
7	3.99	6.86	7.42	9.31	19.46
8	4.56	7.84	8.48	10.64	22.24

	.57	.98	1.06	1.33	2.78
9	5.13	8.82	9.54	11.97	25.02
10	5.70	9.80	10.60	13.30	27.80
11	6.27	10.78	11.66	14.63	30.58
12	6.84	(11.76)	(12.72)	15.96	33.36
13	(7.41)	12.74	13.78	17.29	36.14
14	7.98	13.72	14.84	18.62	38.92
15	8.55	14.70	15.90	19.95	(41.70)
16	9.12	15.68	16.96	(21.28)	44.48

112 Spud—PBC News, popcorn; Idaho—Lincoln movie, beef jerky; Russet—Laurel and Hardy, diet soda; Chip—Dance Party, pizza; Small Fry—Giants-Dodgers, peanuts

	DANCE PARTY	LAUREL & HARDY	PBC NEWS	GIANTS-DODGERS	LINCOLN MOVIE	POPCORN	DIET SODA	BEEF JERKY	PEANUTS	PIZZA
SPUD	N	N	Y	N	N	Y	N	N	N	N
IDAHO	N	N	N	N	Y	N	N	Y	N	N
RUSSET	N	Y	N	N	N	N	Y	N	N	N
CHIP	Y	N	N	N	N	N	N	N	N	Y
SMALL FRY	N	N	N	Y	N	N	N	N	Y	N

113 He married the princess.

DRAGON	DEER	RED DOOR	BLUE DOOR
1. DOOR 1 OR 4	1. DOOR 1 OR 4	1. DOOR 3 OR 4	1. DOOR 3 OR 4
2. DOOR 2	2. DOOR 5	2. DOOR 5	2. DOOR 2
3. DOOR 3		3. DOOR 1	

114 82 feet of cable

115 715 ladybugs; 1430 dragonflies; 2860 moths; 1287 bees

SETS	LADYBUG 5 DROP	DRAGONFLY 10 DROP	TOTAL DROPS	MOTH 40 DROP	BEE 15 DROP	TOTAL	COMBINED TOTALS
1	1	4	45	1	3	85	130

74,360 ÷ 130 = 572

572 × 1 × 5 (DROPS) = 2,860 ÷ 4 FLOWERS PER NIGHT = 715 LADYBUGS

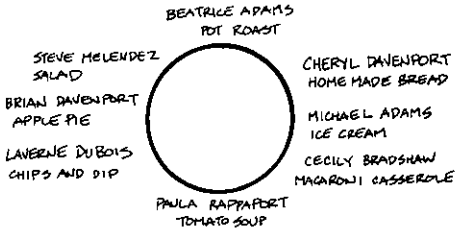
572 × 4 × 10 (DROPS) = 22,880 ÷ 16 FLOWERS PER NIGHT = 1,430 DRAGONFLIES

572 × 1 × 40 (DROPS) = 22,880 ÷ 8 FLOWERS PER NIGHT = 2,860 MOTHS

572 × 3 × 15 (DROPS) = 25,740 ÷ 20 FLOWERS PER NIGHT = 1,287 BEES

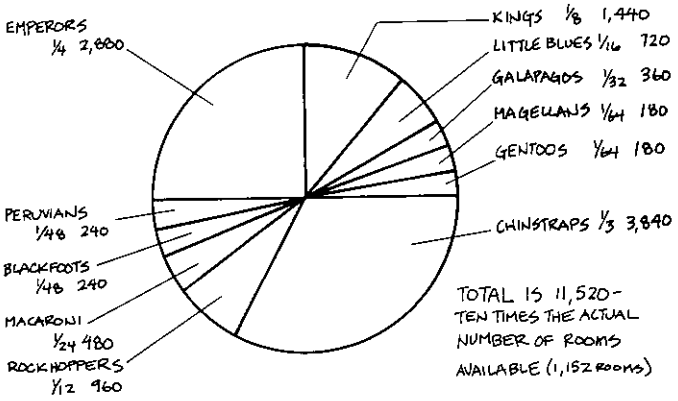
116 9 hours; 2—bike 9, skate 18, walk 15; 1—bike 18, skate 6, walk 18

117



118 Diamond City—20; Heart City—21; Club City—16

119 1,152 (circle graph or equations, plus: Total is 11,520, so number of rooms is 1,152.)



120 5 people: grandfather, father, grandson, great-grandson, great-great-grandson; each person gets $14

