

PROBLEM SOLVING

Set C

Compiled by members of the TEAM project
"Teaching Excellence and Mathematics"

Department of Public Instruction
301 N. Wilmington Street
Raleigh, NC 27601-2825

Michael E. Ward, Superintendent

Original funding through D. D. Eisenhower
Mathematics and Science Education Program

There are many commercial resources available to challenge students to become better problem solvers. This is a collection of some of our favorite problems.

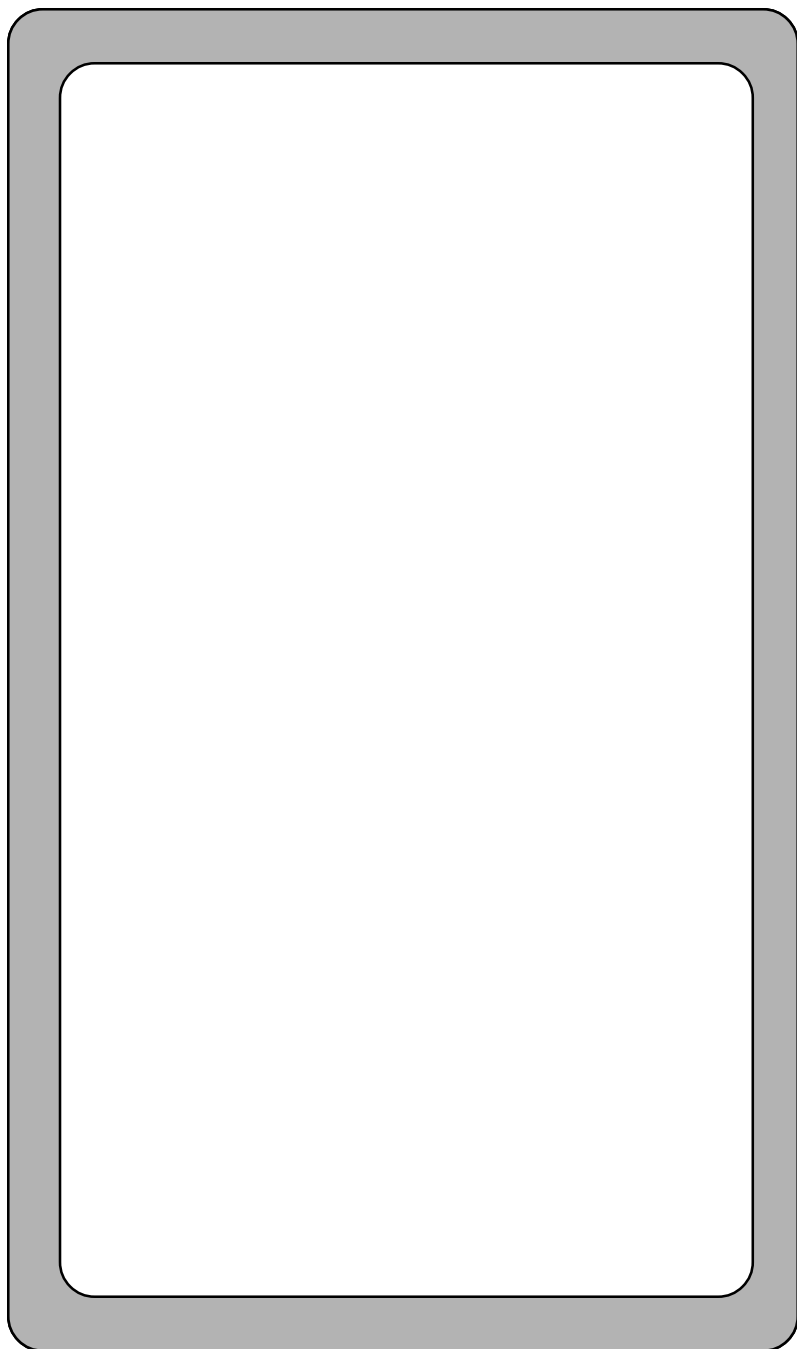
You might consider allowing students to work with partners. Many of these problems are best solved with calculators. All of these problems lend themselves to students telling and writing about their thinking.

Consider expanding this problem solving deck by adding your own problems on the backs of the cards or photocopying the blank master we have included for you.

We hope you will share your great problems with us. Send them to :
Mathematics Section
Department of Public Instruction
301 N. Wilmington St.
Raleigh, NC 27601-2825

**Problem
Solving Strategies**

1. Act out the problem
2. Use models and manipulatives
3. Make a picture or a diagram
4. Make a table or chart
5. Make an organized list
6. Work backwards
7. Use logical reasoning; deduction
8. Guess and check
9. Use or look for a pattern
10. Solve a simpler problem
11. Write an equation
12. Brainstorm ideas



There are many commercial resources available to challenge students to become better problem solvers. This is a collection of some of our favorite problems.

You might consider allowing students to work with partners. Many of these problems are best solved with calculators. All of these problems lend themselves to students telling and writing about their thinking.

Consider expanding this problem solving deck by adding your own problems on the backs of the cards or photocopying the blank masters we have included for you. We hope you will share your great problems with us. Send them to Jeane Joyner at the address on the back of this card.

Create a “Mystery Operation” and supply the first three input and output terms and ask for three more examples. Give your mystery operation to a friend to complete the table and ask the friend to explain your rule. For example, you might set up a table like this:

INPUT	OUTPUT
2	25
6	57
4	41
7	<u>??</u>
9	<u>??</u>
3	<u>??</u>

If n is the input number, then the output is found by multiplying n by 8 and adding 9: $8n + 9$.

Card 1

Set C

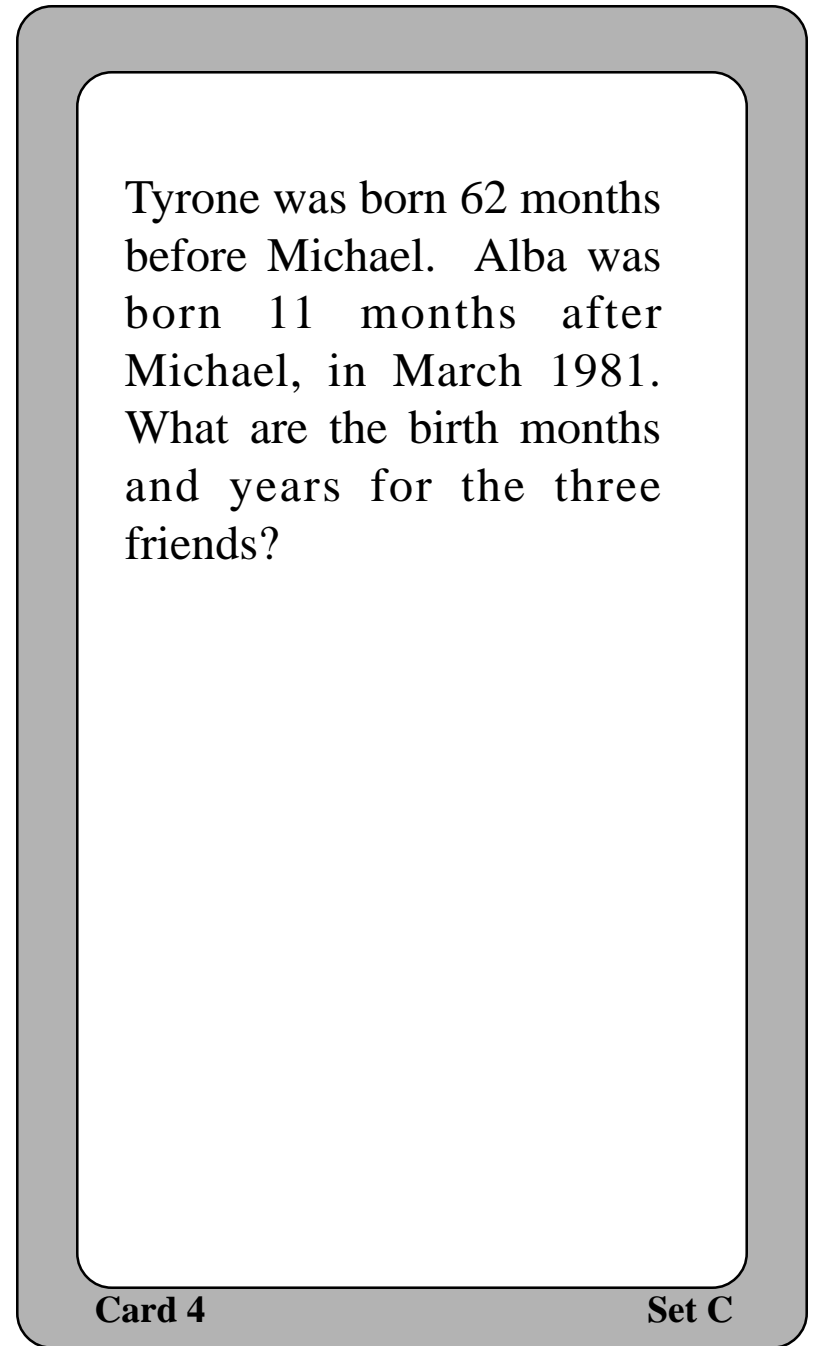
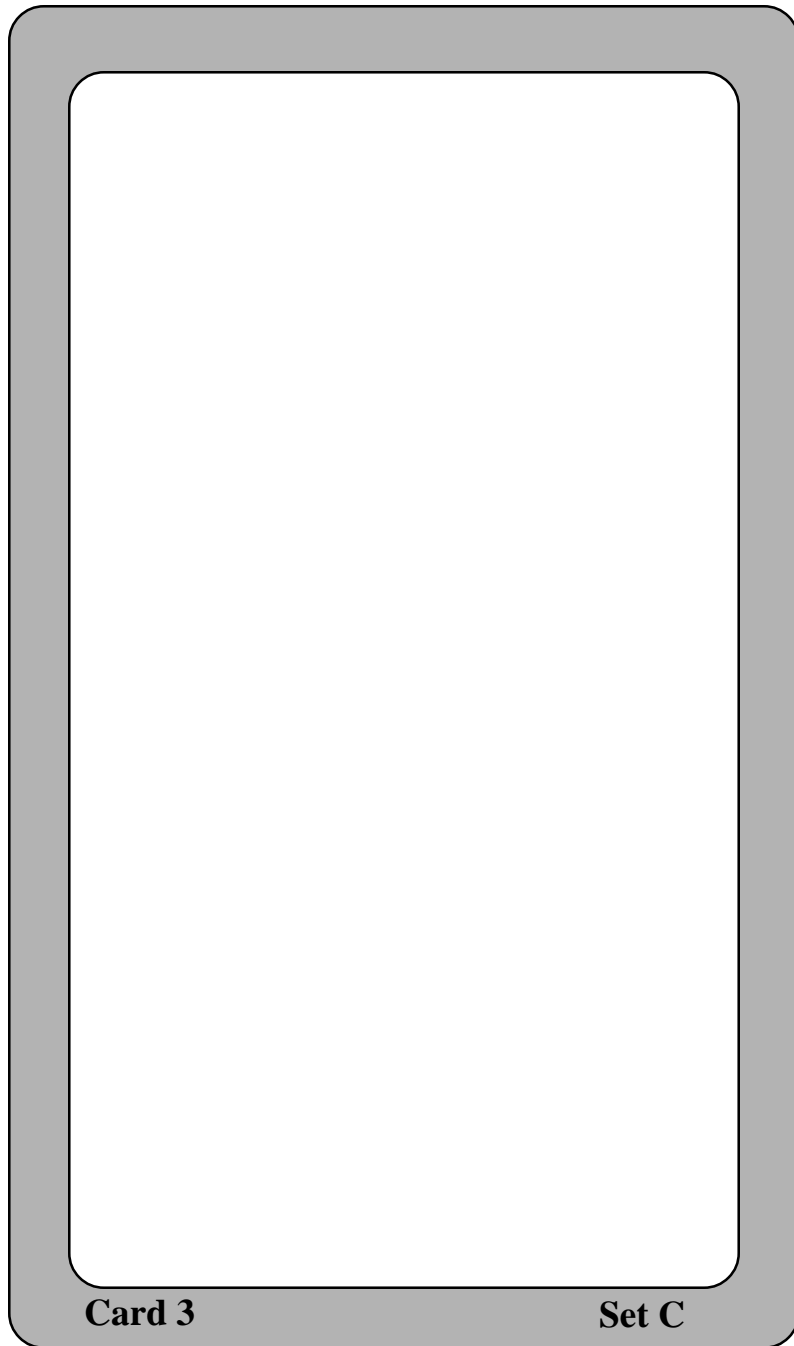
Michael parks his car from 11:30 a.m. to 4:45 p.m. in the “Stay-U-Pay” parking lot. How much will he owe the parking attendant if he pays the least expensive rate?

STAY-U-PAY

First Hour	\$ 0.75
Each Additional Hour	\$0.60
Daily Rate (Over 6 Hours)	\$3.00

Card 2

Set C



Describe how to fold this "map" so that the numbered sections lie on top of each other in order from 1 to 8.

3	4	2	7
6	5	1	8

Card 5

Set C

At **BizBiz Pizza** the token machine takes one-dollar and five-dollar bills. The owner of Biz Biz knows that kids will want to come back if they have tokens left over.

Devise a plan to determine how many tokens can be purchased with one- and five-dollar bills plus how many tokens each game requires to be played. Explain why you think your plan would be likely to leave kids with extra tokens.

Card 6

Set C

Find the sum.

$$23 + 25 + 27 + 23 + 25 + 27 +$$

$$23 + 25 + 27 + 23 + 25 + 27 +$$

$$23 + 25 + 27 + 23 + 25 + 27$$

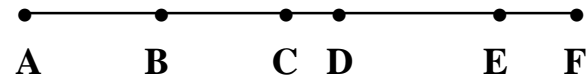
Explain three different ways to solve this problem.

Card 7

Set C

Ten people met at a party. They all exchanged handshakes. How many handshakes were exchanged?

How many different segments can be named using the labeled points as endpoints? List them.

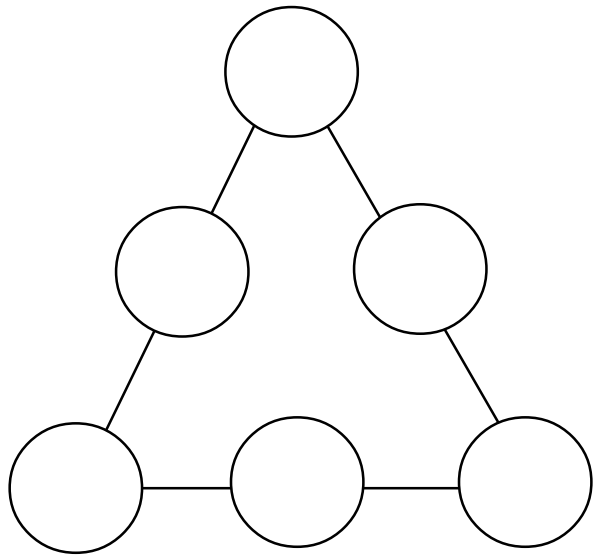


Are these problems related?

Card 8

Set C

Place the first six counting numbers in the circles so that the sum on each side of the triangle is 9.



Is it possible to use the numbers 4 to 9 to make the sum of each side the same?

Card 9

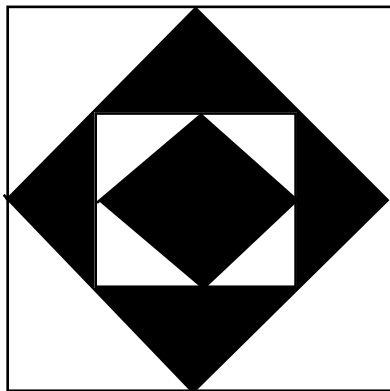
Set C

Bob's Super Ball bounces exactly half the height from which it is dropped. He drops the ball from the top of a building that is 64 meters tall. How high will the ball bounce on its 7th bounce?

Card 10

Set C

What is the area of each black and white piece if the whole square measures 20 cm on each side? Explain how you got your answer.



Card 11

Set C

The cost of making money varies from coin to coin:

Pennies	0.8 cents each
Nickels	2.9 cents each
Dimes	1.7 cents each
Quarters	3.7 cents each
Half dollars	7.8 cents each

What is the cost of making \$5.00 worth of each coin?

With a partner, prepare a presentation to discuss this task: Your office has been directed to eliminate the minting of one kind of coin. What is your proposal?

Card 12

Set C

Which digit (0-9) occurs most often on a calendar for this month. Which occurs least often? Is the answer the same for every month of this year?

Card 13

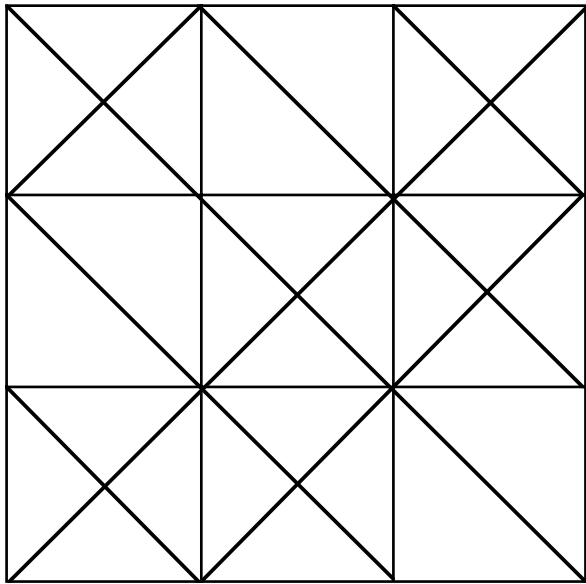
Set C

Which is correct more of the time: a watch that doesn't work at all, or a watch that loses one minute each hour?

Card 14

Set C

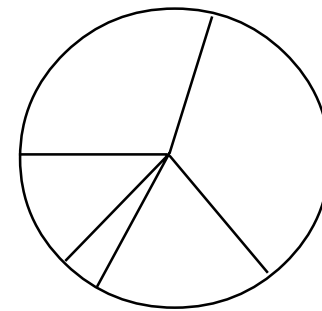
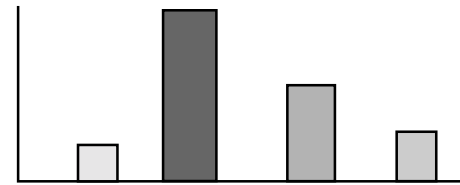
Color this square so that one-half is green, one-third is yellow and and the rest is brown. Each triangle should be just one color. Make any pattern you like. How much of the square is brown?



Card 15

Set C

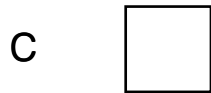
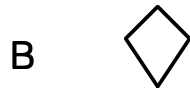
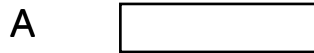
What information about the people in this room would fit these graphs? Title and label the graphs.



Card 16

Set C

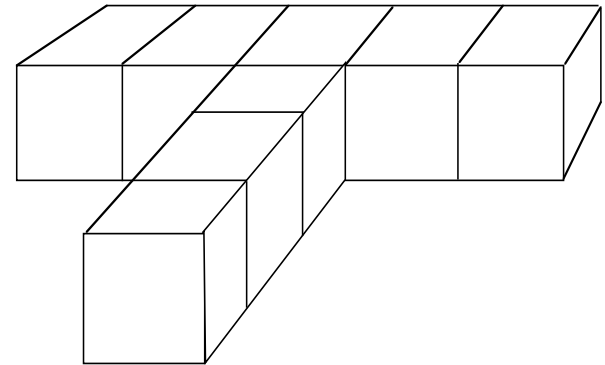
The answer is A and C. What is the question? Write a question with a different answer.



Card 17

Set C

Eight one-inch cubes are put together to make a “T”. If the complete figure is painted blue, how many cubes have exactly four blue faces?



How are the remaining cubes painted?

Card 18

Set C

The first term of an arithmetic sequence is 4 and the 10th term is 58. List the first 10 terms of the sequence. What if the first term is 9 and the 10th term is 90? What would the sequence be?

Card 19

Set C

If the first day of a certain month is Thursday, what day of the week is the 21st day of the same month? On what day of the month will the 17th day be? If the first day of a new year falls on a Monday, what day of the week will February 14 fall on?

Card 20

Set C

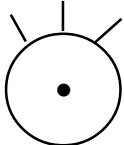

A lizard is 100 feet away from the tree he wanted to climb. At the end of the first minute he has traveled half of the distance to the tree. At the end of the second minute he has traveled half of the remaining distance. At the end of the third minute he has traveled half of that remaining distance.

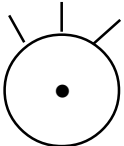
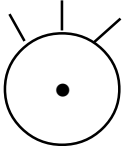
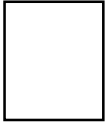
How long will it take him to reach the tree if he continues this pattern of travel?

Card 21

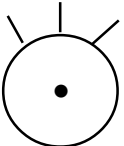
Set C

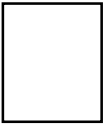
Crack the code:

If  -  = 2 and

  -  = 72

Fill in the blanks.

 = _____

 = _____

Card 22

Set C

If you continue this pattern:
ababbabbbabbbb. . .
what will be the 100th letter?

Which number does not
belong:
1, 2, 4, 8, 12, 16? Explain your
answer.

Can you justify more than
one possible response?

Card 23

Set C

What is the greatest number of
4-inch by 6-inch rectangular
pieces of glass, for inserting
into picture frames, that can be
cut from a rectangular sheet of
glass that measures 2 feet by 4
feet?

Card 24

Set C

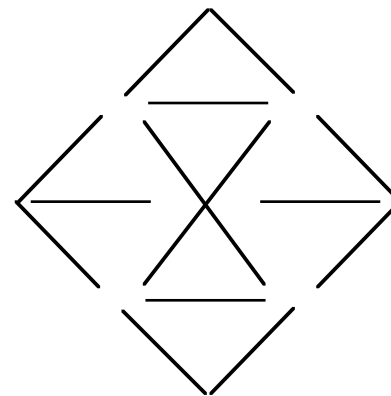
A book has 600 pages which are numbered 1, 2, 3 and so on. How many times does the digit 5 appear in the page numbers?

The sum of two page numbers is 325. When you open the book at these pages, what is the page number of the right hand page?

Card 25

Set C

There are 16 toothpicks in this design. Remove four toothpicks so that only four congruent triangles remain.



Card 26

Set C

Debra bought five pieces of gold chain with four links in each piece to make a necklace

If a jeweler charges \$3 to open a link and \$4 to close a link what should she ask the jeweler to do in order to pay the smallest amount to make her necklace?

Card 27

Set C

$$3^0 = 1, 3^1 = 3, 3^2 = 9, 3^3 = 27, \\ 3^4 = 81, \dots$$

These products have 1, 3, 9, and 7, respectively, in the ones place. If you compute 3^{15} , what number will be in the one's place?

Is there a similar pattern for $4^0, 4^1, 4^2, 4^3, 4^4 \dots$?

If so, what is the digit in the one's place for 4^{20} ?

Card 28

Set C

George bought a Christmas tree to put in his living room. He paid \$50 for the tree. After he took it home, he realized it was too tall and sold it to his neighbor for \$60. His neighbor put lights on the tree and then decided the tree was too wide for the room. George looked at the tree again and offered to buy the tree back for \$70. George cut two feet off the bottom of the tree and when he stood it up, he was no longer pleased with the tree. He sold it for \$80 to another neighbor. What was George's financial outcome from this venture?

Card 29

Set C

A $3 \times 3 \times 5$ cm rectangular prism is painted orange on all sides. Draw the figure.

If the prism is cut into one cm cubes, how many cubes are there? How many of the small cubes are painted orange on six faces? five faces? four faces? three faces? two faces? one face? no faces?

Card 30

Set C

Bob's Bicycle Shop

assembled some tricycles and go-carts. The total number of tricycles and go-carts was 30 and Bob used 103 wheels in all. How many go-carts did Bob make?

Card 31

Set C

Working alone, Johnny can build a model airplane in two hours. It takes Sherry three hours to complete a similar model. How long would it take Johnny and Sherry working together to complete an airplane?

Card 32

Set C

Bill and Rosa have only nickels and dimes. Rosa has 75 cents and Bill has 90 cents. Each has the same number of coins and Bill has the same number of dimes as Rosa has nickels. How many nickels does Rosa have?

Card 33

Set C

While writing the date 6/15/90 (June 15, 1990), James noticed that the month (6) times the day (15) equalled the year (90).

There are four other dates in 1990 that fit this equation. Find and list them.

What do Bastille Day and Christmas Eve in any year have in common? How many dates fit this pattern?

Card 34

Set C

Find a shortcut for computing the sum $1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17 = ??$. Explain your shortcut and how you could use this same shortcut to find the sum of all the odd numbers from 45 to 99.

Card 35

Set C

What is missing in this pattern?

$$\frac{2}{5}, \frac{4}{10}, \frac{6}{15}, \dots, \frac{10}{25}$$

Explain how you got your answer.

Replace each \square with an operation symbol to make the following statement true:

$$100 = 1 \square 2 \square 3 \square 4 \square$$

$$5 \square 6 \square 7 \square 8 \square 9$$

Card 36

Set C

How many people must be gathered together to be certain that two people of the group have birthdays that fall in the same month? Why?

Card 37

Set C

How old will you be, in days, on January 1, 2002?

Card 38

Set C

Michael Jordan, James Worthy, Scott Williams, Brad Daugherty and Sam Perkins all played basketball at UNC-Chapel Hill. If they play in a one-on-one tournament, how many games would have to be played for every player to play the others once?

Card 39

Set C

Draw a rectangle whose perimeter (in linear units) is greater than its area (in square units). Label the rectangle.

What is the least number of tacks you need to display six rectangular pictures of the same size and shape so that they can all be seen? You must tack every corner.

Card 40

Set C

Laura's favorite clothes are five sweaters, four skirts, three jackets, two pairs of shoes and one belt. How many ways can Laura wear her favorite clothes without repeating the exact outfit?

Card 41

Set C

Emily's dad pays her for picking strawberries. Each hour she works he increases her pay. The first hour she earns two cents, the second hour four cents, the third hour eight cents, and so on, doubling the amount each hour. How much money will she earn if she works six hours? How much money will she earn after ten hours? How many hours will she need to work to earn at least \$5.00?

Card 42

Set C

Rick, Maria, and Bob have less than 20 tickets for rides at the fair. Rick has more tickets than Maria, and Maria has more than Bob.

Rick gives Bob 3 tickets and Maria gives Bob 2 tickets. Then they all have the same number of tickets for rides. How many tickets did each person start with?

Card 43

Set C

The average of 5 numbers is 28. What would the 6th number have to be to bring the average up to 30?

Anna's average in math is 92. She wants to raise her average to 93 so she will make an A. She is taking a test on Friday. What score will she have to make on the test to raise her average to 93? Do you have sufficient information to solve this problem?

If yes, what is the score? If no, supply any data you need to answer the questions.

Card 44

Set C

On a math test, students score 10 points for every correct answer. One point is deducted for each incorrect answer. If your score is 45, what could your answers (right and wrong) have been?

Card 45

Set C

The Jones family took a 600 mile trip to the mountains last spring and averaged 50 miles per hour on the trip. On the return trip they averaged 55 miles per hour. What was the average speed for the entire trip? What information do you need to have to solve other problems like this? Explain your answers.

Card 46

Set C

Find all the numbers that divide 100 with a remainder of 4. What is the largest two-digit divisor that can divide 100 and still have a remainder of 4?

Find all the numbers that divide 216 with a remainder of 6.

Card 47

Set C

Can anyone make the claim
**“I was X years old
in the year X^2 ?”**

Explain.

Card 48

Set C

One section of a book contains six pages. The sum of all the page numbers in the section is 525. What are the page numbers?

Card 49

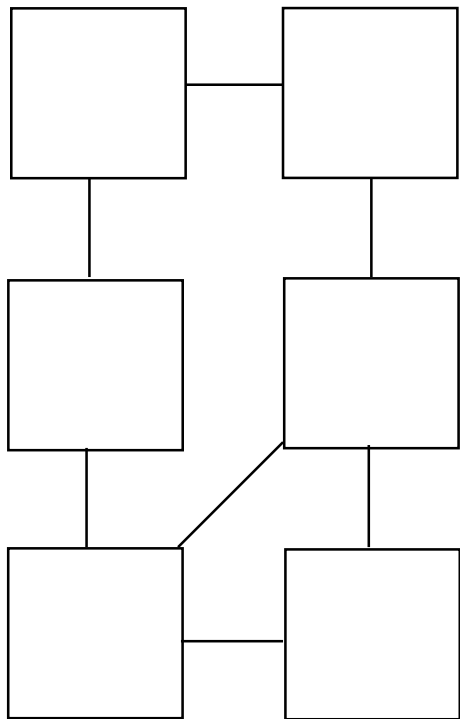
Set C

A camping club took a ten-day camping trip in the mountains. Twelve people signed up for the trip. The club members purchased supplies for the 12 hikers with the understanding that supplies would be divided equally among the twelve on a daily basis. On the morning the hike was to begin, three additional people joined the group but no new provisions were purchased. How long will the supplies last if all 15 hikers receive equal daily supplies? Explain your reasoning.

Card 50

Set C

Place the numbers 0 - 5 in the boxes so there are no lines connecting consecutive numbers.



Card 51

Set C

Joey's little sister must take four steps for every three steps Joey takes. Suppose one step of Joey's covers one foot. How many feet would his little sister cover when she has taken 12 steps?

Card 52

Set C

At The Pizza Emporium, pizzas are sold by the slice or by the entire pizza. They are trying to decide how to price their 14" pepperoni pizza. How would you complete the chart? Justify your answer.

One slice	1-3 pizzas	4 or more pizzas

Card 53

Set C

Which 3-digit numbers, whose digits are 6, 7, and 8, are evenly divisible by 8?

How is the divisibility test for 9 helpful in remembering the multiplication facts for 9?

Card 54

Set C

The page numbers of a book are numbered consecutively 1 to 300. How many page numbers meet these conditions:

1. The page numbers have the digit 5 and are also divisible by 5.
2. The page numbers contain the digit 5 but are not divisible by 5.
3. The page numbers do not have a 5 but are divisible by 5.

Card 55

Set C

The club house is a rectangle that is 25' by 40' in size. The officers voted to put a 6-foot sidewalk all around the building, leaving a 2-foot space for plants between the building and the sidewalk.

Draw the sketch they might have used to explain their plan and give the perimeter of the outer edge of the sidewalk and the area of the sidewalk itself.

Card 56

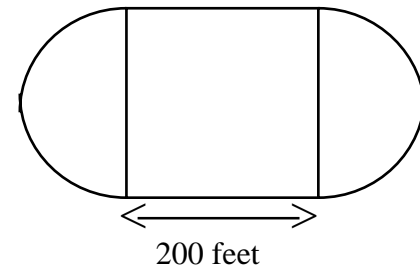
Set C

Assume that the sides of triangles are limited to whole-number measures. How many different triangles have a perimeter of 12? What kinds of triangles are they? Explain how you determined this.

Card 57

Set C

The boundary of a skating rink is formed a 200-foot

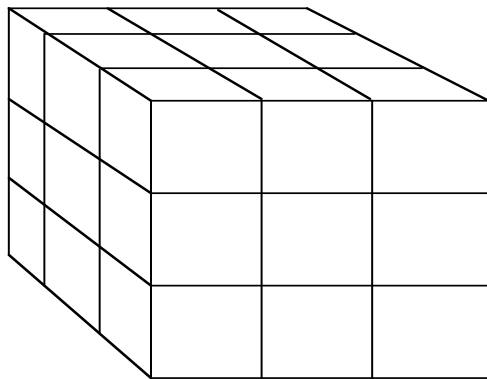


Card 58

Set C

The cube below was made by putting together 27 small cubes. The large cube was then dropped into a bucket of blue paint. The cube was removed from the paint and allowed to dry. After the paint dried, the large cube was taken apart again.

1. How many small cubes had blue paint on three faces?
2. How many of the small cubes were blue on only two faces?
3. How many small cubes had paint on exactly one face?
4. How many small cubes did not have any paint on them?
5. How many faces are painted?



Card 59

Set C

A. Using exactly 50 coins, how can you make change for a dollar bill?

B. If you have 11 coins, what are the possible amounts of money you could have?

Card 60

Set C

If the enrollment of a school is 400, will there always be at least two students in the school whose birthdays fall on the same day of the year? Why or why not?

Card 61

Set C

Week #	Letters This Week	Total Letters
1	8	8
2	8	16
3	8	?
4	8	?

What would this table look like for the first eight weeks?

How many letters were received by the 100th week?

When had 500 letters been received?

Card 62

Set C

Valentine candy bars were sold for \$0.50. After the holiday they were marked down for quick sale and the whole lot sold for \$31.93. What was the reduced price of the candy bars?

Card 63

Set C

Card 64

Set C

