Math Reader

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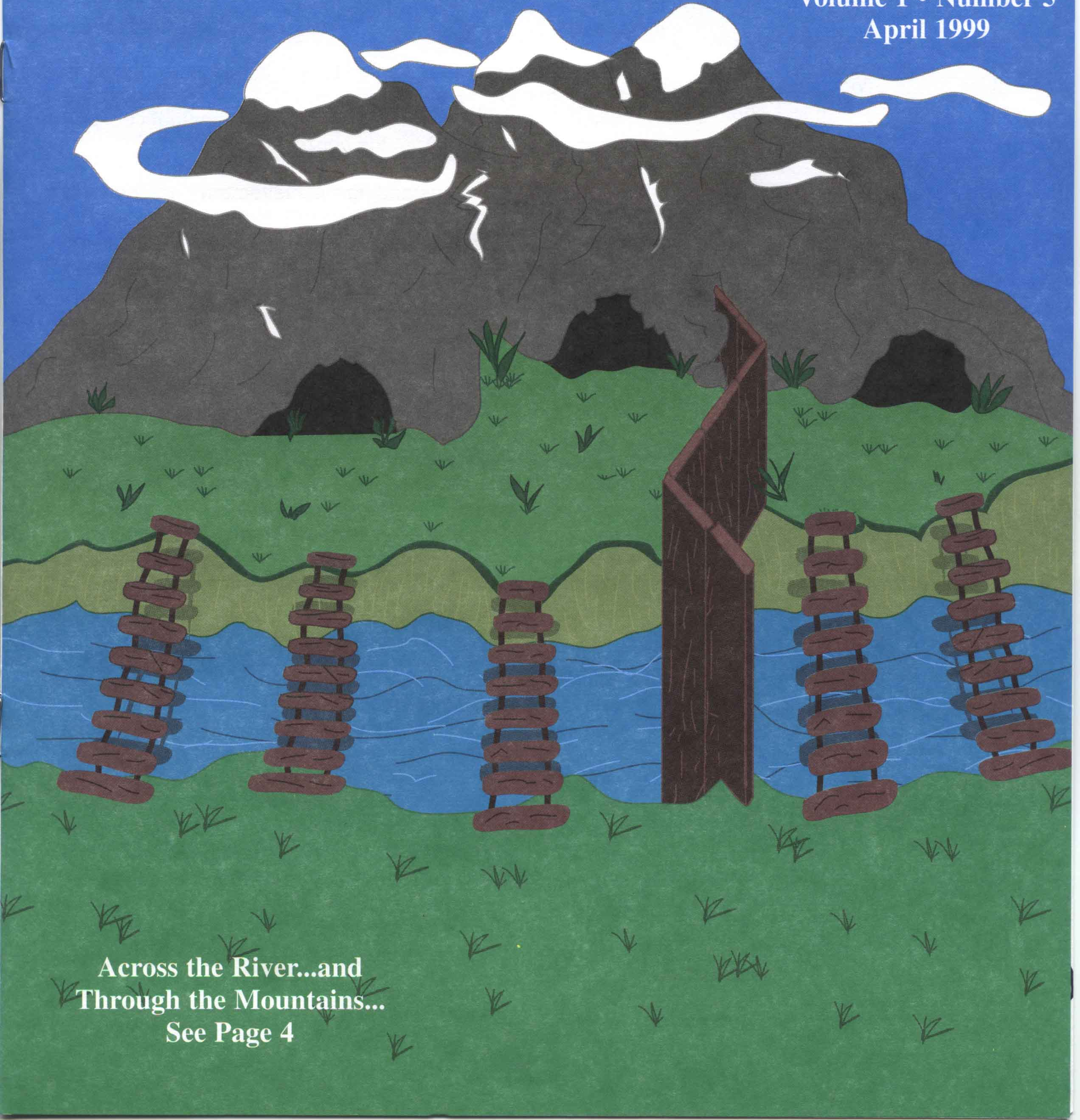

Across the River...and Through the Mountains...
See Page 4

Math Reader

Contents

Math Reader (elementary) and *Math Explorer* (intermediate) are published 8 times a year by the Southwest Texas State University Math Institute for Talented Youth (MITY). An annual subscription is $8.00 for individuals, $6.00 for group purchases of 25 or more, and $4.00 for school purchases of 100 or more. See the back cover for an order form or contact **Math Reader** at the address or phone below.

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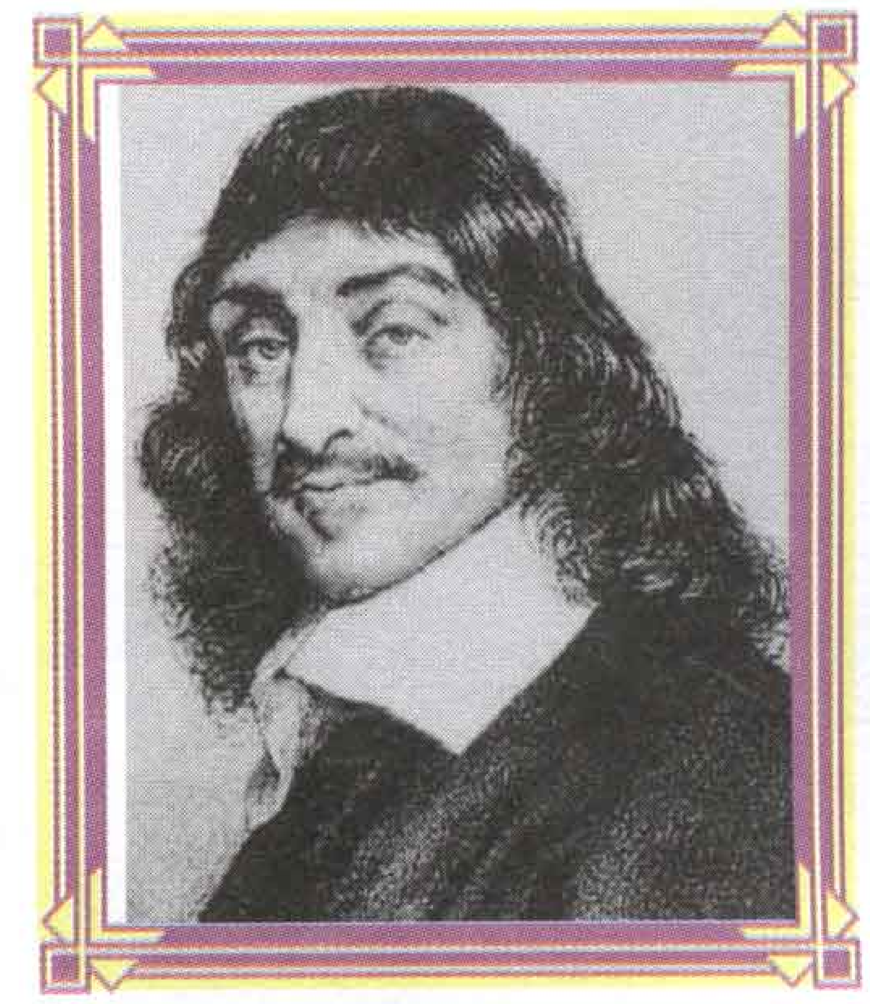
Descartes



by Hiroko Warshauer

Hiroko Warshauer teaches mathematics at Southwest Texas State University. She enjoys music and the arts, as well as working with students on math puzzles, problems, and activities.

Have you ever wanted to stay in bed a little longer in the mornings? Here's one mathematician who often did and who came up with some great mathematical and philosophical ideas from the horizontal position!

A truly outstanding achievement credited to Descartes (pronounced "day-cart") is the connection he made between algebra, the language and words, and geometry, the pictures. The study of coordinate geometry and analytic geometry allows us to talk about points, lines, and curves with corresponding "addresses" or equations. More about this in the article on page 3.

Rene Descartes was born in France on March 31, 1596. At age eight he was sent to a Jesuit school, where he studied the classics (Greek and Latin literature) and gentlemanly behavior. Young Descartes' health was very delicate. For most of his life, Descartes would spend his morning hours in bed contemplating mathematics and philosophy. He left the school eight years later and spent a few years seeing the world and learning about life. In those years, Descartes also earned a law degree and began his work in mathematics and philosophy.

In 1617, at the age of 21, Descartes enlisted as a soldier, serving in the Dutch army and later in the Bavarian army until 1628. Afterwards, he lived in the Netherlands for 20 years. It was during those years in the Netherlands that Descartes published *La Geometrie*, his only mathematical work and other articles on his philosophical ideas. A well-known Latin phrase that is credited to Descartes, "cogito ergo sum" means "I think therefore I am." So the next time you are hurried out of bed you can say that you were thinking deeply like the famous philosopher Descartes.

[B] Bell, E. T., *Men of Mathematics*, Simon and Schuster, NY, NY, 1965.
[Ho] Hollingdale, Stuart, *Makers of Mathematics*, Penguin Books, NY, NY, 1989.

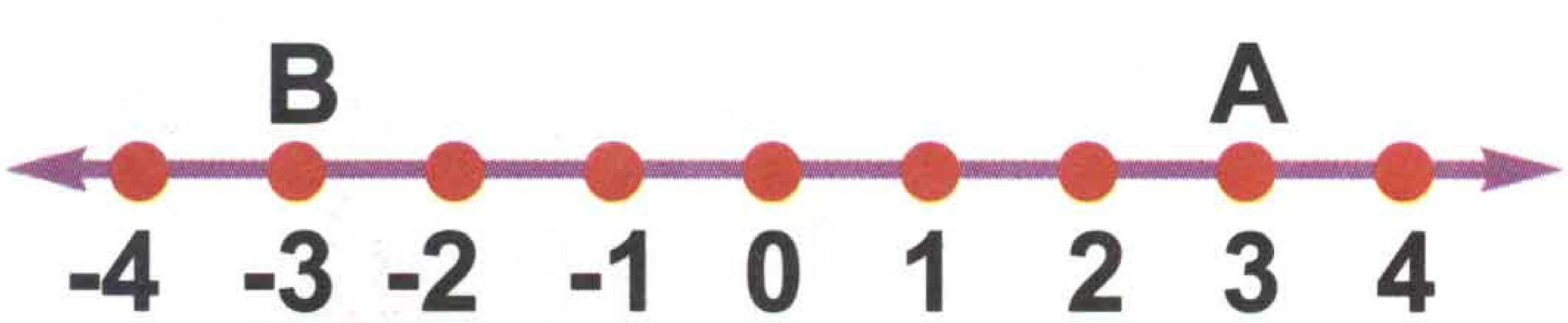
The Cartesian Coordinate System

by Hiroko Warshauer

Finding the location of a building in an unfamiliar city can be difficult without knowing its address. Luckily for us, most cities and towns give homes and buildings addresses. Addresses help mail carriers, fire fighters, and mapmakers (cartographers) locate places in a city.

In mathematics, the geometric shapes such as lines, circles, and curves, made up of infinitely many points, can be related to a mathematical statement or equation that refers to the coordinates or addresses of the points. The sixteenth century mathematician and philosopher Rene Descartes (see page 2) came up with an amazing but simple idea. The location of a point in a plane (a flat surface) can be described using a pair of numbers. The numbers indicate the distance and direction from a pair of lines.

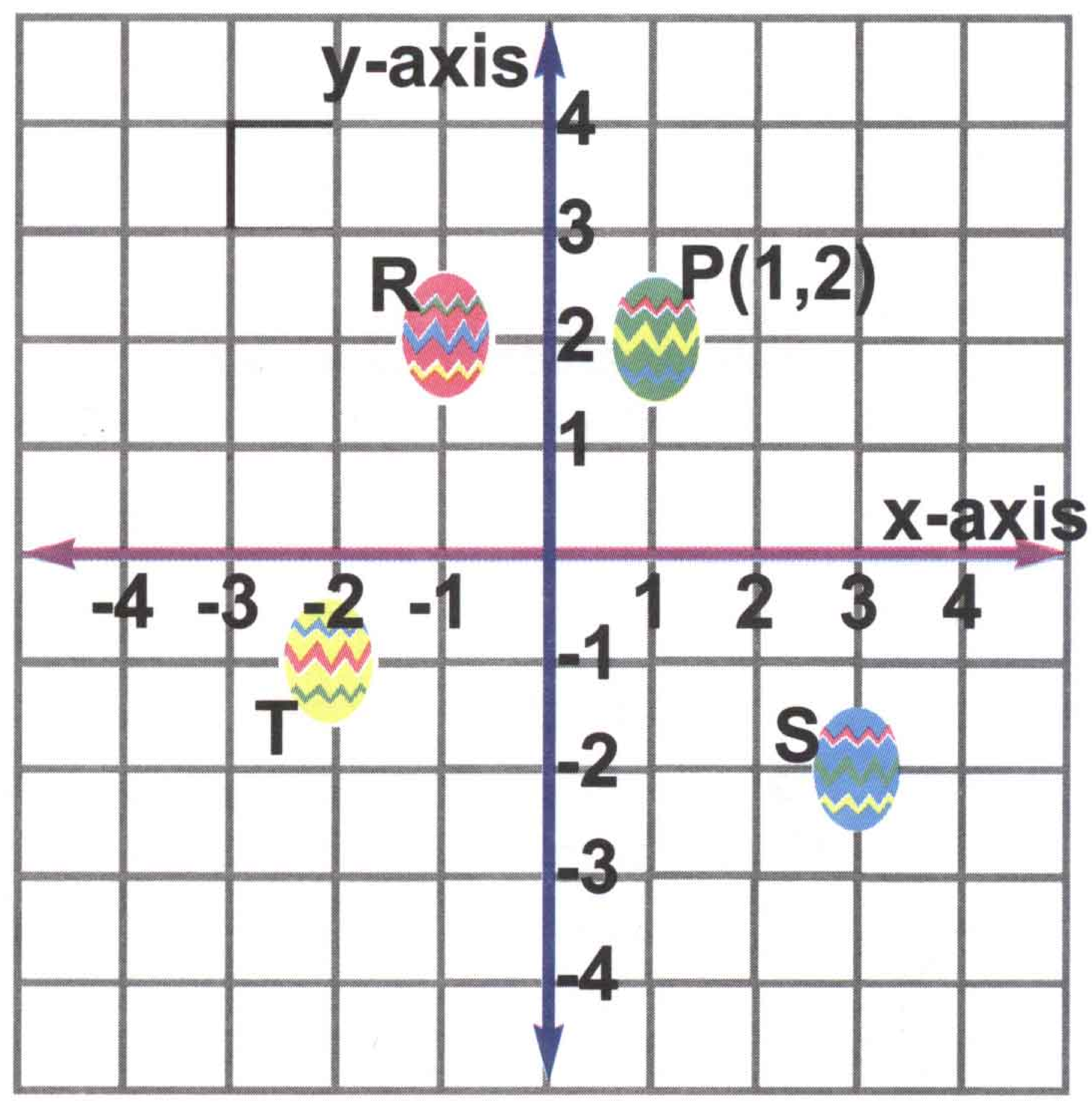
Let's begin with one line, namely the number line. We'll call this the x-axis or the **horizontal axis**. The number line has a number or **coordinate** associated to every point. For example, point A has coordinate 3 and point B has coordinate -3. Coordinates are like addresses for points.



Take another number line, this one vertical, and place it over the first so that they cross at the points labeled 0. We call this vertical line the **y-axis** or **vertical axis**. The intersection point is called the **origin**.

In this layout, called a rectangular coordinate system (or Cartesian coordinate system, after Descartes), each point is given an address consisting of two numbers called coordinates. For example, point P in the graph below marks the location of an Easter egg that has coordinates (1,2). Let's see why this might make sense.

In order to get to our point P, we could begin at the origin and first go 1 unit to the right along the x-axis. We could then go 2 units up along the y-axis. The first coordinate, 1, tells us how many units to go left or right along the x-axis. The second coordinate, 2, tells us how many units to go up or down. We can then use the coordinates to locate our points.

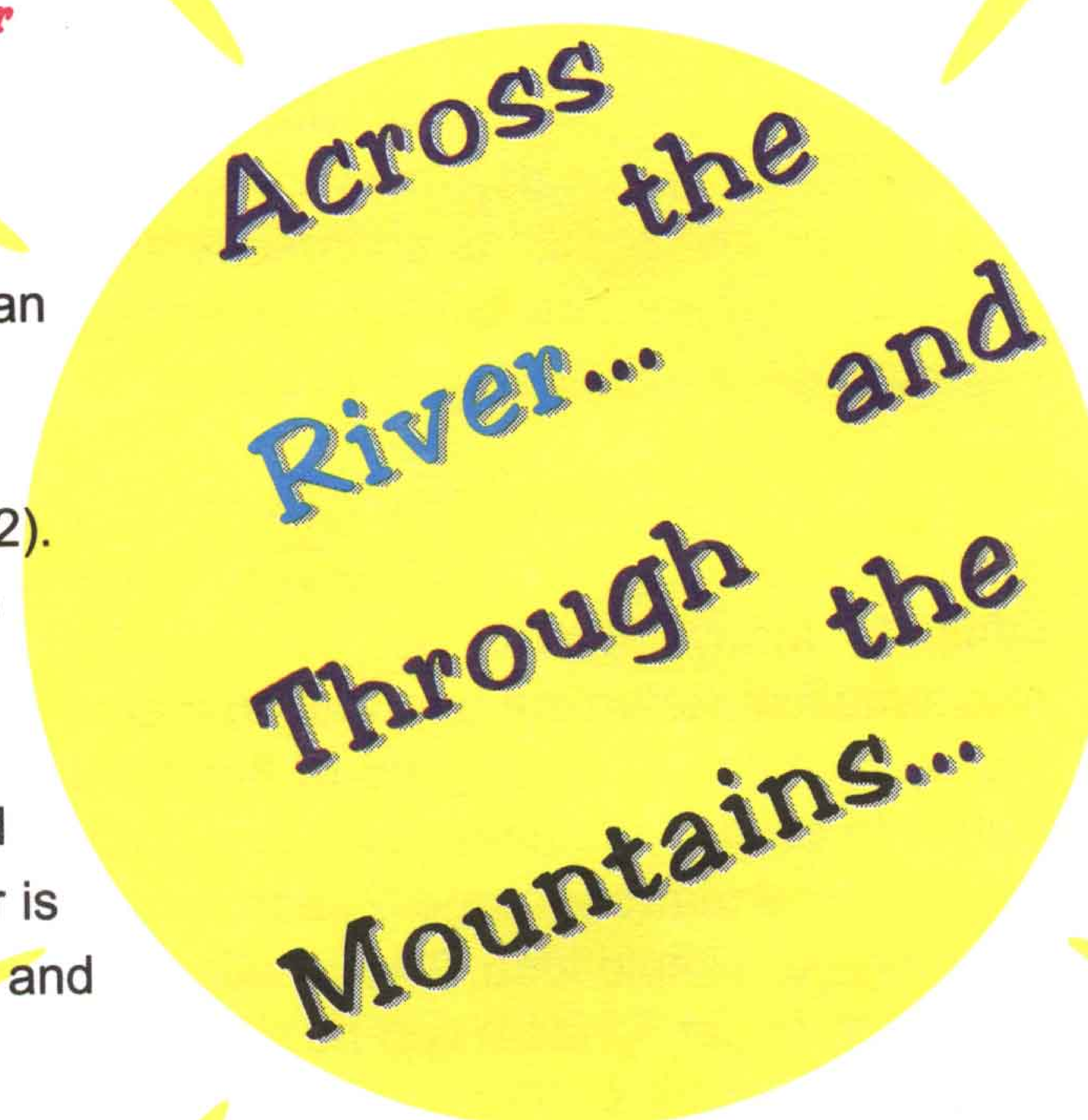


Can you write the pair of coordinates for the points above which mark the location of the Easter eggs?

R has coordinates (____ , ____)
S has coordinates (____ , ____)
T has coordinates (____ , ____)

PROBLEMS OF THE MONTH

Send your solutions to ***Math Reader*** ! We will publish the best solutions each month and send a free ***Math Reader*** pen to everyone whose solution we publish.



1. Draw a grid to locate points in the Cartesian plane. Locate the point (2,3). Find as many points as you can that are a distance of 4 units from the point (2,3).

2. Use your grid above to draw a line from (-4,6) to (6,-2). What point on this line is midway between these two points?

3. A number whose value is the same read forward and backwards is called a palindrome. One such number is 121. How many palindromes are there between 100 and 200?

4. What is the sum of the digits of the palindrome closest to 1999?

5. Sandy puts some slices of cake on the table. If she puts out 8 more slices then she and her 4 friends will be able to have 3 slices each. How many slices did she put out on the table in the beginning?

6. King Pancake ordered 77 pancakes from his chef for dinner. The chef can make 5 pancakes in 1 minute, but every time he makes 5 new pancakes, 4 pancakes mysteriously disappear. Under these circumstances, how long does it take the chef to make the 77 pancakes?

7. **Ingenuity** Terry would like to visit Diann who lives over the river and behind the mountain. There are 5 bridges over the river and 3 tunnels through the mountain. As you can see in the picture, there is a fence between the river and the mountain which Terry cannot climb over. How many different paths can Terry take to get to Diann if he can cross every bridge only once?

Big Numbers

by Dan Shapiro

Dan Shapiro teaches math at Ohio State University. He enjoys working on research problems, as well as making up his own new puzzles and activities.

What is the largest number you can think of? (Here I am asking about actual counting numbers, not "infinity".) People answer this question in different ways depending on how many numbers they know. Preschoolers might answer "one hundred" because that is how far they have learned to count. Others might answer with a "zillion" or a "skillion" or (my favorite) an "impossibillion". But these names are not really defined--they are not standard names for any numbers.

When I first learned about large numbers (a large number of years ago), I read about a "googol". This nonsense name was made up to represent the number

1000000000000000000000000000000000000
0000000000000000000000000000000000000
000000000000000000000.

This is one followed by one hundred zeros. It is a very big number. If the entire visible universe were packed solid with atoms, there would be fewer than a googol atoms there.

The name "googol" was invented around 1940 by E. Kasner and J. R. Newman. They also defined a googolplex to be the number which is a one followed by a googol zeros. Writing out a googolplex in the usual base ten notation would take up a lot of time and paper. In fact, there isn't enough paper on earth to do it!

Here is a more compact way to write such large numbers. If b and n are whole numbers then b^n (read "b to the n") is the product of b times itself, n times. For example,

$5^2 = 5 \times 5 = 25$ $\quad$ $3^4 = 3 \times 3 \times 3 \times 3 = 81$

$10^2 = 10 \times 10 = 100$ $\quad$ $10^3 = 10 \times 10 \times 10 = 1000$

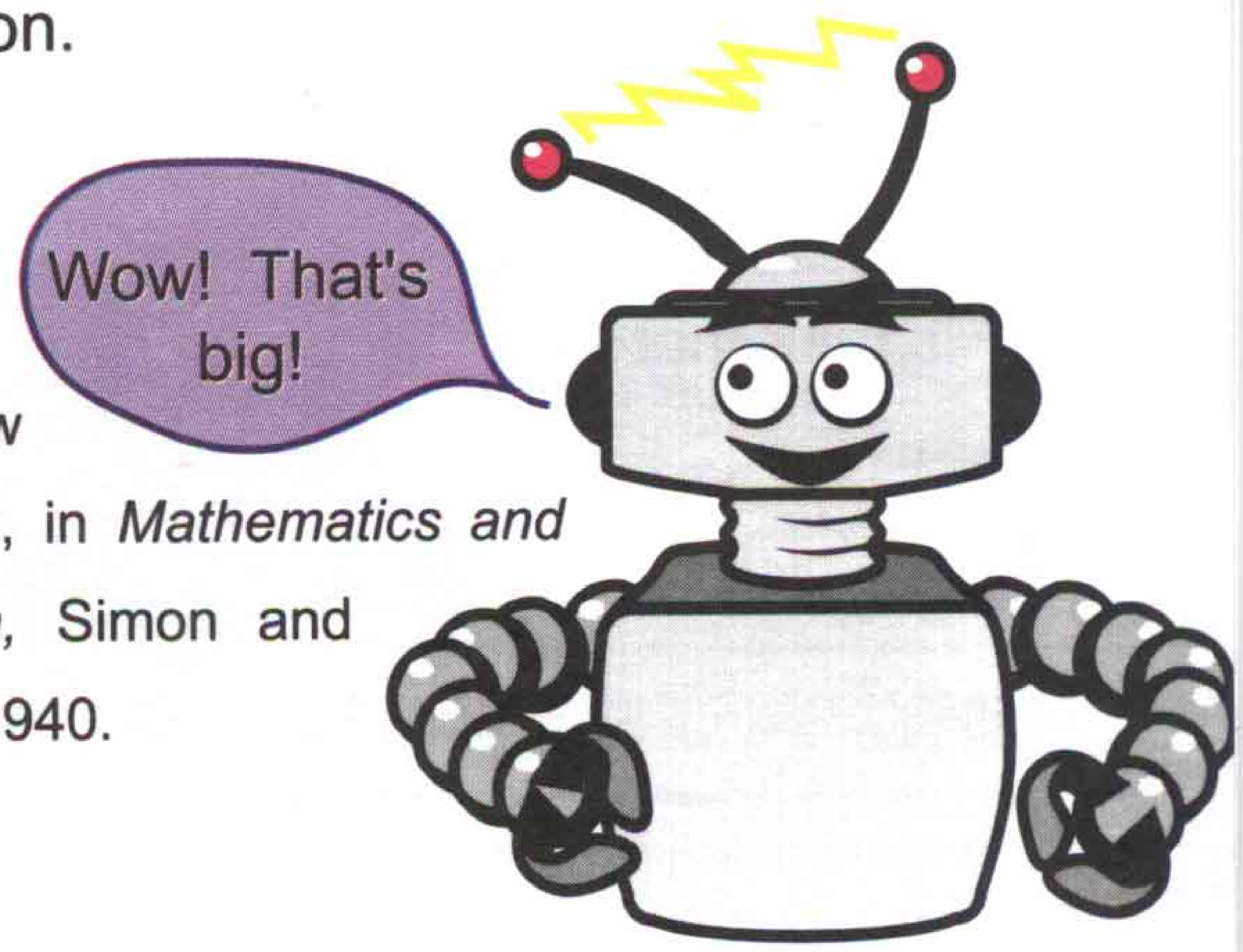
From these examples you can see that 10^n is exactly the number which is a one followed by n zeros. In particular, a googol is 10^{100}. Similarly a googolplex equals

$$10^{(\text{googol})} = 10^{(10^{100})} = (\text{one googolplex})$$

This is certainly a shorter way to write that number. Even though a googolplex is almost inconceivably large, there are other numbers so large that a googolplex seems small in comparison. In fact, most whole numbers are larger than a googolplex! (Does that seem right to you?) Can you use our shorthand notation to write down 3 numbers larger than a googolplex?

Numbers like a googol and a googolplex are ridiculously large compared to those we encounter in the real world. But in mathematics there are no limits to what we can describe with our imagination.

[K] Kasner, E. and J. R. Newman, "New Names for Old", in *Mathematics and the Imagination,* Simon and Schuster, Inc., 1940.



Puzzle Page

Math Readers,

We want to print your work! Send us your own math games, puzzles, problems, and activities. If we print them, we'll send you and your math teacher free *Math Reader* pens.

WORD SEARCH

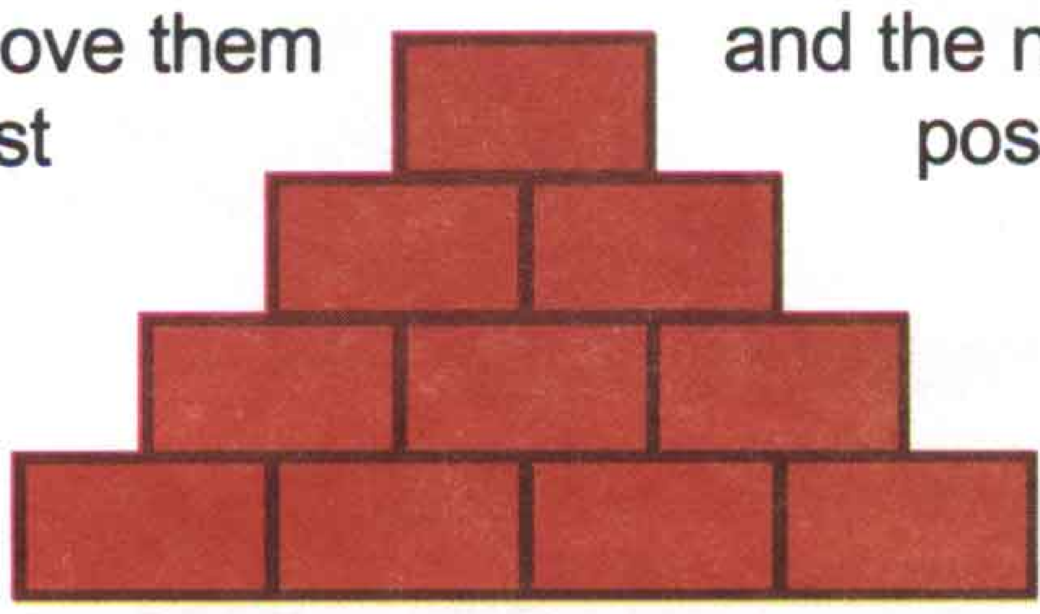
Forwards or backwards, up, slanted, or down. Where can the words in this puzzle be found?

POINT
CARTESIAN
PLANE
DISTANCE
DESCARTES
PAIR
NUMBER
LINE
SUM

S	S	E	L	E	A	N	G	L	E	H	S	M	B
W	A	D	I	G	I	T	I	N	E	E	M	A	T
L	P	R	O	S	P	L	A	N	E	L	S	D	R
I	A	O	M	M	U	I	A	U	D	O	M	A	I
N	S	E	N	I	S	A	E	H	E	I	R	K	J
E	C	T	R	E	A	N	G	L	S	E	A	I	N
V	A	R	T	T	C	I	C	E	C	A	U	R	U
T	L	V	O	E	C	L	V	Q	A	N	Q	B	M
K	A	A	T	T	A	I	O	T	R	G	S	K	B
C	A	D	E	T	N	I	O	P	T	L	H	L	E
R	U	G	O	A	B	E	G	N	E	R	R	A	R
T	E	R	G	N	G	L	E	O	S	M	E	W	X
R	E	R	E	B	E	C	N	A	T	S	I	D	M
Z	N	X	I	T	R	I	A	P	S	S	U	M	I

THE SMALLEST WALL

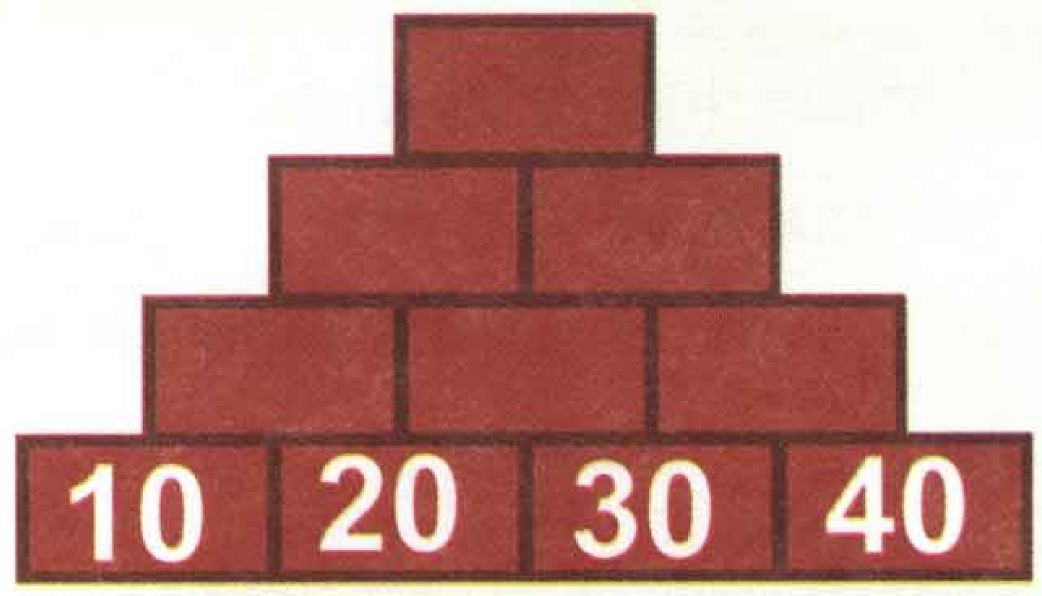
Write different positive whole numbers in the rectangles so that the sum of two neighboring numbers is in the rectangle above them and the number on top is the smallest possible.



THE WALL GAME

Fill in the empty rectangles so that the sum of two neighboring numbers is in the rectangle above them.

a)



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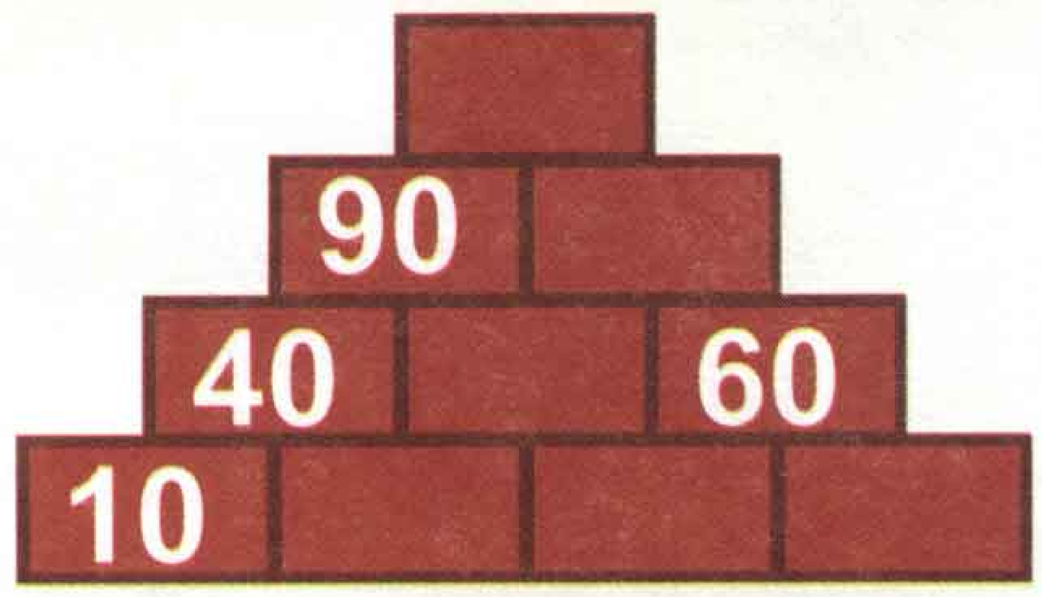

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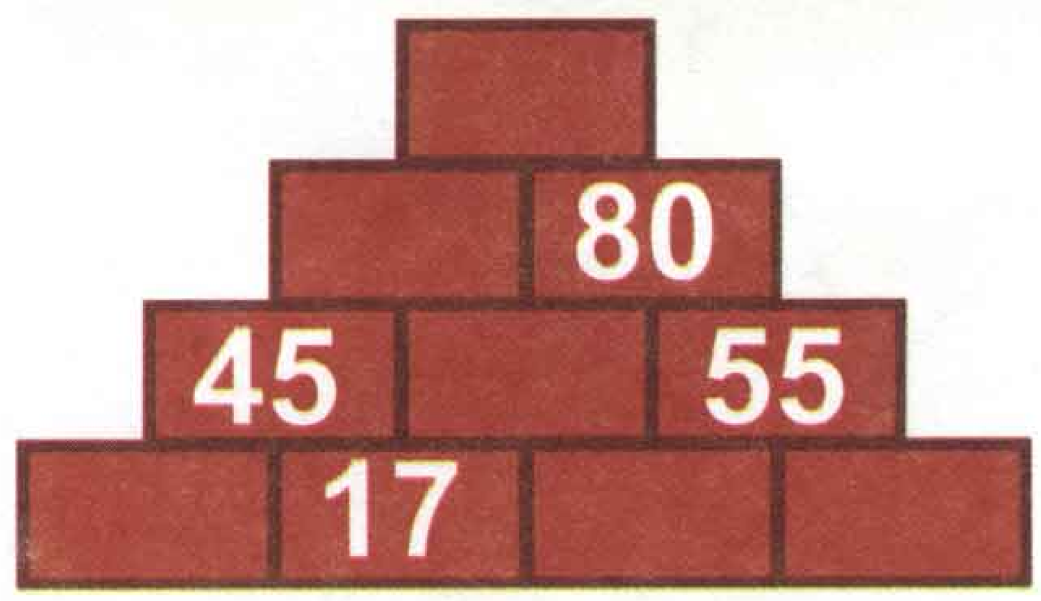
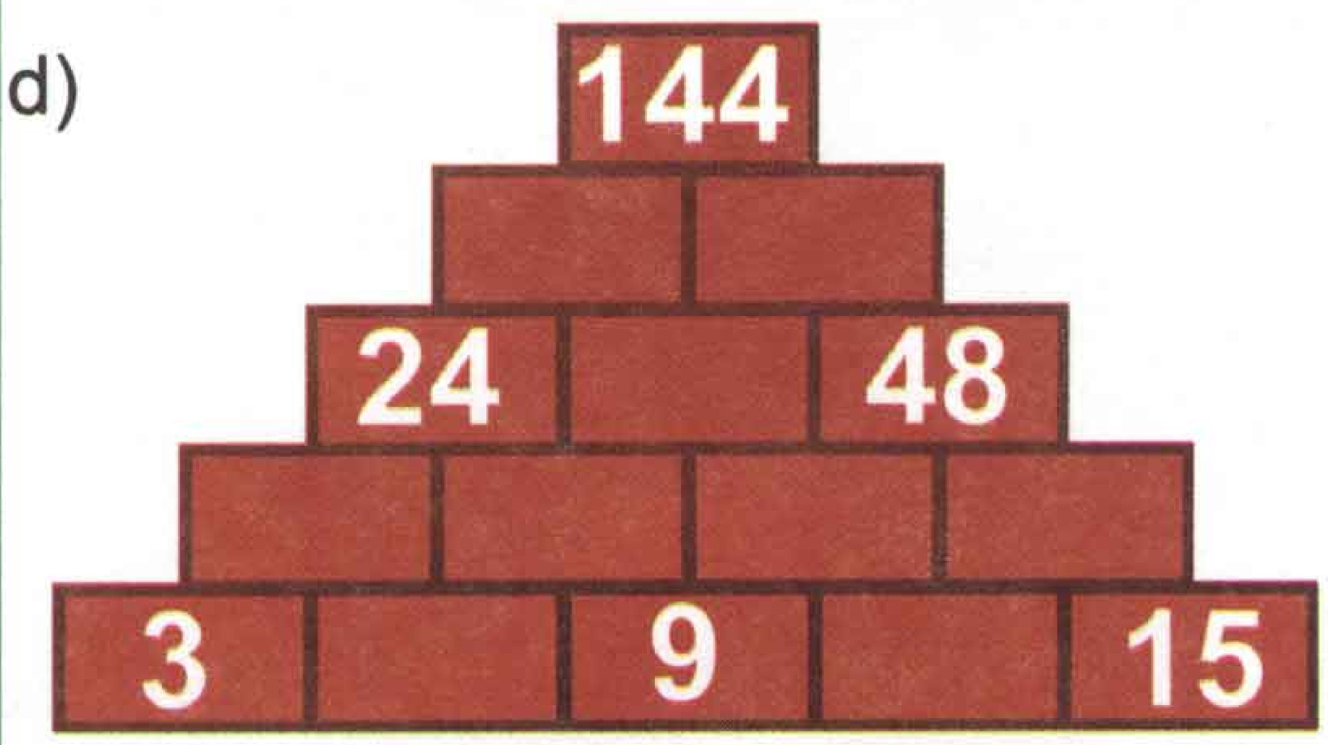


d)



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More Fun Problems

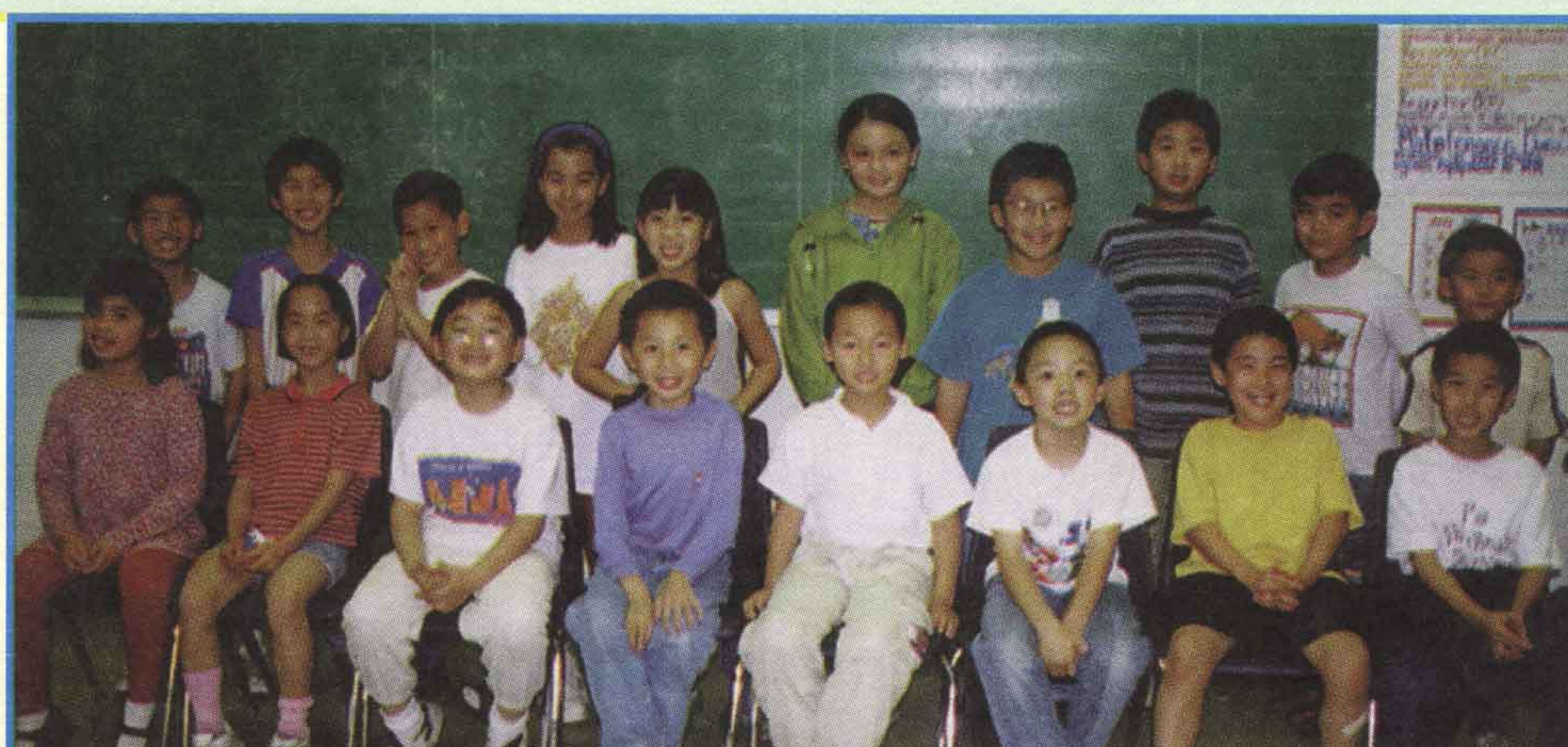
One place to find fun problems is on the web. Xingde Jia has weekly problems and projects that kids can work on. Check it out at
http://erdos.math.swt.edu/contest
His students at the Austin Great Wall Chinese School are pictured below.

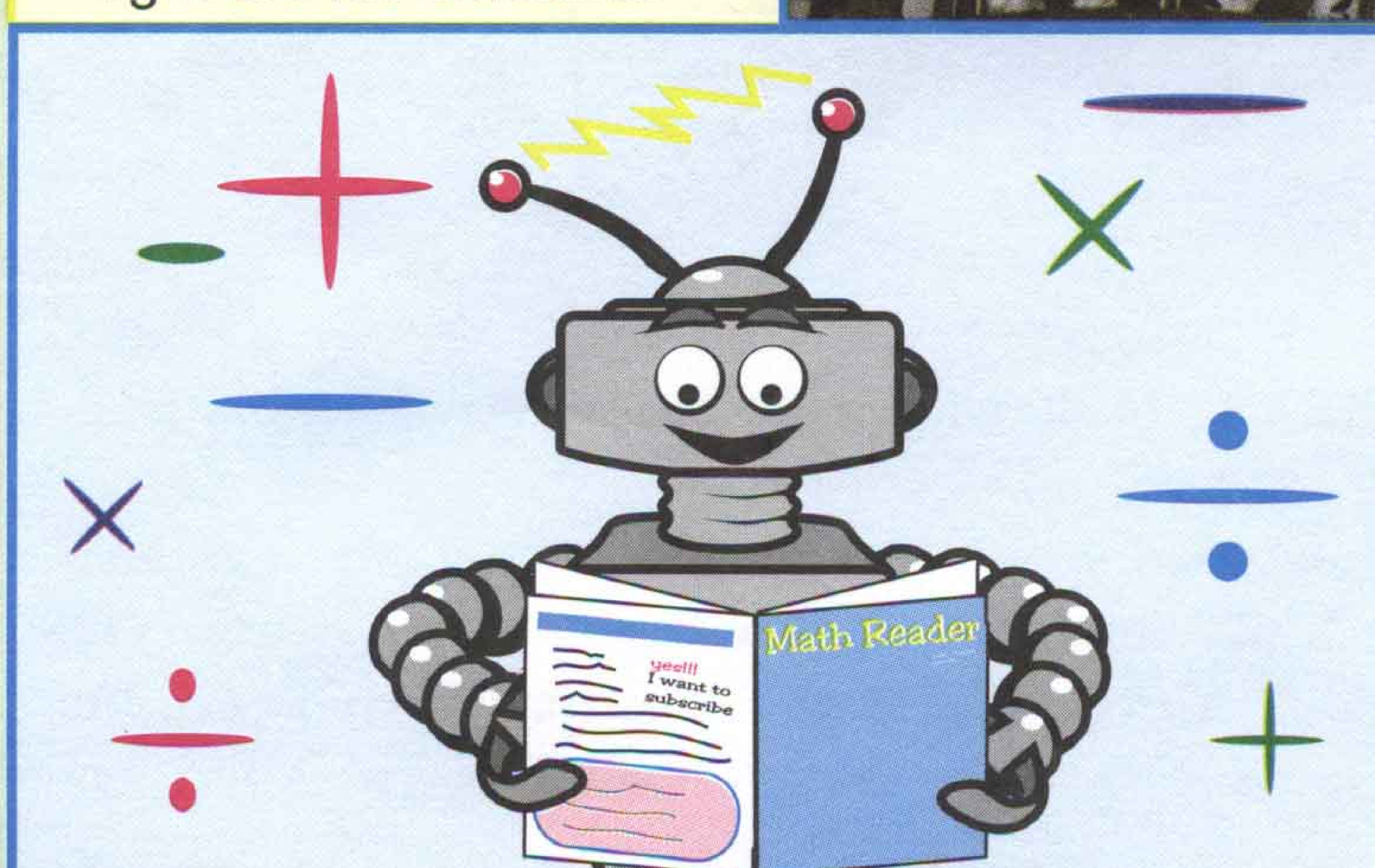
Riddle

When does 2 added to 11 equal 1?

see back cover for answer

Xingde Jia, Professor of Mathematics at Southwest Texas State University volunteers to teach a Sunday math class at the Austin Great Wall Chinese School. Pictured to the right are his students.





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Schools and individuals are encouraged to subscribe now for next year to ensure that you don't miss any issues! Our May issue will be the last in Volume I. We will resume next September with Volume II. All subscribers from last year will continue receiving *Math Reader* until they have a full collection of 8 issues, which in most cases will be in October. Thanks again to everyone for your wonderful support. We hope to hear from you all soon!

Answer to Riddle: At 11 PM at night.