AMAZING CODES

Many readers have probably experienced the frustration of trying to reach the centre or exit of a garden maze consisting of pathways enclosed by high hedges. The famous maze at Hampton Court Palace was first planted during the reign of William III.

The maze has its origin in Ancient Greek and Roman history when "labyrinth" was the name given to a building usually partly underground, which contained a large number of confusing passages to make exit and entry difficult.

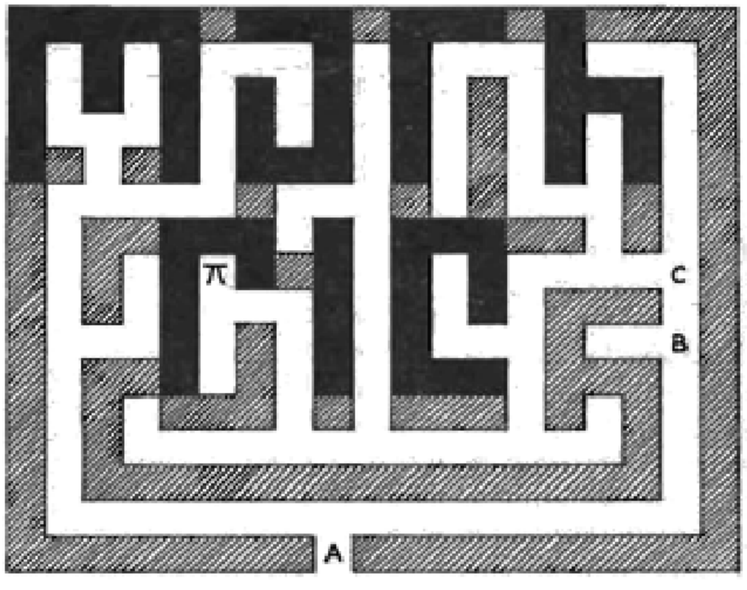
The floors of French Gothic cathedrals often include labyrinth patterns and it has been known for the architects' names to be incorporated in the designs.

Although the "solution" to a maze can be found readily from a plan of the pathway network, the task is more daunting when the high hedges of reality hide everything from view.

For mazes of the Hampton Court type, the use of a binary code can make progress very straightforward. At each junction "0" represents movement to the left and "1" to the right. In the Math Pie maze, a right turn is required on entry (A): hence, a "1" is placed in the units column. "B" and "C" demand movements to the "right" and "left" respectively. The procedure is followed until "π" is reached, giving the binary number (reading from right to left) 10100011. Converting into the denary system, we have 163_8 as the coded key to this maze, the suffix 8 showing that eight junctions are passed.

What is the key to the Hampton Court maze?

Book tokens will be sent to readers whose "mathematical" mazes are published in "Pie".



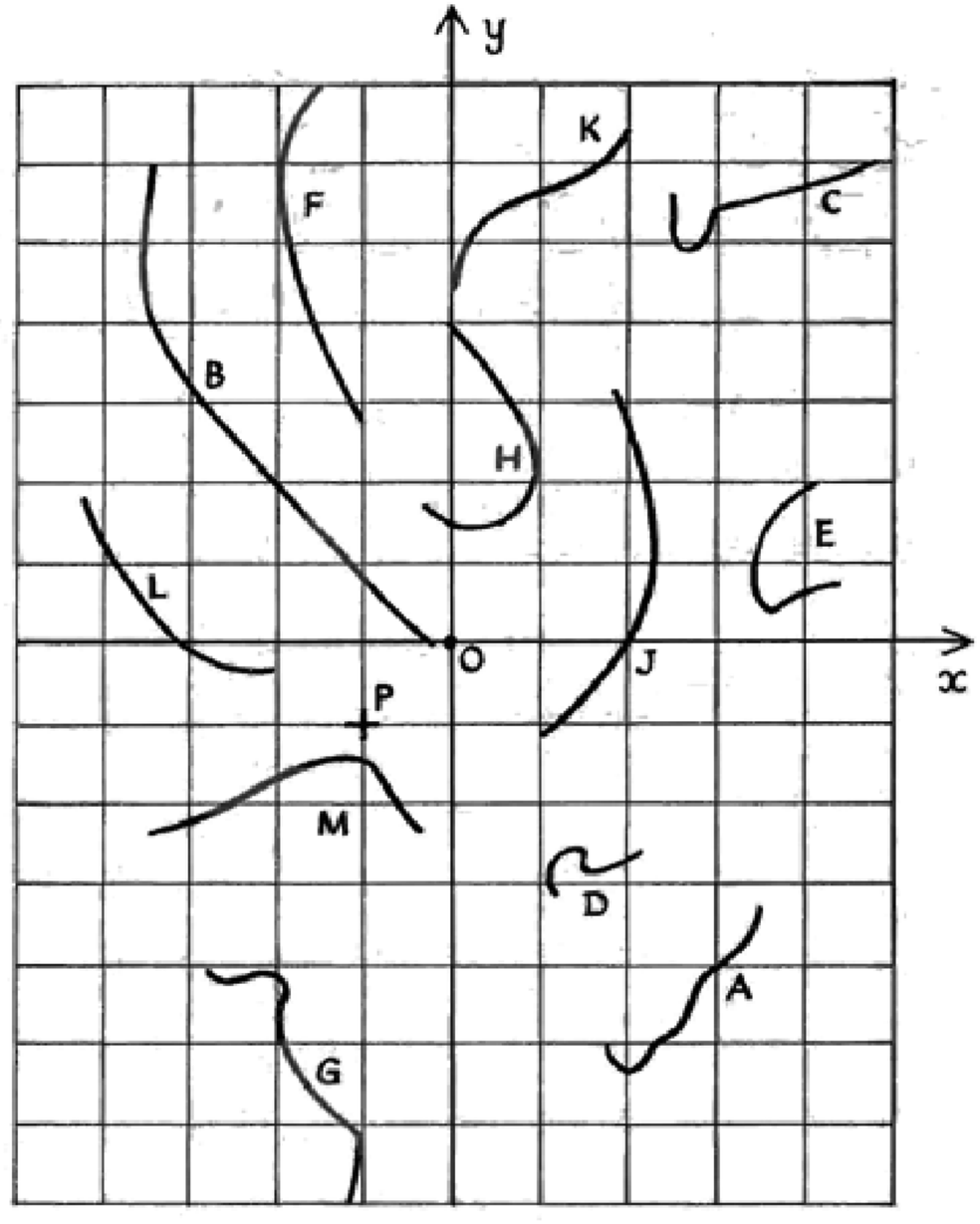
C.V.G.

612

join the mathematical pie

No. 77 *Editorial Address:* West View, Fiveways, Nr. Warwick SPRING, 1976

SCRAMBLE



605

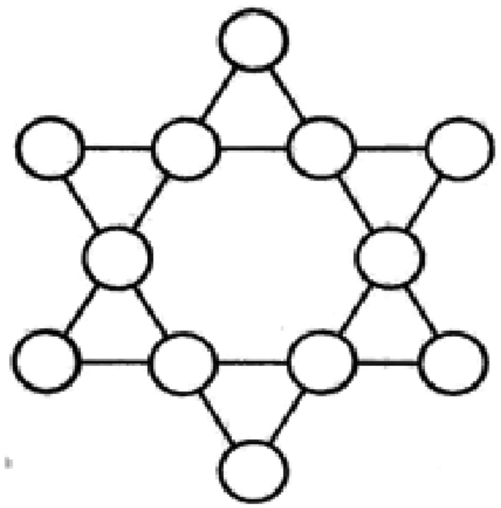
(see overleaf)

To unscramble the drawing you will need a piece of tracing paper large enough to contain the rectangle, about 14 cm by 10 cm. Place the tracing paper over the illustration, draw round the rectangular outline and mark P.

The list below gives the positions to which P on the tracing paper must be moved before you trace each lettered curve. The x— and y— axes and the origin 0 are marked on the diagram, so, for example, P should be placed over 0 before you trace curve A. Be careful to adjust the edges of your tracing paper rectangle to make sure that they are horizontal and vertical after each move. Finally, rotate your tracing paper through 90°.

A (0, 0)	B (−4, −2)	C (5, 4)	D (1, −1)	E (1, 4)
F (−2, −1)	G (−3, −2)	H (−1, 0)	J (−2, 1)	K (−1, 6)
L (−4, 0)	M (−1, −4)			

E.G.



DAVID'S DOZEN

Place the numbers 1 to 12 in the diagram on the left so that the sum of the numbers in any straight line is the same. As each number is used twice, the total of the lines is 156, so that each line has a total of 26.

R.M.S.

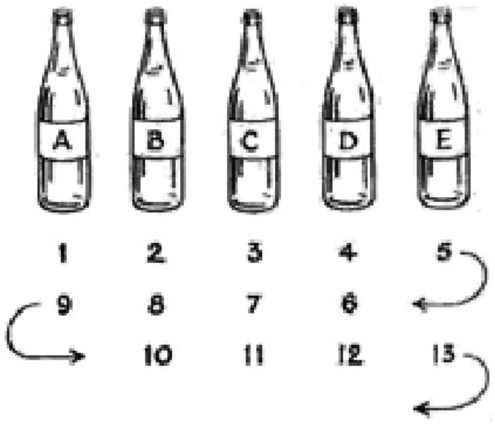
SYMMETRY

$121 = \frac{22 \times 22}{1+2+1}$ Find similar expressions for 12321 and 1234321. R.H.C.

COUNTER ESPIONAGE

Thirteen counters are arranged in a straight line. A and B play the game that you can knock out either one counter or two consecutive counters.

How can A be sure of winning if the one taking the last counter (a) wins, (b) loses? R.H.C.



TOP OF THE POPS

The tuck shop keeper offered to give away one of five bottles on his shelf to whoever could indicate which bottle was their choice and then count up to 500 using the line of five as an aid and able to finish on his chosen bottle.

Cutie Pie chose bottle A. Where should she start so that she wins?

R.H.C.

JUNIOR CROSS FIGURE No. 68

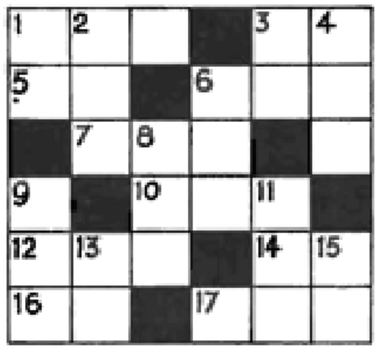


fig. 1

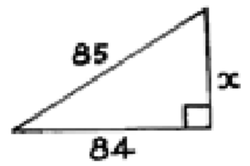
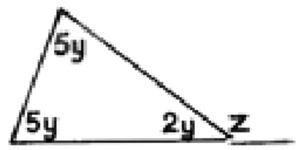


fig. 2



Clues Across

1. x^2 in fig. 1.
3. The sum of two consecutive numbers whose product is 132.
5. The mid-point of the line joining (5,6) to (11,2).
6. Jumbo?
7. The volume of a cube whose surface area is 384 cm².
10. Three consecutive numbers whose sum is 18.
12. One-third of a complete turn in degrees.
14. y in fig. 2.
16. x in fig. 1.
17. The area of the triangle in fig. 1.

Clues Down

1. One-fifth of a right angle in degrees.
2. 17 across with its digits reversed.
3. Two dozen.
4. $\sqrt{(625 \times 225)}$.
6. The surface area of a cube whose volume is 1,331 cm³.
8. z in fig. 2.
9. $(ab)^2 - ab^2 + b$ when a is 4 and b is 3.
11. The point of intersection of $y = 2x$ and $y = x + 7$.
13. The average of 17, 21 and 31.
15. The product of two consecutive numbers whose sum is 15.

E.G.

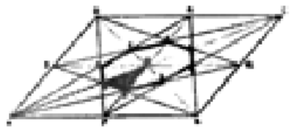
SOLUTIONS TO PROBLEMS IN ISSUE No. 76

JUNIOR CROSS FIGURE No. 67

3	5	7	■	1	2	1
1	■	3	4	3	■	9
5	5	5	■	6	7	8
■	3	■	■	7	■	■
4	8	4	■	2	7	9
6	■	3	1	8	■	1
2	9	2	■	9	6	5

CAT'S CRADLE

The area is one-sixth of the whole.



SENIOR DOUBLE CROSS

■	1	3	5	7	9	■
1	8	■	7	8	6	3
4	9	7	■	1	4	0
7	■	9	6	5	■	4
2	4	3	■	6	5	9
7	9	3	9	■	4	7
■	7	2	8	8	6	■

■	L	E	A	S	T	■
L	O	■	S	O	R	E
I	T	S	■	L	I	D
S	■	T	R	A	■	I
P	I	E	■	R	A	T
S	T	E	T	■	I	S
■	S	P	O	O	R	■

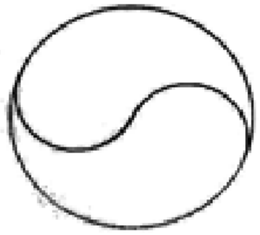
RHYME SOLUTION

Salt sea sailors, it is told,
Persist depressed til Pie is sold:
Dear readers, is it lie or real?
Do spirits soar to pies appeal?

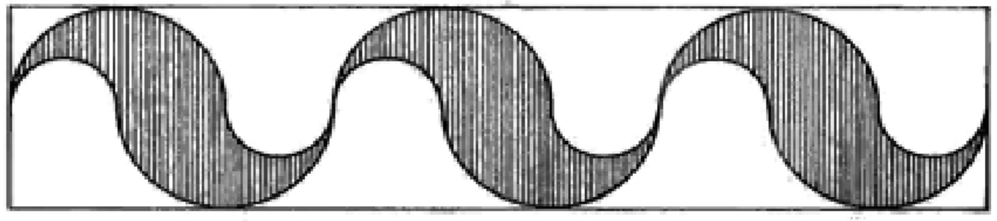
B.A.

BALANCING ACT

SURFIN' SIMON is going to make himself a new hippy headband, and he wants a design to be as balanced as possible, rather like the ancient symbol on the right.



It is easy to see that each half of the motif is the same. Simon has been experimenting with frieze designs of a similar nature as shown below.

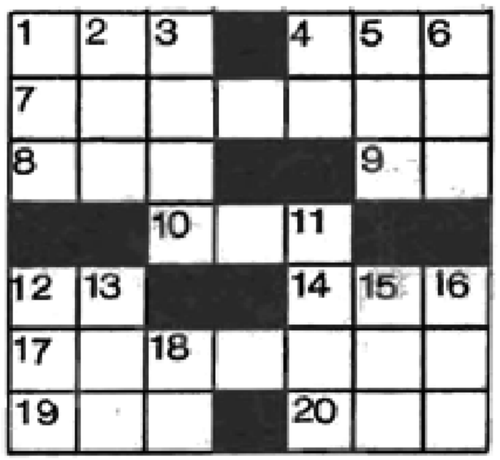


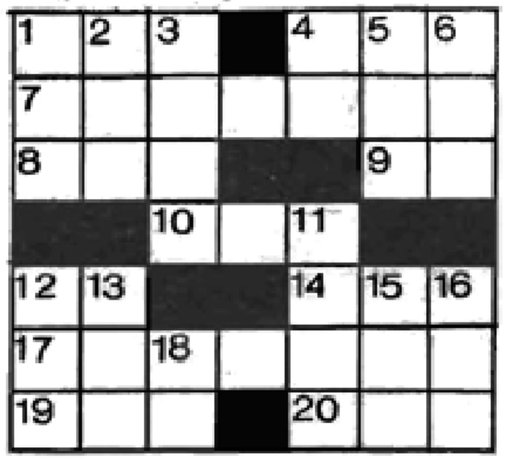
He is pleased with the wave effect but he has realised that less than half the headband is shaded. Being no slouch at Maths (after all, he is a whiz at hydrodynamics) he has calculated that only $\frac{\pi}{8}$ of the band is coloured.

Can you check his result, and, even better, can you find a relationship between the diameters of the arcs which will ensure a balance between the shaded and the unshaded parts? If the diameters are d and md units, try to find the value of m necessary to produce the balance.

E.G.

SENIOR "DOUBLE CROSS" No. 2





Each digit of the cross figure, left matches with one letter in the corresponding position of the crossword, right. Decode the message at the end.

Clues Across

1. Sum of 3 terms of G.P. with $t_4=1500$ and $t_6=37500$.
4. Surface area of cuboid whose sides are $\frac{1}{2}x$, x, $7\frac{1}{2}x$ and whose volume is 248.
7. $2a^3-26a^2-15a$ if $a=111$.
8. An odd number: very orderly but completely uneven.
9. The centre (x,y) of the circle $x^2+y^2+84=18x+4y$.
10. ABC is a triangle, find b if A is 28°12′, B is 90° and a is 30.
12. Four times a two-digit prime. If this were reversed, the result would be a prime six more than the first.
14. Solution of $100^x+3\cdot10^x+2=12$.
17. (x,y,z) if $x+y=109$, $x+z=289$, $y+z=250$.
19. (a,b) where $b=2k=a^2$.
20. $(k+3)^2$, a palindromic number.

Clues Down

1. 20 across +200 gives a countdown.
2. First three digits of 17 across.
3. TRIP minus HAH.
4. Cube root of two to the power fifteen.
5. $15{\cdot}59\times55{\cdot}1$.
6. Twice the sum of all the natural numbers from 1 to 28 inclusive.
11. HARP plus ICE.
12. $(x-y)$, given that $x+y=1026$ and $x^2-y^2=999{,}324$.
13. Number of days in a normal year—but subtract Dec., Jan., July and Aug.
15. Decimal for $\frac{3}{25}$ (including the units).
16. MPH divided by H (but nothing to do with acceleration).
18. The decimal equivalent of duodecimal 30.

Clues Across

1. Play? Perhaps, or maybe only part of the action.
4. This is a silly start for any association.
7. Perfect place to operate, or 1 across.
8. An organ within the heart?
9. Pronoun.
10. Spoil in a farm area.
12. It is the same as nine across, isn't it?
14. Animal copy.
17. This document starts with two down.
19. Edge of a garment.
20. Not an Indian Summer; a French one!

Clues Down

1. Consumed, almost sounding like 20 across.
2. Half of a repetitive dance.
3. One pie every one of these.
4. Where is it? In the middle of 11 down.
5. First part of Ceylon's new name.
6. Very definite ideas about a collection.
11. Rodent, North of East, pays a housing tax.
12. German I.
13. Article? Definitely!
15. Animal companion.
16. Before, in olden times.
18. I, an inaspirate leg of pork!

Message 63248 091 1374 2156 74130 32 241 05971

E.G.

THURSDAY'S CHILD

Are you a Thursday's child? On what day of the week was your grandmother married? Will your hundredth birthday be on a Saturday? Your history teacher says that King John signed Magna Carta on the 19th June, 1215, and that was a Friday. Was he right or not?

How would you like to be able to answer these questions and many others like them instantly (or almost so?). In this issue we shall see *how* to do it for this century and next time we shall see why it works and how to extend the process back into the past and on into the future.

Table I: Day remainder

Su	M	Tu	W	Th	F	Sa
0	1	2	3	4	5	6

Table II: Month remainders

J	F	M	A	M	J	J	A	S	O	N	D
0	3	3	6	1	4	6	2	5	0	3	5

Table III

0	3	3
6	1	4
6	2	5
0	3	5

Table III is another way of writing and remembering Table II. Look for the patterns in it!

To calculate the day of the week of, say, 18th August, 1984, we proceed as follows. Write down—

1.	The day of the month	18	(4)
2.	The month remainder	2	(2)
3.	The year of the century	84	(0)
4.	The number of leap years which have occurred so far	21	(0)
	Adding we get	125	(6)

Now cast out the complete weeks of 7 days. $125 = 17 \times 6 + 6$ and we are left with a remainder of 6 and consulting Table I we see that 18th August, 1984, will be a Saturday. We can save labour if we cast out the sevens as we go. We get the column of figures in brackets which is much easier to add up and gives the same answer with a lot less trouble.

Now try it out on today's date, your birthday, and anything else you can think of this century. Perhaps you can think how to extend it to next century?

R.M.S.