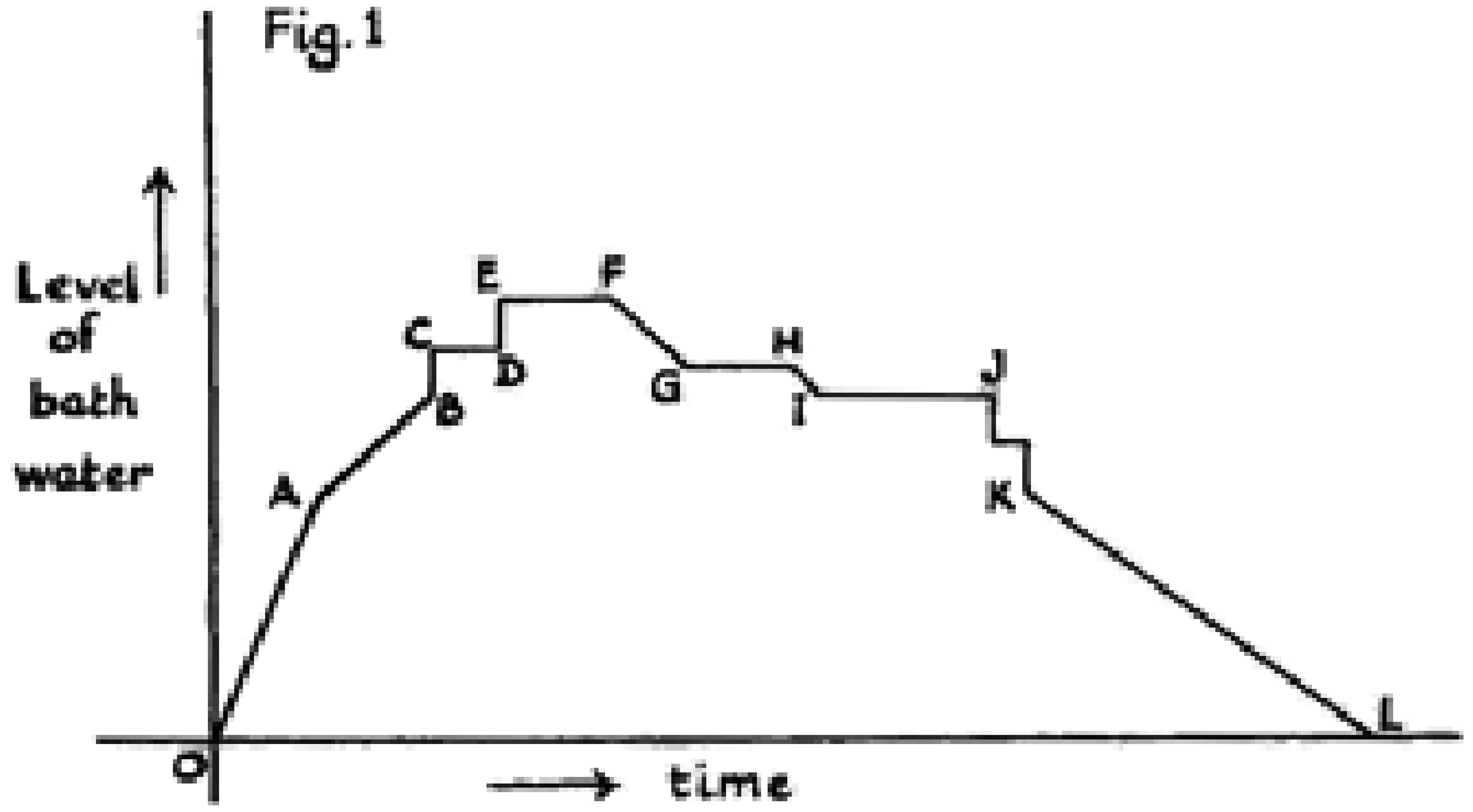


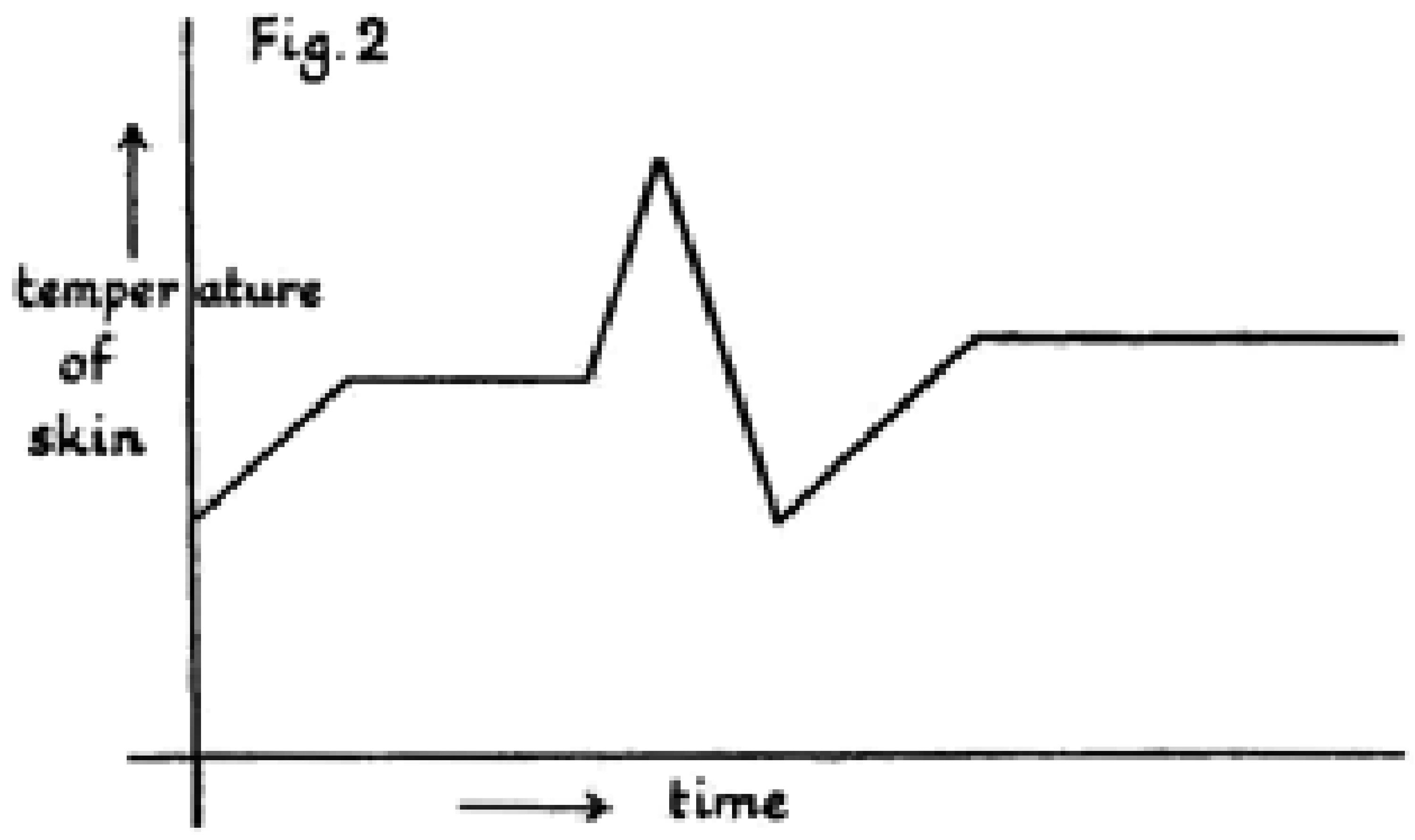
EVERY PICTURE TELLS A STORY

The graph, Figure 1, tells the story of a family's bath time.

O–A: Hot and cold water fills the bath.
A–B: Cold only runs in.
B–E: The twins get into the bath.
F–G: One of the twins accidentally pulls out the plug.
H–I: The twins splash each other and the walls and floor.
J–K: The twins get out of the bath.
K–L: The water is let out.

See if you can make up a story to go with the graph in Figure 2.
Your friend may make up a different story, and both could be correct.

A.M.A.



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MATHEMATICAL PIE

No. 101 *Editorial Address:* West View, Fiveways, Nr. Warwick SPRING, 1984

NOUGHTS AND CROSSES

Play this game with a friend.

8	4	18
23	43	29
51	64	73

Move 1: Select two numbers from the small grid.

Move 2: Multiply the two numbers; some of you may need a calculator.

Move 3: Find your answer on the large grid and cover with an "X".

Move 4: Your friend now repeats these moves but covers the answer with an "O".

32	256	414	116	667	408
1314	989	144	1247	918	1856
3139	584	2117	1472	3264	512
184	522	1173	344	774	92
292	2193	72	1152	2752	204
1679	232	172	1479	4672	3723

The first to put three of their symbols in a row wins.

As you become more proficient, extend the game to four symbols in a row.

C.B.A.

ODD ONE OUT No. 4

Which is the odd one out in each of these sets – and why? This time it's all fractions and decimals.

(1) $\left\{\frac{3}{4}, \frac{15}{20}, \frac{24}{36}, \frac{30}{40}\right\}$

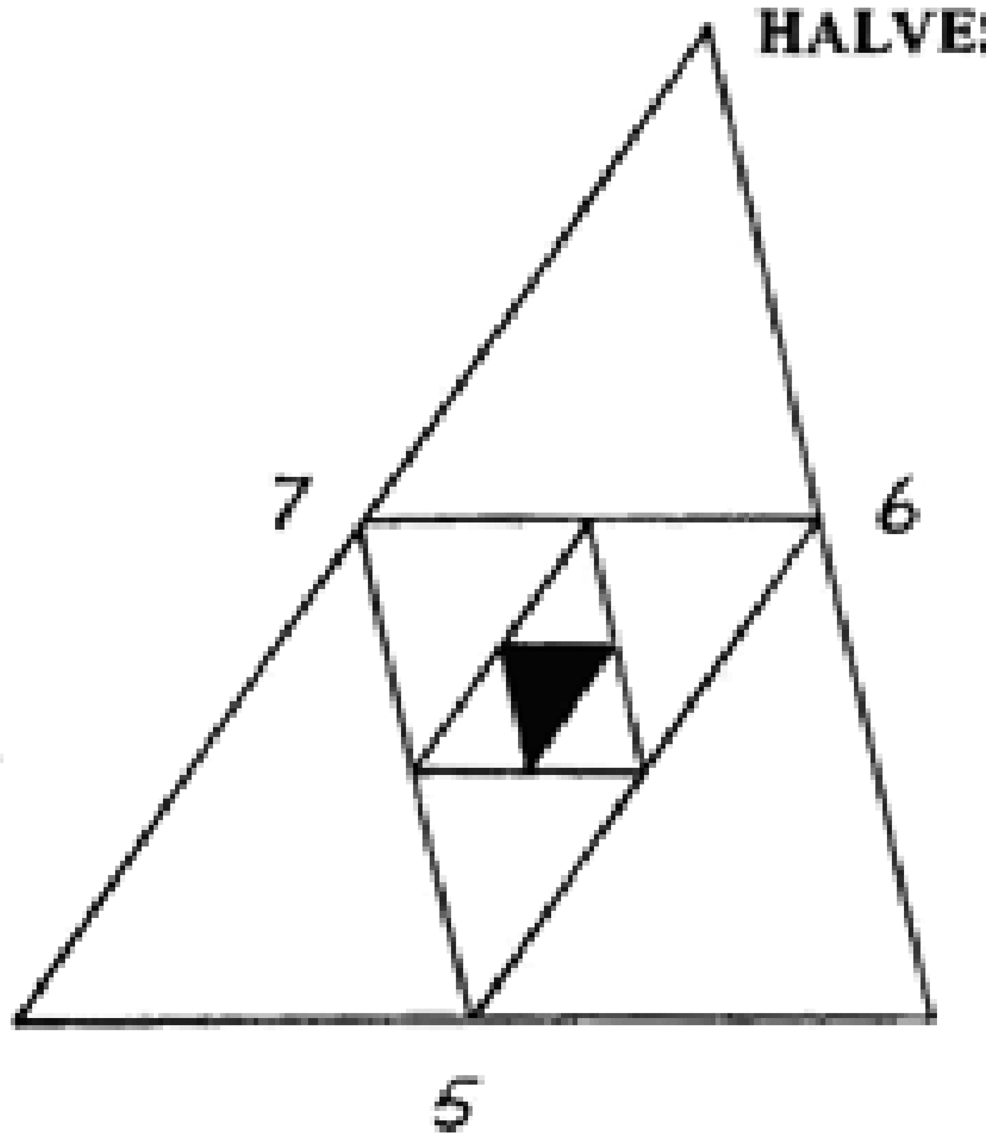
(2) $\left\{\frac{17}{100}, \frac{3}{4}, \frac{6}{25}, \frac{2}{5}\right\}$

(3) $\{0.\dot{3}, 0.25, 0.\dot{2}, 0.125\}$

(4) $\left\{3\frac{2}{3}, 2\frac{1}{5}, 5\frac{1}{2}, 1\frac{5}{7}\right\}$

E.G.

HALVES ALL THE WAY



The diagram on the left shows a triangle whose sides are 5, 6 and 7 units in length. The mid-points of the sides are joined to form a new triangle. What are the lengths of the sides of the black triangle?

What fraction of the original triangle is the black triangle?

B.A.

SUPPLEMENTARY TRIANGLES

submitted by Mr H. L. Kotkin of Kingston-on-Thames

In the triangles ABC, XYZ, AB = XY, BC = YZ and the angles ABC and XYZ are supplementary. The median BM of the triangle ABC is 3.5 cm. Find the length of XZ and generalise the result.

ELLIOTT'S FRIEND

Submitted by G. M. Hicks, The High School, Northampton

On squared paper, mark an x-axis from 0 to 80 and a y-axis from 0 to 110.

Plot the following points and join each group by straight lines.

(42, 67), (39, 38), (30, 34), (24, 39), (13, 41).
(5, 46), (13, 41), (25, 30), (26, 5).
(18, 5), (18, 25), (5, 38).
(36, 37), (40, 34), (50, 32), (57, 35), (63, 36), (70, 33), (80, 21).
(80, 9), (65, 22), (65, 28).

JUNIOR CROSS-FIGURE No. 72

Solve the equations

(i) $\frac{x+2}{5} = 8 - \frac{x-2}{4}$ and (ii) $3a + 2b = 4$, $a + 3b = 13$.

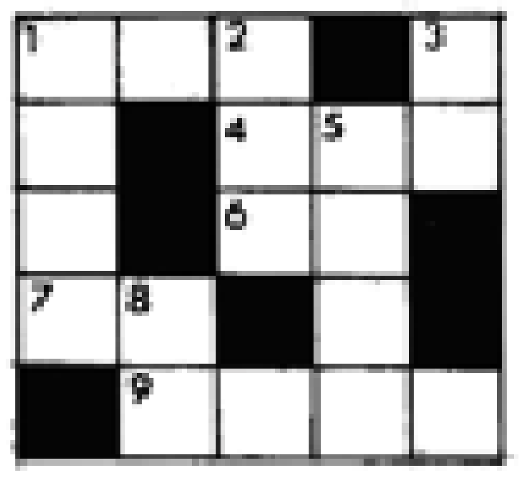
Use your results to evaluate the clues below and find the value of p. Make up a clue of your own for 1 down.

CLUES ACROSS

1. $a^2b + 11x$
4. $x^2 - ab$
6. $x + a + b$
7. $2x + a + 3b$
9. $\frac{2150(x + a + b)}{p}$

CLUES DOWN

2. $x^3 - 5000$
3. $x(a + b)$
5. $10x^2 - 6x - b + a$
8. $bx - 3a$



MAGIC WITH DICE No. 2 – SOLUTION

Trick number one: simply subtract one from each of the end faces.
Trick number two: add together the numbers of the end faces and subtract your result from 21.

All the tricks we have described depend on the fact that the opposite faces on a die always add up to 7.

E.G.

SOLUTIONS TO PROBLEMS IN ISSUE No. 100

Find the Limit The limit is 2.618 as $\sqrt{2.618} = 1.618$.
Centurions The Roman numbers which can be made to equal 100 are CXI, LXII, XXXV, XXX. The factors of 100 occur in pairs whose product is 100 except for the factor 10. Hence the product of the factors is 1 followed by nine 0's.

Senior Cross Figure No. 72 We regret the omission of a black square between the squares marked 9 and 14.

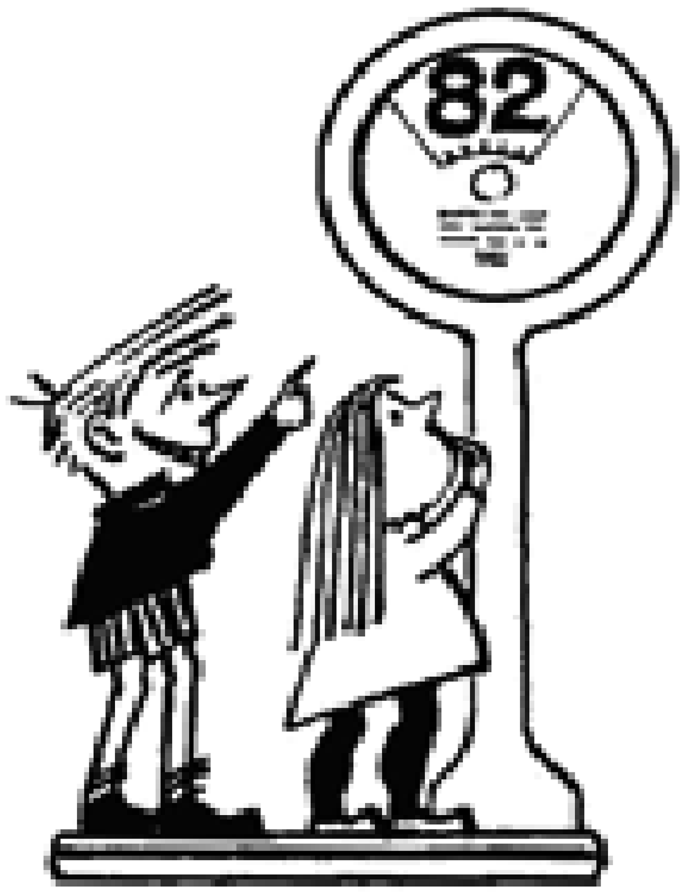
Clues across: 1. 150; 3. 712; 6. 77; 7. 5544; 8. 36; 9. 825; 11. 705; 13. 26; 14. 1032; 16. 64; 17. 108; 18. 150.

Clues down: 1. 1728; 2. 57; 3. 75; 4. 1420; 5. 24; 7. 56; 8. 35; 10. 2000; 11. 76; 12. 5040; 13. 22; 14. 11; 15. 38; 16. 65.

Who's My Friend? No. 3 A. Larry & Harry, B. Bonnie, C. Dennis, D. Phillippa.
Room There are two possibilities with four rooms. Three rooms in the centre with a room all the way round or a central room with three rooms round it.

Magic Squares for Hallowe'en The missing letters spell WIZARDS and WITCHES

B.A.



A WEIGHTY PROBLEM

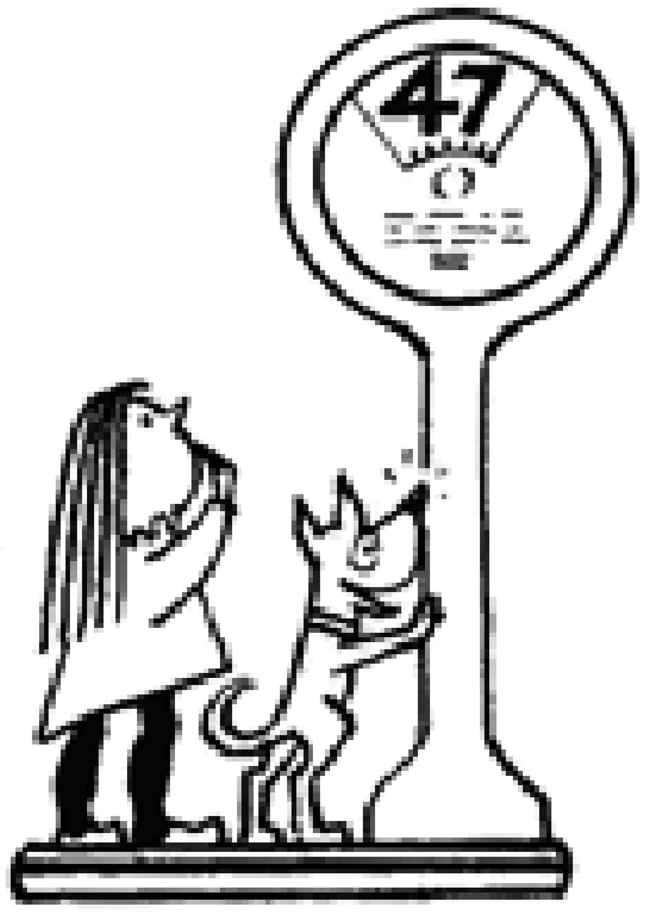
A boy, his sister and their dog stood on a weighing machine in pairs and the readings were as shown on the left.

How much did each weigh if the scale was in kilogrammes? You do not need to use algebra to solve this problem.

B.A.

TRUE OR FALSE

1. If you multiply two numbers together you get a bigger number than if you add them.
2. The square root of a number is always smaller than the original number.
3. The reciprocal of a number is always smaller than the original number.



Which of the above statements are false and what circumstances make them false?

R.H.C.

THE ROOT OF ALL EVIL

$\sqrt{(ab)} = \sqrt{(a)} \times \sqrt{(b)}$ and $1 = (-1) \times (-1)$. Hence $\sqrt{(1)} = \sqrt{(-1)} \times \sqrt{(-1)} = \{\sqrt{(-1)}\}^2$.

Similarly $1 = 1 \times 1$, so that $\sqrt{(1)} = \sqrt{(1)} \times \sqrt{(1)} = \{\sqrt{(1)}\}^2$.

It follows that $\{\sqrt{(1)}\}^2 = \{\sqrt{(-1)}\}^2$ and so $1 = -1$.

R.H.C.

JUMBLED NUMBERS

The digits of the addition $8765 + 3311 = 3346$ are correct but not in the correct order. Rearrange the digits on the left to make the statement true.

R.H.C.

(57, 35), (53, 42), (56, 63), (60, 68), (65, 70), (71, 80), (66, 90), (60, 93), (55, 99), (50, 99), (40, 102), (35, 106), (30, 105), (29, 107), (21, 105), (33, 97), (40, 97), (55, 94), (60, 88).
(60, 93), (61, 78), (52, 72), (41, 79), (37, 85).
(37, 90), (43, 81), (46, 80), (56, 82), (57, 84), (54, 91), (43, 94), (37, 90).
(41, 90), (42, 86), (46, 83), (51, 84), (52, 86), (50, 89), (44, 92), (41, 92).
(45, 84), (44, 88), (48, 90).
(52, 72), (32, 63), (12, 73), (9, 80), (13, 86), (10, 90), (14, 102), (21, 105).
(15, 83), (12, 80), (15, 76), (18, 75), (25, 70), (30, 71), (33, 69), (38, 71), (34, 85), (31, 83), (31, 85), (30, 86), (28, 85), (27, 87), (25, 86), (24, 89), (25, 90), (27, 90), (29, 89), (32, 88), (34, 85).
(28, 85), (26, 79).
(25, 97), (23, 91), (18, 88), (14, 93), (17, 99), (21, 101), (25, 97).
(24, 95), (22, 98), (18, 96), (17, 93), (19, 89).
(20, 90), (19, 94), (23, 96).

MAGIC WITH DICE No. 2

In issue No. 100, the first article on dice tricks described two "mind-reading" tricks using a single die. This time you will need three dice to convince your friends that you have X-ray vision!

Trick number one: The hidden numbers

Give the three dice to a friend and turn your back while he follows these instructions: 'Make a row of three dice, making sure that each pair of faces that touch add up to six".

Now, by looking at the end faces, you can tell your friend the hidden numbers on the middle die!

Trick number two: Totally baffling?

Again turn your back: this time your friend can put the dice in a row in any way he likes, adding together the pairs of numbers on the faces which touch and then working out the final total.

Once more you look at the end faces of the row and quickly tell them their total.

Try to work out how these tricks are done: if you can't, the secrets are on page 803.

E.G.

ROLL-A-COIN

A roll-a-coin board consists of a lattice with a large number of squares each of side 4 cm. Assuming that the sides of the squares are of negligible thicknes what is the probability of a coin of diameter 2 cm rolling into a position where it does not lie across a side?

D.I.B.

1984

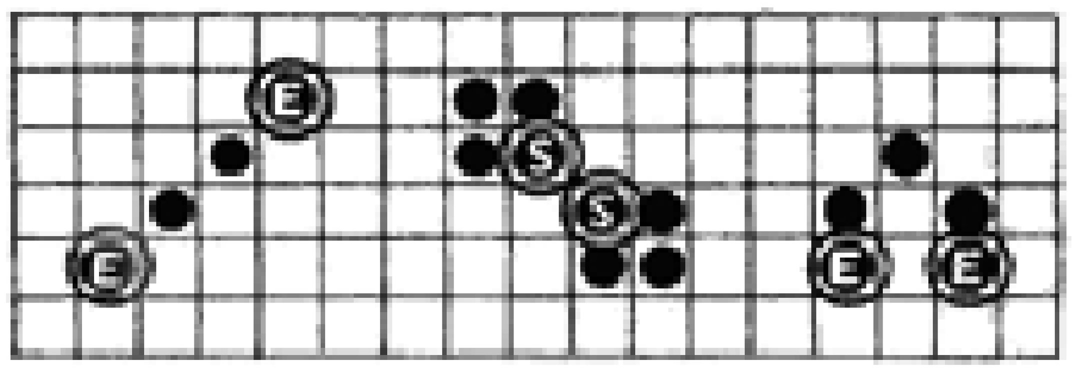
You should not be at 6's and 7's on the twenty-fifth of March unless you forgot to alter your clock. Why not?

1984 days before the first day of this year and 1984 days after the last day of the year both fall on a Wednesday. Can you find the dates?

1984 is a leap year and so does not have a middle day. At what time of which day is the year half gone?

C.B.A.

Fig. 1 "Imminent deaths"



"LIFE"

Fig. 2 " Imminent births"

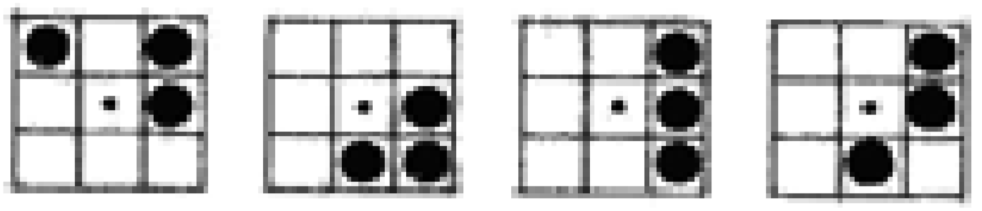
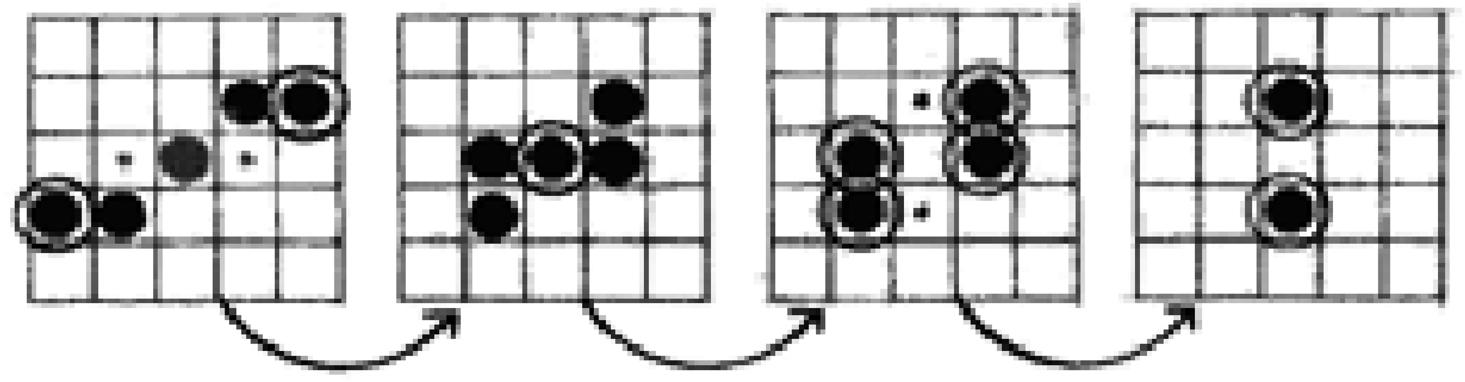


Fig. 3 A sequence of generations



LIFE

This mathematical growth game – guaranteed to send doodlers "dotty" – was popular about ten years ago just after its invention by John Conway. Nowadays, with many schools owning mini-computers, pupils might be able to work out programs based on the "Life" rules. We will describe patterns with pencil-and-paper. The rules are easy but need to be followed carefully. The patterns "grow" on squared paper (you can use 5 mm or 2 mm squares. 2 mm saves space but is a bit on the small side; maybe 5 mm is easier for beginners).

Each square can be "lived in" by a blob, provided that conditions in the eight neighbouring squares are right. A "blob" can live for ever, but blobs with only one neighbour – or none – disappear or "die". So do those with four or more neighbours. I think of these situations as dying from "exposure" or "suffocating" respectively. Figure 1 shows patterns where blobs marked E or S are about to vanish. It's useful to mark them with a coloured ring.

Fig. 4 Some "Immortal" patterns

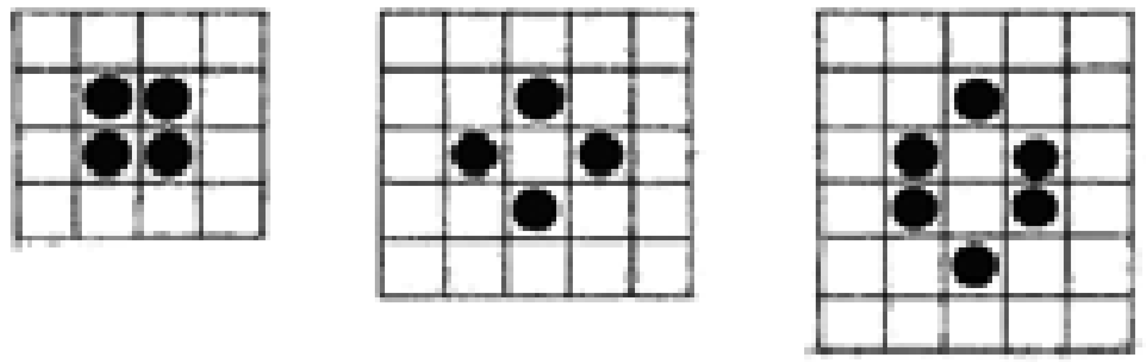


Fig. 5 The traffic lights

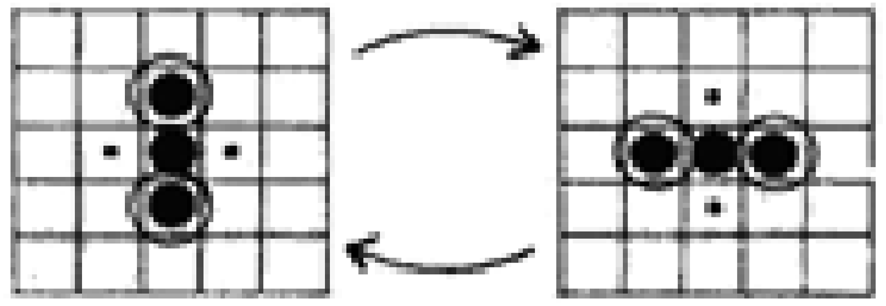


Fig. 6

Find the Frog

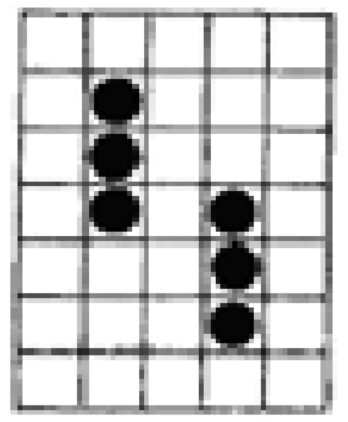
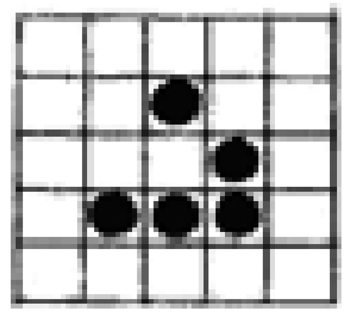


Fig. 7

The glider



Now let's think of happier things – new blobs appear in any empty squares that have *exactly* three blobs in the neighbouring eight squares. Figure 2 shows some examples where the central square is "expecting" (! !). Mark these with a coloured dot when you are working through a sequence.

The important idea is that all "deaths" and "births" happen *together* to form a new pattern based on any given pattern. Figure 3 shows a pattern of five blobs which produces three "generations" of new patterns before the "colony" dies out.

Some patterns never change, with no births or deaths (see Figure 4) – others repeat themselves – the column of three dots (Figure 5) is a well-known example often called the "traffic lights".

Try these: (a) a column of four blobs soon becomes an "immortal" hexagon, (b) a column of five takes a little longer to become a "road junction", (c) can you follow Figure 6 until it becomes a "bullfrog"? and (d) can you discover why Figure 7 is called "the glider"?

E.G.