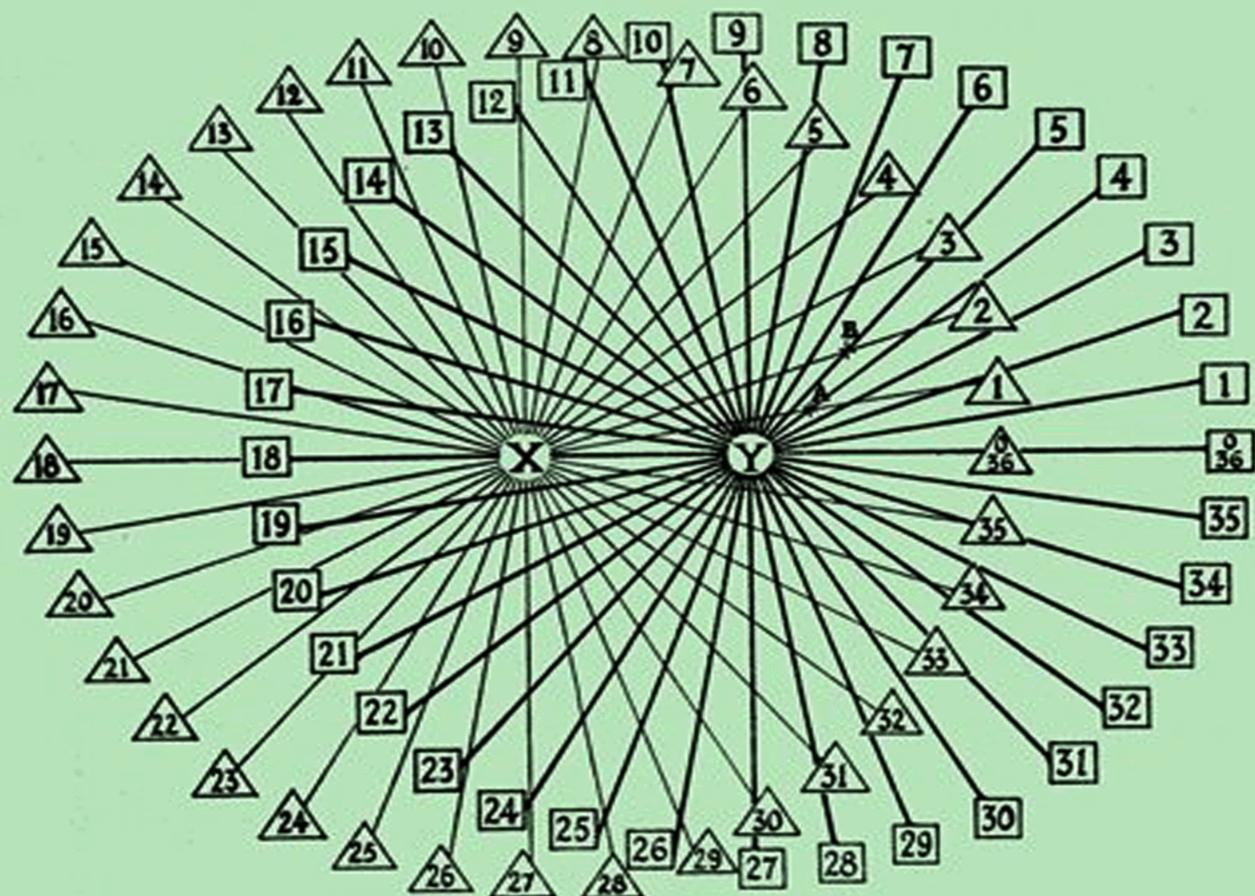## ANGLE, ANGLE

Recently I was playing with two protractors after I had finished some drawings. I happened to slide one over the other, keeping their bases together. It occurred to me that although we often use (distance, distance) pairs of co-ordinates, and sometimes (distance, angle) pairs, for some reason I have never (as far as I remember) seen (angle, angle) pairs, although surely we could use them if we wished.

The diagram above shows some (angle, angle) graph paper! To save space we have labelled the angles 1, 2, 3, and so on, instead of 10°, 20°, 30° . . . To help to prevent you muddling the two different angle measurements, we have drawn triangles around the X-angles and squares around the Y-angles. Our ordered pairs will be written as $(\triangle, \square)$ in that order. For example, A is the point (1,4) and B is the point (2,5).
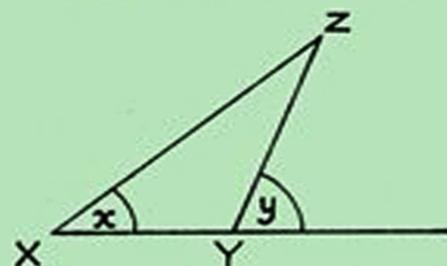
You may have noticed that both these pairs of co-ordinates for A and B obey the rule.

$$\square = \triangle + 3$$
$$\text{or } y = x + 3$$

Find as many other points as you can which obey the same rule. What do you notice?

Try other equations such as $y = x + 4$, or $y = 2x$.

Some of you will be able to explain some of your results by thinking of the small diagram above, and the value of angle YZX in each case.

E.G.

MATHEMATICAL PIE

MERGER

Transfer drawing "a" into the centre by finding its image in the line A. (Use tracing paper for accuracy!) Transfer each of the drawing b, c and d in the same way, finding their images in the lines B, C and D respectively. The merged images produce a "sensible" drawing.
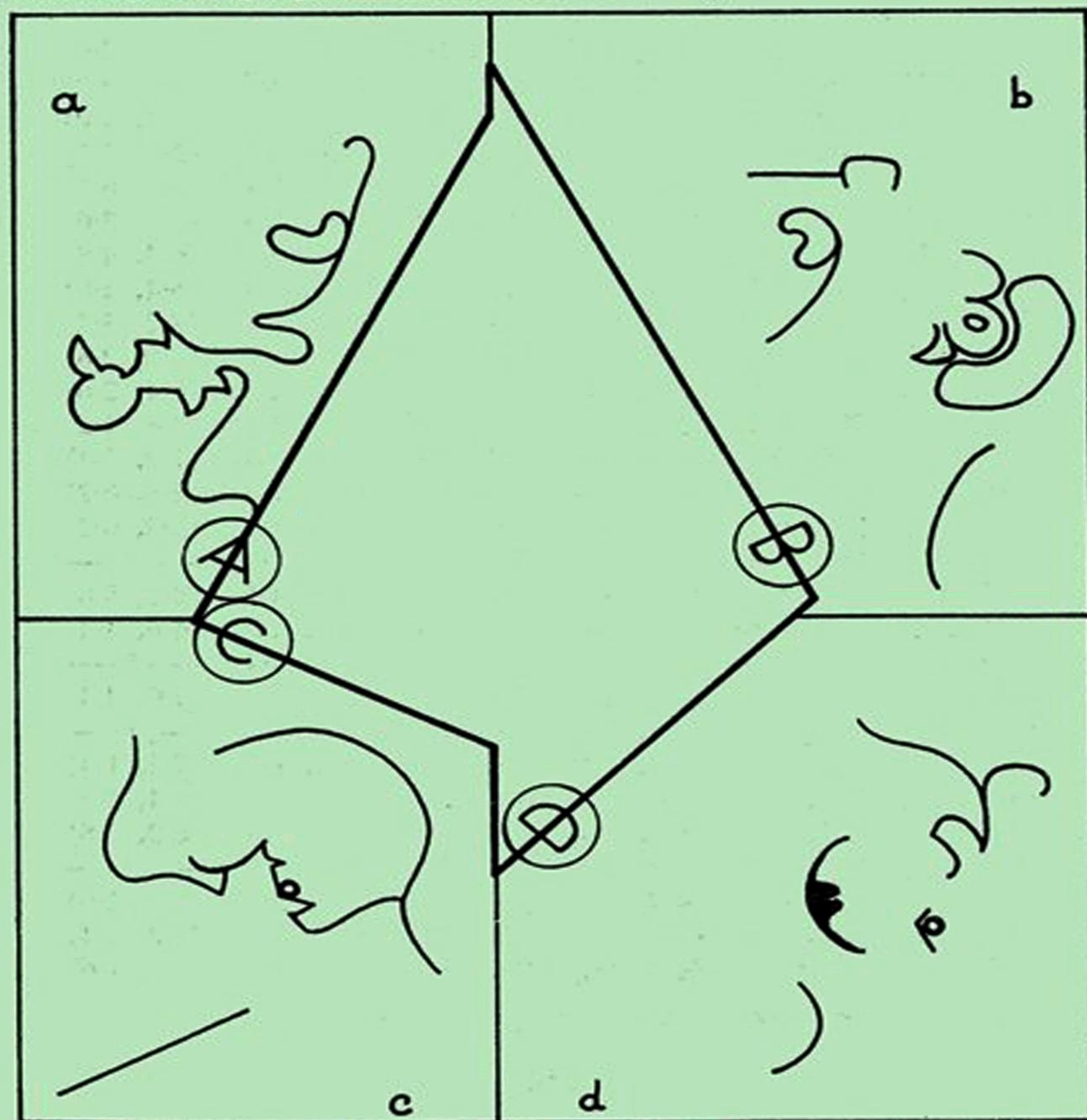
E.G.

SQUARES

Take any number between 2 and 100 and break it down into the sum of a number of squares, e.g., 47=16+25+4+1+1.

What is the smallest number of squared numbers that you can use to make 47? Now consider the other numbers between 2 and 100 in a similar way. Find the smallest number of squares required in each case.

R.H.C.

A CLEVER PLOT

This set of instructions did not come from Peru, but was sent in by Sara Williams of Arden School, Solihull. You will need axes large enough for values of x from 0 to 8 and values of y from 0 to 8. It works very well if you use 2 centimetres for every 1 unit.

Join up the points in the order given but do NOT join together any two points separated by an asterisk *.

→	→	→	→	→	→
(2·0, 0·4)	(1·2, 1·0)	(1·2, 1·6)	(1·0, 1·8)	(1·0, 2·0)	(1·2, 2·0)
(1·8, 2·2)	(2·4, 3·4)	(2·6, 4·0)	(1·4, 3·4)	(1·2, 3·6)	(1·2, 3·2)
(1·0, 3·2)	(0·8, 3·6)	(0·2, 3·2)	(0·0, 3·4)	(0·2, 3·8)	(0·2, 4·0)
(0·8, 4·2)	(1·0, 4·4)	(1·4, 5·0)	(1·6, 4·8)	(2·4, 5·4)	(2·4, 5·6)
(2·8, 6·0)	(3·2, 5·8)	(3·2, 6·0)	(2·6, 6·2)	(2·8, 6·4)	(3·2, 6·6)
(3·4, 6·8)	(3·6, 6·8)	(3·8, 7·2)	(4·0, 7·6)	(4·2, 7·8)	(4·8, 8·0)
(5·2, 7·8)	(6·2, 7·2)	(5·8, 6·2)	(6·0, 6·0)	(6·2, 5·2)	(6·4, 4·8)
(5·4, 5·4)	(5·2, 5·2)	(5·2, 4·8)	(5·0, 4·6)	(5·2, 4·4)	(6·4, 3·8)
(6·6, 4·0)	(6·8, 3·8)	(7·2, 3·8)	(7·4, 3·6)	(7·2, 3·4)	(7·2, 3·2)
(7·0, 3·0)	(7·0, 2·8)	(6·8, 2·6)	(6·6, 2·8)	(6·2, 3·0)	(6·0, 2·8)
(5·6, 3·0)	(5·8, 2·6)	(6·0, 2·6)	(6·2, 2·4)	(6·2, 2·2)	(6·4, 2·0)
(6·4, 1·6)	(6·2, 1·4)	(5·8, 1·2)	(5·2, 1·4)	(5·0, 1·2)	(4·8, 1·2)
(4·8, 1·0)	(2·0, 0·4)	—*—	(6·8, 3·8)	(7·0, 3·8)	(7·0, 3·4)
(6·6, 3·4)	(6·8, 3·8)	—*—	(3·6, 6·8)	(4·6, 7·0)	(5·8, 6·2)
—*—	(3·2, 6·0)	(3·6, 6·4)	(4·2, 6·6)	(4·6, 6·6)	(5·2, 6·2)
(5·4, 5·8)	(5·4, 5·4)	—*—	(1·2, 3·6)	(0·8, 4·2)	—*—
(3·2, 5·8)	(3·8, 5·0)	(4·0, 5·2)	(4·2, 5·0)	(4·0, 4·4)	(3·4, 5·0)
(2·4, 5·4)	(2·4, 5·6)	—*—	(5·2, 5·2)	(4·6, 4·8)	(4·6, 4·4)
(5·0, 4·6)	—*—	(4·6, 4·8)	(4·4, 4·4)	(4·6, 4·4)	—*—
(1·0, 4·4)	(1·4, 3·8)	(2·0, 4·2)	(1·6, 4·8)	—*—	(4·0, 4·4)
(4·4, 3·6)	(4·2, 2·2)	(3·4, 2·0)	(2·6, 1·8)	(1·8, 2·2)	—*—
(3·4, 2·0)	(3·8, 1·8)	(4·4, 1·4)	(4·8, 1·2)	(5·0, 1·2)	(5·2, 1·4)
(5·6, 1·8)	(5·2, 2·2)	(4·6, 2·2)	(4·2, 2·0)	—*—	(4·4, 4·4)
(4·6, 3·8)	(5·0, 3·0)	(5·6, 2·4)	(5·8, 2·6)	—*—	(6·0, 2·8)
(6·4, 3·8)	(6·2, 3·9)	(6·0, 3·6)	(5·6, 3·8)	(5·7, 4·1)	—*—
(4·4, 4·4)	(4·2, 4·6)	(4·0, 3·6)	(4·2, 3·0)	(3·6, 2·2)	(2·8, 2·6)
(3·4, 3·4)	(4·0, 3·6)	—*—	(1·2, 2·0)	(1·8, 1·4)	(2·2, 1·4)
(4·0, 1·7)	—*—	(4·3, 1·5)	(2·2, 1·0)	(1·8, 1·0)	(1·2, 1·6)

You should know what message to put on the label.

JUNIOR CROSS FIGURE No. 66
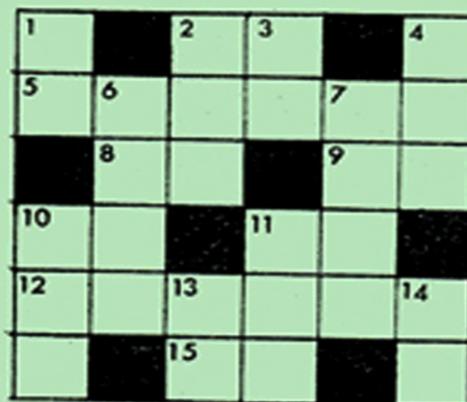
CLUES ACROSS

1. IV.
2. Number of small squares in a large square with 4 small squares on each side.
5. Next three numbers in sequence 1,4,9,16,25,36.
8. Football team plus substitute.
9. Three score and ten.
10. Number of hours between midday on Monday and 3 a.m. the following Friday.
11. Four days after Ides.
12. Half-a-dozen gross gross.
14. Jubilee day 1977.
15. 10 across turned round twice.

CLUES DOWN

1. Number of days in 6 weeks 2 days.
2. Number of cards in three packs (plus jokers).
3. 2×2×2×2×2×2.
4. Next two pages after page eight.
6. Date of birth of five-year-old baby elephant whose birthday is 9th January.
7. Next year reversed.
10. Number of degrees in nine right angles.
11. 7×7×3.
13. 4×4×3.
14. Five dozen.

A.M.A.

SOLUTIONS TO PROBLEMS IN ISSUE No. 81

PICTOCODE No. 2

DYNAMIC DUO DECIMAL
The numbers begin with 1, 2, 3 as the other lines did. To find the second figure, double the first; the third is the second plus five and the fourth is found by adding the second and third figures, ignoring tens each time.

A SEASONAL PROBLEM
The sum is always 1977.

FIND YOUR OWN LEVEL
The larger pipe will hold four times the volume in the smaller one. The height will, therefore, be one-fifth of the original height, i.e., 15 cm.

WINDOW DRESSING
The area of the "moon" will be the same as the area of the rectangle covered twice, i.e., 4 sq. ft.

PYTHAGORAS REVISITED
On the fourth from the last line, a 2 has mysteriously changed to a 1.

BUSINESS SIGNS
A Chinese Take-away.

SWOP SHOP
The donkeys were carrying 5 and 7 measures.

LADY LUCK
The probabilities were 1:144 and 1:24.

B.A.

SING-A-LONG-A-MATHS

If you know enough about music, you could try playing this tune, or perhaps your music teacher might be persuaded to play it for you. Alright, perhaps it's not great *music*, but it is an interpretation of a great *mathematical* idea, and not (as some of you might think) a weak example of some fifteenth century folk-song! To discover the tune's secret, all you need to know is that I have numbered the lines and spaces of the stave like this

A zero could be interpreted as one beat rest. Any number can be changed to a tune, and vice versa! Mum and Dad may think that pop music is repetitive—it certainly *is* true that many pop songs can be turned into recurring decimals! See if you can find the decimal for the fraction $\frac{5598365}{12345679}$. (Keep going until it recurs.)

Then, to "stave" off your curiosity . . . back to that poor, long-suffering music teacher.

<div align="right">E.G.</div>

FAIR'S FAIR

There is an old way of dividing a cake into equal parts: Let one partner cut the cake and let the other one choose.

How could it be done if three are to share the cake?

<div align="right">R.H.C.</div>

TRANSFORMATION

DRINK
. . . .
. . . .
. . . .
. . . .
. . . .
. . . .
CRASH

Need your L plates? Or can you change DRINK to CRASH by changing one letter at a time, making a sensible word at each step?

<div align="right">E.G.</div>

CARTAKER AND CARETAKER

A schoolmaster, who lived some distance from his school, had an arrangement with the school caretaker who came out in his car and collected the master at 8 o'clock each morning and drove him back to school. One morning the master, deceived by some fine weather, got up an hour earlier than usual. When he got to his front gate he found that it was 7 o'clock so decided to walk towards the school. After walking for some time he met the car and rode the rest of the way, arriving twenty minutes earlier than usual. For how long was he walking?

<div align="right">J.F.H.</div>

SAMPLING

You can often get a good idea of what a large population is thinking by asking a small group what they are thinking. Sometimes this can give a reasonable forecast of a result and sometimes not.

Here are some questions that you can try on your class. Take a group of five and then multiply your result by 6 to obtain a class result for 30. Then ask the same questions of the remainder of the class to see how near your small sample group answer was to the actual group.

1. How many brothers and sisters have you?

2. How many have the same date and month of birth as another member of the class?

3. How many can swim?

4. Ask each member of the class to write down the size of an angle between 0° and 359°. How many of your sample have chosen the same number as someone else?

5. How many have a cat? How many have a dog? How many have neither?

6. Write down a number between 1 and 10. How many have chosen the same number as someone else?

<div align="right">R.H.C.</div>

PUNNY ANAGRAMS

loognyp — a disappearing parrot

ceetirvs — blind Verti is glad when this happens

sixa — "This knife isn't sharp, but this . . ."

mmmniiu — mother of a small car

<div align="right">A.M.A.</div>

THIS YEAR

Using the figures 1, 9, 7, 7 in this order and the usual mathematical symbols make the numbers 1, 2, 3, as far as you can. Don't forget factorial and mod.?

<div align="right">R.H.C.</div>

Once upon a time in a little broken down hut in the middle of a dark, dark, wood, there lived three witches called Ida, Zedda and Spida. Ida was a failure as a witch. None of her spells would work! No matter how hard she shouted her magic words a frog stayed a frog and a prince stayed a prince. Zedda had other problems. Try as she might to turn coaches into pumpkins or ladies into mice or lorries into laybys, her spells always made everything disappear. This was awkward when she started on the furniture and explained why the three witches lived in a little broken down hut in the middle of a dark, dark wood.

Spida, however, was an ace witch and was the brains of the trio. She could turn magicians into rabbits and insurance salesmen into budgies at the drop of a broomstick, and she often tried to put right the mistakes of her sisters. Unfortunately, once Zedda had made something disappear it stayed gone, no matter how hard anyone tried to bring it back, and once Spida had changed a secondhand car salesman into a beetle he stayed changed, and even Spida herself could not bring him back. Here are the results of some of the combinations of spells:—

		2nd Spell		
		I	Z	S
1st Spell	I	I	Z	S
	Z	Z	Z	Z
	S	S	Z	S

I stands for Ida's spell (the thing stays the same)

Z stands for Zedda's spell (the thing disappears)

S stands for Spida's spell.

One day a wizard visited the three witches. He had powers equal to Spida's and could even reverse Spida's spells when he wanted to. However, even he could not bring back something that Zedda had made disappear. Spida found that she could reverse his spells and the four of them had a competition to see whose magic was the most powerful. The outcome of the competition was as follows:—

		2nd Spell			
		I	Z	S	W
1st Spell	I	I	Z	S	
	Z	Z	Z	Z	Z
	S	S	Z	S	
	W	W		I	W

Can you finish off the table?

A.M.A.