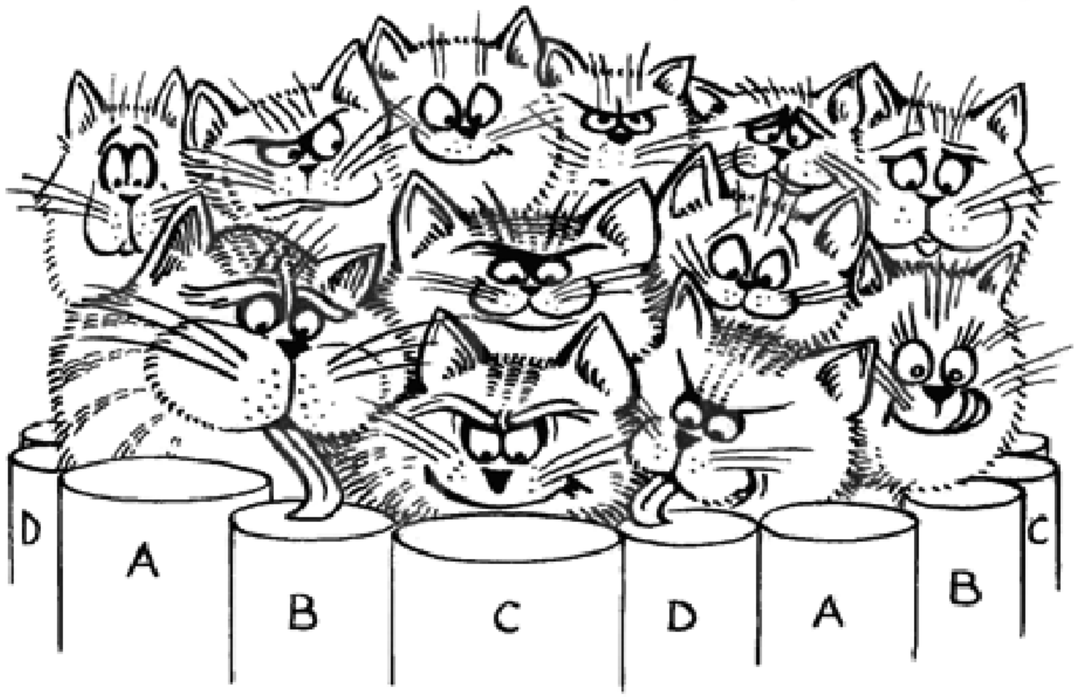
A QUESTION OF CATS!

submitted by Rachel and Alison Franklin, Croydon High School, Surrey.



In a survey, 100 cats were asked which of four brands, A, B, C or D they liked. Two cats liked no cat food, so we conclude that they starved! 44 cats liked brand B; 36 cats liked brand C and 65 cats liked brand D. 20 cats were not fussy and ate the lot. No cat liked brands A and C only, but one cat liked only brand C and brand D. Except for this choosy cat, and the cats who preferred to starve, all the other cats liked brand A, brand D or both. The total number of cats who ate brand B but not brand A was 12, only two of which would not eat brand C. The total number of cats liking both brand C and brand D was 34. Five times as many cats ate only brand A as those who only ate brand D. The number of cats liking brand D only was equal to the number liking both brand A and brand B only.

HOW MANY CATS LIKED BRAND A?

Hint: draw a Venn diagram with four interlocking sets. Ed.

IT'S MAGIC

Think of a number between 1 and 9, inclusive. Multiply by 5, add 8 and multiply by 2. Now add another number between 1 and 9, inclusive – it could be the same number as before, subtract 5.

When you are given the answer, there is a method of deciding what the two original numbers were. Can you find it? E.R.

REFLECT ON THIS

746 = 175 + 571, thus 746 is the sum of two numbers each one being the mirror image of the other. What other numbers between 700 and 800 can be similarly divided into the sum of two mirror image numbers? R.H.C.

MATHEMATICAL PIE

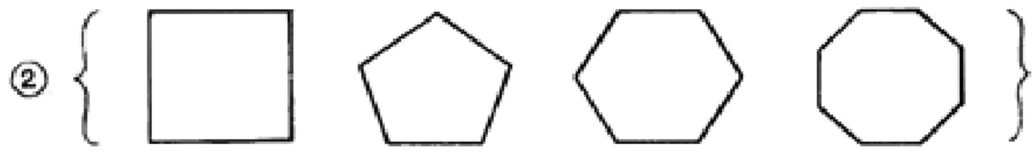
No. 98 *Editorial Address :* **West View, Fiveways, Nr. Warwick** **SPRING, 1983**

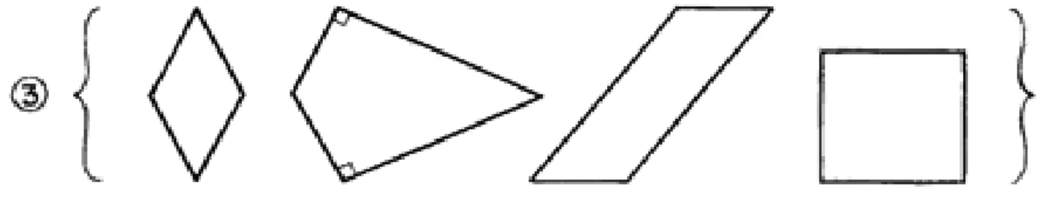
ODD ONE OUT No. 2

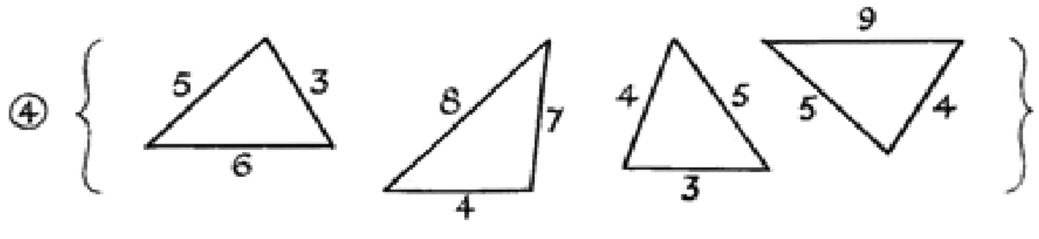
Which is the "odd one out" in each of these sets – and why? The drawings are accurate in 1, 2, 3 but not in 4.

E.G.

① {S X N Z}

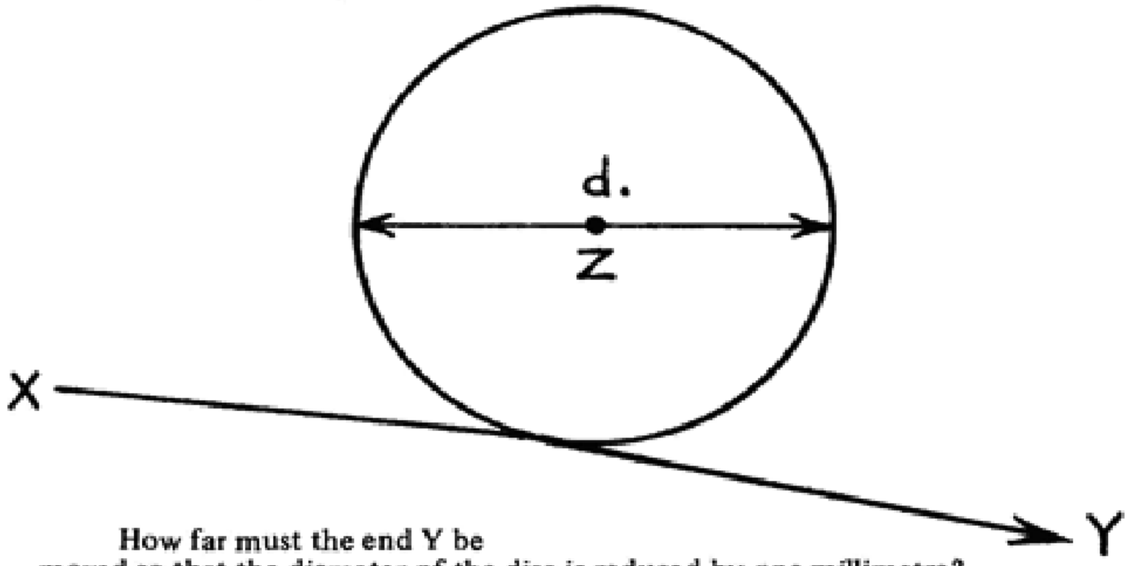
② 

③ 

④ 

EYE CATCHING

The circle illustrated represents a small, thin, fragile, elastic disc with centre Z and a diameter of d millimetres. A fine ligature is wound once round the disc from X to Y. One end of the thread is secured firmly at X, the end at Y is drawn slowly away from X and this distance measured.



How far must the end Y be moved so that the diameter of the disc is reduced by one millimetre?

S.H.F.

ALL SQUARE

Find

1. The square of a reversed two-digit number which is equal to the reversed square of the two-digit number.

2. Three two-digit numbers which are not only perfect squares, but, when arranged one beneath the other, reveal two three-digit perfect squares if read vertically downwards.

D.I.B.

TO READ OR NOT TO READ

In 1950 just under half of the world's men and women could not read nor write. By 1976 the proportion had dropped to about 1 adult in 3, but taking into account the growth of the world population, you realise that in little more than a generation the number of literate adults has doubled.

What is the connection between x, the population in 1950 and y, the population in 1976?

C.V.G.

UNCHANGING DIGITS

The idea that we can make an equality where the digits are the same and in the same order on both sides of the equals sign is an interesting one although they are not as easy to find as they at first appear.

Examples $127 = -1 + 2^7$ and $343 = (3 + 4)^3$.

Many of the examples to be found have 12 as a factor. Can you find ways of expressing 24, 26, 120, 144, 288, 360, 660, 720 and 744 in this way?

C.B.A.

SOLUTIONS TO PROBLEMS IN ISSUE No. 97

Painting by numbers The picture was a scene including a tree.

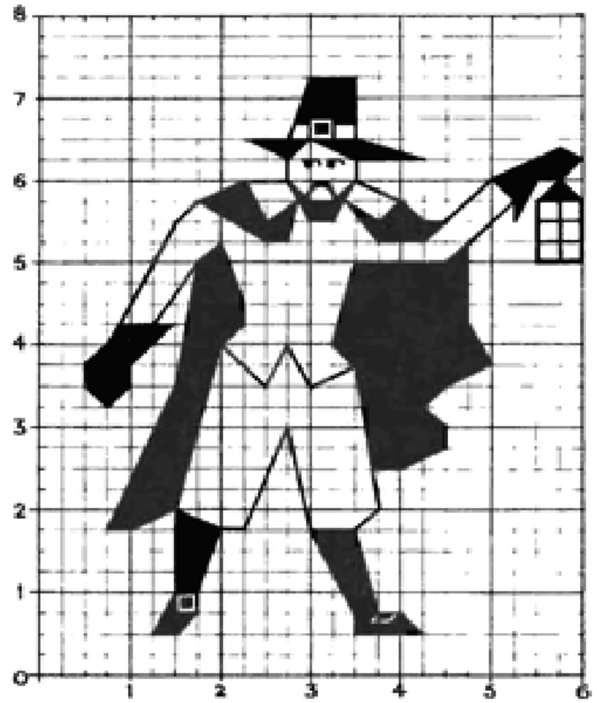
Reverse Cross figure

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

Life and death There were 2 birds, 1 snake and 1 cat.

Square fun The area takes more than 700 but less than 750 square tiles. Hence it must be 29 units square or 729 square units.

A November plot



Odd one out No. 1 The odd ones are:– 1. 8, because it is even (groan), 2. 9, because the others are prime, 3. 12, because the others are squares, 4. seven, because it is the only word without an 'i' or, six, because it is the only word without an 'e'.

Junior cross figure No. 71

Across: 1. 412; 3. 13; 5. 80; 6. 198; 7. 725; 10. 665; 12. 124; 14. 32; 16. 45; 17. 512.
Down: 1. 48; 2. 107; 3. 19; 4. 380; 6. 156; 8. 264; 9. 114; 11. 531; 13. 25; 15. 22.

Twelve days of Christmas The final answer is –1.

Roll a coin The probability is ¼.

B.A.

MAGIC PENTAGON

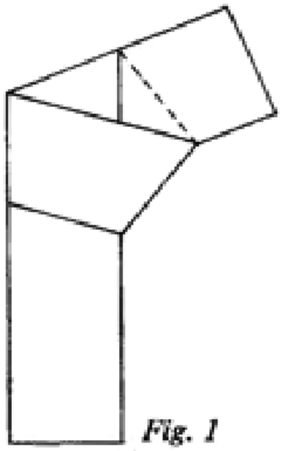


Fig. 1

To make a regular pentagon, cut a strip of paper 20 cm long and 2.5 cm wide. Tie a knot in this strip very carefully, then flatten it and bend back the two protruding pieces.

Find the ratios
AE:AR and AG:GR.

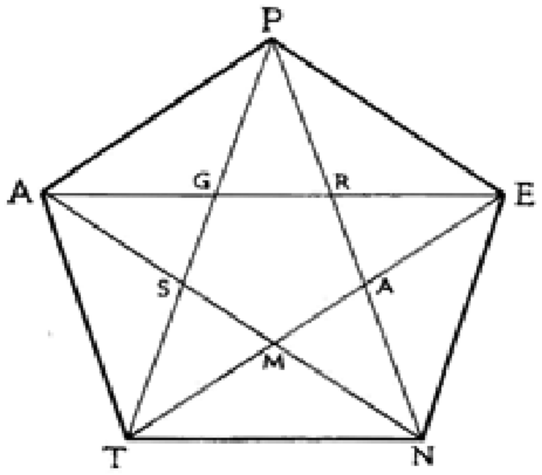


Fig. 2

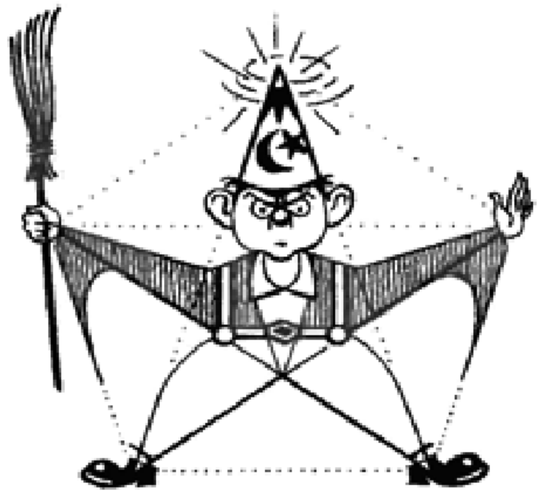


Fig. 3

S.H.F.

THE DISTANT HORIZON

Suppose the eyes of a child are 1.25 metres high, then if he stands: (a) on the sea shore on a clear day, he will be able to see about 4 km out to sea,
(b) on the top of a cliff 30.5 metres high, his horizon will be nearly 22 km.

The table on the right gives the distance of the horizon from the top of some well known buildings.

STRUCTURE	Height m.	Horizon km.
P.O. Tower	189	51
Belmont T.V.	509	80
Elmley Moor T.V.	566	85
Beachy Head	61	29
Cape Wrath	168	50
Lizard	107	39
Spurn Head	37	24

Draw a graph of the heights and horizon distances. Use the graph to find the distance that a pilot can see if he is flying at 300 metres above the sea.

S.H.F.

WHO'S MY FRIEND?

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Using the above substitution and the following clues, can you find the names of my friends?

A. The two letters that are the same multiply together to make 144.
The highest and lowest values multiply together to make 25.
The capital letter has two digits but three symbols in Roman numerals.
Also in Roman numerals its form has both rotational and line symmetry.

B. The two letters that are the same multiply together to make 25.
The other three letters are consecutive even numbers which multiply together to make 5760.

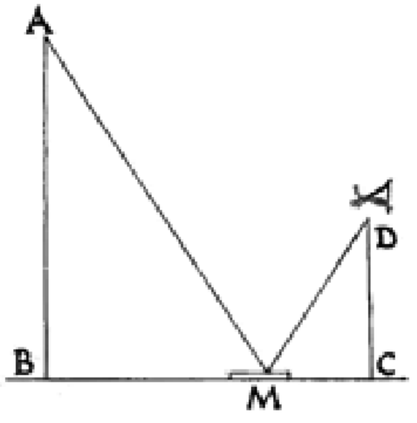
C. Using only the first 21 letters, two letters when multiplied together make 100.
Two other letters when multiplied together make 88.
The other letter is a square odd number not equal to its own root.

D. The two letters that are the same multiply together to make 16.
Two other letters multiply together to make 9.
The last letter is equal to twice the highest valued letter so far plus the value of the letter which is neither the highest nor the lowest.

E. The two letters that are the same multiply together to make 25.
Two non-consecutive letters multiply together to make 56.
The lower of the last two letters is a square number and the higher is worth one more than twice this lower letter.

C.B.A.

TO FIND THE HEIGHT OF A BUILDING



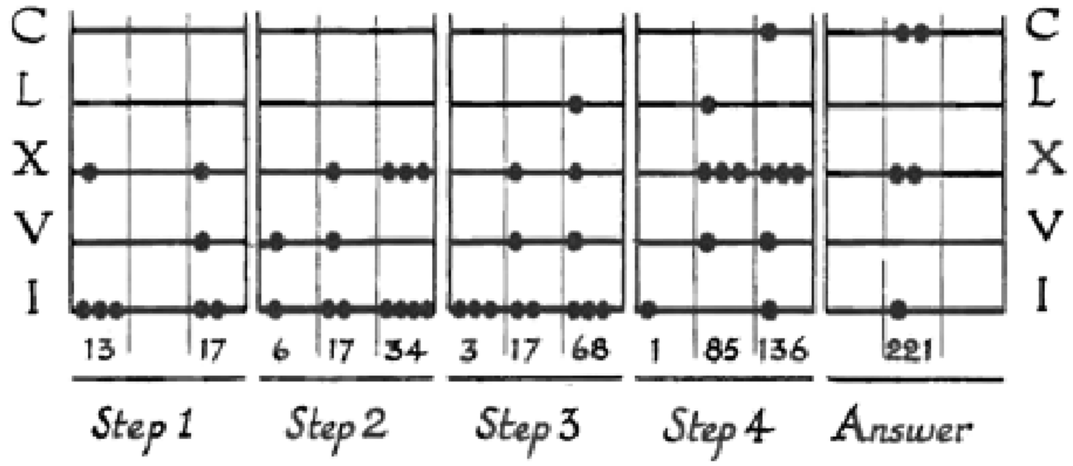
An elegant yet simple method of finding heights of buildings was described in a Seventeeth Century geometry book. Nothing more elaborate than a mirror, a stick of known length and a measuring tape. A yard stick, or metric rule, would do very well for the stick as it must be shorter than the observer. The mirror M is placed on the horizontal ground between the object to be measured, AB, and the observer. The observer looks over the top of the stick DC, which must be held vertically, into the mirror and adjusts his position until the top of the stick, a fixed point on the mirror and the image of the top of the building coincide. When this position is found the distances BM and MC are measured.

The triangles ABM and MCD are similar and so $AB = \frac{BM \times DC}{CM}$

S.H.F.

HOW DID THE ROMANS MULTIPLY XVII BY XIII?

To do this we could make thirteen piles of pebbles each of which is made up of seventeen pebbles. This is a very slow way of getting an answer. The Romans found an easier way of doing this in five simple steps on a board or flat stone marked out as shown in the diagram.



There are three upright columns and five lines across which stand for Units (I), Fives (V), Tens (X), Fifties (L) and Hundreds (C).

Step 1 13 x 17. To do this half one side and double the other. Because 13 is odd and leaves a remainder, add 17 to the centre line.

Step 2 13 x 17 = 12 x 17 + 17 = 6 x 34 + 17.

Step 3 = 3 x 68 + 17

Step 4 = (2 x 68) + 68 + 17. Put 68 in the middle

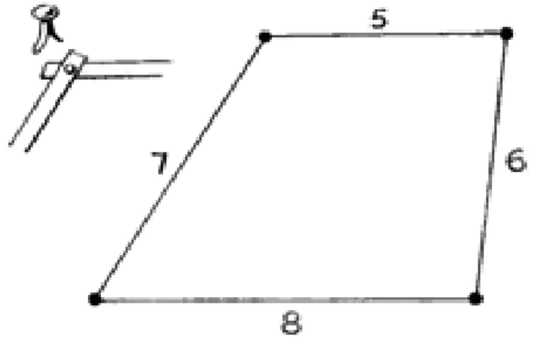
Step 5 = (1 x 136) + 68 + 17 = 136 + 68 + 17 = 221

The answer is left in the centre column.

S.H.F.

QUADRILATERAL CONSTRUCTION

Construct a trapezium with sides 5, 6, 8 and 7 units. To do this practically, cut strips of paper, or card, one unit longer than each of the sides and make holes one half of a unit from each end.



Fasten the strips together using paper clips.

Adjust the arrangement until two of the sides are parallel.

What is the area of the quadrilateral?

R.H.C.

WHAT TIME IS MID-DAY?

According to my diary, sunrise in London on 6 March is 6.36 and sunset is 5.49, or 17.49 in the 24 hour clock. Mid-day is therefore at 12.12½, and this is the time that the sun is due South. Plot a graph at the time of mid-day throughout the year. It will be enough to plot the time at intervals of seven days. You will see that mid-day is at 12 o'clock only four times a year.

Each year, the earth makes a complete orbit of the sun and also makes 366.24 rotations round its axis. Therefore the sun seems to circle the earth 365.24 times. In the XIVth century, it became the custom to set clocks to XII when the sun was due South. The interval between two settings is called a solar day.

There is a complication. Because the earth's orbit is not a circle, the rate of the sun's movement across the sky is not quite the same at different times of the year. Consequently the length of the solar day varies slightly. This began to matter as clocks became more accurate.

C.V.G.

HATEFUL

9 x 9 + 7 =
9 x 98 + 6 =
9 x 987 + 5 =
9 x 9876 + 4 =

Work out the values of the expressions on the left. Can you complete the sequence?

R.H.C.

EVERY WHICH WAY

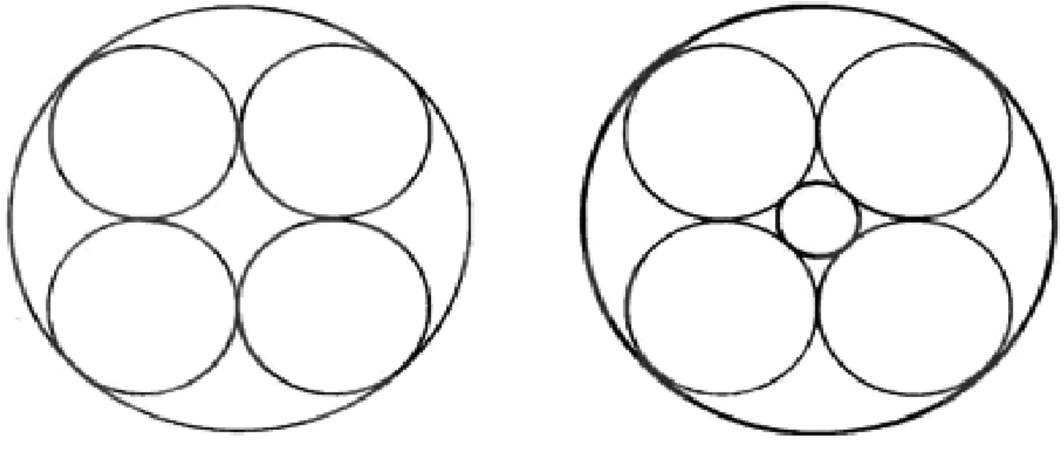
What fraction, less than 1, gives the same value when turned upside down?

Hint: it is not a fraction in its simplest form.

R.H.C.

FOUR INTO ONE

Four circles are drawn as shown with radius 1 cm. What is the radius of the circumscribing circle?



What is the radius of the circle that touches the four circles internally?

C.B.A.