O, O, ANTON I O !

(A puzzle rhyme attributed to mathematician Dr Whewell).

You 0 a 0, but I 0 thee,
O 0 no 0, but O 0 me ;
Then will you 0 no 0 be
But give 0 0 I 0 thee. J.F.H.

SOLUTIONS TO PROBLEMS IN ISSUE No. 31

A FIELD STUDY

Let the length and breadth be x yards and y yards.

Then $x^2+y^2 = 125^2$ and $2(x+y) = 322$

$x+y = 161$

Squaring $(x+y)^2 = 161^2$

$x^2+2xy+y^2 = 161^2$

$2xy = 161^2 - 125^2$

Area $= xy = 4968$ sq. yd.

SENIOR CROSS FIGURE No. 32

ACROSS : (1) 124 ; (4) 725 ; (7) 468 ; (8) 539 ; (9) 24 ; (10) 25 ; (11) 20; (13) 81 ; (17) 81 ; (19) 975 ; (21) 132 ; (22) 223 ; (23) 307.

DOWN : (1) 142 ; (2) 2642 ; (3) 48 ; (4) 7558 ; (5) 23 ; (6) 594 ; (12) 0553 ; (14) 1830 ; (15) 192 ; (18) 127 ; (20) 72 ; (21) 13.

POINTS OF VIEW

The equal sides subtends equal angles at every point on the altitude to the third side of the triangle.

ANOTHER MAGIC SQUARE

Reading the rows from left to right, they are 1, 15, 14, 4 ; 12, 6, 7, 9 ; 8, 10, 11, 5 ; 13, 3, 2, 16.

TREASURE HUNT No. 1

There are four positions for the point P. The distances are $4+2\sqrt{3}$, $4-2\sqrt{3}$, and $2\sqrt{3}-2$ for two of the positions.

JUNIOR CROSS FIGURE No. 29

ACROSS : (1) 314 ; (4) 160 ; (5) 27 ; (6) 50 ; (7) 36 ; (10) 60800 ; (14) 880 ; (15) 56.

DOWN : (1) 365 ; (2) 100 ; (3) 1760 ; (4) 23 ; (8) 168 ; (9) 70 ; (11) 08 ; (12) 80 ; (13) 05.

The frontispiece of issue No. 31 of Sir Isaac Newton and his giants brought no replies from readers. The giants were Galileo, Copernicus, and Kepler, Euclid, Archimedes, Menaechmus and Eudoxus. B.A.

INTELLIGENCE TEST

An alternative solution to the Intelligence Test has the colours of the Rovers, Red, and the name of the cinema, Gaumont.

The arithmetic book I had when I was at school was full of problems like this :—

" The vertical height of a frustum of a cone is 8 in. and the radii of the ends are respectively 7 in. and 3 in. Find the area of its curved surface ? "

If your arithmetic book is like mine this nomogram will help to check your homework.

This is how to use it to answer the question. Find the mark 8 on the h-scale, and find the point where the curves numbered 7 and 3 intersect. Place a ruler between these points and read off the value at its intersection with the A-scale.

If the measurements of the radii are not whole numbers you must estimate the position of the curves.

The nomogram can also be used to find their curved surface areas of cylinders and cones, the areas of circles, and the area between two concentric circles.

Only a limited range of values of the variables can be represented on a nomogram. If you wish to use the nomogram for larger or for smaller values, all the lengths can be multiplied by the same factor. C.V.G.

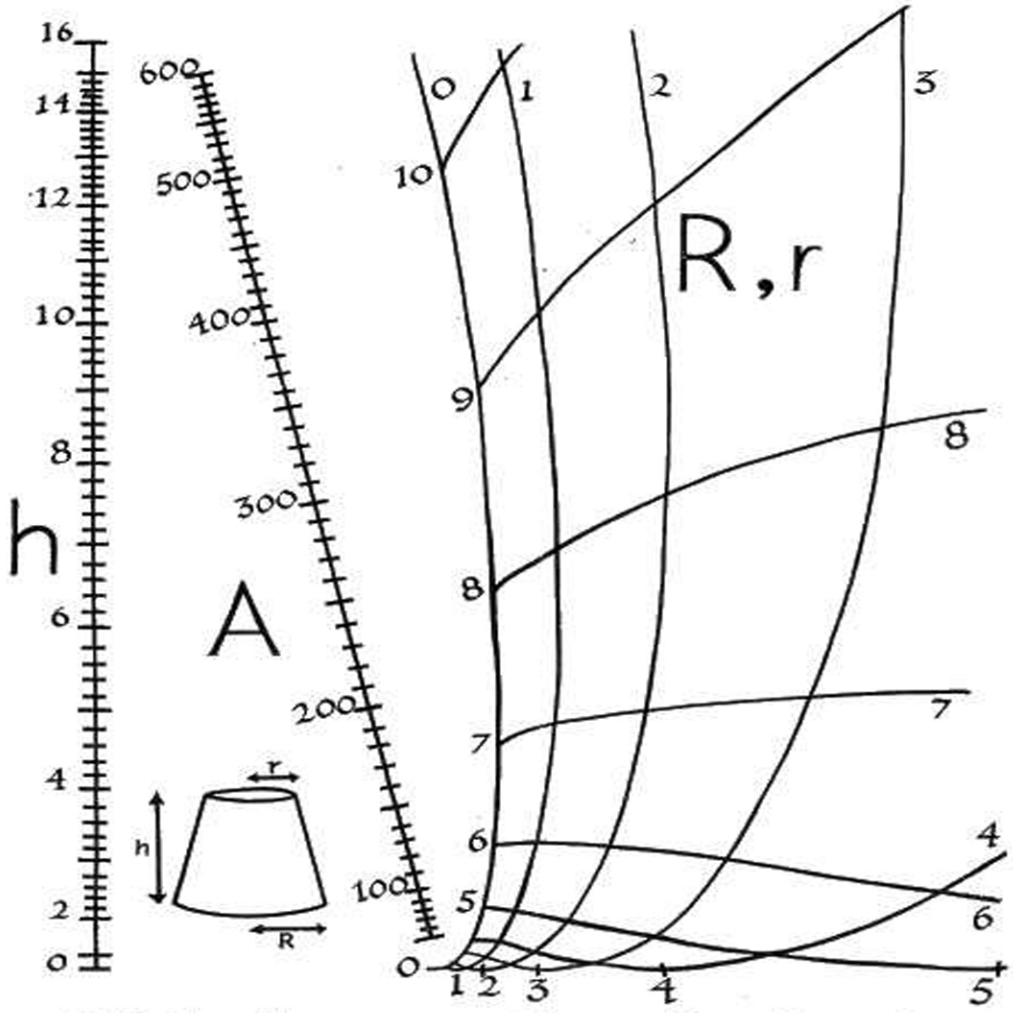
260

23828 06899 64004 82435 40370 14163 14965 89794

MATHEMATICAL PIE

No. 33 *Editorial Offices :* See Issue No. 34 **MAY, 1961**

THE AREA OF THE CURVED SURFACE OF A FRUSTUM OF A CONE



To find how this nomogram can help you with your homework, turn to the back page.

253

61711 96377 92133 75751 14959 50156 60496 31862

MATH MAGIC

Prepare six pieces of card and write on each of the backs one of the following numbers 16, 13, 49, 85, 98, 77. Write a letter on the front of each card as follows ;

A on the reverse side of 16
N on the reverse side of 13
G on the reverse side of 49
L on the reverse side of 85
E on the reverse side of 98
S on the reverse side of 77

Place your six letters on the table face up. Turn your back and ask one of your friends to choose a card, see what number is on the other side of the card. Tell him then to shuffle the six cards and hand them to you. Now produce a pencil and whilst you are tapping the cards with it ask your friend to *spell* out his number silently letting each tap represent a letter in the spelling of his selected number. Ask him to advise you when he has spelt out all the letters and when he has stopped your pencil will be resting on the number selected.

Secret. Lay out the cards to spell the word ANGLES. Take your pencil and tap anywhere for the first six taps but be sure that your seventh tap is on the letter *A*. The eighth must then land on *N*, the ninth on *G* and so on, and your last tap will then be on the back of the correct card number. Can you find out the real reason why the trick works ?

3 SECOND QUIZ

You are allowed 3 seconds to write down the answers to each of the following questions.

(*a*) If 50 articles cost 50/- what is cost of each ?
(*b*) If 100 articles cost 50/- what is cost of each ?
(*c*) If 75 articles cost 50/- what is cost of each ?

Look before you leap.

STAMP COLLECTOR'S CORNER No. 20

East Germany, 1950
Grey

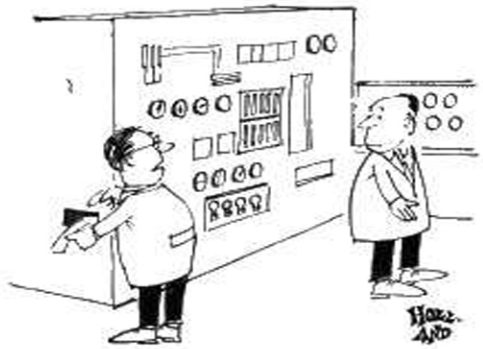
Leonard Euler, 1707–1783, was born in Switzerland, but most of his active life was spent in Berlin and St. Petersburg (Leningrad). He was a most prolific writer. One of his first achievements was a solution of the " problem of three bodies " in astronomy. Newton had proved that a single planet will move in an ellipse round the sun, but the problem of sun, planet, and moon is much more difficult. Euler found a method of predicting the position of the moon by a series of approximations. His method was used in the preparation of nautical almanacs. He also investigated the strength of beams and struts, reformed the Russian system of weights and measures and devised a theory of investment which gave a sound basis for pension schemes, as well as making great advances in pure mathematics.

C.V.G.

94726 54736 42523 08177 03675 15906 73502 35072

I do hate sums. There is no greater mistake than to call arithmetic an exact science. There are permutations and aberrations discernible to minds entirely noble like mine ; subtle variations which ordinary accountants fail to discover ; hidden laws of numbers which it requires a mind like mine to perceive. For instance, if you add a sum from the bottom up, and then again from the top down, the result is always different.

Mrs. La Touche (19*th century*)



It says " Pass the log tables, please "
Reproduced by permission of " New Scientist "

DO YOU KNOW ?

Question : The sun and moon are the most prominent of the visible heavenly bodies. Which appears to the eye to be the larger ?

Answer : They appear to be almost the same size, but the sun appears to be slightly larger.

The sun covers a part of the sky that makes an angle of 32 minutes at the eye ; the moon an angle of 31 minutes.

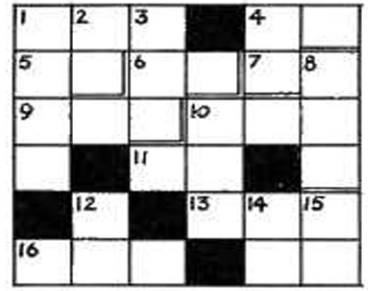
" DO YOU LIKE IT ? "

Who was the first space man, according to Shakespeare to go into orbit round the Earth and what must have been his least average speed for the journey.

R.H.C.

JUNIOR CROSS FIGURE No. 30

Submitted by Ann Grigg, Hazeldene School, Salcombe, Devon.



ACROSS :

1. Area of the four walls of a room, 12 ft. by 10 ft. by 6 ft. high.
4. 27 apples cost 4/6d. Find the cost of 15 apples in pence.
5. $\frac{1}{4}$ of 336.
6. $\frac{1}{5}$ of this number is 8.
7. 9^2.
9. 1 gross.
10. $\sqrt{11236}$.
11. No. of yd. in a chain.
13. No. of lb. in a cwt.
16. 27.01×5 correct to the nearest whole number.

DOWN :

1. 1 ton 5 cwt. 16 lb in lb.
2. 2^6.
3. $\sqrt{197136}$.
4. $646 \div 17$.
8. Square of a prime number.
10. Square of another prime number.
12. $\frac{1}{8}$ of 100 correct to the nearest whole number.
14. $\sqrt{100}$.
15. No. of lb. in $\frac{1}{4}$ cwt.

29741 67729 47867 24229 24654 36680 09806 76928

A MATHEMATICAL COLLECTION

When you are tired of collecting match-box labels, stamps, bus tickets, etc., try making a mathematical collection. This could take many forms—

items in everyday use with the shape of all the regular figures (two dimensional), *e.g.*, a Russian medal for a pentagon,

cartons and containers in common usage representing the regular and prismatic solids, *e.g.*, tetrahedron milk pack,

a collection showing mathematics at work in nature—three leafed clover, six pointed snow crystals, etc.

mathematics in the news—newspaper and magazine items which include mathematical words and prefixes, *e.g.*, " A Hyperboloid Over Your Head," a reference to the timber-shell roof going up at Oxford Road Station, Manchester.

As with all collections only one of each type is collected. Duplicates should be used for swopping with your friends, particularly if you get a spare Great Rhombicosidodecahedron !

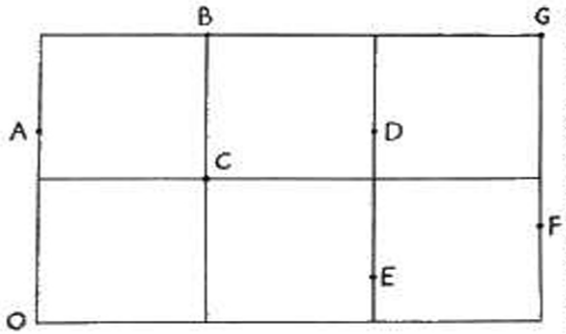
Prize for best list submitted by 15th August. I.L.C.

AN ODD QUESTION

Which is the smallest number which, when divided by 3 leaves a remainder of 1, and when divided by 5 and 7 will leave 3 and 5 respectively?

USING THE HEAD AS WELL AS THE FEET

(From Le Facteur X)



In a novel sort of race, the runners were allowed to choose their own route which, starting from point O, should bring them back to the start as soon as possible. En route, they had to collect tickets from the control points A, B, C, D, E, F and G as shown on the plan above, but not necessarily in strict alphabetical order. Each runner had to keep to the lines. The points A, D, E and F divide the sides of the small squares in the ratio 2 : 1. What is the shortest route? For simplicity you may take the sides of the small squares as 60 yards each. J.F.H.

IT'S ALL GREEK

$\beta\ \theta\ \delta\ \gamma\ \mu$	=	TACIT
$\pi\ \beta\ \delta\ \gamma\ \gamma$	=	AMISS
$\delta\ \sigma\ \lambda\ \gamma\ \gamma$	=	SAILS
$\mu\ \delta\ \pi\ \lambda\ \mu$	=	LEAST
$\gamma\ \delta\ \lambda\ \beta\ \gamma$	=	CLASS

A spy tried to memorise some code words. On writing them down, he got them in the wrong order as above. Find the correct order.

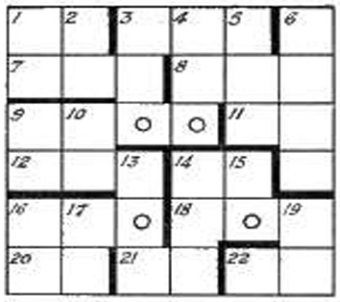
56951 62396 58645 73021 63159 81931 95167 35381

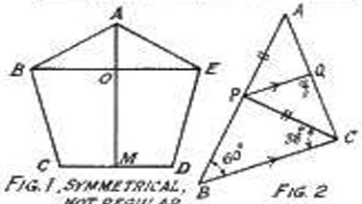
IT'S A TWIST

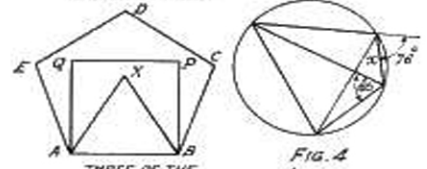
With one line divide a rectangle 16 cm. by 9 cm. into two parts which can be fitted together to make a square of side 12 cm. C.V.G.

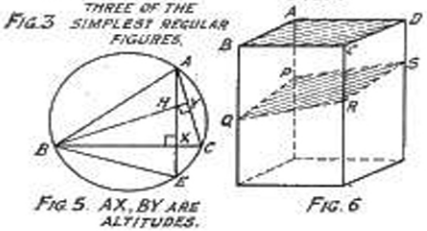
SENIOR CROSS FIGURE No. 33

The number of figures to be inserted for each clue is indicated by the thick lines which act as stops. Small circles indicate zero.









ACROSS :

1. abc if bc=7, ca=3, ab=21.
3. abc if $a^2+b^2=106$, $b^2+c^2=74$, $c^2+a^2=130$.
7. abc if a+b=24, b+c=10, c+a=28.
8. Total surface area of 3 identical cubes is 648 sq. ins. What is the sum of their volumes?
9. Area of the pentagon (Fig. 1) AO=12 in., AM=32 in., BE=70 in., CD=28 in.
11. Sum of all the prime factors of 37037.
12. Angle PXE (Fig. 3).
14. Angle x (Fig. 4).
16. This number increased by 20% and then by 25% is 330.
18. Angle y (Fig. 2) AP=PC, PQ parallel to BC.
20. (Fig. 5). Angle HBE when angle BAC=63° and angle ABC=69°.
21. A, B, C, D, are four points in order on a line. AC=52½ in., BD=46¾ in., AD=84 in. What is BC?
22. x+y when $x^2 - xy + y^2 = 441$ and xy=45.

DOWN :

1. (Fig. 6). A rectangular beam is sawn across giving a section PQRS. AP=33 in., BQ=56 in., CR=47 in. What is DS?
2. Number of sides of a regular polygon whose internal angles are 154½°.
3. $\frac{a(a^3+1)+(a+1)^2+(a+1)}{a+1}$ when a=7.
4. Perimeter of Fig. 1. (See 9 across).
5. abc if a+b − c=14, a − b+c=12, b+c − a=0.
6. Value of C when A=ax+b, B=aA+b, C=aB+b and a=10, b=8, x=8.
9. Value of x when $a^2 + (c - x)^2 = b^2 + x^2$, a = 11, b = 1, c = 10.
10. Angle ACP (Fig. 3).
13. Can be written as $9a^2+1$ or as 90a+1.
14. abc if b=2a+1, c=2b+1, a+b+c=25.
15. abc if $\frac{1}{a}+\frac{1}{b}+\frac{1}{c}=\frac{1}{9}$ and ab+bc+ca=10.
16. There are 52 animals (sheep and goats). For every 7 sheep there are 6 goats. How many sheep are there?
17. How many goats?
19. Area of rhombus with diagonals 4 in. and 7 in.

J.G.

83540 56704 03867 43513 62222 47715 89150 49530

Figure 1

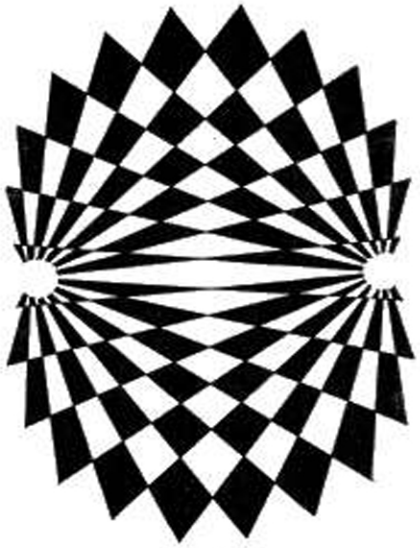


Figure 2

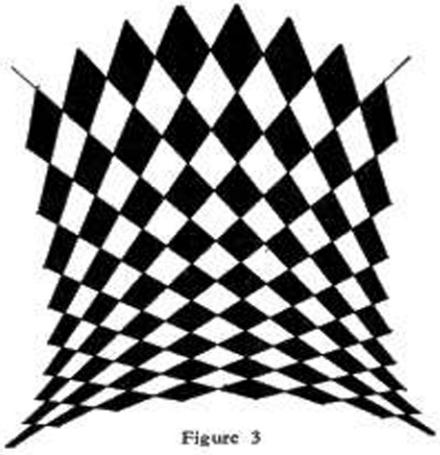


Figure 3

More Mathematical Patterns

Figure 1 shows a familiar pattern treated in a different way. Alternate quadrilaterals are filled in to make a chequered pattern which suggests strings of beads on curves which run diagonally across the quadrilaterals. Patterns of this sort can be made with tangents to any curve.

The other patterns are made by two sets of lines or circles constructed according to some simple rule. In Figure 2 lines are drawn from the ends of a diameter of a circle to 18 points equally spaced round the circumference. The intersections lie on a set of circles and on a set of hyperbolae. Sixth-formers can work out the equations.

The basis of Figure 3 is equally spaced points on each of two lines. The points of one line are joined to one fixed point, and the points on the other line to another fixed point. In Figure 4, equally spaced points on one line are joined to each of two fixed points.

In all these patterns the lines can be extended indefinitely in either direction. In making a design it is important to decide where not to draw the line. Quite different effects are produced by filling a space, as in Figure 4, and by finishing at a string of quadrilaterals, as in Figure 3.

In Figure 5 a network of ellipses is suggested by two sets of parallel lines, the lines being drawn through points equally spaced on two semi-circles (see Figure 6). In this pattern there are the same number of divisions on each circle. Intricate patterns of Lissajous's figures are produced if there are different numbers of points on the two circles.

In Figure 7 a set of parallel lines and a set of concentric circles suggest confocal parabolas. In Figure 8, two sets of concentric circles make confocal ellipses and hyperbolae. It is said that this pattern, formed by ripples on the college pond, set Thomas Young searching for the optical interference patterns which proved the wave theory of light. The pattern is still of importance in one aircraft guidance system.

C.V.G.

The Editor will be pleased to see photographs of any embroidery based on these or similar patterns. Boys who do marquetry work should also be able to find inspiration here.

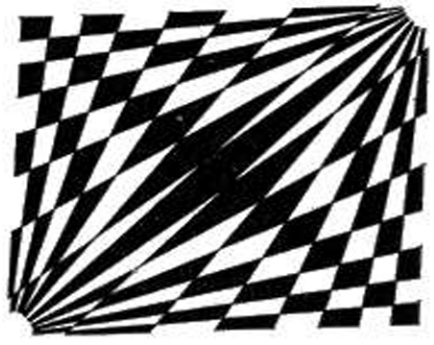


Figure 4

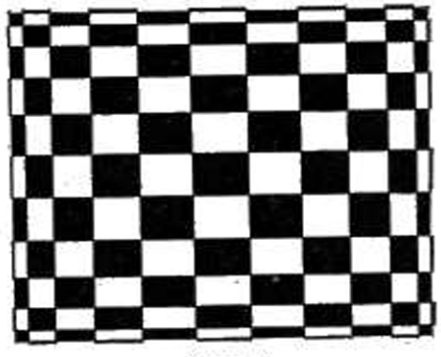


Figure 5

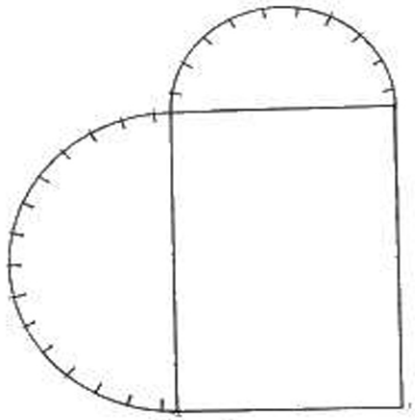


Figure 6

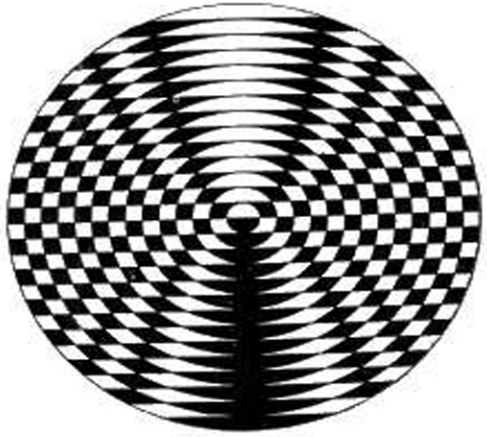


Figure 7

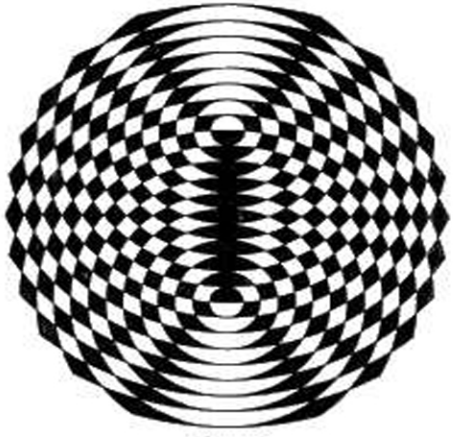


Figure 8