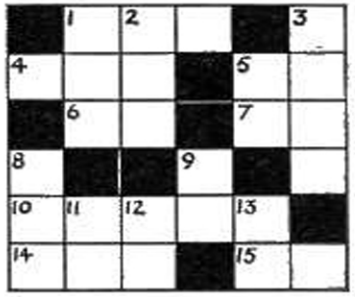
JUNIOR CROSS FIGURE No. 29

Submitted by Maureen Hobbs, Hazeldene School, Salcombe.

Decimal parts of answers are written as numbers without indicating the decimal point.



CLUES ACROSS :

1. π to 2 decimal places.
4. Eight score.
5. 3^3.
6. $\frac{1}{2}$ as a percentage.
7. Area of a square of side 6 inches.
10. 10 nautical miles per hour expressed as feet per hour.
14. Number of yards in $\frac{1}{2}$ mile.
15. Simple Interest when the principal is £640 and the Amount is £696.

CLUES DOWN :

1. Number of days in one year.
2. Number of cm. in one metre.
3. Number of yards in one mile.
5. $\sqrt{529}$.
8. The duty on a watch of value £4 when the customs charge is $33\frac{1}{3}\%$ of the value (in £ s. d.).
9. Percentage equivalent of 7 marks out of 10.
11. $\frac{8}{100}$ as a decimal.
12. $\frac{4}{5}$ as a percentage.
13. 5 metres as a decimal of 1 Hm.

SOLUTIONS TO PROBLEMS IN ISSUE No. 31

NUMBERS IN WORDS

(ii) ONE + SEVEN, (iii) ONE + TWO + SIX,
(iv) THREE + SEVEN, (v) TWO + FOUR + FIVE
(vi) ONE + FOUR + SEVEN, (vii) TWO + THREE + EIGHT
(viii) THREE + FOUR + SEVEN.

ROUND AND ROUND.

Radius of the first circle is $\frac{3}{8}\sqrt{2}$. The largest circle that can be drawn on a sphere is a great circle ; the radius of the compasses must then be $6\sqrt{2}$.

MODERN GEOMETRY

If a point on one side is taken as a vertex, the angle at that vertex will be 180°. Hence the sum of the angles of a pentagon must be 360° + 180° or 540°.

TIM-Ber

In order from greatest to least :— b, a, c, d. The values are log 15, log 8, log 4, and log 2.

SENIOR CROSS-FIGURE No. 31

ACROSS : (i) 749 ; (4) 432 ; (5) 677 ; (7) 25 ; (8) 62 ; (9) 46 ; (11) 41 ; (14) 48 ; (15) 33 ; (17) 052 ; (19) 287 ; (20) 396.
DOWN : (1) 7354 ; (2) 42 ; (3) 37 ; (4) 42 ; (5) 624 ; (6) 72 ; (10) 642 ; (12) 1386 ; (13) 60 ; (16) 37 ; (18) 51 ; (19) 29.

AFTER THE 11 PLUS

The Editor apologises for the error in this problem. The product of the ages of the boys was 2,652. Their ages were 12, 13, 17 and the headmaster was 42.

THE TWO BUCKETS

By the Principle of Archimedes, the weights of the buckets are the same.

FUN WITH NUMBERS—I

$17 + 18 + 19 + 20 + 21 + 22 + 23 + 24 + 25 = 64 + 125.$
$[(n-1)^2 + 1] + [(n-1)^2 + 2] \ldots\ldots\ldots\ldots\ldots\ldots + n^2 = (n-1)^3 + n^3.$

INTELLIGENCE TEST

(1) Astra ; (2) Watkins ; (3) 150 ; (4) Yellow ; (5) Mary ; (6) $2\frac{1}{2}$.

PROBLEMS

(1) 14. (2) 35. (3) 24.

ANOTHER TIGHT FIT

The diameter of the smaller circles are each 3 inches.

JUNIOR CROSS-FIGURE No. 28

ACROSS : (1) 2940 ; (5) 17 ; (6) 44 ; (8) 320 ; (10) 80 ; (11) 33 ; (13) 50 ; (14) 36 ; (15) 99 ; (16) 35 ; (17) 9 ; (18) 574.
DOWN : (1) 27 ; (2) 90 ; (3) 49 ; (4) 04853 ; (5) 1133 ; (7) 400 ; (8) 336 ; (9) 2095 ; (12) 79.
The clue 6 down should have been labelled 7 down.

B.A.

252

25602 90228 47210 40317 21186 08204 19000 42296

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MATHEMATICAL PIE

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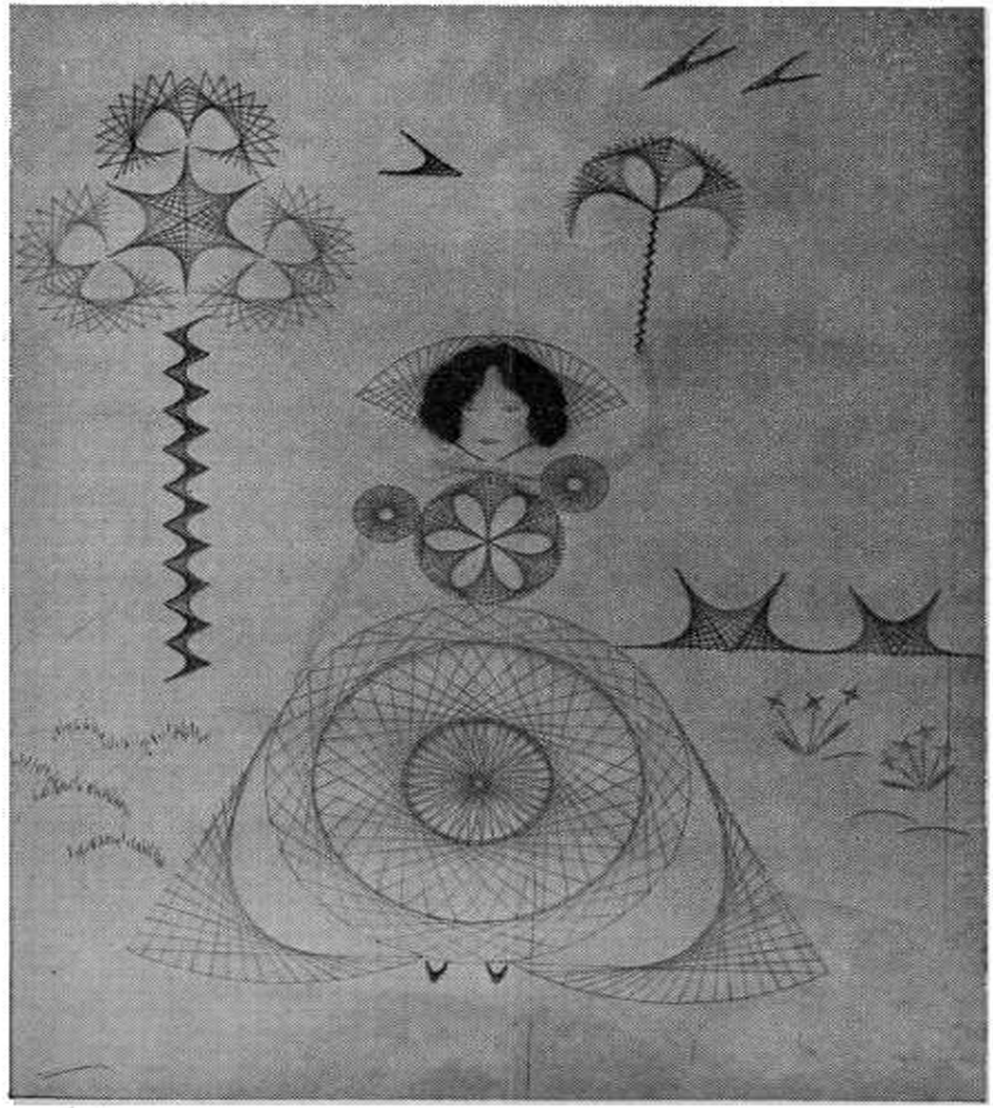


PARABOLA JAEN by VIB, Herts and Essex High School

245

43751 89573 59614 58901 93897 13111 79042 97828

SPOTS BEFORE THE EYES

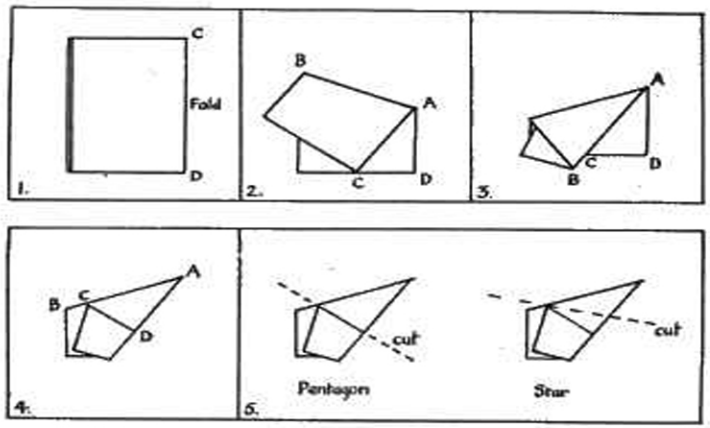
A set of dominoes consists of a set of possible pairs of the numbers 0 to 6. (*a*) How many dominoes are there in a set ? (*b*) What is the total of their spots ? (*c*) Ask four people each to take seven dominoes and add up the value of their spots. The sum of their total should come to (*b*) but you will be amazed at the number of times someone in the four will have made a mistake. Try it on your friends.

R.H.C.

PAPER-FOLDING No. 1

Pentagon and 5-pointed Star

To make a pentagon or a five-pointed star by folding start with a rectangular sheet of paper 5 inches long and $3\frac{1}{2}$ inches wide. A larger sheet may be used so long as you keep the sides in this same ratio.



1. Fold once parallel to the shorter sides.
2. Fold so that C coincides with the middle point of the lower edge and crease along AB.
3. Fold AB onto AC, thus bisecting the angle BAC.
4. Fold the flap ADC behind and turn over.
5. Now that the folding is complete a straight cut along DC will make a regular pentagon ; or an oblique cut through C will make a five-pointed star.

I.L.C.

CENTURY MAKERS

In how many ways can 4 nines be arranged to make 100 ?

A FIELD STUDY

The diagonal of a rectangular field is 125 yards and the perimeter is 322 yards. Find the area of the field.

J.G.

56475 03203 19869 15140 28708 08599 04801 09412

Now let us use U for " umpteen," then to Alice ab stands for $a \times U + b$. Using this notation we can re-examine Alice's system of multiplication :

$4 \times 5 = 12$, this means $4 \times 5 = 1 \times U + 2$. Alice's U stand for 18 in our system.

$4 \times 6 = 13$, this means $4 \times 6 = 1 \times U + 3$. Alice's U stands for 21 in our system.

You will notice that like Topsy " umpteen " has " growed," it has increased by three so that in the next multiplication " umpteen " will have increased by a further three and will be equal to 24 in our system. This means that in the next multiplication " umpteen " will be 27, in the next 30, and in the next 33. We know that

$4 \times 5 = 18 + 2$	To Alice this would be	$4 \times 5 = 12$ " umpteen " is 18
$4 \times 6 = 21 + 3$		$4 \times 6 = 13$ " umpteen " is 21
$4 \times 7 = 24 + 4$		$4 \times 7 = 14$ " umpteen " is 24
$4 \times 8 = 27 + 5$		$4 \times 8 = 15$ " umpteen " is 27

The general statement of these results is $4 \times n = 3(n+1) + (n - 3)$ where umpteen is $3(n+1)$ and the number of units is $(n - 3)$. You will see that only when n is 3 can Alice have no units. When n is 3, Alice says $4 \times 3 = 10$ and " umpteen " is 12.

The results are as follows

$4 \times 1 = 4$ " umpteen " is 6

$4 \times 2 = 8$ " umpteen " is 9

$4 \times 3 = 10$ " umpteen " is 12

. . . . . .

$4 \times 8 = 15$

$4 \times 9 = 16$

However what does Alice write for our ten ? To her, 10 means " umpteen." Suppose for our ten she wrote a, for eleven b, twelve c, thirteen d, fourteen e, her multiplication tables continues :—

$4 \times a = 17$

$4 \times b = 18$

$4 \times c = 19$

$4 \times d = 1a$

$4 \times e = 1b$ and so on.

Poor Alice ! Will she ever reach 20 ? It is not surprising that with so much ambition, distraction, uglification, and derision she found herself shrinking and stretching into so many sizes in Wonderland.

" Mock Turtle."

TREASURE HUNT No. 1

An equilateral triangle has 4" sides. A point P is 2" from one side and 2" from another. By drawing or calculation find the possible distances of the point P from the third side.

J.G.

36096 57120 91807 63832 71664 16274 88880 07869

POINTS OF VIEW

(Adapted from Le Facteur X).

A large isosceles triangle has been painted on a school playground. Show all the viewpoints on the school playground from which the two equal sides subtend equal angles.

ANOTHER MAGIC SQUARE

1			4
	6	7	
8			5
	3	2	

Placez dans chaque case libre les nombres 9, 10, 11, 12, 13, 14, 15, et 16 de façon à former 34 dans tous les sens. J.F.H.

No Place for Squares !

Suggested by Canon Eperson, Bishop Otter College, Chichester.

Instead of squares, place equilateral triangles on each side of the right-angled triangle. Show that the sum of the two smaller triangles is equal to the triangle on the hypotenuse by cutting them into pieces and fitting these into the large one. Bogey is 6 pieces ; can you improve on this by managing with fewer ? J.F.H.

CURIOSER AND CURIOSER

Lewis Carrol, in real life the Reverend Charles Lutwidge Dodgson, was a lecturer in Mathematics at Christ Church, Oxford. It is not surprising that " Alice's Adventures in Wonderland " includes many references to Mathematics. Perhaps it is not realised that what appears to be nonsense has a sound mathematical basis and has application in the world of today.

" Let me see ; four times five are twelve, and four times six are thirteen, and four times seven is ---- oh, dear ! I shall never get to twenty at that rate ! "

Let us examine this statement a little more closely. At first it seems illogical, but let us translate it into the language of Mathematics.

$4\times5=12 \qquad 4\times6=13 \qquad 4\times7=$ --

Now discard all previous ideas. What does 12 really mean? In our system of numbers it stands for one ten and two units, where ten is the base of our number scale, but in Mathematics there are umpteen such scales. So to Alice 12 meant " umpteen " and two units, where umpteen was changing all the time in an orderly manner.

In our system, the decimal system, four times five is twenty, that is two tens. In figures this is $4\times5=2(10)+0$. All our numbers are understood to be of the following form :—

ab stands for $a\times10+b$, i.e., a tens and b units

e.g., 32 stands for $3\times10+2$, i.e., 3 tens and 2 units

25 stands for $2\times10+5$, i.e., 2 tens and five units

10 stands for $1\times10+0$, i.e., 1 ten and 0 units.

65406 28433 66393 79003 97692 65672 14638 53067

ESPECIALLY FOR THE GIRLS

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(1) Draw a segment AB, $1\frac{1}{2}''$ long, in the centre of the paper.

(2) Construct a perpendicular bisector of AB intersecting it at O. Call it XY.

(3) Make OY $2\frac{1}{2}''$ long.

(4) With A and B as centres and a radius of $\frac{7}{8}''$ construct arcs of circles intersecting XO at C and AB extended at points M and N respectively.

(5) Construct a perpendicular bisector of the distance MY and let it intersect the arc CN at D.

(6) Using DY as a radius and D as a centre construct an arc from M to Y.

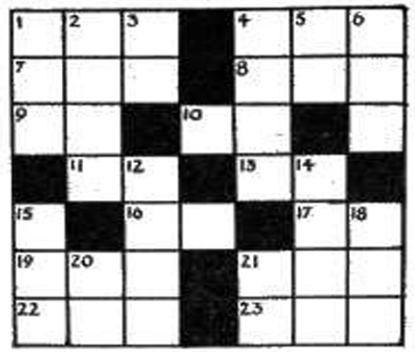
(7) In a like manner construct an arc from N to Y, using a point on arc MC as centre.

(8) When the figure is completed write an appropriate saying on it.

SENIOR CROSS FIGURE No. 32

VABCD is a right rectangular based pyramid. AB = 8, BC = 6, VN = 12 units.

Give irrational answers correct to 3 significant figures. Angles to be given in degrees and minutes.

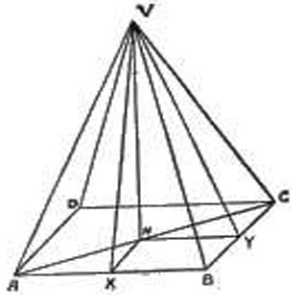


CLUES ACROSS :

1. VX.
4. Angle VAB.
7. 3 consecutive even numbers.
8. AB^3+BY^3.
9. Area of ABC.
10. XY^2.
11. Twice AC.
13. BY^2.
16. One third VX^2.
17. One half of the volume of VABcD.
19. Area Rectangle ABCD + △VAB.
21. Cos VBC reversed.
22. Total surface area.
23. $AB^3 - BC^3 + 11$.

CLUES DOWN :

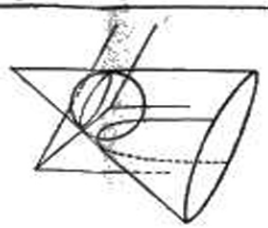
1. Angle XVN.
2. Angle BVC.
3. Area ABCD.
4. Angle VXN.
5. AC + CV.
6. Area VAB reversed.
12. Angle AVB reversed.
14. Angle YVN.
15. Volume of pyramid.
18. VY.
20. Area of VBC + VAD — 4.
21. VA.

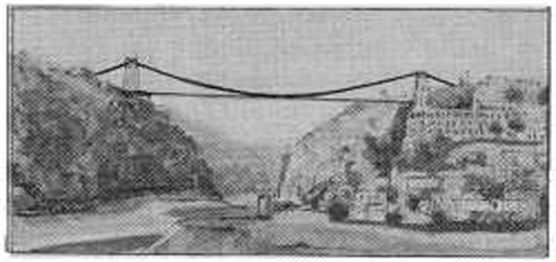


B.A.

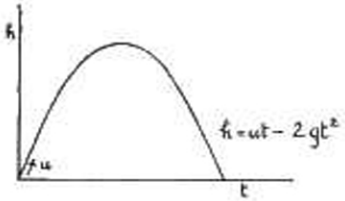
14722 13179 47647 77262 24142 54854 54033 21571

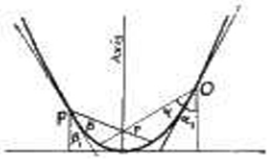
PARABOLIC ARCHES

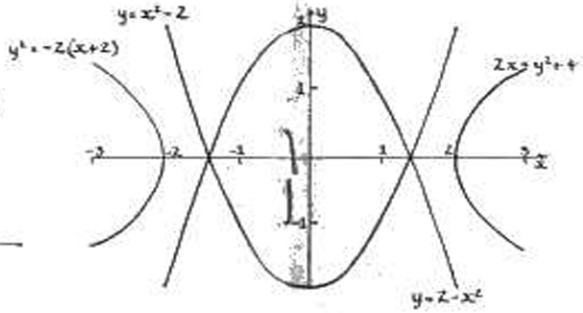


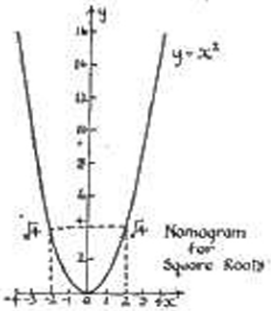


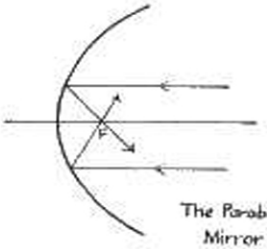
SUSPENSION BRIDGE









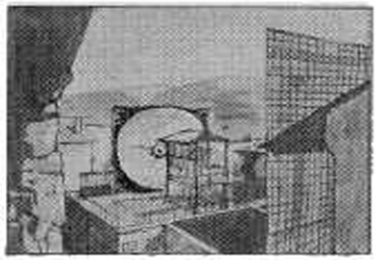


The Parabolic Mirror

PARABOLIC ARCS OF SPARKS

THE PARABOLA

The parabola belongs to the family of curves known as conics because they can be obtained by slicing through a cone in various ways. It is probable that these curves – the circle, ellipse, parabola, hyperbola – were first studied by Menaechmus (B.C. 350), but they were given their names by the famous Apollonious. Archimedes also left some work on the parabola in which he used methods that anticipated the Integral Calculus. Descartes discovery of co-ordinates greatly simplified the study of curves.



SOLAR FURNACE

A conic.

If a cone is cut by a plane, the boundary of the cut surface or surfaces is called a conic section, or just a conic. If the plane is parallel to its sloping edge, the conic is a parabola. The Greeks studied these curves.

Axis, directrix, and focus.

Two important straight lines are associated with the parabola—the axis and the directrix. The axis divides the parabola into congruent halves. The focus is a point on the axis such that every point on the parabola is the same distance from it as it is from the line known as the directrix, which is at right angles to the axis. The diagram shows a construction for finding the focus F, of a given parabola.

Graphs and Parabolas.

Any quadratic expression plotted in the usual way as a graph results in a parabola. In the centre diagram, it is shown that interchange of x and y causes the direction of the parabola to alter. A convenient nomogram for finding squares and square roots can be obtained by plotting $y = x^2$ to suitable scales. The symmetrical curve on the right shows that a square root may be positive or negative.

Projectiles and Parabolas.

Galileo and Newton showed that the laws governing the movement of projectiles,

under the influence of gravity, can be expressed as quadratic expressions. Some projectiles move along parabolic paths. The illustration at the bottom left shows the paths of sparks flying from a blacksmith's anvil.

Architecture and Parabolas.

A beam, when uniformly loaded horizontally, adjusts itself to a parabolic shape under the stress of the load. The two illustrations at the top of the block show how this property is used in civil engineering to obtain maximum strength.

Reflection and Parabolas.

A parabola rotated about its axis forms a parabolic surface. Such a surface shows remarkable properties if it is made into a mirror. If a source of light is placed at the focus, a parallel beam of light emerges. Car headlights, searchlights and beamed radio transmission are examples of the use of this principle. A parallel ray of light, *e.g.*, sunlight, falling on a parabolic mirror is concentrated, after reflection, on the focus. The illustration at the bottom right shows the parabolic mirror of a solar furnace, for obtaining very high temperatures, which the French have built in the Pyrenees. Metals contained in a crucible placed at the focus may be melted easily. The energy obtained from the sun is cheap but the reflecting mirror is very expensive.