NZMATHS new zealand maths

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Reading about Brian Stokes's new book Tickle Tackle in our June issue put me in mind of the well-known game Noughts and Crosses which is also known as Tic-tac-toe, or Ticktacktoe as the Americans call it. Of all the board games ever devised it and its near relatives have undoubtedly been the most popular. I remember seeing two examples in the British Museum in London, one of pottery pieces on a limestone slab dated 850 BCE, the other a New Zealand version made of paua. It is a game of position related to others like Pong hau k'i played in China, the Maori game Mu Torere and Achi played by Ghanian children. Games like Nine Men's Morris and Go-moku are derived from it. More complicated versions of the basic game are played in three dimensions or on boards of unlimited size. I guess the rules of Noughts and Crosses are well-known to everyone. Less well-known, perhaps, is that there are a number of simple alternative versions to the game like, for example, the <u>loser</u> being the first to get three of his pieces in a line (vertically, horizontally or diagonally). This version of the game is sometimes called Toetacktick! In Wild Ticktacktoe, invented by Solomon W. Golomb, players may use either symbol, O or X. The first to complete a line of three in either symbol is the winner. There is also the misère version where the first player to make three in a line loses. Since the game and most of its versions are essentially quite straightforward, strategies for playing them are readily worked out. For example, the standard version of the game will always end in a draw if the opponents play intelligently. Some other versions of the game are included in *Afterthoughts* below.

At evening, when with pencil, and smooth slate
In square divisions parcelled out and all
With crosses and with cyphers scribbled o'er
We schemed and puzzled, head opposed to head
In strife too humble to be named in verse.

William Wordsworth

76 is an automorphic number in that its square ends in itself, this $76^2 = 5776$. Among the famous people who died at age 76 are included Albert Einstein, Edward Elgar, T.S. Eliot and Livy.

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What's new on nzmaths.co.nz

There are three new objects available in the Learning Objects section. These Learning Objects have been developed specifically for the nzmaths site and are not password protected so feel free to have a look. The new objects are:

1. **Angles**: which helps users measure or draw angles using other angles as units of measurement
   http://www.nzmaths.co.nz/LearningObjects/angles/angles.htm
2. **Number Line**: which helps users to record how they solve addition and subtraction problems using a number line
   http://www.nzmaths.co.nz/LearningObjects/NumberLine/index.swf
3. **Mix Up**: which helps users find averages of percentages
   http://www.nzmaths.co.nz/LearningObjects/MixUp2/index.swf

These Learning Objects are also available in Maori from this page:
http://www.nzmaths.co.nz/maori/lo/default.aspx

A handbook to support the Home-School Partnership: Numeracy has been designed as a guide for schools and communities to plan ways to work together to support children's numeracy achievement. It is available from this page:
http://www.nzmaths.co.nz/numeracy/hspn/index.aspx

Diary Dates

A final reminder that Maths Week 2008 is this month - the week of the 11th to 15th August. There is an assurance on the front page of the NZAMT site that "This year is again bigger, better and brighter."
http://www.nzamt.org.nz/sites/cms/

Crop circle

My son-in-law came across this picture in a recent issue of the Melbourne Herald Sun newspaper (http://www.news.com.au/heraldsun/story/0,21985,23886370-5012749,00.html; June 19, 2008). It shows a recent crop circle in Wiltshire. Your mission is to find the mathematical connection here. As a hint I should note that π has a lot to do with circles. We all know about $2\pi r$ for the circumference and πr^2 for the area. But this circle goes a little bit further and tells you what π is, or at least the first 10 significant figures of it. The decimal point might help.


Picture: APEX

If you need any more hints, you should look at the Afterthoughts.

But this is just a reminder that 22/7 is only an approximation to π. A little play on a calculator gives 22/7 as 3.142857214285721428572142857214285721428572. So there are two things to note here straight away. First, 3.142857214 is a long way away from 3.141592654, the first 10 significant figures of π. So 22/7 is only a useful approximation to π. If you want to you can get better approximations. Archimedes did. For instance, 333/106 is not so bad. That weighs in at 3.141509434. There are many more, just do a web search on 'pi approximations'.

And second, 3.142857214285721428572142857214285721428572… keeps cycling round with '1428572' going on for ever. It has to do this because it's a fraction. Every fraction either comes to a halt (that is, at some stage it continues as 0000…) or repeats. The fact that it has 7 numbers in its repeating bit ought not to come as a surprise. What would you expect the periodic piece of 40/41 to be? Now you can make repeating decimals to order. (There is a unit on this you might like to look at Try Number and Algebra, Level 6, Babylonian Mathematics 2.) And in contrast, π never repeats. It always meanders on never quite repeating anything that has gone before.

Booke Review: **A Treatise on the Astrolobe by Geoffrey Chaucer**

Geoffrey Chaucer was the first great poet to write extensively in English. His works, in their original form, continue to be studied at universities today. His prose writings include only one scientific work and that is *A Treatise on the Astrolobe* which was first published in 1391.

The book was originally intended as a text book for Chaucer's son Lewis whose attainments in Latin had not reached the proficiency of what Chaucer called 'plain English words'. The prologue is a fine example of Chaucer's graceful and flowing style. Here's a part:

> Little Lewis my son, I have perceived well by certain signs thy ability to learn sciences touching numbers and proportions; and I also consider thy earnest prayer specially to learn the Treatise of the Astrolobe. Then forasmuch as a philosopher saith, 'he wrappeth him in his friend, who condescendeth to the rightful prayers of his friend', therefore I have given thee an astrolobe for our horizon, composed for the latitude of Oxford, upon which, by means of this little treatise, I purpose to teach thee a certain number of conclusions appertaining to the same instrument.

Chaucer stated for the book that he was not claiming originality but only to provide a reliable authority for the subject under study and for rendering it accessible in the English language. The book begins with a full description of the astrolobe, with diagrams, and shows how it may be used.

In a supplement to the book Chaucer shows how the astrolobe may be used to solve other problems of plane geometry like finding the height of acccessible objects such as towers or poles the feet of which can be reached, or others, inaccessible objects like hills, where it is impossible to reach ground level beneath the highest point.

astrolabe

A French mariner using an astrolabe to fix the position of a star, from a vellum manuscript of Jacques Devaulx (1583; Bibliothèque Nationale, Paris, France). The mariner's astrolabe was introduced in the mid-15th century, but did not see general use until the beginning of the 16th century. It was supplanted by the sextant in the 18th century. (Image © The Art Archive/Dagli Orti) (See http://encyclopedia.farlex.com/_/viewer.aspx?path=hut&name=aa334222.jpg.)

Bill's Number Plates Problem

If you go to the Problem Solving section of the web site and look at Bill's Number Plates, Number Level 5 (6), you'll see the need to create number plates that show a given number. Room 1 of Greenmeadows School has come up with this list for the number 4. I have to say that I don't think that all of them are quite legal, for instance 444, but I admire their ingenuity. Well done Room 1. Can someone else do better?

FOUR	4	04	004	0004	00004
000004	O4	OO4	OOO4	OOOO4	OOOOO4
FOURS	FOURZ	FOUR4	4FOUR	4FOUR4	2PLUS2
1PLUS3	3PLUS1	6B4TEN	6B410	5B49	4B48
3B47	2B46	1B45	0B44	ONEB45	TWOB46
2B4SIX	7B411	8B412	9B413	10B414	11B415
12B416	13B417	14B418	15B419	16B420	17B421
18B422	19B423	20B424	21B425	22B426	23B427
24B428	25B429	26B430	27B431	28B432	29B433
30B434	31B435	32B436	33B437	34B438	35B439
36B440	37B441	38B442	39B443	40B444	41B445
42B446	43B447	44B448	45B449	46B450	47B451
48B452	49B453	50B454	51B455	52B456	53B457
54B458	55B459	56B460	57B461	58B462	59B463
60B464	61B465	62B466	63B467	64B468	65B469
66B470	67B471	68B472	69B473	70B474	71B475
72B476	73B477	74B478	75B479	76B480	77B481
78B482	79B483	80B484	81B485	82B486	83B487
84B488	85B489	86B490	87B491	88B492	89B493
90B494	91B495	92B496	93B497	94B498	95B499
4OVER1	4OVA1	2TIME2	4TIME1	Q4	QQ4
QQQ4	QQQQ4	QQQQQ4	8MNUS4	7MNUS3	6MNUS2
5MNUS1	4MNUS0	9MNUS5	8MNU54	7MNU53	6MNU52
5MNU51	4MNU50	9MNU55	4^{TH}	FOURTH	IV
4AFTR0	3AFTR1	2AFTR2	1AFTR3	0AFTR4	8DVD2
12DVD3	16DVD4	4DVD1	20DVD5	24DVD6	28DVD7
32DVD8	36DVD9	2X2	4X1	FOURSS	FOURZZ
444444	44	444	4444	44444	FOR
FORS	FORZ	FORSS	FORZZ	FORSSS	FORZZZ
3ADD1	1ADD3	2ADD2	FO_UR	F_OUR	F_OU_R
FO_U_R	F_O_UR	_FOUR_	_FOUR	FOUR_	F_O_R
_F_O_R	F_O_R_	FO_R	F_OR	_FOR	FOR_
FOR	F0UR	F0R	4F0UR4	4F0R4	4F0UR4
4F0R	F0R4	F0UR4	4F0UR		

Solution to July's Endeavour

Last month we pointed out that 24 has the property that it is one less than a square number and that it's double is also one less than a square number. The next smallest number with that property is 840.

This Month's Endeavour

In the introduction we mentioned that 76 is an automorphic number because its square ends in itself. There is only one other 2-digit number with this property, can you find it?

Solution to last month's Junior Problem

Last month's coding worked so well I thought that I'd try it again. All the hints this month are in last month's problem. Follow the directions and don't forget in your answer to say who you are and what school you go to. In case you win the month's prize you might want to give an address – your school address will do.

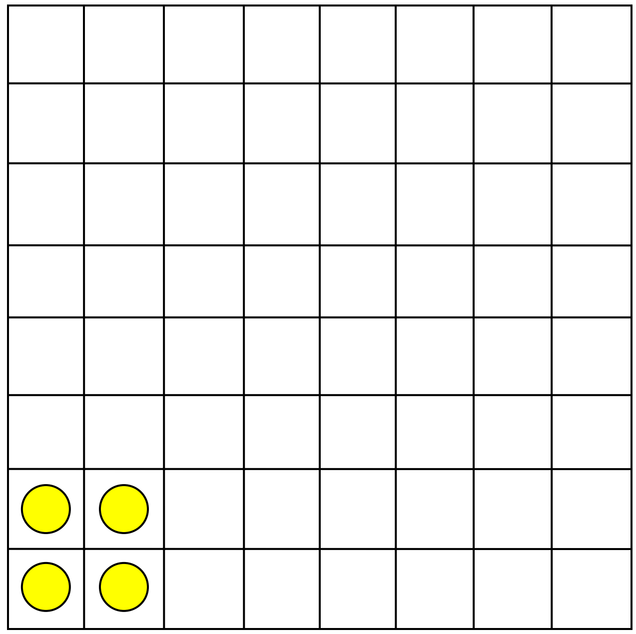
DRSCWYXD	RNOBOUSC	KGKICYZV	OKCOCOXN
DROKXCGO	BDYDRSCA	EOCDSYXD	YKXNBOGR
SCOWKSVK	NNBOCCSC	DROCKWOK	CNOBOUCT
ECDBOZVK	MONOBOUL	IKXNBOGG	RKDSCKXN
BOGCNKEQ	RDOBCXKW	OIYEMKXC	OKBMRYXD
ROXJWKDR	CGOLCSDO		

So the message said "This month Derek is away so please send the answer to this question to Andrew his email address is the same as Derek's just replace Derek by Andrew. What is Andrew's daughter's name You can search the nzmaths web site."

When you do the search you find "Elizabeth". This month's winner was Baxter Robb of Seatoun Primary School.

This Month's Junior Problem

To get this month's $20 I've gone to counters on a chess board. Put four counters on the board as I have done on the board on the next page.



The counters can move by jumping over another counter to a vacant cell on the other side. So, at the moment, three of the counters can move but the one at the top right can't because it has no other counter to jump over.

The first problem is to see whether you can move the four counters into another place on the board so that they are again in the form of a square. (The four counters are in the bottom left 2 by 2 square of cells. Can you move them to some other 2 by 2 square of cells.)

The second problem is to look at nine counters in the bottom left 3 by 3 square of cells and see if you can move them to another 3 by 3 square of cells.
Then finally, look at 16 counters in the bottom left 4 by 4 square of cells and see if they can be moved to some other 4 by 4 square of cells.

Afterthoughts

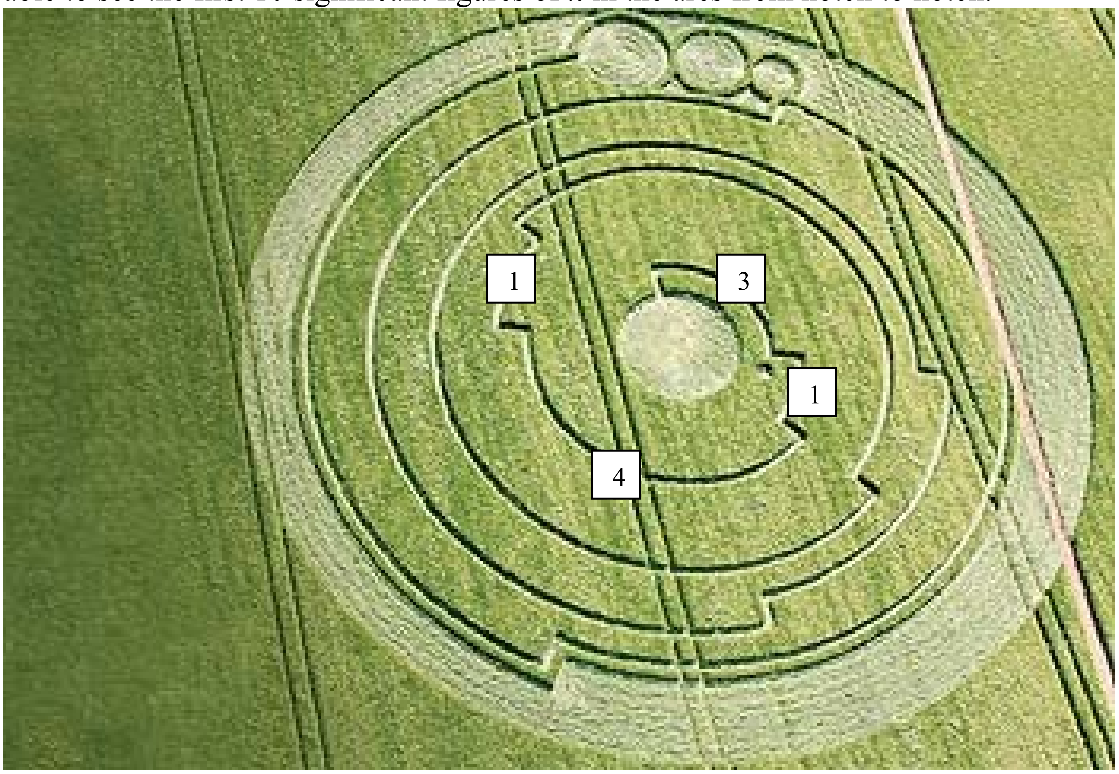
(1) A couple of less interesting versions of the game Tic-tac-toe might be called Noughts and Noughts (or Crosses and Crosses) where both players play with the same symbol. The winner, or the loser in the misère version, is the first to make three in a line.

Two other versions were devised in New Zealand. In Smatick both players in turn first play a O, then both play a X, then both O and so on, The first to complete three in a line is the winner (or the loser in the misère version).

Yet another version of the game, attributed to David Silverman, is called 'Your Move'. The rules are similar to the standard game except that one player tries to achieve a draw while the other attempts the usual three in a line.

Another game just called Noughts, can be found by clicking on our Problem Solving jigsaw piece. It's a Geometry Level 4 problem and I'd really like to see a complete solution.

(2) If you look carefully, maybe using the odd geometric instrument or two, you might be able to see the first 10 significant figures of π in the arcs from notch to notch.



But first find the decimal point: it's to the left of the '1' on the right. The arc between the notch to the left of the '3' and the notch just above the rightmost '1', represents the '3' of π. An angle of about 108° is at the centre of that arc. If you then turn through a further anti-clockwise angle of 36° you get to the next notch and you've turned out the '0.1' of π. After another anti-clockwise angle of 144° you reach the next notch and you've turned out the '0.004' of π. I'll leave the rest of the 3.141592654 to you. As retired astrophysicist Mike Reed, the discoverer of the encoded value of π said in the paper, "The tenth digit has even been correctly rounded up".

Now we've got hold of all of that it wouldn't be difficult for your class to design their own crop circles. Given that '1' in the picture is represented by 36°, it might provide an interesting exercise in using a protractor. On the other hand why stick with π? There are other interesting numbers that they might like to use for a design.