M500 43

M500 is a student operated and owned magazine for Open University mathematics students and staff, and friends. It is designed to alleviate student academic isolation by providing a forum for public discussion of the mathematical interests of readers.

Articles and solutions are not necessarily correct but invite criticism and comment. Anything submitted for publication of more than 600 words in length will probably be split into instalments.

MOUTHS is a list of names addresses, with telephone numbers and previous and present courses of voluntary members, by means of which private contacts may be made, to share OU and general mathematical interests, or to form self-help groups by telephone or correspondence.

THERE IS ALSO A SPECIAL LIST OF SOME OF THE MOUTHS MEMBERS WHO HAVE EXPLICITLY VOLUNTEERED FOR THEIR MOUTHS DETAILS TO BE DISTRIBUTED TO MEMBERS IN CLOSED INSTITUTIONS, SUCH AS PRISONS.

The views and mathematical abilities expressed in M500 are those of the authors and may not represent either those of the editor or the Open University.

The cover design is by Chris Pile and is a diagram of the Great Icosidodecahedron (12 pentagrams and 20 triangles in the same facial planes as the regular icosi-dodecahedron). This model is very beautiful. Instructions can be obtained from Chris Pile or from any comprehensive book on polyhedron models including *Polyhedron Models* by Magnus Wenninger, C.U.P. , in which it is model 94.

ANYTHING SENT TO ANY OFFICER OF THE SOCIETY WILL BE CONSIDERED FOR POSSIBLE INCLUSION IN M500

SYMMETRIES   RICHARD AHRENS

Altair Designs Ltd market pads of designs consisting of very symmetric patterns of lines. They are easily available (try W H Smiths) at about £1. By colouring these sheets one can create patterns that suppress some of the original symmetry. It is possible to classify patterns which are periodic in more than one direction (wall-paper patterns) by examining the group of symmetries of the pattern.

It is a remarkable fact that only seventeen different groups of symmetries are possible. For a brief account and a list of the groups see *Introduction to Geometry* by H S M Coxeter (Wiley 1969) .

For a fuller discussion and examples of all seventeen patterns see the very beautiful book *Regular Figures* by Fejes-Toth (volume 48 of the International Series of Monographs in Pure and Applied Mathematics, published by Pergamon Press; cost the OU £5.50 in 1974).

These seventeen groups are also known as the two-dimensional crystallographic groups. Altair Designs use only two of these groups - one has all the symmetries of a square lattice, the other has all the symmetries of a lattice of equilateral triangles. They market two types of pad - one for each of the two groups. Each pad has several different patterns of lines but in any one pad all patterns exhibit the same symmetry.

Fejes-Toths's *Regular Figures* confirms that the two Altair groups contain all seventeen groups as subgroups; they can be obtained by colouring to suppress some of the symmetry. However colour must be ignored when looking for symmetries and only shape considered. If a symmetry must preserve colour as well then only translations are possible.

In the illustration these muscular but friendly little men leave most of the symmetry of the original pattern but they do turn the centres of 6-fold symmetry into 3-fold centres. Some reflections are also lost. The group of the pattern is called $p3m1$ by Coxeter and $\mathfrak{W}_3^2$ by Fejes-Toth.
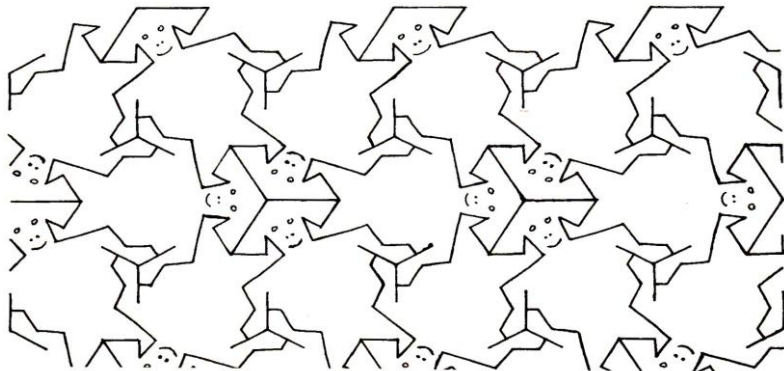
MATHS PROBLEM
(FOR THOSE THAT CAN ADD TWO AND TWO ALREADY)

Now,
the u's and n's and things
in this equation,
are called "variables" ...

Please, Sir!
What's a variable?

If I tell you ...
"Someone was here earlier,
looking for you.
Said he wanted to talk
and when would you be back."
Then "someone"
is a variable.

He was probably
about two metres tall,
heavily built,
scarred face.
looked like a junky faggot,
and you don't have to know
that his friends call him "Frenchie"
or if he's CID or Drug Squad.

This problem
has a very general solution
 i.e.:
Take the money and run.

Bob Phillips
© 9/6/77 T Pettitt & the Winter Solstice Trucking Co.

_____

EDUCATION
At Mr Wackford Squeers's Academy, Dotheboys Hall, at the delightful village of
Dotheboys, near Greta Bridge in Yorkshire, Youth are boarded, clothed, booked,
furnished with pocket-money, provided with all necessaries, instructed in all languages
living and dead, mathematics, orthography, geometry, astronomy, trigonometry, the use
of the globes, algebra, single stick (if required), writing, arithmetic, fortification, and
every other branch of classical literature. Terms, twenty guineas per annum. No extras,
no vacations, and diet unparalleled.

Charles Dickens, *Nicholas Nickleby*

SQUARE ROOT COMPETITION   PETER WEIR

PRELIMINARY RESULTS: In M500 **39** we invited entries for a Grand Square Root Competition. So as to leave everybody gasping with expectation I shall not give the actual winners until next issue.

Out of 13 entries received, 7 used Newton–Raphson knowingly or otherwise. The Newton–Raphson method is mentioned in M100 (Unit 7 page 5) and analysed in depth in M351, first block.

The method consists of deriving a new approximation as $\frac{1}{2}(x + (y/x))$ where x is the last approximation and y the number whose square root you want. It converges quite quickly: for $\sqrt{2}$ with initial estimate 1 we get estimates 1, 1.5, 1.4166..., 1.4142..., already correct to five places.

One difficulty is getting a good first approximation for $0 \leq y \leq 20\ 000$. Some entrants (including our Eddie) ducked the issue. Mervyn Savage had $y/10$, Melanie Folkes's brother $N/4$ and Peggy Adamson 1. Incidentally Peggy had an excellent idea: for $0 \leq y < 1$ go for $\sqrt{1/y}$. G V E Thompson and Dennis Hendley had schemes for a small loop at the start to get the estimate within reasonable range of the root.

So: suspense until the next issue! In the meantime my otherwise sober (hic) judgement may be swayed by a suitable bribe. It doesn't have to be money - other things interest unmarried youths.

I conclude with a laugh. My effort! I had to write a routine at work. I used Newton Raphson with five guesses depending on the range of y, using my knowledge of y's commonest values. All went well until (through an error in a preceding program) y went negative and my program went into a loop! Quite a few pence wasted!

_____

O MY PEOPLE ...   MARION STUBBS

(Ref *Ezra* ii 1-70 and M500 **42** 3)

According to *The Lion Handbook to the Bible* (Lion Publishing, PO Box 50, Berkhamsted, Herts), which is a very pleasant book full of easy-to-read commentary and lots of pictures and photographs, published 1973, "the figures given do not add up to this total (v 64). There may have been mistakes in copying or interpreting the numbers".

I have a couple of other Bible commentaries, namely the famous Peake and the less famous *Catholic Commentary on Holy Scripture*, both of which are scholarly and intended for theology students – the *Lion Handbook* is intended for devoted but less scholarly planes of existence. The *Catholic Commentary* is published by Nelson and my version is dated 1953 (1960 reprint); it has a great deal to say on the whole of this chapter of *Ezra*.

For a start the books of *Ezra* and *Nehemiah* were originally one book, and first appeared as two books in a Hebrew manuscript dated 1448.   Consequently it is interesting that *Nehemiah* vii contains the list of returned exiles repeated. The total number of returned exiles in *Ezra* ii agrees with that given by *Nehemiah* vii (42 360), and also with something called 3 *Esdras* , which in the Vulgate Appendix is an apocryphal third book of *Ezra*, where *Ezra* and *Nehemiah* are the first and second books of *Esdras*. However, "the items in all three lists fail to produce the sum: *Ezra* 29 818; *Nehemiah* 31 089; 3 *Esdras* 30 143. Perhaps the 12 000 persons unaccounted for were the women (only the more wealthy would be accompanied by their wives), or Israelite elements of the old kingdom of Samaria who, during the exile, came into contact with the deportees from Judea. It is not necessary to conclude that there were 42 360 in the first caravan. The list, probably compiled about 520BC, includes all those who returned at various times up to that date, considering them as part of one migration. *Nehemiah* vii 5 testifies to the authenticity of the list".

Thus speaks the *Catholic Commentary*. Mathematicians may lay aside their calculators - nothing is hidden that is not already known!

I personally wonder how the scribes calculated the numbers anyway. AM289 personnel should have better data than I have on this matter. Were they trained Babylon-wise using base 60?? Who translated the base 60 numbers into denary?

_____

BERTRAND'S PARADOX   JEREMY HUMPHRIES

(Ed - *Bertrand asked what is the probability of a chord drawn at random in a circle being longer than the side of the inscribed equilateral triangle; he then showed it is ½ if the chord is determined by a point on the diameter, ¼ by a point in the inscribed circle and ⅓ by two points on the circumference*).

It depends what you mean by 'random'. I understand Bertrand did it to demonstrate pitfalls in extending Laplace's ideas to infinite sets. (The ideas are not quite right even for finite sets.)

An article in the *Mathematical Gazette* of October 1966, by F Garwood and E M Holroyd, considers the random chord determined by two points which range uniformly and independently over the interior of the circle.

This gives Bertrand's probability as $\frac{2}{3} - \frac{3\sqrt{3}}{4\pi}$ = 0.2532... .

(Long proof, which I can get if anyone wants it.)

*   *   *   *   *   *   *   *

THURSTON HEATON
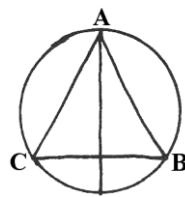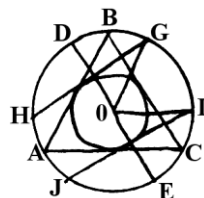
(i)   Let *x* be a chord drawn at random in a circle, AB be the side of an inscribed equilateral triangle, then P(*x*>AB) = ½ as given.

(ii)   The fallacy lies in the comparison of areas to arrive at P (x > AB). Take any diameter of the circumscribing circle DE. This must be common to a diameter of the inscribed circle since the circles are concentric. ∴ on DE there are 2r chords with centre points on DE, and there are 2πr diameters. Hence the space we are considering has 2πr–2r diameters. We are only interested in those diameters which lie in the inscribed circle. That is those which lie between G and I, which is r lines. But since there are 2πr diameters there are 2$\pi r \cdot r$ such lines ∴ $P(x > AB) = 2\pi r \cdot r / 2\pi r \cdot 2r = ½$.

(iii)   The fallacy is that only part of the sample space is used. One could assume that the point x, one end of the chord, started off as A and then by rotating the triangle ABC through $\pi/3$ A(x) then coincides with B and the whole of the required selections have been covered since chords starting on this arc (AB) are repeated when one moves beyond B towards C. ∴ P(chord starting as x > AB) = arc AB/arc BA = $^1/_3$ / $^2/_3$ = ½.

MUMMY, WHAT *IS* A SPECIAL ISSUE?

Joyce Moore wrote, in a letter dated May 6, "Having just seen the cover for issue 42 I'd like to suggest that this excellent design be adopted as a symbol for M500. It has the virtues of simplicity and clarity, and is informative. What do other members think?" This member awaited the arrival of his own issue **42** with barely repressed impatience, only to find the cover when it arrived to be complicated and obfuscative, and badly drawn to boot. I refuse utterly to put such a thing through my shirt cuffs.   Ed.

(Does Ed know anything about drawing and design? Can we have constructive pros and cons please? I LOVE IT!   Pub.)

PRISONERS AND MOUTHS   MARION STUBBS

It seems that the decision taken by Peter Weir and me last winter such that we had no mandate from the membership to issue the complete MOUTHS list to those in closed institutions and therefore would organise a sub-system of volunteers, now known as SPECIAL MOUTHS, was totally justified.

1   Our members in the services state that they are not permitted by the Army, etc. to release their addresses to prisoners and similar, as a matter of security.

2   The Broadmoor Physician Superintendent categorically states that those on the Special MOUTHS list are screened by the police and other authorities (e.g. for undesirable connections such as IRA, Mafia, etc.; or maybe for previous criminal records?) I have no authorisation from the membership to subject them to this invasion of their privacy.

3   Wakefield Prison has not yet replied to me, but has contacted the OU about my letter offering our Special MOUTHS scheme to OU students therein, and it seems that if the offer is taken up at all, then it has to be done via the Home Office and almost certainly could not encompass the complete MOUTHS list. The Special MOUTHS, if permitted to contact prisoners, might perhaps be regarded as official Prison Visitors and be subject to the same screening and conditions as PVs.

Next winter, when the subscription renewal forms are issued, there will be a tick or cross box on it for members to volunteer to join the Special MOUTHS scheme. Nobody who is unwilling to be screened and scrutinised in depth should volunteer, please, as this will only cause difficulties. All mail (and M500 itself) in and out of prisons is censored by the authorities.

Note that our Constitution, which was written by me with full knowledge of what I was doing - having been at the receiving end of 'heavy breathing' telephone calls from one potential member just before the Constitution was written - states that subscriptions shall be "acceptable", not necessarily "accepted", from anyone.

I hope that this is, indeed, the Last Word on this subject:

_____

…

Ille autem gladium vorpalem cepit, et hostem
   Manxonium longa sedulitate petit;
Turn sub tumtummi reguiescens arboris umbra
   Stabat tranquillus, multa animo meditans.

…

CALCULATORS   A SPECIAL PULL OUT SUPPLEMENT

DAVE DIPROSE

Following Ray Partridge (**41** 5) I have thought for some time that it might be worth doing a survey of readers' calculators. If you print my address with this (I cancel my rejection of MOUTHS since I cannot hide away for ever) I would be quite keen to assemble any information. What I would like is

1.   Full title of calculator with UK name and address of maker.
2.   How purchased (e.g. shop / mailorder / direct from firm).
3.   Price and date of purchase.
4.   Brief reasons for choosing this model.
5.   Size and weight of calculator.
6.   Power source.
7.   List of facilities (with special note if you have found a way of getting more than the manufacturer advertises).
8.   Size, colour and number of digits.
9.   Plane of display and width of viewing angle.
10.   Number, size, separation and feel of the keys.
11.   Reliability and effectiveness of guarantee / servicing.
12.   Value of instructions (if supplied).
13.   Additional information (e.g. which courses has it coped with; or unusual notation).

    I should add that I do not know what is meant by 'fully merged key stroke programming' or 'reverse polish notation' so if there is a better qualified volunteer please step forward ----. I imagine that most M500ers are interested in the under £50 end of the market in which case I think I can manage.

    I was going to suggest that M500 could buy in bulk and sell calculators, but individuals appear to have very fixed views on their calculators and if a new particularly good model comes out we could be left with old stock.

Additional references: M500: **36** 11; **37** 10; **38** 4; **38** 5. *Which?* December 1976: a report on the more common calculators. NB *Which*? plans a report on scientific and business calculators later this year.

Two rules for calculators.

If you get a calculator which will not do what you want it to you will kick yourself afterwards.

Try out your calculator before you buy it because the feel and display are as important as the facilities.

<p style="text-align:center">*   *   *   *   *   *   *</p>

I am doing MDT241 (MST282 / M231) this year and used that as an excuse to purchase a new calculator. It sounds very opulent but my first calculator could not cope. Time is

money to the OU student doing three half credits; and I hope to save money by going to the terminal less often. I like to use calculators one-handed and I find the best way to stop them from sliding around on the table top is to put a couple of strips of draught excluder (I have a few yards going free) onto the base. In my price range (up to £30 discount) there was just a chance that I could have bought a fairly cheap programmable, but at this price they have too few memories to allow much to be programmed and switching off erases the programs so you have to start from scratch again. So I then looked at pre-programmed calculators. Under about £15 I thought the CBM899D was best because of its range of facilities but I eventually went a few pence over my limit to buy a CBM SF4190/ 5190R:

Commodore CBM SR4190/5190R: Eaglescliffe Industrial Estate, Stockton-on-Tees, Cleveland County T516 OPN. Mailorder -Executive Calculators, Harrogate. Price £30.45, 12 February 1977. Recharger included.
I wanted something with a large range of facilities to cope with MDT241/MST282.
Particulars: $152 \times 83 \times 35$mm, 220gm, recharger 280gm. Rechargeable batteries can be used while recharging.
Facilities:
Number input forms: decimal; mantissa with 2-digit exponent (base 10); complex; hours–minutes–seconds; degrees; radians (with warning dot); rectangular or polar coordinates in 2 or 3 dimensions. Two memory stores which can be summed individually and one level of parenthesis.
The 4 basic arithmetic operations and a sign change key.
All powers and roots (with separate square, squareroot, reciprocal keys).
e^x and ln, 10^x and log, constant π. Percentage and percentage change. Sin, cos, tan, sinh, cosh, tanh and inverses. Twelve conversion keys, imperial $\leftrightarrow$ SI units.
Factorials, ^nP_r, $\binom{n}{r}$, $\bar{x}$ and $S_{\bar{x}}$ (which can be converted to σ by adding $\bar{x}$ to the data), binomial distribution ($n,\rho,\dot{x}$), point value for natural distribution, Poisson distribution. Trend line for up to 99 pairs (x, y) and approximate integration. Digits are red 3mm high. Display has 10 digits and minus sign, plus 2-digit exponent and minus sign, and radian warning. Plane of display about 30° below plane of keys, viewing cone is about 30° wide - much clearer than the Sinclair Cambridge 2mm digits. 49 keys plus on/off switch. Keys are 7mm square separated by 5mm – I like the feel of the keys.
No troubles yet. The instructions are brief rather than clear and so far I have not tried the 3-dlmensional rectangular/polar facility.
No problems with MDT241 or MST282 yet.

––––––––––––––––––––––––

From-*The Tlmes ES* 22 April 1977, headed "No Comment":
  Arithmetic must have changed since I left school, as I make 85 *per cent of* £56.95 *equals* £8.54. - letter from a building contractor to his client who had queried a bill.
      Sent by Joyce Moore who said "thought it might be useful to fill the odd space."

MARION STUBBS

In reply to Roy Partridge (and others) ref which calculator? I am going to stick my neck out. Buy ANY old calculator preferably at a low price. Do NOT regard it as an investment. Be prepared to throw it away to the nearest young child within six months. (That will happen whatever price you pay!)

Calculators are about the only consumer product with a continuous falling price. The model you buy now, whatever fancy gears clutches and keys it has, will be totally obsolete within a matter of weeks, during which time you will have found out just what you wished you had as facilities but have not. The manufacturers also discover the same things during the same period.

Around Christmas 1976 the CBM models were the 'in' thing. They perhaps still are, but perhaps Casio have taken the lead. You need to be a pro to know that sort of thing. Someone once told me, true or false, that all calculator innards are made by Texas Instruments, though my lot seem to be made in Hong Kong. There is nothing actually wrong with any machine but some are more wrong than others if you are an eager beaver numerical analyst. I will stick my neck out again and say that ANY old calculator is good enough for MDT241 usage since you don't need more than accuracy to a very few places.

My pride and joy was once a Dixon's Prinztronic scientific, which had more keys than any other make at the time and cost £40. Within 6 months I had outgrown it, passed it on to a happy A-level student, and turned to HP55. Within weeks the HP55 (@ £175) was totally obsolete. Mine broke down and had to go for repair. By then I was so dependent on machines to produce 8-diglt accuracy that I propped myself up with a CBM SR1800 @ £20. (SR means slide rule and is the coy way of coding a machine meant for mathematicians and engineers, with logs and things, instead of one for amateurs, VAT-needers and the like).

Since all calculators eat batteries at a frightening and expensive rate it is wise to 'invest' in one which runs on mains as well, or which has rechargeable batteries (not the same thing). It is wise to look for one, at the price you have decided to afford, with one or more memories - usually designated as M. Someone once told me that one with M+ and M– keys were essential (add or subtract whatever you have displayed to whatever you have in M) but they just save some work, that's all, and new calculator owners LIKE work of that sort. You can test calculators in shops with a rapid run of $1 \div 81 \times 1000$ to see what it does. ($1/81 = 0.012345679$ and that $\times 1000$ should give 12.345679 on an 8-digit display.) There is an out-of-date *Which*? report (Dec 1973 I think) which gives this and other nice tests.

When and only when you are adept on a cheap machine go for a personal programmable calculator (PPC) and watch that lot, because the 1977/78 models are going to be near computers to fit into shirt pockets so anything bought now will almost certainly be as obsolete as a dinosaur.

(NB - Any offers (£175 or over) for a PPC HP55 with rechargeable batteries? Mine is for sale!)

PULL-OUT EDITORIAL   EDDIE KENT

If you haven't thrown this section away by now I would like to explain what reverse polish notation is. Since reverse polish is that stuff that makes furniture dull it is evident that reverse polish notation is a kind of symbolism that can be applied to a book to make it boring - even if it is by Ralph Smith.

In M500 41 Richard Ahrens accused me of perhaps "making a sneak attack on computing types who cannot possibly produce the right answer here". Well, whether I was or not, Martin Gardner in the April (get it?) *Scientific American* is certainly having a little fun. After describing the problem of arranging the numbers one to fifteen in a difference triangle (where each number is the positive difference of the two above it) he then asks whether it is possible to do the same thing for the fifteen even numbers in two to thirty. If one problem can be solved by computer then certainly the other can!

The computer in the film *2001* was called Hal you remember - a one-letter shift of IBM, but that might be a coincidence. Isaak Asimov said in an interview some while ago that he saw the film for the first time in the company of the astronomer Karl Sagan. When Hal started misbehaving Asimov yelled "They can't do that; it's breaking the first Law of Robotics". To which Sagan replied, "Alright; strike them dead!"

MGM now have a film (based on the novel by Dean Koontz) with a robot as protagonist. The film is called *Demon Seed* and stars Julie Christie "in one of the most demanding roles of her illustrious career" selected by Proteus IV to be the mother of its (his?) child. I can hardly wait to see it. (Or did I miss it?)

And talking of robots I see that there will be (was, to you) the first full committee meeting of the British Robot Association on May 30. Think about that. But you're wrong, it's not a new trade union for people who clank but a body of academics who feel that robotics in Britain is in danger from government cut-backs, according to Jim Campbell of the Department of Artificial Intelligence at Edinburgh University, in a recent article. The association will seek to "promote robot technology through increased cooperation with industry". The acting secretary of the association is Dr Michael Larcombe of the University of Warwick.

The same issue of *Computing Europe*. that I sneaked that information from had news of a new programmable calculator from Burroughs. It is called C7400 and will replace C7200; so, if you were just about to rush out and buy one, beware. 104 data memories and 1000 program steps.

Can anyone help those *Daily Telegraph* readers who, it seems, have trouble with computer words such as database management, dehardbugging and unbungling please?

Seeking to fill these last few lines I glanced through another issue of *Computing Europe* - a friend recently gave me a heap of them - and sure enough, a headline "GLC blames its computer" directed my eye to an article telling how the Greater London Council is blaming its computer for promising council tenants rent rebates of up to £50. Presumably one cannot sue a computer for breaking its promise!

CLANK OVER   SUE DAVIES

I really don't want to start another M500 slanging match on the lines of the Philip Newton / Richard Ahrens Kronecker delta row, but I can't restrain myself from commenting on Philip's piece in 42.

In the first place I don't object to easy problems, quite the opposite. What I was complaining about was problem **38**.1, an easy problem misleadingly labelled hard, which would put off most M100, and **38**.3 which, as Eddie admits, was not a problem at all but a statement of fact.

I certainly didn't say that the CoRA algorithm was trivial, my point was that trying to investigate the CoRA phenomenon by blindly feeding numbers into a computer is unproductive and unmathematical (and extremely expensive!)

I'm afraid I'm unable to understand Philip's third paragraph. I gather he has a one-line solution to problem **36**.3(c)* but doesn't tell us what it is. It obviously has something to do with the cryptic remark "(2n+l)/2 is not an integer", an amazing fact apparently known only to Philip and similar "practical" mathematicians but not appreciated by lesser mortals like Richard, Eddie and Krysia. I must be very dense because even armed with this secret information I'm still unable to solve the problem in one line. No doubt Philip will enlighten me.

Finally (sic), much as I value his rather patronising advice in the last paragraph, if he'd taken the trouble to check his facts (not one of his strong points) he'd have noticed that I often send in solutions to easy problems - they're the only ones I can do.

*Ed - Problem **36**.3(c) *is Can you prove that in a regular polygon with an odd number of sides, at most two diagonals meet at a point other than a vertex*. This has still not been solved.

<p style="text-align:center">*   *   *   *   *   *</p>

CLANK OUT   RICHARD AHRENS

Despite Philip Newton's hint (42 4) I still can't do my problem about the diagonals of a regular polygon. I suspect that Philip has not noticed all the complications. It is true that in an even sided polygon two diagonals of equal length, which cross, will cross on a diameter giving a triple point and this cannot happen in an odd sided polygon due to the lack of diameters. But these are not the only triple points which are possible. 12- and 18-sided polygons have triple points where a diameter is not involved. Why does this never happen with odd sided polygons?

Incidentally my remark that I thought the problem was hard was not meant to suggest that I can do all easy problems immediately - I only wish I could. I was just suggesting that the oft-used phrase "This looks like a hard problem" can usually be translated as "I can't see how to do this". Similarly the phrase "Oh that's easy" usually means "I've seen the solution to that before".

NOTICE BOARD OR, WHAT YOU WILL

When I attended the Croydon dayschool there were people present from London. London, It seems, compiles its list of dayschools last and gives its members a list of those in other regions so they can behave like a junior jet-set and follow if not the sun round the world at least dayschools round the country.

Now M331 has sent me a similar list. One imagines it applies to most courses that have dayschools (an induction from those represented at Croydon) and so one can assume everyone that needs it will have the list. However, I always lose bits of paper so I thought I would reproduce it here for easy reference. At least I don't throw M500 away.

I will make it different by dropping region names and putting the thing in date order.

All dates are Saturdays that are not *ed.
18   June. 05, Nottingham 2–3.30; 07, Leeds 2 hrs; 08, Manchester 10.30 –12.30.
2   July. 04, Wolverhampton 9.45–12.45.
9   July. 01, Marylebone; 08, Liverpool 10.30 –12.30. 5 September*. 01, Marylebone.
10   September. 13, East Croydon.
17   September. 01, Marylebone.
24   September. 02, Eastleigh; 05, Nottingham 2–3.30; 08, Manchester 10.30 –12.30.
1   October. 06, Cambridge 10–5.
3   October*. 01, Marylebone. 8 October. 02, Oxford.
15   October. 07, Leeds 3 hours; 13, East Croydon.

Of course, if you write to anyone send a stamped addressed envelope.

FORTHCOMING EVENTS:

18 June. Saturday. ½day school at the British Museum, starting 10am. Some important historical materials such as clay tablets and papyri will be shown.

2   July. Saturday. Polytechnic of the South Bank, London road, London. 1030am – 430pm. £1. The Teaching of the History of Mathematics in Schools. Speakers will be Leo Rogers, E J Alton, Graham Flegg and J S A Nicolson, with comments from the floor.

*   *   *   *   *   *   *   *

I wish somebody would look at the current Finance Bill - the bit that wasn't mentioned by Mr Healey in his recent Budget Speech. Paragraph 13 of the sixth schedule. One assumes that THE M500 SOCIETY does not provide "facilities" unless that term could include coffee and biscuits at Aston once a year; however, maybe it provides "advantages" to its members, since one of the definitions of this could be the provision of advice. In which case we could perhaps become liable for VAT and hence have to put it on the subscription.

LETTERS

Jeremy Humphries: (1) Hard information on Professor Sweet. John Edson Sweet was Professor of Engineering at Cornell University. He also died in 1916 so perhaps we should steer clear of such problems. The three-circle problem was given in *Popular Computing*, December 1974 and in *Scientific American*, March 1975.

(2)	There is a 36 move solution for Roll Me Over (Ed-This was problem **28**.3; *eight cubes arranged in a square to be turned over by rolling only and without leaving the square configuration*) which is unique and minimal: LUR DDR UUL DRD LUR ULD RDL LUR ULD RUR DLD RUL.

(3)	Diligent research reveals that Little Piggley Farm is a classic. It was first printed in the *Strand Magazine* as Pigley, one g. Slight name differences occur: Farmer Dunk, Mrs Grooby, Dog's Mead. The date is given (could this be the date it appeared?) and we are asked to find Mrs Grooby's age. I found it in *Fun With Figures* by L Harwood Clarke (Heinemann) .

(4)	Are there any plans to mention Summer Schools in M500? I remember Marion suggested members should wear some identification so that they could recognise each other - a white disc or something. Does any promotion go on at Summer Schools? I could come down to Reading a couple of times if there's anything going on. Several 'leading lights' are not far from Reading. Perhaps we could meet.

John S Hampton: Having not renewed my subscription to M500 and despite my earlier criticism of it, I now find that I rather miss it. Furthermore after two months of M202 (essentially working alone in the barren waste of Lancaster) I see that M500 offers something I had not previously appreciated! Let me back in!!

Arthur Thomson: Problem **40**.4 Relative Truth. I had a quiet chuckle to myself under the impression that this modified problem had been set up deliberately with the April issue in mind as M500's answer to San Serif. You even fooled Sue Davies I thought, and she was way up on a pedestal in my estimation after her letter in **40**. But now comes the May issue and nobody cries April Fool! It was meant as a joke wasn't it? Or hasn't the message been passed on to the new Problems Editor?

Ed - *This is the sort of letter we love to get, down on the form. It makes all our effort worth while.*

Vic Garvey: I may be amongst many to answer Malcolm James's query in **41** 5 (*How did the Romans carry out simple arithmetic calculations*?) but if Malcolm had read AM289 the Numbers Option he would see that the Romans cheated a little. They used a form of abacus to help them! (See Unit 3 pages 6 and 7.) After manipulating the calculation on the abacus they cunningly wrote down the answer in their letter system. The abacus has the advantage of a place-value system without requiring the rather abstract idea of such a system - which is why they missed inventing place-value notation. They were good - but not that good. I am reading M251 at present and the first assignment contains an interesting question on doing exactly what the Romans did, except we replace the abacus by a rather expensive digital computer. *Tempus fugit*!
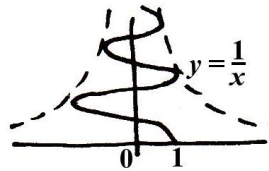
John Reade: In reply to Nigel Graves, who in M500 **42** 6 asked whether the function *f*: $a \longmapsto$ the largest root of the equation $\sin x - ax = 0$, $a \in \mathbb{R}$, is Lebesgue integrable.

No, your function is not integrable. It is actually the inverse of (sin x/x. and has a graph like that on the right.

Therefore

$$\int_0^1 f(x)\, dx > \int_0^\infty \left|\frac{\sin x}{x}\right|\, dx$$

which is a well-known divergent integral.

Brian Woodgate: Two thoughts re the M500 Special Issues.

(1)   Get a member of the faculty to write on course plans, e.g. What courses are coming? What courses are going? Will we get a Full Credit at third or fourth level? What are the long term plans?

(2)   I see from *Sesame* and my post that several courses have jumped on our bandwagon and started requesting course comments. This means that material may be spread more thinly! On my form I put "see M500 Specials 75, 76 and 77 the original and best".

Vibeke Ervø: I have made up my mind to write; not so much to give my opinion of courses as to ask for some information I have been missing in the course handbook and the M500 special issue (if you don't do a course the first two years you can pick it up from the exam handbook). I would have liked to have information about the exams: Which material are you allowed to bring for each course, how many long and how many short questions. Essay haters like me (it is not only because I have non-English mother tongue) might also like the total number of essays for a course. If M500 is meant to make people take M courses why not tell them explicitly how many fewer essays they will get away with here compared to S and T courses.

I found M332 a very nice and interesting course and I had the joy of having Derek Goldrei as tutor but I would not have done that course if I had known that we were not allowed to bring any books to the exam, and were expected to remember lots of theorems and their proofs (take a look at the guide to the exam). I have enjoyed all my OU courses, possibly with the exception of T100, even M202 which I did its first year. I think it was very important that I had not done M201 previously. I actually thought that second level courses were supposed to be like M202. If I were going to plan (not that I have actually done that, it has more or less 'grown' from available courses) my degree today I would not have chosen M202 as it is not leading on to any third level courses. SM351 is another course I would not have chosen today and that would also have been a pity as it is a very good course in applied maths.

I felt M201 a bit of an anticlimax after M202 and did not use time enough on it as I was doing T100 the same year but, in short I have liked all my M courses and would not have liked to miss any of them.

PROBLEM CORNER   JEREMY HUMPHRIES

I begin by clearing up some matters which have arisen from issue 42.
There have been some queries about New Year Resolutions **39**.1, which I didn't explain in sufficient detail. I should have said: 6 implies two from {1, 2, 3, 4, 5}.   a) Assume 5 is one of them then you have kept two from {1, 2, 3, 4}, which forces 5; so you have kept three. Etc.

In solution **31**.3, Combinations, the first proof is wrong. BOB COATES points out that, in part 4 , $\langle 1, 2, 3, \dots ,r\rangle \neq$ r!/(1, 2, 3, ... ,r) . This means that §5 $\not\Rightarrow$ §6. There is also a misprint in §I. $(n + r)/r!$ should be $(n - r+1/r!$

I said we were expecting something like the second proof and I now learn that in fact we got it; from SUE DAVIES. Sorry Sue.

Last but not least, in solution **39**.2, my friend PHIL COLEMAN was a bit put out at being called Bill.

End of grovelling. I shall try to ensure that that part is short or absent in future; but it probably won't be. As DAMON RUNYON says, I long ago came to the conclusion that all life is six to five against.

While I'm dishing out the quotes I give you this, which will inspire you to even greater heights in your contributions. It is from REGINALD CHITTENDEN CHEVALIER, eccentric head of Mathematics at Manchester Grammar School, 1919–1937: "Every mathematics problem has three solutions, corresponding to jargon, prose and poetry in literature. Only if one finds the poetical solution can one feel complete satisfaction."

DAPHNE PARKER has sent me a letter praising issue **41**, which contained Eddie's last go at the problems. She says: "M500 **41** provided the first puzzles I could try since I joined MOUTHS. Up till now I haven't even begun to understand the questions, let alone try to answer them. I was overjoyed to find three puzzles in **41** that I could play around with. Looking at all the previous M500s I wondered why folks who could do those problems needed MOUTHS, they must be absolutely brilliant. There must be many other poor M100 students like me who would appreciate more of these simpler puzzles. And YES PLEASE, I want more crossnumbers."

OK Daphne. We've had several letters like that lately. I'll see what I can do. And come on, all you absolutely brilliant ones, where are the solutions to the difficult problems?

*   *   *   *   *   *   *   *

SOLUTION **41**.2 *FRUSTRATION*: There was quite a response to MICHAEL MCAREE's pyramid problem. As everybody said, the edges don't come to a point when you put the top back on. STEVE AINLEY: FrustRum is right. It isn't, of course, a frustum. SUE DAVIES: Not very frustrating, but a bit sneaky. Solutions also came from RICHARD AHRENS, MERVYN SAVAGE and THURSTON HEATON. And this arrived, unsigned, from the Middle East (Welwyn Garden City):

> If the top and base are similar,
> Then the formula's familiar.
> But it really has no point

When the edges aren't conjoint
In such a case it flops -
Regards, from King Cheops.

SOLUTION **41**.3 *OLYMPIAD* 1   *In a plane convex quadrilateral of area* 32 cm² *the sum of the lengths of two opposite sides and one diagonal is equal to* 16cm*. Determine all possible lengths of the other diagonal.*
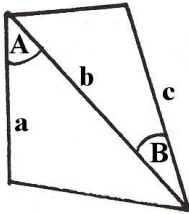
Answers came from RICHARD AHRENS and STEVE MURPHY,

$$a + b + c = 16 \tag{1}$$
$$\tfrac{1}{2}b(a \sin A + c \sin B) = 32 \tag{2}$$

Now $b(a \sin A + c \sin B) \leq b(a + c) = b(16 - b)$
$$= 64 - (8 - b)^2 \,.$$

Substituting in (2) gives $64 - (8 - b)^2 \geq 64$ whence $b = 8$.
It follows that $A = B = 90°$, $a + c = 8$ and the other diagonal is $8\sqrt{2}$.
This is Steve's;   Richard's is similar. Steve was "a little put out by 'determine all possible lengths'. Mathematicians seem to use plurals when ordinary mortals would use singulars - if only to deceive".

SOLUTION 41.4 *CROSSNUMBER*. Only SUE DAVIES has actually sent me the solution to this so far. Because there was a mixup in the clues I'll leave the answer until the next issue.

SOLUTION 41.5 *DISC COVERING*:   *How many discs of unit radius are required to cover a disc of radius n, n an integer*?

I have no solution to this yet, but a few ideas have come in and I hope to have something for **44**. I confirm that 1 and 7 are right for *n* = 1 and *n* = 2. If anybody has done anything on it please send it in.

<p style="text-align:center">*   *   *   *   *   *   *   *   *</p>

PROBLEM 43.1 *OLYMPIAD* III reprinted by permission of the Mathematical Association from 18 IMO 1976, Lienz.

A rectangular box can be filled completely with unit cubes. If one places as many cubes as possible, each with volume 2, in the box one can fill exactly 40% of the box. Determine the interior dimensions of all such boxes.

$$(\sqrt[3]{2} = 1.2599...)$$

PROBLEM 43.2 *TAXATION*: JAMES CHAPPELL.

Unless you are like me you have already completed this year's tax return, and are therefore in practice to tackle this. It was given by HM Government in the form of section (F) subsection (1) explaining Capital Gains Tax leaflet (1966). In response to BERYL BRAYSHAW see M500 **39** 7 I pass it on.

(1) If the asset consists of stocks or shares which have values quoted on the Stock Exchange, or Unit Trust units whose values are regularly quoted, the gain or loss (subject to expenses) accruing after 6th April 1965 is the difference between the amount you receive on disposal and the market value on 6th April 1965, except that in the case of a gain where the actual cost of the asset was higher than the value at 6th April 1965, the chargeable gain is the excess of the amount you receive on disposal over the original cost or acquisition price; and in the case of loss, where the actual cost of the asset was lower than the value at 6th April 1965, the allowable loss is the excess of the original cost of acquisition price over the amount received on disposal. If the substitution of the original cost for the value at 6th April 1965 turns a gain into a loss or vice-versa, there is, for the purposes of tax, no chargeable gain or allowable loss.

Jane bought shares in 1964 for £2000. On 6th April 1965 their market value was £2500. Later in 1965 she sold these shares for £2300. Her expenses were £50. How did she stand with the tax-man?

Construct a flow-chart to simplify things.

JH - *James does not say whether that last paragraph is part of the problem or a hint for solving. Ignore it or not as you see fit.*

PROBLEM **43**.3 *FORBIDDEN TERRITORY.*

On a square of side *l* a straight line is drawn which divides the area of the square in the ratio 3:1. What is the area of that part of the square over which the line cannot pass?

PROBLEM **43**.4 *CRIBBAGE*:   LUCY POLAND.

In cribbage each of two players is dealt six cards from the standard pack. Each player discards two cards which go to make a third hand, or 'box'. The remainder of the pack is cut and a card is turned up. The highest possible score for a hand is 29. This is obtained when the hand contains three fives and a jack, and the turned up card is the other five, which is of this same suit as the jack.
What is the probability of getting a 29 hand?

Lucy says she has played crib almost since she was in one, but has never seen 29 scored.

PROBLEM **45**.5 *PRIME SQUARES*: MICHAEL MCAREE.

Rearrange the numbers 1 to 16 in a square array so that the sum of any two which are horizontally or vertically adjacent is prime.
b) How many ways can you find?
c) Why can't any diagonal pair add to a prime at the same time?

EDITORIAL

I like the way feuds tend to spring up from time to time in magazines, although there is a great danger that they quickly become very boring to outsiders. Many years ago I had two friends who fell out and refused to speak to one another. But they kept up a vitriolic slanging match in, of all things, *Motorist Weekly*. The letters appearing with superb regularity were at first merely unkind but quickly entered a growing spiral of inspired improbability They began with a comment from one on what he felt was the other's misguided concept of what constituted a motorised vehicle but this soon became submerged in pure invective? Eventually the editor, reasoning that a temporary gain in peripheral circulation was no substitute for solid support from those readers with greasy hands and little sympathy for the purity of verbal pyrotechnics quoted those immortal words: This correspondence is now closed.

I think I must do the same for two of our own series. Under the heading Clank and its lineage I believe we have said enough about the concept of computing to keep us going for this year. I don't say I won't print anything more on the subject come what may, but I do ask you to think very carefully before sending me any more. On Prisoners and MOUTHS the issues are a little different. Marion's looks like the last word that can be said for now; I understand that a group of members are busy hammering out some amendments to the constitution which will be printed later in the year for your consideration and votes. I suggest we wait for that. (Of course if you feel you would like to join the debate let me know and I will put you in touch.)

We recently had a letter postmarked London WC from someone with quite pertinent remarks about Prisoners and MOUTHS. Unfortunately it was unsigned - whether by mistake or because the writer wished to remain anonymous is not clear. I have stated before that it is not the policy, in general, of this editor to print anonymous contributions, which go straight in the editorial wpb. I would have said that if the writer on this occasion likes to send me her name the letter can go in the next issue; but after reading the above paragraph I see it is too late.

It had not occurred to me to have a spoof of any kind in the April issue (see Arthur Thomson's letter) and in fact I think it would be a particularly bad idea in a magazine like this. Still there is a well established precedent for the practice. One year Martin Gardner wrote a complete hoax article in *Scientific American* which probably wasted about a million mathematical man-hours around the world. He even had a little dig this year. More unfortunate was the consequence of a little light-hearted fun in a *New Scientist* with the date April 1. There was a description, together with a beautifully detailed illustration, of a manna-making machine; invented by the Israelis of old. The story was picked up, with full acknowledgement, by Eric von Däniken in his new book on astro-theology. He writes "One is tempted to speculate that, about 3000 years ago, the earth was visited by creatures from space and they brought the machines with them." The story is told by Helmut Gurnior in last month's *Encounter* and my source is *The Times*. If you think that's a bit involved and we should watch out for a squirt of soda water in the ear I think the date of *The Times* in question makes it safe enough: May 26 has no significance that I know of.

Eddie Kent.