# SHORT CIRCUIT

Newsletter of the Canberra Mathematical Association INC

VOLUME 13 NUMBER 6 MAY 2022

## NEWS AND COMMENT

Concerning the CMA conference, announcements about keynote speakers, workshop presentations, registration and so on, should arrive in your in-box soon. Preparations are proceeding.

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The Canberra Mathematics Talent Quest, open to students and classes at all levels, is an activity worth considering. Check the April edition of Short Circuit and the CMA website for comprehensive information about the CMTQ.

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We have in this issue a report by a student who attended the 2022 National Mathematics Summer School. The NMSS is of immediate benefit to just a handful of the most mathematically inclined students but these students are among those who are likely to invigorate the mathematical enterprise as a whole. Their teachers will be proud of their successes and their peers may discover aspirations of their own.

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In the Puzzle Section, readers will observe that the 3rd question can be solved relatively easily by a calculus method. However, the question came to Short Circuit from a Year 9 student—pre-calculus. Sometimes there may be better ways of doing things.

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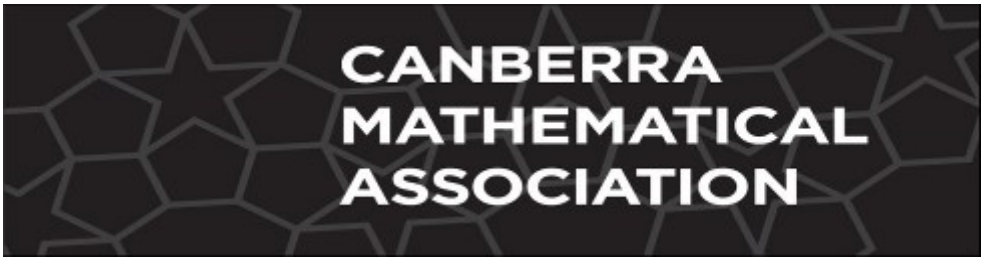
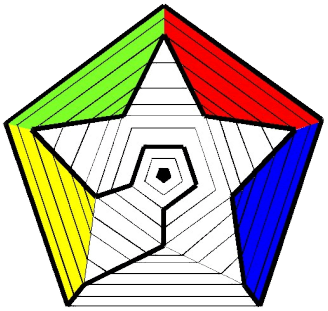
As usual, Short Circuit welcomes readers' comments and contributions.



**Inside:**



**Coming Events:**

2022 CMA conference ADFA August 13.

**Wednesday Workshops:**

Check for notices sent separately.

## MEMBERSHIP

Memberships run from 1 Jan to 31 Dec. each year. Membership forms can be accessed from the CMA website: http://www.canberramaths.org.au

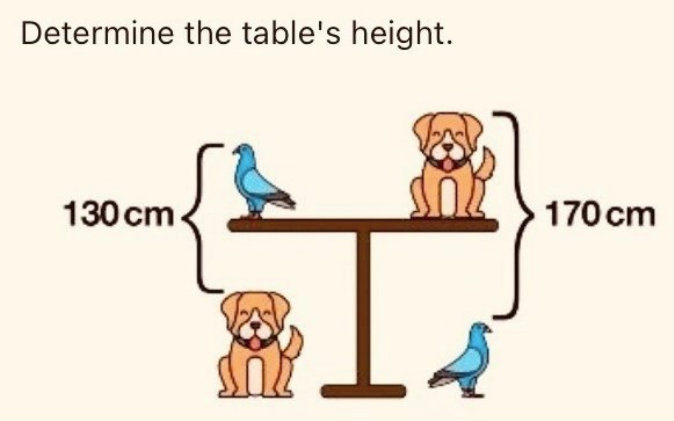
Membership of CMA includes affiliation with the Australian Association of Mathematics Teachers and a subscription to one of two AAMT journals.

As a member, you are entitled to attractive rates for the CMA annual conference and CMA professional development events.

CMA members may attend conferences of the AAMT affiliates in other states, MAV, MANSW, etc. at member rates.

# PUZZLES

**1. Dogs and pigeons**

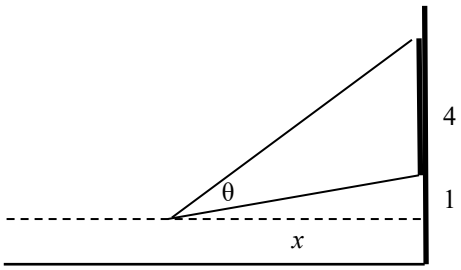



**2. People and chairs**

Two-thirds of the people in a room are seated in three-fourths of the chairs. The rest of the people are standing. If there are 8 empty chairs, how many people are in the room?

**3. Maximum angle**

A picture 4 metres high is mounted on a vertical wall so that its lower edge is 1 metre above eye level as the viewer stands on the floor. How far from the wall should the viewer stand so as to maximise the viewing angle, and what is the maximum viewing angle?




**4. Working words**

*A* and *B* working together can complete a job in 24 days. If *A* completes half of the work alone and thereafter, *B* completes the remaining work, the work will be completed in 64 days. What would be the difference between the time taken by *A* and *B* if each completes the whole job separately?

# NMSS—A STUDENT REPORTS

By Aleksandar Markovic

This last summer, I had the privilege of attending the 54th National Mathematics Summer School, assisted by a generous contribution from the CMA. The program ran over two weeks and delivered an intensive program of lectures and tutorials from experts in mathematics.

The program introduced me to areas of mathematics to which I had little previous exposure, such as number theory, ring theory and algorithms. This included fundamentals such as the extended Euclidean algorithm, the group of solutions to Pell's equation, the axioms that define the set of integers, and even a proof that sorting algorithms have an order of at minimum $O(n \log(n))$.

I found these topics interesting both in and of themselves and as an introduction to the thinking behind the formalism of mathematics.

Perhaps, though, the most important outcome of the NMSS was that it encouraged the students to ask and meaningfully answer their own questions about mathematics. We were encouraged to "think deeply about simple things", and to grasp the origin, motivation, and deeper meaning behind concepts. This has inspired me to think more deeply about mathematics and pursue further study in number theory.

The program also had a strong social aspect, with many organised activities across a broad range of interests, from chess to origami and puzzling. This provided many opportunities to network and engage with like-minded peers.

Overall, I found the program to be immensely valuable and I am grateful to the CMA for the opportunity to attend.

## MY FAVOURITE LESSONS

By Heather Wardrop

**Adding the numbers 1 to 100**

This is again from the MCTP books and is an interesting exploration of number patterns for upper primary school. I used it with year 6 but it can be used right through to year 11 as an introduction to arithmetic sequences and series.

Students should be asked to start adding the numbers from1 to 100 without a calculator.

1+2+3+……+97+98+99+100

Stop them when they look bored. Then tell the tale of the naughty school boy Carl Gauss (later to become a famous mathematician) who had detention after school. The punishment was that he couldn't leave until he had correctly added the numbers from 1 to 100. I tell the students he did this, in his head in less than 30 seconds and that, before this lesson is over, they will be able to do it too.

Looking at the pattern above 1+100=101, 2+99=101, 3+97=101 etc. The students can se that there will be 50 lots of 101. 100 lots of 101 will be 10100, so 50 lots will be 5050. Done!

The students get quite excited about this. It can be extended to adding all of the even numbers 2+4+6+8……+94+96+98+100. You can do all the multiples of 4 or 5 and extend it further to other number patterns like 9+12+15+……..+111.

Get them to explore how to work out how many terms there are and what to do with an odd number of terms. They will come up with the solutions to these questions, even at a primary school level.

I had some students adding the numbers 1 to 1 000 000 without a calculator before the hour long class ended.

## CONFERENCE


## SAD NEWS

**1** We record the passing of Neville de Mestre who has died, at age 83.

Neville made a huge contribution to mathematics education, mathematics, CMA and AAMT. Many readers will have been familiar with has regular column in the journal The Australian Mathematics Teacher, which he wrote for a long time.

His funeral will be held on Wednesday 1 June at Palmdale, NSW. The service can be live streamed for 10 days after the event by visiting the website palmdalegroup.com.au/scheduled-funerals-palmdale/.

**2** Former mathematics teacher and social activist Dr Audrey Guy has died at age 85, on 13 May.

Dr Guy worked at Erindale College for a time. A colleague there remembers her as a champion for student welfare and student learning. Her forthright manner and tendency to question organisational and administrative matters was an admirable quality, if sometimes unsettling.

Audrey's many letters-to-the-editor cut deep and were 'spot on' most times.

**NEWSLETTER OF THE CANBERRA MATHEMATICAL ASSOCIATION INC**

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We're on the Web!
http://www.canberramaths.org.au/

# ABOUT THE CMA

The Canberra Mathematical Association (Inc.) is the representative body of professional educators of mathematics in Canberra, Australia.
It was established by, among others, the late Professor Bernhard Neumann in 1963. It continues to run - as it began - purely on a volunteer basis.

Its aims include

* the promotion of mathematical education to government through lobbying,
* the development, application and dissemination of mathematical knowledge within Canberra through in-service opportunities, and
* facilitating effective cooperation and collaboration between mathematics teachers and their colleagues in Canberra.

# THE 2022 CMA COMMITTEE

| | | |
|---|---|---|
| President | Aruna Williams | Erindale College |
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| | Yuka Saponaro | |
| | Jo McKenzie | ACT Education Directorate |
| | Joe Williams | |

Theresa Shellshear is CMA's COACTEA representative.

Sue Wilson is CMA's AAMT representative.

Joe Wilson is the website manager.

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**Find us on Facebook**

http://www.facebook.com/pages/Canberra-Mathematical-Association/110629419011275

# CAREERS AND MATHEMATICS

**Careers and Mathematics**

Mathematics is in every job - we all know that but do our students? We will explore a different job and the mathematical activities involving this job from the website "On the Job".

Let's have a look at the Neurologist. This job investigates the disorders of the nervous system including diseases of the brain, spinal cord, nerves and muscles. Detailed information on the Neurologist can be found here: https://onthejob.education/community/neurologist.htm

**Context and relevance**: The first activity is for primary students to research and graph the results of an experiment on "brain freeze". The second activity is based around the age-old dilemma of the amount of sleep required by teenagers. The last activity is around Concussion and Sport which has become a very relevant topic in the last few years.

**Activities for the Classroom:**

**Activity 1: Does my brain really freeze when I eat ice cream?**

Primary

Students look firstly at Power Words in an article and then test out the hypothesis by using ice blocks and crushed ice blocks. They record and graph the results. They are to recreate an infographic to explain a "brain freeze" to younger students.

**Activity 2: Research Study: How much sleep, on average, does your class get?**

Middle

Using an article from The Conversation, students summarise the main points. Then over the course of a week, they are to collect the hours and minutes they sleep. They compile their group results and collate as a class. They are to discuss how they could get more sleep and why it is important to get enough sleep.

**Activity 3: Concussion and Statistics**

Years 9 – 12

During this activity, students are to use the cooperative learning strategy - Expert Jigsaw Strategy – to read one article each from the Conversation about Concussion, the effects of concussion on Women and Men, how scientists can detect concussion on the field through spit, the concerns about children's sport rules and concussion and a free choice article about concussion.

Students are to compile their results about the facts and figures from each article in a group presentation using an infographic. As a class, groups share their infographics and then discuss what they have learnt about the brain.

**Careers & Mathematics can be found at**

https://onthejob.education/teachers_parents/Mathematics_Teachers/Careers_Mathematics_Index.htm

**Contact Information**

If you are investigating an aspect of mathematics or would like information about a person in that job, please contact me Frances Moore – I would be happy to hear from you.

Frances.Moore@onthejob.education

Mob 0410 540 608

# LIES, (DAM)N LIES AND STATISTICS

The 19th century Scottish poet, novelist and literary critic Andrew Lang once said that,

> Most people use statistics like a drunk man uses a lamppost; more for support than for illumination.

And the American novelist Mark Twain once wrote,

> Facts are stubborn, but statistics are more pliable.

In 1978, the Tasmanian Hydro Electric Commission (HEC) proposed the building of a hydroelectricity dam on the Gordon River, below its junction with the Franklin River. The *Gordon–below-Franklin* dam controversy dominated Tasmanian politics, and in the years following, the proposal polarised the Tasmanian community. Conservationists fought to stop its construction, and almost every other eligible voter wanted it built for the economic and employment benefits the project would provide.

To reach a compromise, the then premier of Tasmania, Doug Lowe, put an alternative on the table – to build the dam further upstream (the so called *Gordon above Olga* scheme) – that would be more environmentally friendly and yet still provide the positive economic outcomes. A referendum was put to the people in December 1981, originally designed to allow voters one of three options – build the *Gordon below Franklin* (GBF), build the *Gordon above Olga* (GAO) or not to build anything (NO DAMS). However, before the referendum was conducted, the NO DAMS option was withdrawn, so the conservationists encouraged voters to simply write NO DAMS across their ballot paper, deeming them informal.

The initial count of 254,119 votes (92.1% of the Tasmanian adult population) came in as 20,184 votes for GAO (7.94%) and 119,875 votes for GBF (47.17%) with the rest, 114,060 votes (44.89%), deemed informal (including the *No Dams* votes irrespective of whether those ballot papers indicated a dam preference). The conservationists claimed victory with 52.83% rejecting the original GBF proposal. The Government claimed victory because the GBF option was clearly favoured by most people.

Later, the Tasmanian Electoral Office sought legal advice regarding the significant proportion of informal votes and were subsequently ordered to include *No Dams* votes that also indicated a dam preference. As a result, 23,838 extra votes were incorporated, changing the above percentages to 9.78% (GAO), 54.72% (GBF) and 35.5% (informal votes).

The dam was never built – The Commonwealth Government legislated to prohibit construction of the dam, which was subsequently upheld on appeal, by the High Court of Australia.

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# PUZZLE SOLUTIONS from Vol 13 No 5

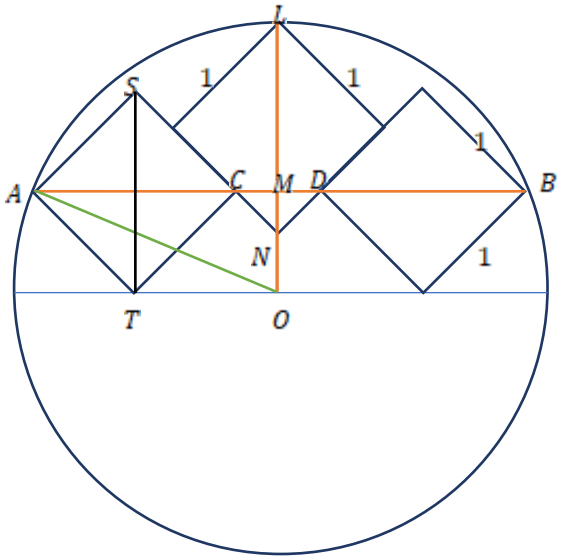
## 1. Tik Tok

There are 100 people in a room and exactly 99% of them are tiktokers. If $n$ tiktokers leave the room, there will be $99 - n$ tiktokers remaining out of $100 - n$ people.

We require the fraction $(99 - n)/(100 - n)$ to equal 98/100 or 49/50. By inspection it is clear that $n = 50$ is a solution, and since the equation formed by the expression for the fraction is linear in $n$, this must be the only solution.

## 2. Packed squares

In the diagram, three unit squares are packed in the semicircle. We wish to find the radius of the circle. This solution comes from Ed Staples.




In the diagram, the radius is $r = LO$. Then we have $AO = r$, and $ST = \sqrt{2}$.

Therefore, $MO = \frac{1}{2}ST = 1/\sqrt{2}$ and so, by Pythagoras, $AM = \sqrt{(r^2 - \frac{1}{2})}$.

This means $CD = 2CM = 2\sqrt{(r^2 - \frac{1}{2})} - 2\sqrt{2}$, and since angle $MCN = 45°$, $MN = \sqrt{(r^2 - \frac{1}{2})} - \sqrt{2}$.

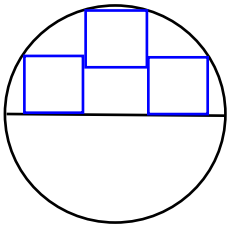
This makes

$NO = MO - MN = 1/\sqrt{2} - (\sqrt{(r^2 - \frac{1}{2})} - \sqrt{2})$. But $LN = \sqrt{2}$ so that

$r = \sqrt{2} + 1/\sqrt{2} - (\sqrt{(r^2 - \frac{1}{2})} - \sqrt{2})$.

We finally have an equation in $r$ that we can solve. Eventually, $r = 13/(5\sqrt{2}) \approx 1.838$.

We have not yet shown whether this configuration represents the smallest semicircle into which three unit squares can be packed. One might start by considering some other configurations, accumulating evidence or perhaps finding a counterexample.



This (non-unique) configuration of unit squares fits into a semi-circle of radius $\sqrt{13}/2 \approx 1.802$. Thus, it is a counterexample. The question remains as to whether there are still better configurations.

## 3. Algebra

We compare the two expressions

$$a^{(b^c)} \quad \text{and} \quad (a^b)^c$$

The second of these is equivalent to $a^{bc}$. Thus, whatever the (positive real) value of $a$, the two expressions are equal when $b^c = bc$.

That is, $b(b^{c-1} - c) = 0$.

Taking $b \neq 0$, we find $c = b^{c-1}$ and so, $b = c^{1/(c-1)}$. One solution is $b = c = 2$. Another is $b = \sqrt{3}$ when $c = 3$.

Something bad happens when $c = 1$. Looking at the original expressions we must conclude that when $c = 1$, $b$ can be any number whatsoever.

From the equation for $b$, the function $c^{1/c-1}$ defined on the set of positive real numbers excluding 1, approaches the special number $e \approx 2.718$ when $c$ is close to 1 (but it is undefined at $c = 1$).