SHORT CIRCUIT

Newsletter of the Canberra Mathematical Association INC

VOLUME 12 NUMBER 6 JUNE 2021

NEWS AND COMMENT

Serendipitously, AAMT has sent the latest edition of the journal Australian Primary Mathematics Classroom (APMC) to many members who do not normally receive it. A mistake it may have been, but a happy one. If you have received a copy, it is well worth reading. The edition predominantly contains articles about issues that are relevant across all levels—ideas about ability grouping, structured inquiry, problem solving, social justice, and intriguingly, about a 19th century United States military influence on current mathematics pedagogy in Australia.

The authors put forward ideas of a kind that could well feed into the ACARA review, which is mentioned on page 2 of this newsletter.

Still with the AAMT, their printed newsletter, The Highest Common Factor is now an e-newsletter. It goes out automatically to members of AAMT affiliate organisations. (If you are a member of CMA, you are a member of AAMT.) The latest edition has news of projects underway, some coming events, snippets from four affiliates: MAWA, MTANT, QAMT, MAV, and staff picks from the AAMT mathstore.org.au.

On page 7 we reproduce a flyer that will go out soon, about the 2022 National Mathematics Summer School (NMSS). More information and application forms will be available shortly but, as a first step, teachers of mathematically promising Year 11 students should think about who they might encourage to apply.

On page 3, we announce a new initiative by CMA—The Canberra Mathematics Talent Quest. Thanks are largely due to Andy Wardrop who has driven the thinking and the organisation behind this project.

It is hoped the idea will attract interest across all primary and secondary levels in the ACT. In this the year of launching the CMTQ, entries will be free of charge in the expectation that schools, classrooms and individuals will thus be tempted a little more strongly to 'give it a go'.

The Public Relations department of the Australian Tax Office announces, on page 5, the resumption after the 2020 gap of their competition for school students called Tax, Super + You.

CANBERRA MATHEMATICAL ASSOCIATION

Inside:

Coming Events:

CMA conference: 7 August at ADFA

Theme: '19, 20, 21 – What's next?'

AAMT virtual conference 29-30 September. Theme: 'Future Proofing'

AGM: 10 November.

Wednesday Workshop:

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.

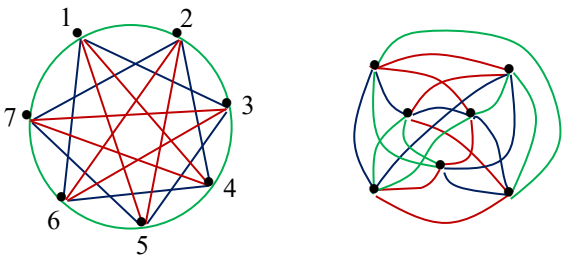
CMA members may attend conferences of the AAMT affiliates in other states, MAV, MANSW, etc. at member rates.

PUZZLES

1. Different or not

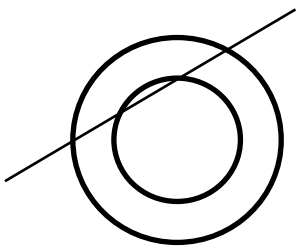
A graph is a collection of edges and vertices. Only the connections matter: shape is irrelevant. The diagrams below show two versions of a graph with seven vertices, with every vertex connected to every other vertex by a single edge.

We notice that in each graph it is possible to define three different ways in which to travel from vertex to vertex, visiting each vertex exactly once, and ending at the starting point. These circuits have been given different colours. Were it not for the colours, we would be confident that the two diagrams represent the same graph arranged differently. But to be sure in this case we need to find a way to number the vertices in the second graph so that the coloured edge connections match those in the first graph. Can you do it?



2. Annulus

An *annulus* is the region between two concentric circles. It is often possible to draw a line cutting an annulus and its central circle so that, inside the larger circle, the line is divided into three equal parts.



What would make the division into 3 equal parts impossible?

If each of the equal parts has length 2 units, what is the area of the annulus?

ACARA REVIEW

From the editor:

The Australian Curriculum and Reporting Authority (ACARA) is reviewing the K-10 curriculum documents and has made available a draft version for comment by teachers and other stakeholders.

One of the functions of the Canberra Mathematical Association is to be an advocate in matters concerning mathematics education. However, it is not easy for a group of busy committee members to digest a large and complex document within a reasonable time and to formulate a meaningful response. One difficulty is the need for a suitable frame through which useful insights might appear—a perspective that might serve as a starting point for thought. Such a tool may not be immediately available to those of us who have focused on issues at the chalkface rather than on broader ideas in education policy.

Nevertheless, a subgroup from the CMA committee is about to join with a relatively more organised and better resourced group from the Queensland Association of Mathematics Teachers (QAMT) with a view to producing a credible response to the ACARA draft.

The following remarks are offered as a contribution to the aforementioned frame.

While it is possible to quibble endlessly about whether this or that item of content should be included in the curriculum and at what year level and in what order, there is a view that there are some fundamental outcomes of mathematics education that need to be re-emphasised. Mathematics, it is held, trains a person in logical thinking; it trains one to be observant – to notice details, patterns, and relationships; it allows for the development in the young mind of a sense of wonderment – an aesthetic appreciation. In a similar vein, we might list *creativity*, *communication*, *reasoning*, *argument*, *strategic thinking*, *modelling* – the sorts of things learners DO to activate their mathematical knowledge. To these we might add the benefit of understanding the place of mathe-

matics in the culture – appreciating social and historical contexts and narratives.

There is no doubting the utility of being able to count, to add and multiply, to uncover hidden quantities in geometrical figures, to solve problems expressed algebraically, to factorise polynomial expressions, and much more; but there is also value in seeing these pieces of content as vehicles that can help engender the kinds of outcomes mentioned above. Perhaps by requiring that these further outcomes be reported on, a signal would be sent both to students and to teachers that these things are valued.

A change in emphasis in the curriculum could lead to changes in teachers' practice. Consider, for one of many possible examples, a lesson on factorisation in algebra. Certain numbers can be written as a sum of squares, like $4^2 + 7^2 = 65$ or $2^2 + 9^2 = 85$ and there are many others in the same form. Of these, some can be factorised, but many other sums of two squares, like $2^2 + 13^2 = 13$ and $9^2 + 4^2 = 97$, are prime numbers and do not factorise. In general, we can say that the sum $x^2 + y^2$ when x and y are integers, sometimes has non-trivial factors and sometimes does not. Is it not remarkable then that by simply inserting the term $2xy$ into the sum, to make $x^2 + 2xy + y^2$, we find that the resulting number *always* has factors, whatever the choices of x and y? (For example, $9^2 + 2\times9\times4 + 4^2 = 169 = 13\times13$.) And not only does the expression factorise, but it is always a square!

What if the tasks set for the students in this lesson included verifying the truth of this claim for some further cases, looking for possible counterexamples that would falsify the assertion, proposing a strategy for confirming the statement for all values of x and y, and then communicating what has been discovered?

Many teachers adopt an approach of this sort instinctively or through experience or after absorbing the evidence of educational research, but its validation through the ACARA document may well have a salutary effect.

CANBERRA MATHEMATICS TALENT QUEST

The National Mathematics Talent Quest has provided a venue to showcase the creative thinking skills of students in Australia for many years. To be eligible to enter the national quest a project has to be successful in a similar quest at the state level. Students throughout the ACT have put considerable time and effort into mathematics assignments and projects yet they have not had a mechanism where they could get local or national recognition and encouragement for their work.

The executive of CMA has decided that we should launch our own mathematics quest this year. The Canberra Mathematics Quest has the following aims:

To promote mathematics in schools and in the community

To develop students' appreciation of the scope of mathematics

To encourage creativity and develop thinking skills

(Continued on page 5.)

CMA ANNUAL CONFERENCE 2021

SAVE THE DATE

Saturday 7th August 2021, at ADFA

"19, 20, 21, ...What's next?"

Teachers and educators in all sectors are warmly invited to attend this year's conference.

The 2021 Conference committee is also pleased to call for **expressions of interest in being a presenter** at the conference. All presentations to do with the teaching, learning or use of Mathematics are welcome. If you can incorporate the conference theme or respond to it, so much the better.

For further details, please contact Valerie Barker: vnwb@internode.on.net .

NEWSLETTER OF THE CANBERRA MATHEMATICAL ASSOCIATION INC

PO Box 3572
Weston ACT 2611
Australia

E-mail: canberramaths@gmail.com

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 2021 CMA COMMITTEE

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Find us on Facebook

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

AAMT

Call for presenters and registration to attend the AAMT e-conference, 29-30 September, is now available.

The conference is virtual so our presentations will be almost exclusively pre-recorded. We are able to welcome presenters from around the globe but we are keenly looking inward to our membership to provide the foundations of Future Proofing mathematics education.

Early Bird Tickets remain on sale until the end of the May at $110 for members. Non-member full price registrations $165

Click this link to the revamped AAMT website to register as a presenter on an attendee.

The AAMT newsletter 'Highest Common Factor' for May 2021 announces the following program:

ECONOMICS + MATHEMATICS = FINANCIAL CAPABILITY

Deakin University is hosting an online professional learning series for teachers, with the aim of boosting teachers' knowledge and confidence for teaching economics and finance topics in Year 7-10.

The course aims to challenge what it means to be financially capable and promote research-informed teaching ideas and strategies

The series will explore

1. Curriculum and pedagogy for developing financial capability.
2. Teenage tap n go,
3. All fun and games? A focus on music, entertainment and gaming subscriptions,
4. The real cost of buying now and paying later,
5. Climate-conscious consumption: A focus on renewable energy,
6. Climate-conscious consumption: A focus on new fashion trends.

Full fee $350
AAMT members receive a 20% discount.
Click here to register.

If you have questions about the program write to pledhub@deakin.edu.au

ATO—TAX, SUPER + YOU

The Tax, Super + You competition didn't run in 2020, but this year it's back, and better than ever!

The competition is a fun and engaging way for high school students to learn about the value of tax and super, and the role they play in our community. Plus, there are some great prizes for both the winning students and their schools!

Students are asked to develop a creative project on their topic. There are two entry topics this year:

- **Junior (Year 7–9)**: Highlight the value of tax or super (or both) in the community.
- **Senior (Year 10–12)**: Your first job – what you need to know about tax and super.

Watch this video featuring Assistant Commissioner Sally Bektas as she explains how students and their schools can get involved!

We have also created a some resources for teachers who would like to incorporate the competition into their lesson plans. You can find out more at taxsuperandyou.gov.au/competition-teachers-kit.

CANBERRA MATHEMATICS TALENT QUEST

(From page 3)

Entry to the Quest

Students may participate in the quest in one of three categories:

Submit an **individual** entry
Be part of a **small group** (up to 6 students)
Be part of a **whole class** entry (7 or more students)

The work must be submitted by **Friday 13th August 2021**.

Entry is free.

All students from Kindergarten to Year 12 in the ACT may submit an entry.

Any topic that involves a mathematical investigation is acceptable. The topic may be something that the student has found interesting, or it could be something the class has been given as a task.

Information about presentation formats, how to submit an entry, the rubric that will be used in judging the entries, and other things, will be available shortly in the form of a booklet downloadable from the CMA website. (See the 'upcoming events' section.)

Further details will be published in Short Circuit as they become available.

PUZZLE SOLUTIONS from Vol 12 No 5

1. Eight nines

$$9 \times 999 + 999 + 9 = 9999$$

(We inadvertently printed a row of nine nines but the question specified eight.)

2. Board game

As stated, the game appears to be identical to ordinary tik-tac-toe. The first player wins by creating a configuration that can be completed in two ways so that the second player can only block one of them. A related game is the Chinese/Japanese gomoku or 'five in a row'. An extension to the question is, again, to find the winning strategy for the first player.

3. Quotition

The big segments contain 100 19/20 small ones. So, using the small segments as a unit of measure, we see that the first join between big ones is at the 100 19/20 mark. Then, the second join is at the 200 +2×19/20 mark. Continuing, we find that the last join, the 19th, is at the 1900 + 19×19/20 mark. None of the fractional parts of these quantities is a whole number because no factor in the denominator can cancel with the prime number 19 in the numerator. It must be that 19 of the small segments contain a join. Therefore, the remaining 2000 small segments are the good ones.

4. Cycling

With multiplication understood in the usual way, no matching of letters to numbers produces the required cycling property. However, multiplication term-by-term in which only the remainder after division by some modulus is kept does lead to cycles. To get a cycle of six distinct remainders, corresponding to the six letters, we might take 7, 8 or 9 as the modulus. Of these, only modulo 7 gives a single complete cycle. (This is related to 7 being a prime number.) On multiplication by 3 (mod 7) we obtain the cycle 1, 3, 2, 6, 4, 5, …, and on multiplication by 5 (mod 7) we get 1, 5, 4, 6, 2, 3, … These are the reverses of each other, which accords with the given cycles of letters. It is not possible to determine precisely the mapping between letters and numbers but we can say what happens when any numbers are multiplied by 7 in modulo 7 arithmetic. The string of 6 numbers must be 0, 0, 0, 0, 0, 0.

5. Dogs

This problem can be solved the hard way or in an easy way. A highly competent student with procedural skills might invoke the binomial probability distribution. For example, the probability that, say, 7 out of Harriet's 10 puppies are female is the number of ways of choosing 7 female puppies out of 10 multiplied by the probability of each outcome.

We can list and add up these probabilities. The table shows the probability of obtaining each number of female puppies in Harriet's and Matilda's litters.

Think of the outcomes in which Harriet has n females AND Matilda has fewer than n. The column on the right shows the product of the probabilities of each n for Harriet with the cumulative probabilities up to $n-1$ for Matilda. The total of these is the probability that Harriet's litter has more females than does Matilda's—shown at the bottom right.

Harriet's females		Matilda's females			
n	p	n	p	cumulative	AND
0	9.76×10^{-4}				
1	9.76×10^{-3}	0	1.95×10^{-3}	1.95×10^{-3}	1.9×10^{-5}
2	0.0439	1	0.0175	0.0195	8.56×10^{-4}
3	0.117	2	0.0703	0.0898	0.0105
4	0.205	3	0.164	0.2539	0.052
5	0.246	4	0.246	0.5	0.123
6	0.205	5	0.246	0.746	0.153
7	0.117	6	0.164	0.9101	0.1064
8	0.0439	7	0.0703	0.9804	0.043
9	9.76×10^{-3}	8	0.0175	0.998	9.74×10^{-3}
10	9.76×10^{-4}	9	1.953×10^{-3}	1	9.76×10^{-4}
Total					0.499

For a simpler approach, consider whether the probability would be different if Harriet's preference had been for non-female puppies. Since there is no difference, the required probability is 0.5.

NMSS

NATIONAL MATHEMATICS SUMMER SCHOOL

Since 1969

nmss.edu.au

Canberra 2022
9-22 January

Applications close 30 July

Hosted by

nmss National Mathematics Summer School

aamt Australian Association of Mathematics Teachers Inc.

Australian National University

NATIONAL MATHEMATICS SUMMER SCHOOL

nmss National Mathematics Summer School

For Teachers

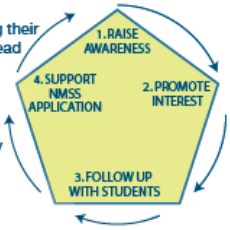
9-22 Jan 2022

Is there a student in your school who could use a 'nudge' toward NMSS?

A well-timed and directed nudge can be all it takes. This simple act can have profound and lasting positive benefits. The endorsement you offer through a 'nudge' can reinforce their commitment to learning mathematics and really bolster their self-esteem.

Applying for NMSS can be challenging because there are so few places offered, but the process itself can be transformative for students in terms of solidifying their interest and enthusiasm in mathematics. It might lead to other opportunities...

The cost of the program is $1300*. You should research new and existing options for financial support that exist within your school or local community. Ensure that no applicant is deterred by the cost.



Supporting Student Applications:

- Discuss NMSS with interested students.
- Download and review the application from your state or territory.
- Provide endorsement and application support as required.
- Follow your student's application process and keep up to date with other enrichment opportunities.

https:// nmss.edu.au/apply/

*correct at time of publication

aamt Australian Association of Mathematics Teachers Inc.

Applications close 30 July 2021 **nmss.edu.au**

NATIONAL MATHEMATICS SUMMER SCHOOL

nmss National Mathematics Summer School

Q&A

9-22 Jan 2022

I am in Year 11, why would I apply?
You are REALLY interested in mathematics. You could spend all day talking and thinking about mathematical problems and you'd like to meet and work with other like-minded students.

Sounds great can I go with my own school friends?
Probably not, but you can make new friends at NMSS. Places are limited to only 64 students. Proportional allocation means that some states field more students than others and representation is sought from all regions from all states.

Are my mathematics competition results considered?
Actually, you don't have to have completed any competitions, but they may have helped you confirm your interest in mathematics. NMSS is not a competition experience. You will, however, need to be able to demonstrate to selectors your genuine affinity for mathematical thinking. Your high achievements thus far should provide some evidence of your mathematical potential.

What makes NMSS different from my usual school?
NMSS is a two week program of academic lectures, tutorials, workshops and maths games. There is a supportive team of staff and ex-students who provide a rich program of mathematics theory and activities to inspire.

How do I find out more about NMSS and whether this experience is for me?
Talk with your maths teacher and let them know you are interested, together you can find resources from the NMSS website including past student testimonials and stories. You should also talk with your family or guardian about your interest in this residential program.

Where do we stay?
John XXIII residential college at ANU provides accommodation and meals.

How much does it cost?
The cost per student is ~$1300* inclusive of return travel to Canberra. There are a small number of bursaries available each year to support eligible students on application.

Where do we find out more information?
Information to support teachers and student is available from both nmss.edu.au and directly through each State Mathematics Teachers Association Selector.

*correct at time of publication, confirm on website.

aamt Australian Association of Mathematics Teachers Inc.

Applications close 30 July 2021 **nmss.edu.au**

NATIONAL MATHEMATICS SUMMER SCHOOL

nmss National Mathematics Summer School

Opportunity awaits

9-22 Jan 2022

The National Mathematics Summer School (NMSS) is a two-week residential mathematics school that takes place every year in January at the Australian National University. It has been enriching and broadening the mathematical minds of young Australians since 1969. It is the oldest and most prestigious summer school in Australia.

The NMSS is a great place for students who are going into Year 12 and who have a passion for mathematics. They can advance their skills with leading mathematicians. There is also an exciting program of social activities that provides participants the chance to get to know each other and develop life-long friendships. For any student with a talent for mathematics, the NMSS is not to be missed.

Applications:

High achieving mathematics students who have completed Year 11 should discuss their interest in NMSS with their mathematics teacher.

Download and complete an application for your state or territory https://nmss.edu.au/apply/

In some states and territories there may be a further assessment as part of the application process.

aamt Australian Association of Mathematics Teachers Inc.

Applications close 30 July 2021 **nmss.edu.au**