SHORT CIRCUIT

Newsletter of the Canberra Mathematical Association INC

VOLUME 12 NUMBER 4 APRIL 2021

NEWS AND COMMENT

In place of the traditional welcome event at the beginning of the year, CMA this year ran two 'welcome workshops', one for teachers in the primary years and the other for secondary teachers.

There is a reflection on page five of this edition by Anna Williams on the primary event, at which Michelle Tregoning delivered a keynote address. Attendance was very good, as was the feedback.

At the secondary event, Chris Wetherell spoke around the subject of 'problem solving'. It would be good to get a reflection for the next Short Circuit from anyone who attended Chris's workshop.

The success of the welcome workshops suggests that while the social character of a welcome event is valued by the community CMA serves, having a substantial professional development component as well is considerably more attractive.

Planning for the CMA conference—face-to-face in August—is under way. Details will be announced as they become available.

The AAMT conference, however, which was to have been held in Canberra, will be virtual. Information about this is on page 3. Organisers express confidence in the potential benefits of the on-line setting.

Readers may be interested in a virtual conference for primary and early childhood teachers, presented by the Mathematics Association of Victoria. A link to this is given on page 3.

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.

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. Slice

Your task is to cut a triangle into two equal parts with one line segment. The cut line can have any slope you like and can start anywhere on the triangle.

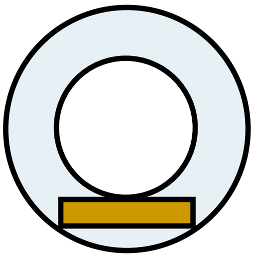
(a) Is there a point inside the triangle that belongs to every cut?

(b) How should the cut be made to minimise its length?

(c) How should the cut be made to maximise its length?

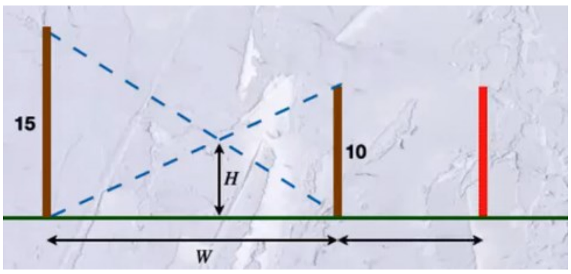
2. Awkward fit

This puzzle came to us via Erin Gallagher. A rectangular raft just fits in a canal in the shape of an anulus.



The raft is 56m long, and half as wide as the canal. The radius of the inner circle of the canal is 37m. How wide is the canal?

3. Poles apart



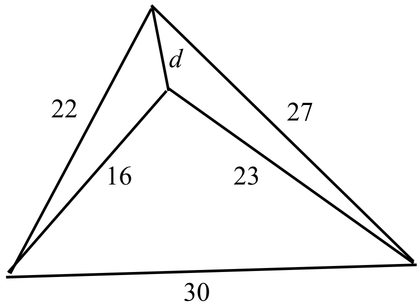
This one came from a YouTube video by Martin Wakeman. Two vertical poles of different heights are separated by *w* metres. (In the diagram some heights are given but you can chose your own.) The top of each pole is linked to the bottom of the other by dotted lines that intersect at a height *h* above the ground. If the right pole is moved to a position further to the right, what happens to the height of the intersection point?

4. Uncertainty

ABC radio gave us this question. A normal coin and a coin with two heads are in a bag. You select a coin at random from the bag and see that one side shows a head, but you do not turn the coin over. What is the probability that the other side is also a head?

5. Near enough ...?

In the diagram, the length *d* can be calculated. It turns out to be very close to an integer. A harder question is, can there be a configuration like this one in which all the lengths really are integers?



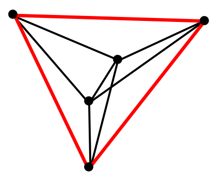
6. Long story short

From Quanta magazine where it is called **The Zen of Accepting the Empty Seat.**

You are invited to an event that has 100 assigned seats. You arrive last, but the person who arrived first, a VIP, did not have his assigned seat number and occupied some random seat that he liked. As the rest of the guests arrived, they took their assigned seats if they were unoccupied, or any arbitrary seat if not. Only one seat is left when you arrive. What is the chance that it is your assigned seat?

7. Enigma

The graph represents five people who know or do not know each other. There is a group of three who are mutually acquainted, and three groups of three who are not. Can you find a different way to colour the graph so that it represents five people with neither a group of three who know each other nor a group of three who do not know each other?



TEACHER MAGAZINE

Could you, at a moment's notice, explain the difference between Numeracy and Mathematics?

An article by Dave Tout in Teacher Magazine goes further and explains why Numeracy and Mathematics both count.

And from an article by Dr Sue Thomson, a quote from Bonnor, C., Kidson, P., Piccoli, A., Sahlberg, P. & Wilson, R. (2021). *Structural Failure: Why Australia keeps falling short of its educational goals.* UNSW Gonski Institute:

'...Our schools are increasingly characterised less by what they do and more by who they enrol. Our framework of schools has become more regressive, divided, and segregated.'

INTRODUCTION TO ACTUARIAL SCIENCE

The Australian National University (ANU) is running its popular Introduction to Actuarial Science course for Year 11/12 students in Australia. The purpose of the course is to provide students considering an actuarial career with an interactive introduction to the profession. As such, it is a perfect fit for high school students who are strong in maths to find out if an actuarial degree would be good university program choice for them. The course is FREE for all students.

Click here for more information and to register interest

MAV CONFERENCE 2021

Mathematical Association of Victoria

2021 Primary and Early Childhood Conference - Virtual

AAMT CONFERENCE 2021

AAMT CEO Alan Dugan writes— 'As you would be aware, we postponed our biennial conference last year due to the pandemic. The plan had been to hold the conference in Canberra in September of this year. However, given the continued state of flux that we are in with the virus, it has been decided that it best to hold this as a fully **virtual conference** rather than face-to-face.'

Key dates:
e-Conference: 29th-30th September
Conference Proposals Open: 20th March-30th April
Early Bird Ticket Sales: 25th March-31st May

Theme:

Future Proofing Australia's Mathematical Capacity

Conference Website

CMA CONFERENCE 2021

7 August at ADFA

Theme: *'19, 20, 21 – What's next?'*

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 2021 CMA COMMITTEE

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CLASSROOM MATHSMOSPHERE

By Anna Williams,
Year Five Teacher and Numeracy Coordinator —

> A reflection on a professional learning event presented by The Canberra Mathematical Association in partnership with Mother Teresa School on Saturday, February 20th, 2021.

Instead of our usual welcome drinks, this year, in partnership with Mother Teresa School, The Canberra Mathematical Association, decided to hold a welcome conference. This program, named **'Creating a Mathsmosphere* in your classroom and school'** was open to Numeracy Leaders and primary teachers across the ACT.

Members of the Canberra Mathematical Association council worked closely with the Mother Teresa School Numeracy Team to consider the needs of Primary School Mathematics teachers in the ACT. We collaborated to design and prepare a 3 hour mini-conference that was accredited by the Teacher Quality Institute.

We proudly presented one of Australia's leading Mathematics educators, Michelle Tregoning, who delivered the keynote address. Michelle is currently employed by NSW Education as the leader for Mathematics professional learning. Following Michelle's 90-minute workshop, attendees chose two shorter workshops presented by six local ACT Primary Numeracy Leaders.

We were thrilled to have 67 cross-sectoral participants. It was wonderful to see so many teachers interested in enlivening mathematics to improve student outcomes. Participants were able to build their knowledge of the Australian Mathematics Curriculum and explore practical ways to connect concepts with processes. Teachers were able to deepen their understanding of the importance of inquiry dialogue, task choice and flexible student grouping.

We have been pleased with the overwhelmingly positive feedback we have received from participants. According to the TQI program evaluations collected to date, many participants were inspired by the presenters' *practical and powerful* ideas and have already made high-impact changes to their classroom practice. When asked how the program could be improved, most participants indicated they wanted to stay longer to hear all of the presenters, several saying it was *the best professional learning they've been to in a long time*. Many new collegial connections have been made, with teachers across sectors reaching out to one another.

*Mathsmosphere is a cheeky term used to define an inspiring mathematics environment where all learners are engaged in Puzzling, Predicting, Playing and Proving their Maths. An essential element of a Mathsmosphere is an enthusiastic teacher.

LANGUAGE STRATEGIES FOR MATHS

By Heather Wardrop

The importance of language in mathematics teaching and learning

Throughout the latter part of 2020 I wrote a series of articles for Short Circuit describing language strategies that are useful in teaching Mathematics. The introduction and the first 5 strategies can be found in previous editions.

Strategy 6: Exploring Text Types

Students use a variety of text types in mathematics but we do not identify them and say what they mean in a usual mathematics lesson. We assume they know because we have assimilated them ourselves in our past and we take the knowledge for granted.

Some of the text types are: recount, report, explain, procedure, discuss, describe, persuade, narrate. We may ask students to *recount* their learning at the start of a lesson or in a journal. We often ask them to *report* on an investigation, *explain* their answer to a problem encountered in class, *describe* how they conducted an investigation, *persuade* a specified audience that their conclusion is correct or indeed prove it and provide a *narrative* to add context to their mathematical investigations.

A good investigative project will include many of these styles. Some discussion is needed about what these words mean and how the text type is used in mathematics. It is common that a student, when asked to prove something, just gives one or two examples. Students get frustrated when asked to explain their answer because they do not under-

LANGUAGE STRATEGIES—continued

stand the importance of expressing their thoughts clearly and communicating them to others. If they were asked in NAPLAN or the AST to discuss whether or not cats should be controlled in Australia they would not expect to just say YES and put their pen down but they resist persuading others that their assertions are correct in mathematics, complaining that they got the answer or did it in their head. I came to the cat conclusion in my head but it wouldn't get me many marks.

We need to point out mathematical instructions rather than assume the students understand the subtle differences between them.

Strategy 7: Unpacking Problems

Students have trouble unpacking a worded problem and, as I mentioned in a previous article, the teacher often reads it for them, draws a diagram with them and leaves them with a drill and practice problem which is similar to the introductory questions and does not enhance their ability to solve worded questions. They often do not learn to do it themselves.

Teaching this takes patience, persistence and time.

Let's return to the problem posed at the beginning of this series of articles. I am sure all teachers can find a worded problem that suits the ability level of their classes.

Two cars, A and B depart the same position. A travels along a straight road due East at 30km/h. B departs 15 minutes after A and travels along another straight road in a North Easterly direction at 40 km/h. How far apart are the cars 15min after B departs?

I would begin by asking the student to read the question to me and stop at any words they don't understand. These would then be added to the glossary at the back of their notebook. Then, students need to learn to break the problem into chunks:

Two cars, A and B depart the same position

– this should prompt a dot on the page

A travels along a straight road due East

– this should prompt a line with an arrow to the left, labelled "*A*"

at 30km/h

– write 30km/h on that line

Nothing can be done with the 15 minutes after, yet, but a line can be drawn from the point and labelled "*B*" noting that North Easterly means N45°E not "generally in that direction" as we may use in descriptive English.

– write 40km/h on that line.

Now, students can be invited to solve the problem.

Hints could be

"Can you work out for how many minutes each of them has travelled? Now how far have they travelled? You have a triangle, what sort of maths could you use? Solve the problem."

Finally, they should re-read the question, make sure they have answered it and note that a worded question requires a worded answer. Check units!

The teacher can walk away and attend other questions in between, checking back every now and again. There is no point at all in the teacher just doing it or drawing the diagram for them. It is ultimately disempowering for the student.

PUZZLE SOLUTIONS

These are solutions to puzzles from Short Circuit Vol 12 No 3

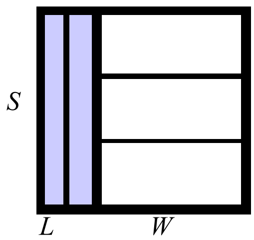
1 Some product

We have to determine how many parts will be in the sum and whether they could have unequal sizes. It can be shown that the product is maximised when the parts are equal. (E.g. With two parts, $(x + \delta)(x - \delta) = x^2 - \delta^2$, which is less than x^2) Two parts gives $5^2 = 25$; three gives $(10/3)^3 = 37.03\ldots$. By experiment, five parts is best: $2^5 = 32$.

2 Risk

In the long run, the player loses three times out of four. The expected value per game for the player is $(1/4) \times \$50 - (3/4) \times \$17 = -\$0.25$. The house wins!

3 Algebra anybody?



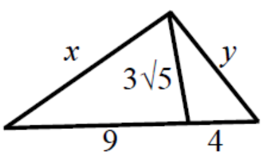
$2L + 2S = 2W + 2S/3$. (perimeters)

$S = 2L + W$

So, $7L = W$.

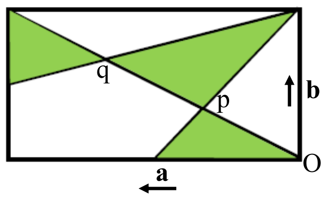
A shaded rectangle has area $9L^2$. An unshaded rectangle has area $21L^2$. Ratio, 3 : 7.

4 Maximum difficulty



By the cosine rule and some calculus we deduce $x + y$ is maximised when $x = 10.7121\ldots$ and $y = 4.7609\ldots$ so that the sum is about $15.47\ldots$. Observe that the ratio x/y is 2.25—the same as the ratio 9/4 of the segments forming the base of the triangle. Had we possessed this insight to begin with, the job may have been easier!

5 Pieces of rectangle



Thinking of vectors **a** and **b** as basis vectors,

Op = $1/2\,\mathbf{a} + k(\mathbf{b} - 1/2\,\mathbf{a})$ and Op = $h(\mathbf{b} + \mathbf{a})$.

Using the fact that a vector is uniquely represented as a linear combination of basis vectors, we must have $(1 - k)/2 = h$ and $h = k$, from which we deduce that the length Op is 1/3 of the main diagonal. Similarly, Oq = $m(\mathbf{b} + \mathbf{a}) = \mathbf{b} + n(\mathbf{a} - (1/2)\mathbf{b})$ and we deduce Oq = 2/3 of the diagonal. By finding the values of the coefficients we have also shown that p and q divide the other sloping lines in the ratio 1:2.

The areas of the three triangles above the main diagonal are equal since their bases and vertical heights are the same. The green triangles below the diagonal can be compared with their respective adjacent white triangles to see that each has half the area of an upper triangle.

If A is the area of an upper triangle, the area of the rectangle is $6A$ and the green triangles have area $A + 1/2\,A + 1/2\,A = 2A$.

Thus, 1/3 of the total area is green.