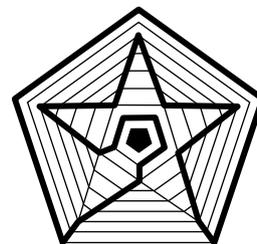


# SHORT CIRCUIT

Newsletter of the Canberra Mathematical Association INC

VOLUME 12 NUMBER 11      NOVEMBER 2021



## NEWS AND COMMENT

Lately, CMA has presented a flurry of Wednesday workshops, not all of them occurring on Wednesdays but remarkably successful nonetheless. These have been online, via Zoom.

The question will surely be asked by CMA council whether people might henceforth, or sometimes, find it more convenient to participate in online events of this sort rather than venturing out for a face-to-face experience.

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Click this [link](#) to see the slides for Jonathan Adams' presentation that was given on 14th October.

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The fourth of these workshops, also on a Thursday, is scheduled for 11th November. It is to be presented by Rachael Whitney-Smith of ACARA. See page 3 for details.

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The Annual General Meeting is al-

most upon us. It is scheduled for 24th November. The AGM will need to elect a new president, to replace Bruce Ferrington whose term expires, and a new treasurer.

Our current treasurer, Paul Kruger, has decided not to continue in the role. This means there is a vacancy for any member who might be willing to put their hand up at the AGM to take on the position.

Paul has run the financial side of the organisation smoothly and has updated the accounting procedures. The CMA council greatly appreciates his contribution as treasurer and as an educator.

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Every CMA member is entitled to participate in the AGM and is encouraged to consider becoming a councillor as a way of contributing to the mathematics education community.

### Inside:

- Puzzles – p. 2, 7
- Professional development—p.3
- CMA council 2021 – p. 4
- Puzzle solutions—p. 7

### Coming Events:

AGM: 24th November.

#### Wednesday Workshops:

3. 27th October (Term 4, Week 4)
4. Thursday 11th November (Term 4, Week 6) from 4.00-5.30pm



## 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.

**CANBERRA  
MATHEMATICAL  
ASSOCIATION**

## PUZZLES

### 1. Inheritance

(From an old book.) Is this fair? Is it unambiguous?

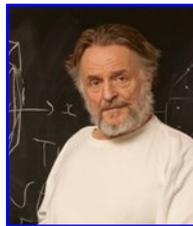
A man makes a will and dies leaving his wife pregnant. His will disposes of 100 *écus* such that if his wife has a daughter, the mother should take twice as much as the daughter, but if she has a son, he should have twice as much as the mother. The mother gives birth to twins, a son and a daughter. How should the estate be split, respecting the father's intentions?

See page 7 for three more puzzles.

## THE CALENDAR & CONWAY'S DOOMSDAY

By Ed Staples

Quite recently the mathematician, the late John Horton Conway (1937-2020), who died as a result of Covid-19, noticed something quite bizarre in the modern Calendar.



### Background

A solar year, the time interval between the Sun's leaving and returning to a fixed point in its apparent orbit around the Earth, is 365.242218 mean solar days. A *mean solar day* is an average of many observations of a solar day which is defined as the time between successive transits of the Sun over the noon meridian at any place. It's an average because the length of any solar day varies somewhat for all sorts of reasons that we won't go into here.

Things would have been far simpler had the solar year been exactly  $365\frac{1}{4}$  days, but the history of the Calendar would have been far less colourful. The missing 11 minutes and 12.3648 seconds was not too much of a problem in the Roman Julian Calendar when it was first devised, but as the centuries rolled on, the spring equinox began to appear progressively earlier.

It happened that the equinox that fell on 21 March in 325 CE fell on 11 March in 1582 CE and consequently Pope Gregory, in 1582, caused 10 days to be omitted in that year so that the day following 4 October was 15 October. To stop any future drift in what became the Gregorian calendar, 'end of century' leap years (for example 1700, 1800, 1900, etc.) were discarded whenever the year number was not divisible by 400 (for example 1600, 2000, etc.).

### Conway's observation

Conway noticed that the **fourth** day of the **fourth** month, April, the **sixth** day of the **sixth** month, June, the **eighth** day of the **eighth** month, August, the **tenth** day of the **tenth** month, October, the **twelfth** day of the **twelfth** month, December, and, because employees work 9 to 5 in a 7-11 shop, the **ninth** day of the **fifth** month, May, the **fifth** day of the **ninth** month, September, the **seventh** day of the **eleventh** month, November and the **eleventh** day of the **seventh** month, July, and finally, the **last day in any February**, all occur on the same day of the week. That day will be different for different years, but once you know what it is for any particular year, all the listed dates will fall on it. He called it the Doomsday.

This year (2021) it happens to be Sunday, so the 4th April, 6th June, 8th August, 10th October, 12th December, 5th September, 9th May, 7th November, 11th July, and 28th February are all Sundays. The Doomsday Rule can be used to identify days of the week for other days as well. For example, the 21st July is a Tuesday because the 11th July, and thus the 18th July are Saturdays, so an extra 3 days brings us to Tuesday.

Days in March are covered by knowing that the last day of February, leap year or otherwise, is the doomsday. Days in January are a little harder, although for non-leap years the last day of January must fall on the Doomsday, and so for leap years the last day of January must be the day before the Doomsday.

## CMA WORKSHOPS

### The Revised Curriculum: What has Changed... and Why?

CMA Workshop 4, on-line with Rachael Whitney-Smith (ACARA).

Thursday 11th November (Term 4, Week 6) from 4.00-5.30pm.

Target audience: All levels

Attend the workshop from the comfort of your own space – all you need is pencil and paper. Register by email at [canberramaths@gmail.com](mailto:canberramaths@gmail.com). Include your email contact so that we can send you the Zoom link. We look forward to having you join us.

#### Abstract:

On 12 June 2020, education ministers agreed that it was timely to review the Foundation – Year 10 Australian Curriculum, which had been in place since 2015, to ensure it is still meeting the needs of students and providing clear guidance for teachers. ACARA has worked in close consultation with the profession and key stakeholder groups to complete the review by 2022.

For Mathematics we will look to prioritise what is essential for students to learn by identifying core concepts, draw on existing research into learning progressions to guide decisions around sequencing and concept development, embed the proficiencies into content descriptions and achievement standards in an interconnected way and ensure that curriculum content is relevant, connected and coherent.

This presentation will provide insight into what has changed and why.

#### Bio:

Rachael is the Australian Curriculum: Mathematics specialist at ACARA and is currently leading the Review for Mathematics. She is also undertaking her PhD at Notre Dame University in Mathematics Education. Rachael is passionate about applied mathematics, STEM and teaching mathematics through rich tasks that engage student thinking and reason-

ing, problem solving, modelling and inquiry processes. Rachael has worked on National and International projects focussed on improving the mathematical outcomes of Australian students and has actively participated in the OECD Education 2030 project through her role at ACARA. Rachael is an active member on a number of mathematics advisory and reference groups and led the work in revising the National Numeracy Learning Progressions Version 3 as part of the National Online Formative Assessment Initiative. Rachael has been the Executive Officer, Professional Learning consultant and is currently a board member for the Mathematical Association of Western Australia.

## ACU MASTERCLASS SERIES

The Australian Catholic University—Mathematics Teaching and Learning Centre (MTLC) is offering, at modest cost, a series of masterclasses by webinar.

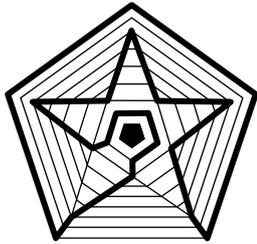
There are 12 webinars, running from September to December with various target audiences within the primary and junior secondary areas.

For details click this [link](#).

## NATURE PLAY

The fourth book in Bruce Ferrington's *miniMaths/Nature Play* series is on its way. Bruce is planning a workshop later in term 4 as part of the writing process.

How and where this will occur is yet to be determined but information about it will be circulated in due course.



**NEWSLETTER OF THE CANBERRA  
MATHEMATICAL ASSOCIATION  
INC**

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We're on the Web!

<http://www.canberramaths.org.au/>

## THE 2021 CMA COMMITTEE

President	Bruce Ferrington
Vice Presidents	Jo McKenzie Aruna Williams
Secretary	Valerie Barker
Treasurer	Paul Kruger
Membership Sec.	Paul Turner
Councillors	Peter McIntyre Theresa Shellshear Heather Wardrop Andrew Wardrop Sue Wilson Yuka Saponaro Jane Crawford

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.

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Short Circuit is edited by Paul Turner.

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## PERCENT OF WHAT?

From Sue Wilson.

Some years ago (quite a few!) I did some work in schools on percentages with Paul White, Mike Mitchelmore and Rhonda Faragher. When interpreting percentages, we emphasised the need to ask "percent of what?"

I thought back to this, when reading news articles about the falling unemployment rate.

They used a rectangle (somewhat akin to the Singapore bar model) to explain.

<https://www.abc.net.au/news/2021-08-22/how-did-the-unemployment-rate-fall-last-month/100396374>

The table in the article shows what happens to the unemployment rate when the number of unemployed and the labour force grows and shrinks .

The explanation is based around the definition of the labour force as people who are able to work immediately. If people looking for work are unable to work immediately, (in lockdown, for instance) they are "not in the labour force" and hence, not counted as unemployed.

<https://www.abc.net.au/news/2021-05-23/jobs-why-one-hour-enough-work/100155676>

If you have attended a Charles Lovitt workshop on the Maths Task centre or Maths 300, you will remember that he presents a social context for some of his tasks. This context is relevant now.

Interesting reading, and perhaps the stimulus for a lesson.

## TEACHING OUT-OF-FIELD

CMA has submitted a detailed response to AAMT's request for input to the [National Out of Field teaching summit](#), online 21-23 October 2021.

Individual responses from CMA councillors and others were collated by Sue Wilson.

We await the final report with interest.

## THE CANBERRA MATHEMATICS TALENT QUEST 2021

Hearty congratulations are due to two entrants from the ACT who have become National Mathematics Talent Quest winners at the judging in Perth recently. They are a Year 1 group from North Ainslie Primary School and the Year 6 class from Arawang Primary School.

To be eligible for the National Awards candidates had to first enter their local state Mathematics Talent Quest or equivalent. Only the winning local submissions were then in the running for the national prize.

Before this year, the National Mathematics Talent Quest was inaccessible to Canberra students because there was no local quest.

To remedy this situation, in 2021 the Canberra Mathematical Association launched the CMTQ under the enthusiastic guidance and management of Andy Wardrop.

CMA received many entries in eleven categories of the competition with students coming up with many imaginative ideas for their projects.

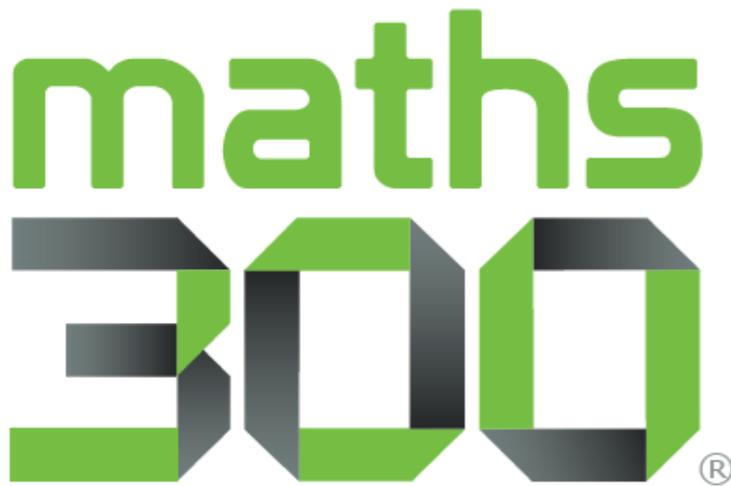
The excellent response from ACT schools and students encourages the CMA to run the talent quest again in 2022 and on into the future.

See the CMA [webpage](#) for the full local results.

Speaking about the CMTQ process, Andy Wardrop explained that entries from some schools could not be delivered because of the sudden covid shutdown. There were entries in year 11 and 12 that were not submitted, for example.

Andy acknowledged that he got 'a great deal of help to run the CMTQ' from several members of the CMA council.

Above all, the efforts of all the teachers and students who participated are gratefully recognised.



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## **COLLABORATE INVESTIGATE & COMMUNICATE AS MATHEMATICIANS**

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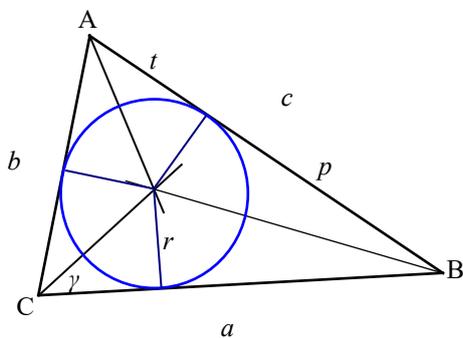
## PUZZLE SOLUTIONS from [Vol 12 No 10](#)

### 1. Triangles constrained

Three sides of a right-angled triangle in arithmetic progression can be represented as  $a, a + d, a + 2d$ . By Pythagoras, we have  $a^2 + (a + d)^2 = (a + 2d)^2$  which is a quadratic equation in  $a$  with the solution  $a = 3d$ . Thus, the three sides are  $3d, 4d, 5d$  so that the integer multiples of the (3, 4, 5) triangle are the ones that have sides in arithmetic progression.

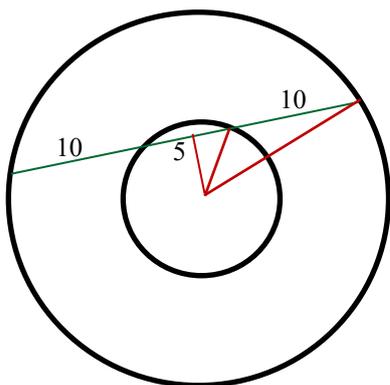
In the geometric case, with sides  $a, ar, ar^2$ , we can form the equation  $a^2 + (ar)^2 = (ar^2)^2$  which simplifies to  $r^4 - r^2 - 1 = 0$ . Thus,  $r^2 = (1 + \sqrt{5})/2 = 1.618\dots$  ( $\varphi$ ) and  $r$  is the positive square root of this. Since  $r$  is an irrational number, and  $a$  is an integer, there cannot be such a triangle with integer sides.

### 2. Incircles



It can be seen that that  $p = a - r \cot \gamma$  and  $t = b - r \cot \gamma$ . Thus,  $c = a + b - 2r \cot \gamma$ . When  $\gamma = 45^\circ$ , the triangle is right-angled with hypotenuse  $c$ . In that case,  $r = (c - (a + b))/2$ .

### 3. Annual annulus



We have inserted some construction lines to make two right-angled triangles. Call the radii of the inner

and outer circles  $r$  and  $R$  respectively, and let the altitude of the two right triangles be  $h$ . Then, by Pythagoras,  $h^2 = r^2 - (5/2)^2$  and

$h^2 = R^2 - (10 + 5/2)^2$ , from which we deduce that  $R^2 - r^2 = 10^2 + 5 \times 10 = 150$ . But the area of the annulus is  $\pi(R^2 - r^2)$  or  $150\pi$ .

As in the puzzle from Short circuit Vol. 11 No. 5 (2020), the radii of the circles was not needed if the pieces of the chord were known.

In the earlier puzzle the chord was tangent to the inner circle and we found that the area of the annulus was  $\pi(c/2)^2$  where  $c$  was the length of the tangent chord. Working backwards, we see that a tangent chord in the current puzzle's annulus would be such that  $150\pi = \pi(c/2)^2$  and so,  $c = 10\sqrt{6}$ .

## MORE PUZZLES

### 2. Missing digits

9 3 - - - 2 - 0 is an eight digit number but the third, fourth, fifth and seventh digits are missing. Find these digits if it is known that the eight digit number is the product of three consecutive integers.

### 3. Pythagoras forever

Take a right-angled triangle with integer sides  $a, b$  and  $c$  with  $a < b < c$  and the smallest number  $a$  is a prime. It seems that  $a^2 = b + c$ . Can you explain why this is always true?

### 4. Ellipse and circle

A loop of string of length 24 cm can be pulled into a triangle shape with one side 10 cm. The other sides must be  $x$  and  $14 - x$ . By varying  $x$  between 0 and 14, the vertex opposite the 10 cm side traces out an ellipse.

Let the 10 cm side coincide with the diameter of a circle. Explain why when  $x = 6$  and when  $x = 8$ , the ellipse and the circle intersect.

When  $x = 7$ , the vertex of the triangle is slightly inside the circle. Can you use this setup to illustrate visually the fact that  $\sqrt{2}$  is close to  $7/5$ ?