



2021 Maths Challenge

Director's Handbook



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AMT.
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Published by

AMT PUBLISHING

Australian Maths Trust
170 Haydon Drive, Bruce ACT 2617 AUSTRALIA
Telephone: +61 2 6201 5136
www.amt.edu.au



Australian Government

**Department of Industry, Science,
Energy and Resources**

This project is supported by the Australian Government Department of Industry, Science, Energy and Resources through the Science Competitions: Mathematics and Informatics Olympiads grant opportunity.

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Mathematics Challenge for Young Australians Challenge Stage ISSN 1328-4444

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FROM THE DIRECTOR

Welcome to the 2021 Maths Challenge and congratulations on deciding to take the time and tantalising risk in being part of it. Whether this is your first time or 31st time in the Challenge, we hope that you and your students find the experience fresh, enjoyable, and rewarding. It is worth noting the Challenge aims, which we all share and contribute to:

- encouraging and fostering
 - a greater interest in and awareness of the power of mathematics
 - a desire to succeed in solving interesting mathematical problems
 - the discovery of the joy of solving problems in mathematics
- identifying talented young Australians, recognising their achievements nationally and providing support that will enable them to reach their own levels of excellence
- providing teachers with
 - interesting and accessible problems and solutions as well as detailed and motivating teaching discussion and extension materials
 - comprehensive Australia-wide statistics of students' achievements in the Challenge.

Timing events such as the Challenge is important for it to be effective, but not always easy. We trust that amongst the constraints of busy school schedules, directors can find up to *four* suitable consecutive weeks in the allocated period from the date of delivery of the Challenge package to 25 June. Here are some time-saving suggestions which could help.

- using the electronic sample letter to parents which is available by email from mcya@amt.edu.au
- recruiting colleagues to help with marking by allocating one problem to each person
- encouraging each student to use a separate bound exercise book for all their Challenge work, showing their preliminary investigations, progressive drafts, and final complete solutions
- recruiting parents, trainee teachers, or retirees with relevant experience to coordinate one or more levels of the Challenge for your school
- ensuring students know the difference between a simple answer or calculation and a full solution with reasoned argument
- encouraging feeder primary and other schools to participate in the Challenge so there is a wider pool of experience and support amongst local colleagues
- setting early deadlines for some problems so they can be marked while students work on others
- explaining to students any unfamiliar terms in a problem and clarifying a question where necessary.

Marking is always a quandary. The Problems Committee endeavours to present problems, marking schemes, and model solutions so they indicate as precisely as possible how marks should be allocated. Nevertheless discretion is often required particularly for reasoning and explanation. Where there is only one mark available, the desire to award a half mark is strong; the stipulation not to do so is seen as unfair. However, students have four weeks to prepare and revise their solutions so they are correct and complete. Past Challenge problems and solutions can help

them see what is expected. Encourage students to criticise their own writing, to look at their solution as building a bridge of understanding. Half a bridge will never do but where there is doubt, award the mark.

I would like to record my thanks and appreciation to the members of the Challenge Committee for the time, expertise and enthusiasm they contribute to the Mathematics Challenge for Young Australians. Their names are recorded in the Teacher Guide. Collectively they have given over 350 years of invaluable service. It is worth noting that the Committee now has gender parity: 8 women and 8 men. My thanks go also to the many moderators for their insightful and meticulous review of Challenge drafts and to the dedicated and ever reliable Australian Mathematics Trust staff for the efficient administration of the Challenge program. We have in the Challenge a wonderful legacy of mathematics enrichment for young Australians, a program I believe that is unique in the world.

I wish you and your students well for the 2021 Challenge.

Kevin McAvaney
MCYA Director

ADMINISTRATIVE PROCEDURES AND GUIDELINES

A. On receipt of the Challenge package

1. You should have:

- Maths Challenge Director's Handbook
- Sealed package (to be opened at commencement of the Challenge) containing:
 - Student Problems books (Middle Primary, Upper Primary, Junior and/or Intermediate) as ordered
- Sealed complimentary Teacher set(s) containing:
 - Teacher Guide with solutions and marking schemes for the Challenge problems, as well as extension material
 - One each of the Middle Primary, Upper Primary, Junior and Intermediate Problems books.

IMPORTANT: You will receive the results spreadsheet via email. If you do not, please contact us at mcya@amt.edu.au to request it.

2. Explanation of the coding on the label attached to the front of this handbook:

| | |
|------------------------------|-----------------------------|
| Your AMT school code | (See below for explanation) |
| School name | MP:1 UP:0 J:2 I:0 T:1 |
| The Maths Challenge Director | |
| | |
| | |

where MP# reflects the number of Middle Primary Problems books (i.e. the number of registered Middle Primary students)

where UP# reflects the number of Upper Primary Problems books (i.e. the number of registered Upper Primary students)

where J# reflects the number of Junior Problems books (i.e. the number of registered Junior students)

where I# reflects the number of Intermediate Problems books (i.e. the number of registered Intermediate students)

where T# reflects the number of complimentary Teacher sets (one for up to 30 student entries and multiples thereof; if you have 31 students entered at any level, 2 complimentary Teacher sets will be included)

3. The Challenge Committee strongly recommends to schools that they formally allocate, if possible, special class periods on the school's timetable. This recommendation is based on the comments and suggestions of many teachers who reported most positively of the benefits to their students of similar arrangements made in previous Challenge and Enrichment Stages.
4. Included at the back of this handbook are brief solutions to each problem. These may be photocopied and given to students after 25 June. Do **not** give them to students earlier, even if they finish the Challenge earlier — friends in other schools may still be working on it. Do not use these solutions for marking the students' efforts, use the solutions and marking scheme in your Teacher Guide.
5. To help teachers with marking deadlines, it is suggested that students hand in their completed problems progressively.

B. The day when students are given their Challenge Problems

1. Arrange a meeting of all students participating in the Challenge.
 - a. Collect the information below for each student and record it on your spreadsheet, along with the name and mailing address of your school:
 - their last name and first name
 - school year, sex, date of birth
 - answers to the diversity information questions on the sheet.
 - b. Give the Student Problems books and any photocopied worksheets to each participant, making sure that they understand the 'Instructions to Students' at the front of their book and the 'Mark Allocation' at the back of their book.
 - c. Outline arrangements made for monitoring progress and handing in solutions.

C. The day when students hand in their attempts to the Challenge Problems

1. Collect the Teacher Guide.
2. Collect the students' Challenge scripts ensuring that they have clearly recorded their names on their scripts. For all students check and record whether the students have attempted the problems individually or have discussed them with a partner, and if so, have recorded their partner's name.

3. Marking Papers

- a. Award marks as shown in the mark allocation (see Teacher Guide). Marks are to be awarded in whole numbers only.

Be lenient — if you are unsure whether a mark should be awarded or not, award it (i.e. always give the student the benefit of the doubt). Be particularly *lenient* with reasoning marks, as students at this level are usually inexperienced at writing reasons. Students' solutions need not be as detailed as those given. Sometimes a brief interview with the student can clarify whether the student deserves the mark or not. *No half marks are to be awarded.*

- b. If an incomplete attempt is presented, which is different from the solution supplied, award marks for comparable work. If you are not sure, again give the student the benefit of the doubt. We have identified several alternative solutions for each problem.

4. Recording Results and Name Details

Submit results electronically on the spreadsheet that will be sent to your email, or contact mcya@amt.edu.au to request it.

To help us improve, please complete the electronic survey which we will send out in June.

D. Submit results to the Australian Maths Trust by 25 June

Return the results spreadsheet by email to:

mcya@amt.edu.au

Note: It is intended that the overall results, statistics and award certificates will be posted to participating schools in late July.

E. Follow-up Support for Students

1. It is suggested that teachers discuss the solutions of the Challenge problems with their students. A set of short solutions is provided at the back of this handbook, which may be photocopied, distributed to students and used as a basis for discussion.
2. To help further motivate and challenge the students, a number of extension problems are provided in the Teacher Guide. We recommend that students should be given these further problems to help reinforce the concepts and ideas already met in the Challenge problems and to provide further practice in problem solving.

3. Students in Years 5-10 who have done well or who have shown commitment in the Challenge should be encouraged to participate in the Maths Enrichment. It is not too late to enter as it is designed to be scheduled, by the school, in a convenient set of 12-16 weeks between April and September. For further information contact:

Australian Maths Trust

Tel: 02 6201 5136

Fax: 02 6201 5052

Email: mcya@amt.edu.au

4. Australian Intermediate Mathematics Olympiad

Students who do well or show commitment in the Maths Challenge and/or Enrichment and other talented students should be encouraged to enter the Australian Intermediate Mathematics Olympiad (AIMO) to be held on 9 September 2021. Registration is online and materials will be sent to the registered email address. It is a four-hour closed book contest, consisting of ten questions based on broad mathematical ideas. Students sit the AIMO at their own schools, and papers are sent to AMOC State Directors for marking.

The AIMO is the major identifier of students who will be invited to participate in the AMOC's other activities such as the maths extension programs and training schools.

HOW MUCH MAY A TEACHER HELP?

It is stated in the instructions to students that solutions to the problems must be completely the work of the student and that students may seek the use of resources such as textbooks or library books, computers and calculators, but may not seek help from other people. Where a problem is worked on with a partner (or partners), the final solutions must be written out by each entrant individually and in the student's own words.

However, where there are circumstances in which students cannot proceed, perhaps because of language or terminology, teachers may give some guidance. Further, general problem-solving techniques may be discussed.

It is suggested that the teacher negotiate arrangements whereby students report on their progress at regular intervals during the course of the Challenge. This will encourage the student to discuss any difficulties in getting started and to spread his or her efforts over the entire Challenge period (up to *four* consecutive weeks), rather than leaving it until the last minute.

The following guidelines are designed to assist teachers in deciding what they may tell students.

- Help if asked, but only give as much as will get the student thinking in the right direction.
- Give hints very sparingly, and never in such a way that a solution is directly revealed.
- Direct the student to consider a similar problem on a smaller scale.
- Suggest, where appropriate, that the student make a table, list, diagram, etc.
- Remind the student: 'There are more options than you think. Can you look at it another way?' Don't show the other way(s), but rather force the student to take a broader view and consider alternatives.
- Ask the student to give a *wrong* answer and explain why it is wrong. This may provide an entry point to a solution.
- Help clarify the student's thinking by asking questions such as:
 - Do you understand the question?
 - What are you told in the question?
 - What are you required to find?
 - Are you using all the information?
 - Do you understand the terminology?
 - What have you found so far?
- Make sure that the student has noted the need to show uniqueness of a solution to some problems. This means that full marks will not be awarded for a solution established by 'guess-and-check' or a spreadsheet, unless the student demonstrates that all possible values have been tried.

Teachers may assist with the terminology. For example, words such as 'adjacent' may need to be explained, as may the means by which scientific notation is displayed on the calculator. A general discussion of exponents and scientific notation may be necessary. Encourage students to look things up and lead them to suitable references and resources, if necessary. Don't ignore the potential of a mathematical dictionary.

The Instructions to Students in the Student Problem booklets advise that, except for specified student collaboration, students may not seek help from other people, including people whom they could contact via the internet. This has become a significant issue in recent years. Some students have submitted problems to one or more problem-solving web sites and simply waited for a solution to be provided by another user. This form of plagiarism can usually be detected by the deviation in style, accuracy, and sophistication from the student's usual work.

The following suggestions are made regarding each question in the Challenge. *The teacher should help only when help is requested.*

SOME STATISTICS FROM 2020

MIDDLE PRIMARY

The cut-offs for certificates in Middle Primary were as follows:
(Each question is marked out of 4, so there were 16 marks available.)

| Award | Score | Distribution of Awards |
|-------------|-------|------------------------|
| Distinction | 16-14 | 25% |
| Credit | 13-10 | 41% |
| Proficiency | 9-6 | 23% |

The remaining students were awarded a Certificate of Participation.

UPPER PRIMARY

The cut-offs for certificates in Upper Primary were as follows:
(Each question is marked out of 4, so there were 16 marks available.)

| Award | Score | Distribution of Awards |
|-------------|-------|------------------------|
| Distinction | 16-14 | 30% |
| Credit | 13-10 | 36% |
| Proficiency | 9-6 | 26% |

The remaining students were awarded a Certificate of Participation.

JUNIOR

The cut-offs for certificates in the Junior Level were as follows:
(Each question is marked out of 4, so there were 24 marks available.)

| Award | Score | Distribution of Awards |
|------------------|-------|------------------------|
| High Distinction | 24-22 | 9% |
| Distinction | 21-19 | 17% |
| Credit | 18-14 | 24% |

The remaining students were awarded a Certificate of Participation.

INTERMEDIATE

The cut-offs for certificates in the Intermediate Level were as follows:
(Each question is marked out of 4, so there were 24 marks available.)

| Award | Score | Distribution of Awards |
|------------------|-------|------------------------|
| High Distinction | 24-21 | 14% |
| Distinction | 20-18 | 19% |
| Credit | 17-13 | 23% |

The remaining students were awarded a Certificate of Participation.

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