

2010

MATHS CHALLENGE STAGE

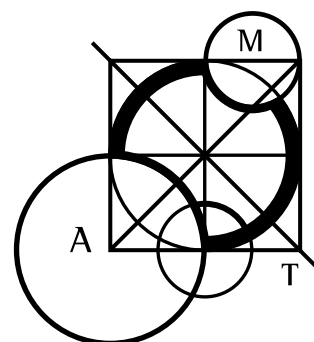
MATHEMATICS CHALLENGE
FOR YOUNG AUSTRALIANS

MARCH – JUNE

DIRECTOR'S HANDBOOK

AN ACTIVITY OF THE
AUSTRALIAN MATHEMATICAL OLYMPIAD COMMITTEE

A SUBCOMMITTEE OF THE AUSTRALIAN MATHEMATICS TRUST
IN ASSOCIATION WITH THE AUSTRALIAN ACADEMY OF SCIENCE
AND THE UNIVERSITY OF CANBERRA



FROM THE DIRECTOR

Welcome to Mathematics Challenge for Young Australians 2010 and congratulations on deciding to take the time and tantalising risk in being part of it. Whether this is your first time or twentieth 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; and
 - 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 three suitable weeks in the Challenge allocated period from the date of delivery to 11 June. Here are some time-saving suggestions which could help:

- using the electronic sample letter to parents which is available by email from mcy@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 three 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's Reference Book. Collectively they have given over 200 years of invaluable service. 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 Challenge 2010.

Kevin McAvaney
Director, MCYA

Chapter Two

SAMPLE LETTER TO PARENTS

Dear Parents,

Your child has been selected to participate in the Mathematics Challenge for Young Australians. This is a problem-solving activity organised by the Australian Mathematics Trust which is aimed at the top 15% of students in their year level.

The Mathematics Challenge for Young Australians takes place over three weeks in Term 1 or Term 2. Students receive a problem booklet containing 6 problems (Years 7 to 10 – Junior and Intermediate levels) or 4 problems (Years 5 to 7 – Primary level). Students are required to present written solutions to as many of these problems as they can. The problems are challenging and require time and persistence, but are based on mathematics which should be known at that level. Students in the Junior and Intermediate levels may work with a partner on two of the problems, students in the Primary level may work in groups of up to three on all the problems. Individual solutions must be submitted.

Teachers mark the submitted solutions from marking schemes and solutions provided by the Australian Mathematics Trust in the Teacher Reference Book. This also provides alternative solutions, some discussion of the origin, mathematics and teaching issues associated with each problem and some extension problems, with solutions; it is a valuable classroom resource. Marks are submitted to the Australian Mathematics Trust on computer sheets and, after processing, certificates are issued.

Students are allowed to seek help from any resources other than human ones – textbooks, encyclopedias, etc., and use calculators and computers. Note that websites offering help with problems are really human resources and not allowed, but the use of a computer-based encyclopedia or a website providing information of a general nature is quite alright. Teachers will be checking on progress from time to time and may be able to answer questions of clarification. Some classtime will be set aside for consultation with partners.

I hope the Challenge is an enjoyable and valuable learning experience for your child.

Yours sincerely,

Chapter Three

ADMINISTRATIVE PROCEDURES AND GUIDELINES

A *On receipt of Maths Challenge Stage Package*

1. You should have:
 - School Maths Challenge Director's Handbook
 - Return address envelope (plastic) containing
 - School Details & Suggestions Questionnaire (yellow)
 - AMOC High School Mathematics Problem Solving Program brochure
 - Australian Mathematics Trust's Publication order form
 - Sealed package (to be opened at commencement of the Maths Challenge) containing
 - Student Problems books (Primary, Junior and Intermediate)
 - Sealed complimentary Teacher set(s) containing
 - Teacher's Reference Book that includes solutions and marking schemes for the Maths Challenge problems as well as extension material
 - Sample of the Primary, Junior and Intermediate Problems books
 - Answer sheets.
2. Explanation of the coding on the label attached to the front of this Handbook:

Your AMT school Code	(See below for explanation)
XXXXX	P:0 J:2 I:0 T:1 A:2
The Maths Challenge Director	
.....	
.....	

- where P#...** reflects the number of Primary Level Problems books
(i.e. the number of registered Primary Level students)
- where J#...** reflects the number of Junior Level Problems books
(i.e. the number of registered Junior Level students)
- where I#...** reflects the number of Intermediate Level Problems books
(i.e. the number of registered Intermediate Level 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)
- where A#...** reflects the number of answer sheets
(i.e. the number of registered Primary, Junior and Intermediate students plus one extra).
3. Check you have a sufficient number of answer sheets for the entrants in your school. If there are not enough please request extra sheets from the Australian Mathematics Trust — Tel: 02 6201 5173 Fax: 02 6201 5052.
 4. The Maths 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 Maths Challenge and Enrichment stages.
 5. Included at the back of this handbook are brief solutions to each problem. These may be photocopied and given to students after 11 June. Do not give them to students earlier, even if they finish the Challenge earlier — friends in other schools may still be working on the Challenge. Do **not** use these solutions for marking the students efforts, use the solutions and marking scheme in your Teachers Reference Book.

6. 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 Maths Challenge Stage Problems

1. Arrange a meeting of all students participating in the Challenge.
 - (a) Ask each to complete an answer sheet, using a soft lead pencil (e.g. 2B), including:
 - their surname and first name
 - school year, sex, date of birth
 - name and address of school
 - two questions asked at the bottom of the sheet.

Collect the completed sheets and secure for later coding of students' marks and level attempted.

- (b) Give the Maths Challenge Stage Problems book and any photocopied sheets 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 problem book.
- (c) Outline arrangements made for monitoring progress and handing in solutions.

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

1. Collect the answer sheets and the Teacher's Reference Book from the secure place.
2. Collect the students' Maths Challenge Stage scripts ensuring that they have clearly recorded their names on their scripts. For Junior and Intermediate students check and record whether the students have attempted Maths Challenge Problems 5 and/or 6 individually or have discussed these problems with a partner, and if so, have recorded their partner's name.
3. It is suggested that you mark students' work progressively as they finish the Challenge.
4. **Marking and Scoring Procedures**

The instructions for marking and scoring are given in the Teacher's Reference Book, namely:

Instructions to School Challenge Directors

Marking Papers

- a) Award marks as shown in the mark allocation (see Teacher's Reference Book or at the end of each Problem book). 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 here. 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.

Recording Results and Name Details

- a) On each student's computer answer sheet using a soft lead pencil (e.g. 2B), code in the student's name, results and other required information (if not already done).
- b) Rub out mistakes *completely*, using a plastic eraser, and re-code.
- c) Please complete the School Details Form / Comments and Suggestions Questionnaire.
- d) Collect all the completed answer sheets, School Details Form/Comments and Suggestions Questionnaire. Place these into the Maths Challenge Stage return-addressed envelope.

***D Mail the Answer Sheets
to the Australian Mathematics Trust by Monday 28 June***

Mail (express post or courier etc.) the return-addressed envelope to:

**Australian Mathematics Trust
University of Canberra ACT 2601**

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 Maths Challenge Stage 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's Reference Book. We recommend that students should be given these further problems to help reinforce the concepts and ideas already met in the Maths Challenge Stage problems and to provide further practice in problem solving.
3. Students who have done well or who have shown commitment in either of the Primary, Junior or Intermediate Divisions should be encouraged to participate in the Maths Enrichment Stage. 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 Mathematics Trust
Tel: 02 6201 5173
Fax: 02 6201 5052

4. Australian Intermediate Mathematics Olympiad

Students who do well or show commitment in the Challenge and/or Enrichment Stages should be encouraged to enter the Australian Intermediate Mathematics Olympiad (AIMO) which will be held on 12 August 2010. Question papers will be sent to schools in July (included with Challenge Stage results). 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 Residential Schools.

Chapter Four

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 problems are designated for discussion 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 three 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 Problems 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 websites 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.