Department of Mathematics and Statistics

University of Otago
Te Whare Wānanga o Otāgo
New Zealand

Junior Mathematics Competition 2018

Teachers Competition Report

General comments

The new format (with every student answering six out of eight questions) appears to have worked well. We deliberately tried to make the first three questions straightforward although Question 2 proved to have 'tricky' parts (the Year 11 students 'dodged a bullet' there). There was more challenge towards the end, although with several students scoring perfect or near perfect results we will need to toughen up the final questions just a little.

The number of students taking part in the competition in 2018 was 6634 (last year 6119). The number of schools taking part was also up, from 157 in 2017 to 164 this year. Welcome to the 'new' schools. We hope that you enjoyed the experience and that you are willing to have at least one more go! There were 3026 students (2911 last year) in Year 9, 2243 (2202) in Year 10, and 1365 (1006) in Year 11. We were pleased to see the reasonably large increase in Year 11 numbers – we feel that the competition serves as practice for external examination with little of the associated stress.

This year there were five students who scored zero (no attempt).

The planned date for next year's competition is Wednesday April 3.

Please record this date.

For the overall scores in 2018 see the table on page 2.

We advise that doing as much as possible in a question before moving onto another question is better than jumping back and forth between questions. Another good idea is to write the answer down with the minimum working possible. Students can return to 'pad' the working out when they have done as much of the competition as they can do. (Too many capable students are spending several lines on each part of the early questions and then running out of time. The previous idea of concentrating on three questions no longer applies now that the number of questions has increased and some questions are worth 'half' marks.)

Cost

The cost of the competition in 2019 will not rise. We do not aim to make an inordinate amount of money, but we do need to break even (at least) and the cost rises in 2018 have helped the competition to return to a more even keel.

Brief comments on individual questions

Question One (year 9 and below)

The Mathematics taught to Juniors needs to be practical and sensible. Nowhere was this seen better than in part (c) where many students rounded 5.4 'down' to the nearest integer (5) instead of realising that this would leave part of the wall uncovered. There's no substitute for common sense.

Part (a) was often (inexplicably) missed out! There were also several students who take four or five lines to answer the very first question in the competition and are bound to run out of time. Many students wrote 'English' sentences with things like 'Well you have to multiply the base by the height which means multiplying 4.5 by 3. This is done by multiplying 4 by 3 and adding on 4 times 0.5. This gives 12 which you add 1.5 onto. The final answer is 13.5.' All this could be written in one line by the simple mathematical statement '$4.5 \times 3 = 13.5$'.

Question Two (year 10 and below)

Being able to deal with the 'tricks' that stores play is essential for every citizen. We have heard of a Department Store that routinely makes 600% 'profit' (although they do have legitimate costs of their own to cover) so the 400% quoted in (d) is possibly an underestimate! Also it is not beyond the realm of possibility for stores to charge more in Boxing Day sales than the 'regular' price. Caveat emptor!

Generally speaking (a) and (b) proved to be straightforward for most but (c) and (d) need attention.

Question Three

This was 'easy' for most. Ratios seem to be well understood. Over 29% of students gained full credit for the question.

The mistake in 3(b)(iii) is regretted (see the Student Report). From what we can see most students put down an answer and didn't notice that both 'True' and 'False' are potentially correct.

Question Four

Here is where the competition became 'Mathematical'. Competitors were divided between those who could handle fractions easily (some completed the question in fewer than 10 lines) and those who gained no credit except in the True/False questions and the simplification of 3/24.

In (d) we 'expected' the answer $2/3 + 1/3 + 1/11 + 1/11$. However several of the many alternatives were sighted.

Tel: 03 466 7498
Fax: 03 479 8427
Email: jmc@maths.otago.ac.nz
Twitter: twitter.com/uojmc

Our website and email

Please remember to check our website (and our Twitter account) regularly for updates on the availability of results, as these will be typically available weeks before we sent out the results packs to schools. You should monitor the website before emailing us for information which is already on there. We have emailed results to all schools. Many thanks to those who continue to use email – we have found this to be the most effective form of communication by far, and has reduced our administrative burden no end.

Final comments

Don't forget to try the questions yourself (even before you look at the model solutions!), and then see if you can "tweak" them a little to help students' investigative and problem solving skills.

And remember to use the questions throughout the year, and not just in the days before the actual competition. As usual some of the questions would make good review or revision questions. You should also visit us at our web-site if you want to print off copies of questions and solutions from recent years.

Problem solving pervades the mathematics curriculum, crossing the various strands. We hope that this competition assists all of you to help fulfil this important aspect of mathematics education.

Warren Palmer

Warren Palmer
Competition Manager

Question Five

Here many could handle 'numbers' in part (a) easily but couldn't cope with 'letters' in part (b). Another problem appears to be that competitors don't always look for the simplest approach. For example quite a few expanded 10! and 8! out in (a)(iii) fully to reach the division 3 628 800 / 40 320 which they then couldn't handle. But if they'd spotted that most of the terms divide out (with only 10 × 9 left) much work could have been saved. Why walk from Christchurch to Blenheim by heading to Invercargill first?

Such an approach didn't work for the algebra in (b). Some students were wedded to the idea of expanding the brackets, a few even reaching a quintic (with more terms to go) before they gave up.

Question Six

This was the "pure mathematics" question. As such many candidates elected not to answer it, often choosing to go straight from Question Five to Question Seven or Eight (where applicable). Those who attempted it actually found the going not much harder than the previous question.

Quite a few students failed to get credit here simply because they did not read the question properly. Those who missed the word "consecutive" almost always earned nothing for the question. The word "inclusive" also caught a few students out. There were quite a few candidates who had 11 numbers in their list, rather than 10. The other common (but much more understandable) mistake was in misidentifying primes; 119 (which is 7 × 17) and 143 (which is 13 × 11) were notable examples of this. Perhaps a class exercise sometime is to apply the 'Sieve of Eratosthenes' to all numbers from 100 to 200. (In fact 143 = 144 – 1 so it cannot be prime because it's the difference of two squares, since 122 – 12 = (12 + 1)(12 – 1).)

Question Seven (year 10 and 11)

Part (a) was well done by those students who got this far. In part (b) students needed to give the answer and verify it was the minimum by checking values on either side. A few students used calculus but only two or three obtained full credit this way. Part (c) was 'hit or miss'. Some students knew instantly that 1 ha = 10 000 m^2. (It is 100m × 100m or about the size of two adjacent rugby fields.) Many students had no idea however.

Question Eight (year 11)

A simple question for those Year 11 students who knew their 'Trig without right angles' formulae, specifically (in this case) that the area of a triangle is given by Area = ½bc sin α. It was difficult for those students who didn't know the formula however. We will continue to ask questions of a similar nature from time to time.

A note on calculators

We continue to stress how difficult it is for students without calculators to cope in a Mathematics competition. They can certainly work things like 2.7 / 13.5 × 100 = 20% out but it uses up precious time. Even a simple calculator with the 'four basic functions' would save much time.

Percentiles

The percentiles at each level are given below. (The total possible marks for all candidates was 100.) Note that the top papers (about 20% at each level) have been check-marked by experienced members of the Mathematics and Statistics Department of the University of Otago. This does use up considerable time in returning results, but we feel that the greater accuracy in final marks makes the check-marking justified.

2018	Year 9	Year 10	Year 11
Top 100	70	76	77
Top 200	64	68	68
Merit	55	61	65
70th %ile	47	52	57
60th %ile	43	48	52
50th %ile	39	43	48
25th %ile	29	34	38

2017	Year 9	Year 10	Year 11
Top 100	62	56	66
Top 200	56	50	59
Merit	48	45	*
70th %ile	40	37	54
60th %ile	35	34	49
50th %ile	32	31	45
25th %ile	22	23	33

* In 2017 there were insufficient entries at the Year 11 level for a Merit Award to be given.

A comparison with last year's percentiles (at the right) shows that generally the marks this year were higher, meaning that most students found this year's competition easier.

You should check the list of marks against the percentiles above. If there are any students who seem to be eligible for Merit Awards or above, but who do not appear to have received anything on the mark list, please contact us.

Explanation of the symbols on the mark-sheets

The following symbols have been utilised on the mark sheets:

Questions 3, 4, 5, and 6:

(blank) No work presented.

0 Work presented, but ungradeable, or fundamentally incorrect.

\- Minimal partial credit (1 – 5 marks).

\+ Significant partial credit (6 – 13 marks).

√ Near complete solution (14 – 17 marks).

√ √ Full, or near full credit (18 – 20 marks).

Questions 1, 2, 7, and 8:

(blank) No work presented.

0 Work presented, but ungradeable, or fundamentally incorrect.

\- Minimal partial credit (1 – 4 marks).

\+ Significant partial credit (5 – 8 marks).

√ Near complete solution (9 – 10 marks).

At the end of each row we have recorded the marker's estimate of the final score for each student.