

Department of Mathematics and Statistics



Junior Mathematics Competition

The University of Otago Junior Mathematics Competition 2019

Teacher's Competition Report

General Comments

The reasonably new format (with every student answering six out of eight questions) appears to have become well understood, although a few “older” students did waste time by answering questions intended for earlier Years. The first questions were mostly “straightforward” while the last three questions proved to be tricky for many.

The number of students taking part in the competition in 2019 was 6975 (last year 6639). The increasing trend continues although the number of Year 11 participants was down from 1365 last year to 1202. However there were 3242 students (3026 last year) in Year 9, and 2531 (2243) in Year 10. The number of schools taking part also continues to climb from 164 in 2018 to 175 this year.

For the second consecutive year there were five students who scored zero (no attempt).

Date for 2020 Competition:

Because of organisational matters we are unable to announce the date for next year's competition at this stage. Please keep an eye on the website: www.maths.otago.ac.nz/jmc

For the overall scores in 2019 see the table on page 3.

We continue to emphasise 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. Once again several “capable” students answered the early questions nearly perfectly but ran out of time and could not do justice to the later ones, mainly because they wrote too much at the beginning. There is a fine line between explaining and over-explaining your answers.

Cost

The cost of the competition in 2020 will not rise.

Brief Comments on Individual Questions

Question One (Year 9 and below)

The question was well answered in the main although several students couldn't handle all of part (c). We apologise for not reflecting "true life" in (a)(iii). The exchange rate between the \$US and the \$NZ was the wrong way around, meaning B was correct whereas A is more in keeping with reality. No student seems to have been affected from what we could tell. Obviously no checker picked the mistake up!

Of more concern was the number of students who thought that the "calculator" answer of \$22.4 in (b) was better than \$22.40. Money should be rounded to 2 d.p. if a whole number of dollars does not occur.

Question Two (Year 10 and below)

There appeared to be three issues here. Firstly a few students don't seem to be able to subtract three digit numbers. Too many times we saw students write down the subtraction $854 - 458$ correctly but they were then unable to reach the answer! Secondly students didn't answer a question, even though it was easy. In (c) we asked "Do you get the same result . . ."? Many students found the same answer 1089 in (b) and (c) but then they lost credit by not writing "Yes" (or equivalent). Thirdly (as expected) the algebra involved in (d) and (e) was beyond many. We eventually wanted the answer "99a - 99c" but numerous students gave a number instead.

Question Three

A straight forward start for Year 11, and well handled by many Year 10, 9, and below students. However the word "product" in (c) did cause some difficulty (a surprise to the question writer) and many were unable to generalise and write an algebraic answer at the end. The answer 13 (being half of the 26 letters of the alphabet!) was common in (f).

Question Four

We originally wrote a "darts" question but decided to simplify it. Mixed results occurred, although there was enough to keep most students "going". Being systematic and thorough were essential skills in (diii). Some students couldn't decide whether order counted here, although the "best" students saw the word "all" and proceeded to list "all" possibilities.

Question Five

The aim of this question was to make students try to grasp how immensely big one billion really is. We casually wiped several million years off the generally agreed age of the earth to make the arithmetic a little simpler. Despite this "abbreviation" it turns out that dinosaurs became extinct at a compressed (rounded) time of 23:30 and modern humans have only been in existence for less than (a compressed) four seconds (hence the nearest minute is 24:00!). One student stated this result explicitly: "This shows that the period of humans is insignificant compared to the age of the earth." It was especially disappointing to see that many students failed to realise that 20 minutes is one third of an hour.

Question Six

This question ended up being the hardest question in this year's competition. Having said that at least 50% credit was possible if the "easy" parts of the question were done. Unfortunately many capable students were not accurate in these parts. For example, a lot of candidates do not seem to know the meaning of the word "respective", costing them marks in part (a), while in part (b) the factorisation of some numbers proved problematic, and far too frequently 14 and 15 were completely absent from the list of numbers.

In parts (c) and (e) we expected a level of mathematical rigour that the vast majority of students

were not capable of providing. Instead of providing algebraic arguments, far too often we were presented with word salads which only gave very weak answers to the questions we gave. In fact in these parts only two students provided adequate answers, and it is perhaps no coincidence that these students received the first two placings in Year 11.

Question Seven (Years 10 and 11)

Students either did extremely poorly (the majority) or extremely well in this question. The first thing we looked for was an adjustment of the probabilities as more cards were being drawn. The probability of the first card being red (for example) is $4/12$. But then there are only eleven cards left (and only three red cards). So the probability of the second card being red is $3/11$. And so on. These probabilities must be multiplied. A few students added, and occasionally probabilities larger than one were seen.

Next the different ways had to be considered: R R R, B B B, . . . (27 in total).

Moreover the three cases represented the only possibilities. So once Cases 1 and 2 were calculated Case 3 could be found by subtraction from 1.

Question Eight (Year 11)

Some students knew how to solve a quartic using the “formula”. But many gave up once they realised that their equation involved x^4 .

It is noticeable that a small number of students could set up the equation then solve it using an “equation-solver” built into their calculator. This gives such students an unfair advantage, and future questions will have to be written to circumvent this problem.

It should be noted that there was a “fish-hook” at the end. Students were asked to state the “dimensions” of the pool. This included the depth, 1.5 m, which otherwise played no part in the question.

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.

2019	Year 9	Year 10	Year 11		2018	Year 9	Year 10	Year 11
Top 100	64	67	66		Top 100	70	76	77
Top 200	57	61	60		Top 200	64	68	68
Merit	47	55	58		Merit	55	61	65
70th %ile	38	44	51		70th %ile	47	52	57
60th %ile	33	40	46		60th %ile	43	48	52
50th %ile	30	35	42		50th %ile	39	43	48
25th %ile	21	26	30		25th %ile	29	34	38

A comparison with last year’s percentiles (at the right) shows that the marks in 2019 were lower (indicating a more difficult set of questions). We feel that the 2018 competition was a little too easy and that the standard of questions in 2019 was “about right”.

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.

A Note on Calculators

We continue to stress how difficult it is for students without calculators to cope in a Mathematics competition. Even a simple calculator with the 'four basic functions' would save much time. Certainly Years 10 and 11 students cannot be expected to work out the more complicated problems towards the end without a calculator.

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 or not applicable.
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 score for each student.

Our Website and email

Please remember to check our website 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

The manager is retiring. I would like to thank the many teachers who have communicated with me over the years. You have shown humour, intelligence and forgiveness on the many occasions when I made mistakes. Yours is a stressful occupation. I have not taught full-time at secondary level for over 20 years, but I well remember how traumatic (but occasionally rewarding) it could be. My hat is off to you all. Politicians simply do not understand, unless they have been there.

I would also like to thank my team here, especially my wife Loas, my son Chris, and the Departmental secretary Leanne Kirk. Others have contributed as well, especially in ideas for questions and the checking of wording. You'll be surprised at the number of emails that fly back and forth discussing the merits or otherwise of one little word.

Warren Palmer

Warren Palmer, Competition Manager.