

Rules for the Mental Calculation World Championship Final Version

General Information

The entry form and more information about the event can be downloaded from the website at www.recordholders.org/en/events/worldcup/.

Registration

Eligible for participating in the Mental Calculation World Championship are mental calculators, who have received a registration confirmation from the organizer. Men and women will compete in the same competition. Prior to the competition, each participant has to announce clearly whether he or she will take part in all categories or just in selected categories.

In order to receive a registration confirmation, the participant will have to register by sending the signed entry form until the 1st of May 2008. Registrations by e-mail will not be accepted.

The organizer reserves the right to make an appropriate selection out of the registrations in order to limit the number of participants. Should such a selection be necessary, the organizer will make sure that:

- a) the mental calculators with the best achievements so far will be invited
- b) the number of nations involved will be as high as possible.

Titles

The following titles will be awarded:

- for the overall winner: *"Mental Calculation World Cup Winner"*
- for the winner in the category "Addition": *"Mental Calculation World Cup Winner in the category addition"*
- for the winner in the category "Multiplication": *"Mental Calculation World Cup Winner in the category multiplication"*
- for the winner in the category "Extracting Square Roots": *"Mental Calculation World Cup Winner in the category Extracting Roots"*
- for the winner in the category "Calendar from Memory": *"Mental Calculation World Cup Winner in the category Calendar from Memory"*
- Should there be enough participants, there will be an additional competition for the calculation with mechanic aids (Abacus, Soroban).

Jury

The jury will consist of at least three suitable persons (e.g. mathematicians or math teachers). At least one member of the jury will speak German and one member English. The organizer will try to provide translators for participants who neither speak German nor English.

Categories

The overall competition is divided into six single categories:

- a) Addition of ten ten-digit numbers
- b) Multiplication of two eight-digit numbers
- c) Extracting the square root from a six-digit number (solution has to be given with eight significant digits)
- d) The calculation of the day of the week from randomly selected dates of the years 1600 to 2100
- e) and f) two "surprise problems", which are unknown to the participants prior to the competition. These problems can include only basic arithmetic operations (addition, multiplication, subtraction and division) or raising powers with integer exponents.

General Rules

All participants should know the rules prior to the competition, as there will be no time for explaining them during the competition.

A sheet of paper which contains several randomly selected mathematical problems from a category will be put on the table in front of each participant. All participants will get the same set of problems. After the starting signal each participant has to turn over his/ her sheet of paper and solve as many problems as possible in the given time. The solution of each problem is to be noted readable beside or below each problem.

Unreadable solutions will be regarded as being wrong in case of doubts!

All problems must be solved mentally; aids and written calculations (i.e. writing down auxiliary calculations or intermediate results) are not permitted! If a solution has to be corrected, this should be done clearly on the sheet. The possibility of correction may not be misused to write down intermediate results.

For the rating of the noted solutions the following principle always applies: Correct solutions are more important than speed. (e.g. if ten problems are to be solved, then nine correct solutions in ten minutes will be regarded as being better than eight correct solutions in three minutes.)

For physically handicapped participants, who are unable to read the problems, hear the explanation of the surprise problems or write down the solutions, the jury may set special rules.

All participants should be absolutely quiet during the competition. If someone disturbs other participants, he or she can be disqualified. In particular, participants, whose mobile phone starts ringing during the competition, will be disqualified immediately!

Schedule

The contests will be held in the following order:

- Calendar - Round 1
- Calendar - Round 2
- Multiplication - Round 1
- Addition - Round 1
- Square Roots - Round 1
- Multiplication - Round 2
- Addition - Round 2
- Square Roots - Round 2
- First Surprise Problem
- Second Surprise Problem

There will be breaks (ca. 5 minutes) between each round. A break of about 45 minutes will be held between Round 1 of the Square Root category and Round 2 of the Multiplication category.

After the first round in the Calendar category, the participants can compare their answers with the correct results. Before the second round of the Multiplication category, the participants will be informed about the results achieved in the previous rounds (as far as they are already available at this point of time).

For all rounds, the procedure is as follows:

1. receiving of the exercise sheet
2. filling in of the name fields
3. concentration time (one minute)
4. start command: "Neurons: On the ready, go!"
5. announcements when 5 minutes / 1 minute / 10 seconds remain (acoustic signal)
6. stop command: "Three, two, one, stop!"

After the stop command, the exercise sheet has to be turned upside down instantly. Helpers write down the time taken and the participants sign their exercise sheet. Any further use of writing tools after the stop command is prohibited; otherwise the jury may take sanctions.

If (and only if) all problems of one category are solved correctly, additional points can be scored by finishing earlier (see below). Being finished has to be signaled by turning over the exercise sheet and then clearly raising one hand. If afterwards the participant has a look at his or her solutions, or adds/changes/deletes anything, he or she is accounted for the maximal time given for this round.

The interruption of a round is only possible by the head of the jury. Protests by participants due to unforeseen events are only possible after the end command (to limit disturbance of other participants).

Special rules for single competitions

- a) Addition of ten ten-digit numbers.
Time to solve the problems: *10 minutes*
Ten problems of the following type will be asked:

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  4190187220
+3967093178
+8567125486
+1005683165
+3635944647
+7645865467
+3506970235
+6710259450
+2347894647
+4995420559
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All numbers will be randomly selected and will contain ten digits; zero as the first digit is impossible. The required solution is the sum of the ten numbers.

- b) Multiplication of two eight-digit numbers
Time to solve the problems: *15 minutes*
Ten problems of the following type will be asked:

$$\begin{array}{r} 18467941 \\ \cdot 73465135 \\ \hline \end{array}$$

(If a participant prefers to get the problem as $18467941 \cdot 73465135$ in a single row, he or she can request an exercise sheet that shows the problems in this way.)

All numbers, containing eight digits, will be randomly selected; zero as first digit is impossible, though zeros and ones are possible at every other position, including the last. The solution would be the product of both numbers.

- c) Extracting the square root from a six-digit number (solution with an accuracy of eight digits).
Time to solve the problems: *15 minutes*
Ten problems of the following type will be asked:

$$\sqrt{530179}$$

All numbers, each containing six digits, will be selected randomly; zero as the first digit is impossible.

- d) Calendar from memory
Time to solve the problems: *1 minute*
55 problems of the following type will be asked:

08-12-1721 (for 8 December 1721. The first number will be the day, the second number will be the month!)

All dates will be randomly selected from the years 1600 through 2100. All dates are assumed to be Gregorian calendar dates.

The required solution is the correct day of the week of the given date (Monday in the example).

If participants prefer to get their problems in another way, for example as "8/DEC/1721", they must send the required format by e-mail to info@recordholders.org until the 1st of June 2008.

For the days of the week abbreviations are permitted if they clearly show the day of the week. (e.g.: In German Mo, Di, Mi, Do, F, Sa, So; in French L, Ma, Me, J, V, S, D would be sufficient.) Prior to the competition each participant has to write down on a special sheet of paper, which abbreviations he or she wants to use for each day of the week.

The usage of numbers for writing down the day of the week (e.g. 1=Monday, 2=Tuesday etc.) is not permitted! If the abbreviations are unclear, the solution will be rated as being wrong.

- e) and f) Surprise problems

Time to solve the problems: *10 minutes*

In both competitions, a number of problems of the same type will be asked (e.g.: in the first surprise problem calculations where powers have to be calculated, in the second one calculations where fractions are to be added.)

Scores for the single competitions

For those categories where two rounds are contested, **only the better result counts** for each participant. Only if two participants share the same result in a single competition, the result of the other round will be considered to determine the ranking between those participants.

Participants can forego their right to take part in one of both rounds. In this case, this round is counted with a score of 0.

The ranking of the participants of a single competition will be determined for every single category. This will be done in the following way:
For the categories:

a) Addition of ten ten-digit numbers and b) Multiplication of two eight-digit numbers

Every correct solution counts as one point. It does not matter how many wrong solutions are written down.

All participants with the same number of points will be ranked equally.

Participants who were able to solve all ten problems correctly will earn additional points in relation to their time needed (see "Additional points for completely correct solutions").

c) Extracting the square root from a six-digit number. The number of correct digits written will be accounted as follows:

One point for the first digit given correctly, two points for the second digit given correctly, ..., 8 points for the eighth digit given correctly.

This means that for a solution correct to:

- one digit, 1 point will be given
- two digits, 3 (=1+2) points will be given
- three digits, 6 (=1+2+3) points will be given
- eight digits, 36 (=1+2+3+4+5+6+7+8) points will be given

The maximum number of digits, for which points are given, is 8 for each problem - so the maximum of total points in this category is 360 (=ten problems with 36 points for 8 correct digits).

In order to decide how many digits are given correctly, the following rule applies:

Let A be the answer written down by a participant and B the exact solution. Then let N be the maximal integer for which $|A-B| \leq 5 \cdot 10^{2-N}$ holds. Then the number of digits regarded as being correct is N, but no more than 8 or the number of digits written down by the participant.

The scores will be explained by the following examples:

Solution written	Correct digits	points	Comments
$\sqrt{683722}$ (correct: 826.87483938...)			
8 or 800	1	1	(It is clear that 8 means the hundreds, so it is unnecessary to write down 800.)
812	1	1	Just one correct digit
82 or 820	1	1	The correct solution rounded to 2 significant digits is 830, not 820 !
83	2	3	see above
830			
826	2	3	
827	3	6	
827.1	3	6	
826.875	6	21	
826.87483	7	28	
826.87484	8	36	does not count as 8 correct digits, as the correct solution is 826.874839... perfect!
826.87483938	8	36	max. 36 points per problem!

Solution written	Correct digits	points	Comments
$\sqrt{365598}$ (correct: 604.6470044)			
6	1	1	
600	2	3	In contrast to the example above, a written "6" will be rated different from a written "600", as 600 contains two correct digits and 6 just one correct digit.
604.647	6	21	See below
604.64700	8	36	Even though 604.647 (see column before) is exactly the same as 604.64700, only the second solution will give 36 points, as only the second solutions shows that eight significant digits have been calculated.

Participants, who solved all ten problems correctly, will earn additional points depending on the time needed (see "Additional points for completely correct solutions").

d) Calendar from memory:

The problems are numbered from a_1 through a_{55} .

Let k be the highest number for which the following applies: "Among the problems a_1 through a_k there is at most one problem either not or wrongly solved." Then this will lead to a score of $k-1$ points. (Or to put it differently: The highest number of correctly solved problems, where at most one mistake is allowed, a second mistake will end the attempt. It doesn't matter how many correctly calculated problems follow after the second mistake.)

e) and f) Surprise problems

The scoring system for the surprise problems will be announced prior to the surprise contests.

Additional points for completely correct solutions

In the categories "addition", "multiplication" and "square roots" the participants can earn additional points, if all ten problems have been solved correctly.

The number of additional points will be determined in relation to the time needed. Let t be the time needed (in seconds) and T the time given (in seconds) for a single category (e.g. $T=900$ for "Extracting Square Roots"),

then, instead of the maximum number of points (e.g. 10 for "Addition"), the participant will earn $\frac{T}{t}$ -times the maximum number of points – rounded to two significant digits behind the decimal point.

Scores for the overall competition

Using the procedure above, points will be given for each single category. If someone is not participating in a category, he or she will enter the ranking for this category with 0 points. If two rounds are held for a category, only the better result of each participant will be taken into account.

The best participant in each category gets 100 points for the overall competition. This means that the theoretical maximum score in the overall competition is 600 points.

A participants' result in one category adds to his overall score as follows:

Points for the overall competition = $100 \cdot (\text{score of this participant in the category}) / (\text{winner's score in the category})$, rounded at two decimal places.

The ranking of the participants in the overall competition will be computed from the sum of their scores according to the above formula. Participants with the same score share the same rank.