WOCOMAL (Worcester County Math League) Mathematical Conventions

Information for Question Writers and Student Readers

Instructions embedded in the question supersede this document for that specific question.

Units of any answer, if required, must be the same as the units used in the statement of the problem and if possible will be provided on the answer sheet by the test writers.

If a diagram is given with a problem, it is not necessarily drawn to scale.

The letter i is used for complex numbers, where $i^2 = -1$.

Lattice points are points all of whose coordinates are integers.

The line segment whose endpoints are A and B is denoted by $\overline{AB}$, and the length of $\overline{AB}$ is denoted by AB.

Written numbers and logarithms are base 10 unless indicated otherwise by a subscript.
The use of log (x) (or ln (x)) also implies that x is positive.
Unless otherwise specified, log denotes the common logarithm, and ln denotes the natural logarithm.

Examples: $\log_3 81 = 4$
321_4 equals $3 \cdot 4^2 + 2 \cdot 4^1 + 1 \cdot 4^0 = 57$
ln (x) refers to $\log_e (x)$, where $e \approx 2.718281....$

Divisors (or factors) of an integer refer to positive integer divisors (or factors) only.
"Proper divisors" of an integer are those divisors that are less than the integer itself.

The designation *primes* refers to positive primes only. Primes are positive integers with exactly two different factors. Composite numbers have more than two different factors. Note: 1 is a unit, neither prime nor composite.

If a problem refers to the digits of a number, those digits are usually underlined to distinguish the digits of the number from the product of those digits. For instance, in the question "Find the missing digits A and B if $k = \underline{A\,2\,5\,B}$ and k is a multiple of 72". It should be interpreted as $k = 1000A + 200 + 50 + B$, where A is an integer between 1 and 9 and B is an integer between 0 and 9.

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Symbols for combinations: $\binom{n}{r} = {}_nC_r = C(n,r) = \frac{n!}{(n-r)!r!}$ The number of combinations of *n* things taken *r* at a time, that is a selection, where order is <u>not</u> important.

Symbols for permutations: ${}_nP_r = P(n,r) = \frac{n!}{(n-r)!}$ = the number of permutations of *n* things taken *r* at a time, that is an arrangement, where order is important.

When a polygon is named by letters, the letters are vertices occurring in their given order around the polygon. (For example, a polygon named *ABCDE* is understood as a pentagon with vertices *A*, *B*, *C*, *D*, *E* occurring in that order.) Unless otherwise specified, all polygons are non-degenerate (no angles of 0 or π) and non-self intersecting, but not necessarily convex.

The open interval bounded by real numbers *a* and *b,* a < *b,* is written (*a*, *b*), and the closed interval bounded by *a* and *b*, $a \le b$, is written [*a*, *b*]. Semi-open/semi closed intervals are written as (*a*, *b*] or [*a*, *b*).

The sum of all the elements of the empty set is 0.
The product of all the elements of the empty set is 1.

The expressions Arcsin *x*, $\sin^{-1} x$, Arccos *x*, $\cos^{-1} x$, Arctan *x*, and $\tan^{-1} x$ refer to the principal values of these inverse trigonometric functions. Their ranges are as follows: $-\frac{\pi}{2} \le \sin^{-1} x \le \frac{\pi}{2}$, $0 \le \cos^{-1} x \le \pi$, $-\frac{\pi}{2} < \tan^{-1} x < \frac{\pi}{2}$.
If a trigonometry problem does not specify the use of degrees, all values should be given in radians.

The product $n(n-1)(n-2)\cdot \ldots \cdot 2 \cdot 1$ is frequently written as n! (read n factorial).
Note: As a special case, 0! = 1.

max $\{a_1, a_2, \ldots a_n\}$ denotes the largest element in a set and min $\{a_1, a_2, \ldots a_n\}$ denotes the least element in a set.

Multiplications and other calculations should be reasonable to be done without a calculator. For example: $72 \times 73 \times 74$ would not be considered reasonable.