Central Jersey Mathematics League Contest

[Problems]

January 14, 2026

Name: ___________________________________ Score: __________

School:

__ Bridgewater-Raritan HS

__ Colonia HS

__ East Brunswick HS

__ Edison Academy Magnet HS

__ Edison HS

__ Highland Park HS

__ Hillsborough HS

__ J.F. Kennedy HS

__ Metuchen HS

__ Middlesex HS

__ Monroe Twp. HS

__ Montgomery HS

__ South Plainfield HS

__ Union County AIT

__ Union County AAHS / APA

__ Union County Magnet HS

__ Union County Vo-Tech HS

__ Other

Directions:

Put all significant work related to the solution of the problem in the space provided, and place the final answer on the indicated line.

Note: Depending on the wording of the problem, answers may be required in specific format.

Always leave answers in simplest form: specifically, in your answer the following are required:

1. Fractions will be reduced ($\frac{4}{8}$ is not acceptable)
2. Denominators will be rationalized ($\frac{1}{\sqrt{3}}$ is not acceptable)
3. Radicals will be simplified ($\sqrt{18}$ is not acceptable)
4. Like terms will be combined ($2x + 3x$ is not acceptable)
5. Trigonometric functions of special right angles will be evaluated ($\sin\frac{\pi}{2}$ is not acceptable)
6. Log expressions with a rational result will be simplified ($\ln e$ is not acceptable)

Decimal answers must be exact. Never approximate π or radicals.

Although the problems vary in difficulty, in scoring, each problem has an equal value of one point and no partial credit is given.

1. Let N be a positive integer with exactly 4 distinct prime factors, each of which is raised to the first power. How many positive integers divide N without remainder?

Answer: ______________

2. Alice and Bob play the following game. Laying on the table are 26 stones. The players alternatively remove 1, 2, 3, 4, or 5 stones from the table, with Alice going first. Whoever takes the last stone wins. There is one value of k such that Alice can guarantee a win by taking k stones on her first turn and then playing perfectly. What is the value of k?

Answer: ______________

3. Real numbers a and b are chosen with $1 < a < b$ such that there are no triangles with positive area whose sides have lengths 1, a, and b or $\frac{1}{a}$, $\frac{1}{b}$, and 1. What is the smallest possible value of b?

Answer: _______________

4. Let $\lfloor x \rfloor$ be the greatest integer less that or equal to x. For $0 < x \leq 100$, the values of x satisfying $\lfloor log_{10}(x + 2) \rfloor = \lfloor log_{10}x \rfloor + 2$ can be written as $a \leq x < b$. Find a and b. Present as an ordered pair (a, b).

Answer: _______________

5. In quadrilateral $MNPQ$, two non-intersecting circles are located in such a way that one circle touches $\overline{MN}$, $\overline{NP}$, and $\overline{PQ}$, and the other circle touches $\overline{MN}$, $\overline{MQ}$, and $\overline{PQ}$. Points B and A lie on $\overline{MN}$ and $\overline{PQ}$ respectively, and $\overline{AB}$ is tangent to both circles. Compute $\overline{MQ}$ in terms of b and p, where $b = \overline{NP}$, and the perimeter of quadrilateral $BAQM$ is greater than the perimeter of quadrilateral $BAPN$ by $2p$. Express your answer in terms of only b and p.

Answer: ______________

6. The equation $x \ln 27 \log_{13} e = 27 \log_{13} y$ has integer solutions (x, y). Find the integer solution with the smallest value of y that exceeds 70 and present your answer as $x + y$.

Answer: ______________

7. Aaron took 30 numbers, rounded each of them up to the nearest integer, added the results, and got 2026. When he took the original numbers, rounded each of them down to the nearest integer and added the results, he got 2010. How many of his original numbers were integers?

Answer: ______________

8. Solve $1 + 2^{\tan x} = 3 \cdot 4^{\left(\frac{\sin(\frac{\pi}{4} - x)}{\sqrt{2}\cos x}\right)}$ where $0 < x \leq 2\pi$.

Answer: ______________

9. In isosceles triangle ABC, point E is located on the base $\overline{AC}$, and points D and F are located on the lateral sides $\overline{AB}$ and $\overline{BC}$, respectively. $\overline{DE}$ is parallel to $\overline{BC}$ and $\overline{EF}$ is parallel to $\overline{AB}$. What part of the area of triangle ABC is the area of triangle DEF if $BF : EF = 2:3$?

Answer: ______________

10. Find real a such that the solution of the following system is an interval of length 5:

$$\begin{cases} x^2 - x(3a-2) + 2a^2 - 4a < 0 \\ x < 3 \end{cases}$$

Answer: ______________