



MONTHLY PROBLEMS IN MATHEMATICS

September 2024 Problems

1. Let S be the set of positive integers whose only prime factors are 2, 3, or 5. Evaluate

$$\sum_{x \in S} \frac{1}{x} = \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{8} + \frac{1}{9} + \frac{1}{10} + \frac{1}{12} + \frac{1}{15} + \dots$$

2. Let B be a bounded closed convex symmetric (with respect to the origin) set in R^2 with boundary the curve Γ . Let B have the property that the ellipse of maximal area contained in B is the disc D of radius 1 centered at the origin with boundary the circle C .

Prove that $A \cap \Gamma \neq \emptyset$ for any arc A of C of length $l(A) \geq \frac{\pi}{2}$.

3. Let S be the set of 3 by 3 symmetric matrices all of whose entries are 0 or 1. Find the number of matrices in S for which five entries are 1 and four are 0.

4. Prove that the arithmetic mean of all positive divisors of a positive integer n lies in

the interval $\left[\sqrt{n}, \frac{n+1}{2} \right]$.

(Problems 2, 3, 4 are proposed by Henry Ricardo)

5. (a) For a real number a , and integer $n > 1$, if possible, find functions f and g , each having at least n nonconstant derivatives, such that a is a zero of f , g and all their non constant derivatives.

(b) Do the same if f and g are required to be polynomials of degree $n + 1$, $n \geq 1$.

(Proposed by Mahmoud Sayrafiezadeh)

MEC Monthly Problems in Mathematics
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Deadline for submitting solutions is September 30

Please send solutions to Mah_Sayr@icloud.com
You may send solutions in Mathtype or LaTeX

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