PROBLEMS

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Proposals

To be considered for publication, solutions should be received by September 1, 2018.

2041. *Proposed by Vadim Mitrofanov, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine.*

Let $ABCD$ be a quadrilateral that circumscribes a circle of radius r and is also inscribed in a circle of radius R. Let s be the semiperimeter of $ABCD$. Prove the inequality $s^2 \leq 6R^2 + 4r^2$.

2042. *Proposed by Rick Mabry and Debbie Shepherd, Louisiana State University Shreveport, Shreveport, LA.*

Recursively define random variables $X_0, X_1, \ldots, X_n, \ldots$ and $Y_0, Y_1, \ldots, Y_n, \ldots$ taking values in $[0, 1]$ as follows:

- $X_0 = 0$ and $Y_0 = 1$ are constants;
- for $n = 0, 1, 2, \ldots$, X_{n+1} and Y_{n+1} are chosen uniformly and independently in the closed interval with endpoints X_n, Y_n.

Prove that, with probability 1, the limits $\widetilde{X} = \lim_{n\to\infty} X_n$ and $\widetilde{Y} = \lim_{n\to\infty} Y_n$ both exist and are equal, and find their common distribution.

2043. *Proposed by Greg Oman, University of Colorado, Colorado Springs and Adam Salminen, University of Evansville, Evansville, IN.*

Find all commutative rings R with unity such that:

(i) R contains some element x that is neither nilpotent nor a unit (i.e., $x^n \neq 0$ for all $n \geq 1$ and $xy \neq 1$ for all $y \in R$), and

(ii) every proper nonzero ideal of R is maximal.

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We invite readers to submit original problems appealing to students and teachers of advanced undergraduate mathematics. Proposals must always be accompanied by a solution and any relevant bibliographical information that will assist the editors and referees. A problem submitted as a Quickie should have an unexpected, succinct solution. Submitted problems should not be under consideration for publication elsewhere.

Proposals and solutions should be written in a style appropriate for this MAGAZINE.

Authors of proposals and solutions should send their contributions using the Magazine's submissions system hosted at http://mathematicsmagazine.submittable.com. *More detailed instructions are available there. We encourage submissions in PDF format, ideally accompanied by LaTeX source. General inquiries to the editors should be sent to* mathmagproblems@maa.org.