PROBLEMS AND SOLUTIONS

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with the collaboration of Itshak Borosh, Paul Bracken, Ezra A. Brown, Randall Dougherty, Tamás Erdélyi, Zachary Franco, Christian Friesen, Ira M. Gessel, László Lipták, Frederick W. Luttmann, Vania Mascioni, Frank B. Miles, Richard Pfiefer, Dave Renfro, Cecil C. Rousseau, Leonard Smiley, Kenneth Stolarsky, Richard Stong, Walter Stromquist, Daniel Ullman, Charles Vanden Eynden, Sam Vandervelde, and Fuzhen Zhang.

Proposed problems and solutions should be sent in duplicate to the MONTHLY *problems address on the back of the title page. Proposed problems should never be under submission concurrently to more than one journal. Submitted solutions should arrive before December 31, 2014. Additional information, such as generalizations and references, is welcome. The problem number and the solver's name and address should appear on each solution. An asterisk (*) after the number of a problem or a part of a problem indicates that no solution is currently available.*

PROBLEMS

11789. *Proposed by Gregory Galperin, Eastern Illinois University, Charleston, IL, and Yury J. Ionin, Central Michigan University, Mount Pleasant, MI.* Let a and k be positive integers. Prove that for every positive integer d there exists a positive integer n such that d divides $ka^n + n$.

11790. *Proposed by Arkady Alt, San Jose, CA and Konstantin Knop, St. Petersburg, Russia.* Given a triangle with semiperimeter s, inradius r, and medians of length m_a, m_b, and m_c, prove that $m_a + m_b + m_c \le 2s - 3(2\sqrt{3} - 3)r$.

11791. *Proposed by Marián Štofka, Slovak University of Technology, Bratislava, Slovakia.* Show that for $r \ge 1$,

$$\sum_{s=1}^{r} \binom{6r+1}{6s-2} B_{6s-2} = -\frac{6r+1}{6},$$

where B_n denotes the nth Bernoulli number.

11792. *Proposed by Stephen Scheinberg, Corona del Mar, CA.* Show that every infinite dimensional Banach space contains a closed subspace of infinite dimension and infinite codimension.

11793. *Proposed by István Mező, Nanjing University of Information Science and Technology, Nanjing, China.* Prove that

$$\sum_{n=1}^{\infty} \frac{\log(n+1)}{n^2} = -\zeta'(2) + \sum_{n=3}^{\infty} (-1)^{n+1} \frac{\zeta(n)}{n-2},$$

where ζ denotes the Riemann zeta function and ζ' denotes its derivative.

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