

Title: A generalization of Menon's identity to higher exponent

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In this note, we shall explicitly compute the following sum

$$\sum_{\substack{1 \leq a, b_1, \dots, b_k \leq n \\ \gcd(a, n) = 1}} \gcd(a^\ell - 1, b_1, \dots, b_k, n),$$

where $n \geq 1$, $k \geq 0$, $\ell \geq 1$ are integers. Our results extend Menon's identity and Sury's identity (i.e., $\ell = 1$ in the above summation) to higher exponents. Note that in the case $k = 0$, some of our results are recovered by the results of [21].

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