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Recent results on near-factorizations of groups

Let $(G, \cdot)$ be a finite multiplicative group with identity e. For $A, B \subseteq G$, define $AB = \{gh : g \in A, h \in B\}$. We say that (A, B) is a *near-factorization* of G if $|A| \times |B| = |G| - 1$ and $G \setminus \{e\} = AB$. We prove some new structural properties of near-factorizations in certain classes of groups. We also show that a "mate" B of a set A in a near-factorization (A, B) of a finite group G is unique, and we describe how to compute the mate B very efficiently using an explicit formula for B. Then we examine all the noncyclic abelian groups of order less than 200 in a search for a possible nontrivial near-factorization. All of these possibilities are ruled out, either by theoretical criteria or by exhaustive computer searches. (In contrast, near-factorizations in cyclic or dihedral groups are known to exist by previous results.)