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**RESEARCH ARTICLE**

# The size, multipartite Ramsey numbers for $C_3$ versus all graphs up to 4 vertices

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**Abstract:** In this paper we restrict our attention to finite graphs containing no loops or multiple edges. The multipartite graph $K_{j\times s}$ ( $j \geq 3$) consisting of $j$ partite sets of uniform size $s$ is defined as $V(K_{j\times s}) = \{v_{mn} \mid m \in \{1,2,...,j\}$ and $n \in \{1,2,...,s\}\}$ and $E(K_{j\times s}) = \{v_{mn} v_{kl} \mid m,k \in \{1,2,...,j\}$ and $n, l \in \{1,2,...,s\}$ where $k \neq m\}$. The set of vertices of the $m^{th}$ partite set is denoted by $\{v_{mn} \mid n \in \{1,2,...,s\}\}$. If for every two-colouring (red and blue) of the edges of a graph $K$, there exists a copy of $H$ in the first colour (red) or a copy of $G$ in the second colour (blue), we write $K \to (H,G)$. Given two simple graphs $H$ and $G$, the Ramsey number $r(H,G)$ is defined as the smallest positive integer $s$ such that $K_s \to (H,G)$ and along the same line of reasoning, the multipartite Ramsey number $m_j(H,G)$ is defined as the smallest positive integer $s$ such that $K_{j\times s} \to (H,G)$. Thus, multipartite Ramsey number $m_j(C_3,G)$ is defined as the smallest positive integer $s$ such that any red-blue colouring of $K_{j\times s}$ contains a red $C_3$ or a blue $G$. Since only a few multipartite Ramsey numbers for pairs of graphs have been found so far, in this paper we find all such multipartite Ramsey numbers $m_j(C_3,G)$ when $G$ is any graph up to 4 vertices.

**Keywords:** Combinatorics, graph theory, mathematics, multipartite Ramsey numbers, Ramsey theory.

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