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The head of diffy.

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Summary: Diffy is a simple mathematical puzzle that provides elementary-school students with subtraction practice. The idea appears to have originated in the late nineteenth Century with E. Ducci of Italy. Thirty years ago Professor J. Copley of the University of Houston introduced the diffy game to teachers in elementary schools and it widely spreaded out. During the diffy activity we naturally guess many interesting conjectures. First, does diffy always end? Second, does the head of diffy always exist? Third, for an arbitrary given natural number n, is there any possible method to find the diffy with the given length n? In this study I give the necessary and sufficient condition for the existence of the head of diffy. Using this condition I classify all possible heads of diffy and provide an algorithm to find the diffy with any given length n. With this algorithm I find four natural numbers with diffy length 200. To ensure my numbers are correct, I make a diffy program for Mathematica and check they are correct. I suggest the diffy game is good for enlarging the mathematical thinking to all graded students, especially gifted and talented students. It will produce rational consideration and synthetic judgement.

Classification: A90
Keywords: mathematical thinking; game for gifted students