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A Heart-Stopping Solution

During a first-year calculus class I taught several years ago, my midterm took place on Valentine's Day. To fit the occassion, a problem on the exam asked the students to determine the polar equation of a heart. Overall, the students found the question to be very challenging, as we had only discussed how to sketch a curve given the polar equation; and this question required them to go backwards. Some of my students came up with the correct answer I was looking for, namely $r = 4 - 4\sin\theta$, where θ runs from 0 to 2Π. However, one student came up with a completely different equation, using various transformations and translations of the absolute value function. In this brief session, we will determine "Steve's equation", and unpack the sophisticated ideas involved in his solution. We hope to present this heart-stopper as an example of a beautiful and pedagogically-rich problem in the first-year calculus course.