2. [8 points]

The *castar*, a coin widely used in Middle-Earth, allegedly has the shape graphed to the right. The outer perimeter can be modeled by the implicit equation

\[ x^4 + y^4 = 1 \]

and the perimeter of the hole in the middle is a square. To help his fellow Hobbits detect counterfeit coins, Samwise Gamgee, the Mayor of the Shire, is working on obtaining the specifications of a genuine castar. Sam needs your help.

**a.** [2 points] Find a function \( f(\theta) \) so that the outer edge of the castar is given by the function \( r = f(\theta) \).

**Answer:** \( f(\theta) = \) ________________

**b.** [3 points] Write an expression involving one or more integrals that gives the total area of the quarter of a castar in the first quadrant (shaded above).

**Answer:** __________________________________________________________________________

**c.** [3 points] Approximate the area of a castar by estimating your integral(s) from part (b) using TRAP(2). Write out all the terms in your sum(s).

**Answer:** __________________________________________________________________________