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CASE INSTITUTE OF TECHNOLOGY

ON THE EQUATION $f^n + g^n = 1$

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There is a close relationship between Fermat's last theorem and the family of solutions f and g of the functional equation

$$x^n + y^n = 1. \tag{1}$$

If, for example, S_D denotes the class of all pairs (f, g) of single valued functions f and g meromorphic in a domain D and having the additional property that, for some z_0 in D, $f(z_0)$ and $g(z_0)$ are both positive rationals, then either, for $n > 2$, (1) has no solutions in S_D or Fermat's last theorem is not true.

In this note we discuss the solutions of (1) meromorphic in the complex plane. We shall call such solutions *M_c solutions.*

THEOREM 1. *For $n = 2$, all M_c solutions are of the form*

$$f = \frac{2\beta(z)}{1 + \beta(z)^2} \quad \text{and} \quad g(z) = \frac{1 - \beta(z)^2}{1 + \beta(z)^2}. \tag{2}$$

PROOF. This follows directly from a theorem on uniformization [1]. We need only note that for $n = 2$, (1) is of genus zero and that the rational solution (2), with $\beta(z) = z$, maps the whole z-plane in a 1-1 manner on the Riemann surface of (1).

THEOREM 2. *For $n = 3$, M_c solutions exist. One such solution is given by:*

$$\begin{aligned} f &= 4^{-1/6}(\wp')^{-1}(1 + 3^{-1/2}\cdot 4^{1/3}\,\wp), \\ g &= 4^{-1/6}(\wp)^{-1}(1 - 3^{-1/2}\cdot 4^{1/3}\,\wp), \end{aligned} \tag{3}$$

where $\wp$ is a Weierstrass $\wp$-function.