

# Math Diversion Problem 658

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Mathematics is the art of reducing any  
problem to linear algebra.  
— William Stein

The YouTube video is found at:

Source: [https://www.youtube.com/watch?v=pz7NaY\\_KUwI](https://www.youtube.com/watch?v=pz7NaY_KUwI)  
Title: Tricky Maths Olympiad Question with Square Roots  
Presenter: Math Beast

## 1 The Problem

Given the relation

$$\phi = \sqrt{5\sqrt{6\sqrt{5\sqrt{6\cdots}}}}, \quad (1)$$

find the values for  $\phi$ .

## 2 The Solution

Using the self-similarity embedded in  $\phi$ , the Given relation can be rewritten as

$$\phi = \sqrt{5\sqrt{6\phi}}. \quad (2)$$

On squaring this twice, we get

$$\phi^4 = 25 \cdot 6\phi, \quad (3)$$

or

$$\phi^3 = 150. \quad (4)$$

Therefore,

$$\phi = \sqrt[3]{150}, \quad (5)$$

for a real root.