# Math Diversion 1077

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April 23, 2026

> Solving math puzzles can enhance cognitive functions such
> as problem-solving, logical reasoning, and memory,
> contributing to overall brain health.
> — Daniel Levitin (renowned neuroscientist)

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Source: https://www.youtube.com/watch?v=yoilUnHtr_M
Title: This Equation Shouldn't Exist...
 Presenter: SyberMath
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## 1 Problem

Given the relation

$$x^{\log x} = 10^{10^{10}}\,, \tag{1}$$

solve for positive real values of $x$, where the logarithm is base 10.

## 2 Solution

Technique: What I call the 'alpha transform'.

Let

$$x = 10^{\alpha}\,, \tag{2}$$

where $\alpha$ is a positive real number. Then (1) becomes

$$10^{\alpha \log_{10} 10^{\alpha}} = 10^{10^{10}}\,, \tag{3}$$

or

$$10^{\alpha^2} = 10^{10^{10}}\,. \tag{4}$$

On equating exponents, we get

$$\alpha^2 = 10^{10}\,. \tag{5}$$

On taking the square root, we have that

$$\alpha = 10^{5}\,. \tag{6}$$

Hence,

$$x = 10^{10^{5}}\,. \tag{7}$$