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Unveiling an Elementary Proof for Fermat's Last Theorem

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***Abstract:** This paper presents a straightforward and elementary proof of Fermat's Last Theorem (FLT), asserting that there are no integer solutions to $a^n + b^n = c^n$ for $n > 2$. Leveraging basic number theory and algebraic manipulations, we offer a concise demonstration that makes this fundamental result accessible to a broad mathematical audience.*

***Keywords:** Transformation Equations, Fermat's Equations, the 2020 Mathematics Subject Classification (MSC) Code: 11A-XX.*

Nomenclature:
FLT: Fermat's Last Theorem
MSC: Mathematics Subject Classification

I. INTRODUCTION

Fermat's Last Theorem, famously stated by Pierre de Fermat in 1637, has intrigued mathematicians for centuries. The theorem states that there is no integer solutions exist for $a^n + b^b = c^n$, where n is an integer greater than 2.

Since Fermat, Euler and Gauss had already proved the theorem for the cases $a^4 + b^4 = c^4$ and $a^3 + b^3 = c^3$, it would suffice to prove the theorem for the exponent $n = p$, where p is any prime > 3[1]

Hundreds of mathematicians in the last 350 years contributed to Fermat's Last Theorem by which number theory developed leaps and bounds. Sophie Germain, E. E. Kummer, Galois, Shimura-Taniyama-Weil, Frey, Ken Ribet, Serre, Richard Taylor, and Faltings, among many other eminent mathematicians, have contributed to this theorem over the past centuries. Finally Andrew Wiles provided a complete proof in 1994 using advanced techniques [2], [3], [4].

This paper revisits the problem using elementary methods to ensure simplicity and clarity.

II. ASSUMPTIONS

A. We hypothesize that all r, s and t are non-zero integers satisfying the equation $r^p + s^p = t^p$ where p is any prime > 3 and establish a contradiction in this proof. Clearly $\gcd(r, s, t) = 1$ and any two of the variables r, s and t cannot simultaneously be squares.

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Without loss of generality, we can have r as a non-square integer, and r, s and t are coprimes to z^3 where $x^3 + y^3 = z^3$ where y is a square integer and x is not a square integer.

B. We use another auxiliary equation $x^3 + y^3 = z^3$ (proven case) in which we assert both x and y as positive integers; z^3 will be a positive integer and z and z^2 will be irrational. We define in this proof x as a non-square integer and y as a square integer. Hence $\sqrt{xy}$ will be irrational.

C. We combine the two equations $x^3 + y^3 = z^3$ and $r^p + s^p = t^p$ by means of transformation equations, using parameters called a, b, c, d, e and f.

D. We use the Ramanujan-Nagell equation's three solutions $2^5 = 7 + 5^2$; $2^7 = 7 + 11^2$; and $2^{15} = 7 + 181^2$, in the genreal solution $2^n = 7 + \ell^2$, excluding the two solutions $2^3 = 7 + 1^2$ and $2^4 = 7 + 3^2$. Therefore n is odd and ℓ will be an odd prime, either 5, 11, or 181, for this proof.

E. r is coprime to x.

F. By giving suitable values for x and y we can fix z^3 as coprime to r, s and t.

Proof. By trails, we have created the following transformation equations

$$\left(\frac{a\sqrt{\ell^{7/3}r} + b\sqrt{t^p}}{\sqrt{z^3}}\right)^2 + \left(\frac{c\sqrt{r^p} + d\sqrt{r}}{\sqrt{x}}\right)^2 = \left(e\sqrt{7^{1/3}} + f\sqrt{\ell^{5/3}}\right)^2$$

and

$$\left(a\sqrt{s^p} - b\sqrt{2^{n/2}}\right)^2 + \left(c\sqrt{s} - d\sqrt{2^{3n/2}}\right)^2 = \left(e\sqrt{t} - f\sqrt{7^{5/3}y}\right)^2 \quad \ldots \quad (1)$$

representing the equations $x^3 + y^3 = z^3$ and $r^p + s^p = t^p$ respectively, through the parameters called a, b, c, d, e and f.

Here we have used only three solutions of Ramanujan-Nagell equations $2^n = 7 + \ell^2$, namely $2^5 = 7 + 5^2, 2^7 = 7 + 11^2$ and $2^{15} = 7 + 181^2$, where n is odd and ℓ is an odd prime, either 5, 11, or 181.

From equation (1) we get

$$a\sqrt{\ell^{7/3}} + b\sqrt{t^p} = \sqrt{x^3z^3} \quad \ldots \quad (2)$$

$$a\sqrt{s^p} - b\sqrt{2^{\frac{n}{2}}} = \sqrt{r^p} \quad \ldots \quad (3)$$

$$c\sqrt{r^p} + d\sqrt{r} = \sqrt{xy^3} \quad \ldots \quad (4)$$

$$c\sqrt{s} - d\sqrt{2^{\frac{3n}{2}}} = \sqrt{s^p} \quad \ldots \quad (5)$$

$$\text{and } e\sqrt{t} - f\sqrt{7^{\frac{5}{3}}y} = \sqrt{t^p} \quad \ldots \quad (7)$$

$$e\sqrt{7^{1/3}} + f\sqrt{\ell^{5/3}} = \sqrt{z^3} \quad \ldots \quad (6)$$

Solving simultaneously (2) and (3), (4) and (5), (6) and (7), we get the values of the parameters as given by

$$a = \left(\sqrt{2^{n/2}x^3z^3} + \sqrt{r^pt^p}\right) / \left(\sqrt{2^{n/2}\ell^{7/3}r} + \sqrt{s^pt^p}\right)$$
$$b = \left(\sqrt{x^3z^3s^p} - \sqrt{\ell^{7/3}r^{p+1}}\right) / \left(\sqrt{2^{n/2}\ell^{7/3}} + \sqrt{s^pt^p}\right)$$
$$c = \left(\sqrt{2^{3n/2}xy^3} + \sqrt{rs^p}\right) / \left(\sqrt{2^{3n/2}r^p} + \sqrt{rs}\right)$$
$$d = \left(\sqrt{xy^3s} - \sqrt{r^ps^p}\right) / \left(\sqrt{2^{3n/2}r^p} + \sqrt{rs}\right)$$
$$e = \left(\sqrt{7^{5/3}yz^3} + \sqrt{t^p\ell^{5/3}}\right) / \left(7\sqrt{y} + \sqrt{\ell^{5/3}t}\right)$$
$$\text{and } f = \left(\sqrt{z^3t} - \sqrt{7^{1/3}t^p}\right) / \left(7\sqrt{y} + \sqrt{\ell^{5/3}t}\right)$$

From (2) and (7) we get

$$\sqrt{t^p} \times \sqrt{t^p} = \left(\sqrt{x^3z^3} - a\sqrt{\ell^{7/3}r}\right)\left(e\sqrt{t} - f\sqrt{7^{5/3}y}\right) / (b)$$

$$\text{i.e., } t^p = \frac{\left\{(e)\sqrt{x^3z^3t} - (f)\sqrt{7^{5/3}x^3yz^3} - (ae)\sqrt{\ell^{7/3}rt} + (af)\sqrt{7^{5/3}\ell^{7/3}yr}\right\}}{(b)}$$

From (3) and (4) we have

$$\sqrt{r^p} \times \sqrt{r^p} = \left(a\sqrt{s^p} - b\sqrt{2^{n/2}}\right)\left(\sqrt{xy^3} - d\sqrt{r}\right) / (c)$$

$$\text{i.e. } r^p = \frac{\left\{(a)\sqrt{xy^3s^p} - (ad)\sqrt{rs^p} - (b)\sqrt{2^{n/2}xy^3} + (bd)\sqrt{2^{n/2}r}\right\}}{(c)}$$

From (3) and (5) we get

$$\sqrt{s^p} \cdot \sqrt{s^p} = \frac{\left(\sqrt{r^p} + b\sqrt{2^{n/2}}\right)\left(c\sqrt{s} - d\sqrt{2^{3n/2}}\right)}{(a)}$$

$$\text{i.e., } s^p = \frac{\left\{c\sqrt{r^ps} - (d)\sqrt{2^{3n/2}r^p} + (bc)\sqrt{2^{n/2}s} - (bd)(2^n)\right\}}{(a)}$$

Substituting the above equivalent values of t^p, r^p and s^p in the equation $t^p = r^p + s^p$, and on multiplying both sides by {(abc }, we get the equation (8)

$$\{ac\}\left\{(e)\sqrt{x^3z^3t} - (f)\sqrt{7^{\frac{5}{3}}x^3yz^3} - (ae)\sqrt{\ell^{\frac{7}{3}}rt} + (af)\sqrt{7^{\frac{5}{3}}\ell^{\frac{7}{3}}yr}\right\}$$
$$= \{ab\}\left\{(a)\sqrt{xy^3s^p} - (ad)\sqrt{rs^p} - (b)\sqrt{2^{\frac{n}{2}}xy^3} + (bd)\sqrt{2^{\frac{n}{2}}r}\right\}$$
$$+ \{bc\}\left\{(c)\sqrt{r^ps} - (d)\sqrt{2^{3n/2}r^p} + (bc)\sqrt{2^{n/2}s} - (bd)(2^n)\right\}$$

We are interested in computing all rational terms in equation (8), after multiplying both sides by

$$\left(\sqrt{2^{n/2}\ell^{7/3}r} + \sqrt{s^pt^p}\right)^3\left(\sqrt{2^{3n/2}r^p} + \sqrt{rs}\right)^2\left(7\sqrt{y} + \sqrt{\ell^{5/3}t}\right)$$

to be free from denominators on the parameters a, b, c, d and f and again multiplying both sides by $\sqrt{yz^3}$ for obtaining some rational terms, as worked out term by term below.

I term in LHS of Equation (8), after multiplying by the relevant terms, and substituting for {ace}

$$= \sqrt{x^3z^3t}\left\{\left(\ell^{7/3}r\sqrt{2^n}\right) + \left(s^pt^p\right) + \left(2\sqrt{2^{n/2}\ell^{7/3}rs^pt^p}\right)\right\}\left(\sqrt{2^{3n/2}r^p} + \sqrt{rs}\right)$$
$$\times\sqrt{yz^3}\left(\sqrt{2^{n/2}x^3z^3} + \sqrt{r^pt^p}\right)\left(\sqrt{2^{3n/2}xy^3} + \sqrt{rs^p}\right)\left(\sqrt{7^{5/3}yz^3} + \sqrt{t^p\ell^{5/3}}\right)$$

(i) On multiplying by

$$\left\{\sqrt{x^3z^3t}\left(2\sqrt{2^{n/2}\ell^{7/3}rs^pt^p}\right)\right\}\sqrt{2^{3n/2}r^p}\sqrt{yz^3}\sqrt{r^pt^p}\sqrt{rs^p}\sqrt{t^p\ell^{5/3}}\right\}$$

we get

$$\left\{(2^{n+1}\ell^2z^3r^{p+1}s^pt^p)\sqrt{t^{p+1}}\sqrt{x^3y}\right\}$$

which is irrational, since y is a square and x is non-square.
(ii) Also, on multiplying by

$$\left\{\sqrt{x^3z^3t}\left(2\sqrt{2^{n/2}\ell^{7/3}rs^pt^p}\right)\sqrt{rs}\sqrt{yz^3}\sqrt{r^pt^p}\sqrt{2^{3n/2}xy^3}\sqrt{t^p\ell^{5/3}}\right\}$$

we get

$$\left\{\left(2^{n+1}\ell^2x^2y^2z^3rt^p\sqrt{(rst)^{p+1}}\sqrt{r}\right\}$$

which is irrational, since r is not a square.

II term in LHS of Equation (B), after multiplying by the respective terms, and substituting for $\{acf\}$

$$= \left(-\sqrt{7^{5/3}x^3yz^3}\right)\left\{\left(\ell^{7/3}r\sqrt{2^n}\right) + (s^pt^p) + \left(2\sqrt{2^{n/2}\ell^{7/3}rs^pt^p}\right)\right\}\left(\sqrt{2^{3n/2}r^p} + \sqrt{rs}\right)$$
$$\times \sqrt{yz^3}\left(\sqrt{2^{n/2}x^3z^3} + \sqrt{r^pt^p}\right)\left(\sqrt{2^{3n/2}xy^3} + \sqrt{rs^p}\right)\left(\sqrt{z^3t} - \sqrt{7^{1/3}t^p}\right)$$

On multiplying by

$$\left\{\left(-\sqrt{7^{5/3}x^3yz^3}\right)(s^pt^p)\sqrt{rs}\sqrt{yz^3}\sqrt{r^pt^p}\sqrt{rs^p}\left(-\sqrt{7^{1/3}t^p}\right)\right\}$$

we get

$$\left\{(7yz^3s^pt^{2p})\sqrt{(rs)^{p+1}}\sqrt{x^3r}\right\}$$

which will be irrational, since r is coprime to x.

III term in LHS of Equation (B), after multiplying by the respective terms, and substituting for $\{(a^2ce)\}$

$$= \left(-\sqrt{\ell^{7/3}rt}\right)\left(\sqrt{2^{n/2}\ell^{7/3}r} + \sqrt{s^pt^p}\right)\left(\sqrt{2^{3n/2}r^p} + \sqrt{rs}\right)\sqrt{yz^3}$$
$$\times \left\{\left(x^3z^3\sqrt{2^n}\right) + (r^pt^p) + \left(2\sqrt{2^{n/2}x^3z^3r^pt^p}\right)\right\}$$
$$\times \left(\sqrt{2^{3n/2}xy^3} + \sqrt{rs^p}\right)\left(\sqrt{7^{5/3}yz^3} + \sqrt{t^p\ell^{5/3}}\right)\right)$$

On multiplying by

$$\left\{\left(-\sqrt{\ell^{7/3}rt}\right)\sqrt{s^pt^p}\sqrt{rs}\sqrt{yz^3}\left(2\sqrt{2^{n/2}x^3z^3r^pt^p}\right)\sqrt{2^{3n/2}xy^3}\sqrt{t^p\ell^{5/3}}\right\}$$

we get

$$\left\{-(2^{n+1}\ell^2x^2y^2z^3t^p)\sqrt{r}\sqrt{(rst)^{p+1}}\right\}$$

Which is irrational, since r is not square.

IV term in LHS of Equation (8), after multiplying by the respective terms, and substituting for $\{a^2cf\}$

$$= \sqrt{7^{5/3}\ell^{7/3}yr}\left(\sqrt{2^{n/2}\ell^{7/3}}r + \sqrt{s^p t^p}\right)\left(\sqrt{2^{3n/2}} + \sqrt{rs}\right)\sqrt{yz^3}$$
$$\times\left\{\left(x^3z^3\sqrt{2^n}\right) + (r^pt^p) + 2\sqrt{2^{n/2}x^3z^3r^pt^p}\right\}$$
$$\times\left(\sqrt{2^{3n/2}xy^3} + \sqrt{rs^p}\right)\left(\sqrt{z^3t} - \sqrt{7^{1/3}t^p}\right)$$

There is no rational part in this term, (Since ℓ is a prime, either 5 or 11 or 181).

I term in RHS of Equation (8), after multiplying by the respective terms, and substituting for $\{a^2b\}$

$$= \sqrt{xy^3s^p}\left\{\left(r^p\sqrt{2^{3n}}\right) + (rs) + \left(2\sqrt{r^{p+1}}\sqrt{2^{3n/2}s}\right)\right\}\left(7\sqrt{y} + \sqrt{\ell^{5/3}t}\right)\sqrt{yz^3}$$
$$\times\left\{(x^3z^3)\sqrt{2^n} + (r^pt^p) + \left(2\sqrt{2^{n/2}x^3z^3r^pt^p}\right)\right\}\left(\sqrt{x^3z^3s^p} - \sqrt{\ell^{7/3}r^{p+1}}\right)$$

(i) On multiplying by

$$\left\{\sqrt{xy^3s^p}\left[\left\{\left(r^p\sqrt{2^{3n}}\right)(x^3z^3)\sqrt{2^n}\right\} + (rs)(r^pt^p)\right](7\sqrt{y})\sqrt{yz^3}\sqrt{x^3z^3s^p}\right\}$$

We get

$$\left\{(7x^2y^2z^3s^p)\sqrt{y}(2^{2n}x^3z^3r^p + r^{p+1}st^p)\right\}\}$$

which is rational, since y is a square.

(ii) Again, on multiplying by

$$\left\{\sqrt{xy^3s^p}\left(2\sqrt{r^{p+1}}\sqrt{2^{3n/2}s}\right)\sqrt{\ell^{5/3}t}\right)\sqrt{yz^3}\left(2\sqrt{2^{n/2}x^3z^3r^pt^p}\right)\left(-\sqrt{\ell^{7/3}r^{p+1}}\right)\right\}$$

We get

$$\left\{-(2^{n+2}x^2y^2z^3\ell^2r^p)\sqrt{r}\sqrt{(rst)^{p+1}}\right\}$$

which is irrational, since r is not square.

II term in RHS of Equation (8), after multiplying by the respective terms, and substituting for $\{a^2b)d$

$$= \left(-\sqrt{rs^p}\right)\left(\sqrt{2^{3n/2}r^p} + \sqrt{rs}\right)\left(7\sqrt{y} + \sqrt{\ell^{5/3}t}\right)\sqrt{yz^3}$$

$$\times\left\{\left(x^3z^3\sqrt{2^n}\right) + (r^pt^p) + 2\sqrt{2^{n/2}x^3z^3r^pt^p}\right\}$$
$$\times\left(\sqrt{x^3z^3s^p} - \sqrt{\ell^{7/3}r^{p+1}}\right)\left(\sqrt{xy^3s} - \sqrt{r^ps^p}\right)$$

On multiplying by

$$\left\{\left(-\sqrt{rs^p}\right)\sqrt{2^{3n/2}r^p}\sqrt{\ell^{5/3}t}\sqrt{yz^3}\left(2\sqrt{2^{n/2}x^3z^3r^pt^p}\right)\left(-\sqrt{\ell^{7/3}r^{p+1}}\right)\sqrt{xy^3s}\right\}$$

We get

$$\left\{-(2^{n+1}x^2y^2z^3\ell^2r^p)\sqrt{(rst)^{p+1}}\sqrt{r}\right\}$$

which will be irrational, since r is non-square integer.

III term in RHS of Equation (8), after multiplying by the respective terms, and substituting for $\{ab^2\}$

$$=\left(-\sqrt{2^{n/2}xy^3}\right)\left\{\left(r^p\sqrt{2^{3n}}\right) + (rs) + \left(2\sqrt{r^{p+1}}\sqrt{2^{3n/2}s}\right)\right\}\left(7\sqrt{y} + \sqrt{\ell^{5/3}t}\right)$$
$$\times\sqrt{yz^3}\left(\sqrt{2^{n/2}x^3z^3} + \sqrt{r^pt^p}\right)\left\{(x^3z^3s^p) + \left(\ell^{7/3}r^{p+1}\right) - \left(2\sqrt{r^{p+1}}\sqrt{x^3z^3s^p\ell^{7/3}}\right)\right\}$$

(i) On multiplying by

$$\left\{\left(-\sqrt{2^{n/2}xy^3}\right)\left(2\sqrt{r^{p+1}}\sqrt{2^{3n/2}s}\right)\sqrt{\ell^{5/3}}t\sqrt{yz^3}\sqrt{r^pt^p}\left(-2\sqrt{r^{p+1}}\sqrt{x^3z^3s^p\ell^{7/3}}\right)\right\}$$

We get

$$\left\{\left(2^{n+2}x^2y^2z^3\ell^2\right)\left(r^p\sqrt{(rst)^{p+1}}\sqrt{r}\right\}$$

which is irrational, since r is not a square.

(ii) Also, on multiplying by

$$\left\{\left(-\sqrt{2^{n/2}xy^3}\right)\left(r^p\sqrt{2^{3n}}\right)(7\sqrt{y})\sqrt{yz^3}\sqrt{2^{n/2}x^3z^3}(x^3z^3s^p)\right\}$$

We get

$$\left\{-(7\times 2^{2n}x^5y^2z^6r^ps^p)\sqrt{y}\right\}$$

which is irrational, since y is a square.

IV term in RHS of Equation (8), after multiplying by the respective terms and substituting for $\{(ab^2)d\}$

$$=\sqrt{2^{n/2}r}\left(\sqrt{2^{3n/2}r^p}+\sqrt{rs}\right)\left(7\sqrt{y}+\sqrt{\ell^{5/3}t}\right)\sqrt{yz^3}\left(\sqrt{2^{n/2}x^3z^3}+\sqrt{r^pt^p}\right)$$

$$\times\left\{(x^3z^3s^p)+\left(\ell^{7/3}\sqrt{r^{p+1}}\right)-\left(2\sqrt{r^{p+1}}\right)\sqrt{x^3z^3s^p\ell^{7/3}}\right\}\left(\sqrt{xy^3s}-\sqrt{r^ps^p}\right)$$

On multiplying by

$$\left\{\sqrt{2^{n/2}r}\sqrt{2^{3n/2}r^p}\sqrt{\ell^{5/3}}t\sqrt{yz^3}\sqrt{r^pt^p}\left(-2\sqrt{r^{p+1}}\sqrt{x^3z^3s^p\ell^{7/3}}\right)\sqrt{xy^3s}\right\}$$

We get

$$\left\{-\left(2^{n+1}x^2y^2z^3\ell^2\right)\left(r^p\sqrt{(rst)^{p+1}}\sqrt{r}\right\}$$

which is irrational, since r is a non-square integer.

V term in RHS of Equation (8), after multiplying by the respective terms, and substituting for $\{bc^2\}$

$$=\sqrt{r^p}s\left\{\left(\ell^{7/3}r\sqrt{2^n}\right)+(s^pt^p)+2\sqrt{2^{n/2}\ell^{7/3}rs^pt^p}\right\}\left(7\sqrt{y}+\sqrt{\ell^{5/3}t}\right)$$

$$\times\sqrt{yz^3}\left(\sqrt{x^3z^3s^p}-\sqrt{\ell^{7/3}r^{p+1}}\right)\left\{\left(xy^3\sqrt{2^{3n}}\right)+(rs^p)+2\sqrt{2^{2n/2}xy^3rs^p}\right\}$$

(i) On multiplying by

$$\left\{\sqrt{r^ps}(s^pt^p)(7\sqrt{y})\sqrt{yz^3}\sqrt{x^3z^3s^p}(rs^p)\right\}$$

we get

$$\left\{(7yz^3rs^{2p}t^p)\sqrt{s^{p+1}}\sqrt{x^3r^p}\right\}$$

which is irrational, since we have defined r as coprime to x.
(ii) Also, on multiplying by

$$\left\{\sqrt{r^pS}\left(2\sqrt{2^{n/2}\ell^{7/3}rs^pt^p}\right)\sqrt{\ell^{5/3}}t\sqrt{yz^3}\sqrt{x^3z^3s^p}\left(2\sqrt{2^{2n/2}xy^3rs^p}\right)\right\}$$

we get

$$\left\{(2^{n+2}\ell^2x^2y^2z^3rs^p)\sqrt{r}\sqrt{(rst)^{p+1}}\right\}$$

which is irrational, since r is not a square.

VI term in RHS of Equation (8), after multiplying by the respective terms, and substituting for $\{b(cd)\}$

$$= (-\sqrt{2^{3n/2}r^p})\left\{(\ell^{7/3}r\sqrt{2^n}) + (s^p t^p) + 2\sqrt{2^{n/2}\ell^{7/3}rs^p t^p}\right\}\left(7\sqrt{y} + \sqrt{\ell^{5/3}t}\right)$$
$$\times \sqrt{yz^3}\left(\sqrt{x^3z^3s^p} - \sqrt{\ell^{7/3}r^{p+1}}\right)\left(\sqrt{2^{3n/2}xy^3} + \sqrt{rs^p}\right)\left(\sqrt{xy^3s} - \sqrt{r^p s^p}\right)$$

On multiplying by

$$\left\{\left(-\sqrt{2^{3n/2}r^p}\right)\left(2\sqrt{2^{n/2}\ell^{7/3}rs^p t^p}\right)\sqrt{\ell^{5/3}t}\sqrt{yz^3}\sqrt{x^3z^3s^p}\sqrt{rs^p}\sqrt{xy^3s}\right\}$$

we get

$$\left\{-(2^{n+1}\ell^2x^2y^2z^3s^p)\sqrt{(rst)^{p+1}}\sqrt{r}\right\}$$

which will be irrational, since r is non-square integer.

VII term in RHS of Equation (8), after multiplying by the respective terms, and substituting for $\{b^2c^2\}$

$$= \sqrt{2^{n/2}s}\left(\sqrt{2^{n/2}\ell^{7/3}r} + \sqrt{s^p t^p}\right)\left(7\sqrt{y} + \sqrt{\ell^{5/3}t}\right)\sqrt{yz^3}$$
$$\times\left\{(x^3z^3s^p) + (\ell^{7/3}r^{p+1}) - 2\sqrt{r^{p+1}}\sqrt{x^3z^3s^p\ell^{7/3}}\right\}$$
$$\times\left\{\left(xy^3\sqrt{2^{3n}}\right) + (rs^p) + 2\sqrt{2^{3n/2}xy^3rs^p}\right\}$$

On multiplying by

$$\left\{\sqrt{2^{n/2}s}\sqrt{s^p t^p}\sqrt{\ell^{5/3}t}\sqrt{yz^3}\left(-2\sqrt{r^{p+1}}\sqrt{x^3z^3s^p\ell^{7/3}}\right)\left(2\sqrt{2^{3n/2}xy^3rs^p}\right)\right\}$$

we get

$$\left\{-(2^{n+2}x^2y^2z^3\ell^2s^p)\sqrt{(rst)^{p+1}}\sqrt{r}\right\}$$

which is irrational, since r is non-square integer.

VIII term in RHS of Equation (8), after multiplying by the respective terms, and substituting for $\{b^2(cd)\}$

$$= (-2^n)\left(\sqrt{2^{n/2}\ell^{7/3}r} + \sqrt{s^p t^p}\right)\left(7\sqrt{y} + \sqrt{\ell^{5/3}t}\right)\sqrt{yz^3}$$
$$\left\{(x^3z^3s^p) + (\ell^{7/3}r^{p+1}) - \left(2\sqrt{r^{p+1}}\sqrt{x^3z^3s^p\ell^{7/3}}\right)\right\}$$
$$\left(\sqrt{2^{3n/2}xy^3} + \sqrt{rs^p}\right)\left(\sqrt{xy^3s} - \sqrt{r^p s^p}\right)$$

(i) On multiplying by

$$\left\{(-2^n)\sqrt{s^p t^p}\sqrt{\ell^{5/3}t}\sqrt{yz^3}\left(-2\sqrt{r^{p+1}}\sqrt{x^3z^3s^p\ell^{7/3}}\right)\sqrt{rs^p}\sqrt{xy^3s}\right\}$$

we get

$$\left\{(2^{n+1}\ell^2x^2yz^3s^p)\sqrt{(rst)^{p+1}}\sqrt{r}\right\}$$

which is irrational, since r is a non-square integer.

(ii) Also, on multiplying by

$$\left\{(-2^n)\sqrt{2^{n/2}\ell^{7/3}r}\sqrt{\ell^{5/3}t}\sqrt{yz^3}(x^3z^3s^p)\sqrt{2^{3n/2}xy^3}\sqrt{xy^3s}\right\}$$

we get $\left\{-(2^{2n}\times\ell^2x^4y^3z^3s^p)\sqrt{yz^3rst}\right\}$

which is irrational, while r, s and t are coprime to z. There is no rational term in LHS of equation (8). Sum of all rational term on RHS of equation (8)

$$(7x^2y^2z^3s^p)\sqrt{y}(r^{p+1}st^p) \text{ (combining I \& III terms)}$$

Equating the rational terms on both sides of equation (8), and after dividing both sides by

$$(7x^2y^2z^3)\sqrt{y}$$

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we get

$$\{r^{p+1}s^{p+1}t^{p}\} = 0$$

That is either $r = 0$ or $s = 0$ or $t = 0$. This contradicts our hypothesis that all r, s and t are non-zero integers and proves that only a trial solution exists in the Fermat's equation $r^p + s^p = t^p$, where p is any prime > 3.

III. CONCLUSION

Since equation (8) was derived from the transformation equations $x^3 + y^3 = z^3$ and $r^p + s^p = t^p$, the result we get from the equation (8) should reflect on the equation $r^p + s^p = t^p$.

DECLARATION STATEMENT

Some of the references cited are older, noted explicitly as [1], [2], [3] and [4]. However, these works remain significant for the current study, as they are pioneering in their fields.

I must verify the accuracy of the following information as the article's author.

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