The Theoxist Coefficient Shortcut Method

Written: Marciano L. Legarde

I. Abstract

This paper introduces and formalizes the **Theoxist Coefficient Shortcut Method,** an Intuitive shortcut for solving a specific class of quadratic equations of the form $(ax)^2 = bx$. The method allows for quick identification of solutions using proportional reasoning. We outline the process, prove its validity, provide examples, and discuss its educational significance within the broader context of algebraic problem-solving strategies

II. Introduction

Quadratic equations, defined as equations of the form $ax^2 + bx + c = 0$ where $a \neq 0$, are foundational in algebra and applied mathematics (Stitz & Zeager, 2015). While the quadratic formula provides a universal solution, alternative approaches and shortcuts often improve efficiency in special cases (Newcastle University, n.d.). This paper presents a shortcut for equations where a squared term equals a linear term:

$$(ax)^2 = bx$$

This form corresponds to classical "squares equal roots" problems, historically studied by mathematicians such as al-Khwārizmī (Corry, n.d.). By leveraging proportional reasoning and pattern recognition, this method exemplifies intuitive problem-solving strategies emphasized in modern mathematics education (Obara, 2019; Burgos et al., 2025).

III. The Theoxist Coefficient Shortcut Rule

For any real numbers $a \neq 0$ and b, the equation:

$$(ax)^2 = bx$$

Has solutions:

$$x = 0 \text{ and } x = \frac{b}{a^2}$$

Proof

Starting from:

$$(ax)^2 = bx \rightarrow a^2x^2 = bx$$

For $x \neq 0$, dividing both sides by x yields:

$$a^2x = b \rightarrow x = \frac{b}{a^2}$$

Testing $x = 0$ in the original equation:

$$(a \cdot 0)^2 = b \cdot 0 \rightarrow 0 = 0$$

Therefore, the solutions are $x = 0$ and $x = \frac{b}{a^2}$

IV. Examples

Equation	Shortcut $x = \frac{b}{a^2}$	Solutions
$\boldsymbol{(2x)^2 = 2x}$	$\boldsymbol{\frac{2}{4} = 0.5}$	$\boldsymbol{x = 0, 0.5}$
$\boldsymbol{(3x)^2 = 9x}$	$\boldsymbol{\frac{9}{9} = 1}$	$\boldsymbol{x = 0, 1}$
$\boldsymbol{(5x)^2 = 25x}$	$\boldsymbol{\frac{25}{25} = 1}$	$\boldsymbol{x = 0, 1}$
$\boldsymbol{(6x)^2 = 12x}$	$\boldsymbol{\frac{12}{36} = \frac{1}{3}}$	$\boldsymbol{x = 0, \frac{1}{3}}$
$\boldsymbol{(x)^2 = 4x}$	$\boldsymbol{\frac{4}{1} = 4}$	$\boldsymbol{x = 0, 4}$

V. Educational significance

This method illustrates proportional reasoning in action, aligning with research emphasizing its critical role in algebraic thinking (Institute of Education Sciences, 2011; Obara,2019). Recognizing patterns such as $(ax)^2 = bx$ as a proportional relationship enables learners to bypass more cumbersome procedures like the quadratic formula when applicable. As Burgos et al. (2025) note, such pattern-based approaches can deepen students' understanding of algebra's structural properties.

VI. Limitations

The Theoxist Coefficient Shortcut Method applies to only to equations of the form:

$$(ax)^2 = bx$$

It does **not** generalize to:

- Equations with constant terms (e.g., $(ax)^2 = bx + c$),
- Higher-degree equations (e.g., $(ax)^3 = bx$),
- Shifted Variables (e.g., $(ax + d)^2 = bx$)

For such cases, standard methods (Factoring, quadratic formula, completing the square) and other available shortcuts remain necessary.

VII. Conclusion

The Theoxist Coefficient Shortcut Method offers an elegant, proportional solution for a specific family of quadratic equations. While limited in scope, it underscores the importance of pattern recognition and proportional reasoning in algebra—key skills for learners and problem solvers alike.

VIII. References

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