Scholars Journal of Physics, Mathematics and Statistics OPEN ACCESS
Abbreviated Key Title: Sch J Phys Math Stat
ISSN 2393-8056 (Print) | ISSN 2393-8064 (Online)
Journal homepage: https://saspublishers.com

Regular Hexagoning a Circle with Straightedge and Compass in Euclidean Geometry

Tran Dinh Son[1*]

[1]Independent Mathematical Researcher in the UK

DOI: https://doi.org/10.36347/sjpms.2025.v12i06.002 | **Received:** 22.05.2025 | **Accepted:** 07.07.2025 | **Published:** 10.07.2025

***Corresponding author:** Tran Dinh Son
Independent Mathematical Researcher in the UK

Abstract **Review Article**

The topic of this article means "one can construct a regular hexagon of which area is equal exactly to a given circle (O, r), using a straightedge and a compass only".
No scientific theory lasts forever, but specific research and discoveries continuously build upon each other. The three classic ancient Greek mathematical challenges likely referring to are "Doubling The Circle", "Trisecting An Angle" and "Squaring The Circle", all famously proven Impossible under strict compass-and-straightedge constraints, by Pierre Wantzel (1837) using field theory and algebraic methods [4], then also by Ferdinand von Lindemann (1882) after proving π is transcendental. These original Greek challenges remain impossible under classical rules since their proofs rely on deep algebraic/transcendental properties settled in the 19th century. Recent claims may involve reinterpretations or unrelated advances but do overturn these conclusions above. Among these, the "Squaring The Circle" problem and related problems involving π have captivated both professional and amateur mathematicians for millennia. The title of this paper refers to the concept of "constructing a regular hexagon that has the exact area of a given circle," or "Regular Hexagoning The Circle" for short. This research idea arose after the "Squaring The Circle" problem was studied and solved and published in "SJPMS" in 2024 [6]. This paper presents an exact solution to constructing a regular hexagon that is concentric with and has the same area as a given circle. The solution does not rely on the number π and adheres strictly to the constraints of Euclidean Geometry, using only a straightedge and compass. The technique of "ANALYSIS" is employed to solve the "Regular Hexagoning The Circle" problem precisely and exactly with only a straightedge and compass, without altering any premise of the problem. This independent research demonstrates the solution to the challenge using only these tools. All mathematical tools and propositions in this solution are derived from Euclidean geometry. The methodology involves geometric methods to arrange the given circle and its equal-area regular hexagon into a concentric position. Building on this method of exact "Regular Hexagoning The Circle," one can deduce an equivalent problem to formulate a new mathematical challenge: "Regular Heptagoning The Circle" (i.e., constructing a regular heptagon that has the same area as a given circle, using only a straightedge and compass).
Keywords: Hexagoning the Circle; regular hexagoning circle; circle hexagonise; hexagon area of a circle; constructing a regular hexagon with the same area as a circle; Euclidean geometry; straightedge and compass.

INTRODUCTION

For over three millennia, three classical geometric well-known problems from ancient Greece—Squaring the Circle, Doubling the Cube, and Trisecting an Angle— emerged and have challenged the ingenuity of mathematicians. These problems, first posed with the constraint of using only an unmarked straightedge and compass, have long been declared impossible to solve within the framework of Euclidean geometry. Foundational impossibility proofs by 19th-century mathematicians such as Pierre Wantzel and Ferdinand von Lindemann [4] - using algebraic field theory and transcendental number theory - seemed to confirm that exact solutions were unattainable. Specifically, the transcendence of π implied that a square with an area exactly equal to that of a given circle could not be constructed through purely geometric means [2] & [3]. Yet, while these algebraic impossibility theorems are rigorous within their own domains, they diverge in nature from the original geometric spirit of the ancient challenges. The historical emphasis on purely constructive geometry, devoid of algebra, arithmetic or trigonometry, leaves space for a critical re-evaluation [6].

Among them, Hippocrates meticulously studied the problem of squaring the circle. The problem is stated as follows: Using only a straightedge and a compass, is it possible to construct a square with an area equal to a given circle? These problems were proven unsolvable using only straightedge and compass in the 19th century. In 1882, mathematician Ferdinand von Lindemann proved that π is an irrational number, which means that it is impossible to construct a square with the same area as a given circle using only a straightedge and a compass, as posed by Hippocrates. One of the most fascinating aspects of this problem is that it has captured the interest of mathematicians throughout the history of mathematics. From the earliest mathematical documents to today's mathematics, the problem and its relation to π have intrigued both professional and amateur mathematicians for millennia.

A significant step forward in proving the impossibility of squaring the circle occurred in 1761 when Lambert proved that π is irrational [2] & [3]. This, however, was not sufficient to demonstrate the impossibility of squaring the circle using a straightedge and compass, as certain algebraic numbers can be constructed with these tools. Despite the proof of the impossibility of squaring the circle, the problem has continued to captivate mathematicians and the general public alike, remaining an important topic in the history and philosophy of mathematics.

In 1837, French mathematician L. Wantzel proved that the three classical problems of ancient Greece are impossible to solve using only a straightedge and compass. Although based on algebra, Pierre Laurent Wantzel (1837) declared the verdict, "Arbitrary angle trisection is impossible", I experienced that my achieved procedure was possibly not arrested by this verdict [4]. After applying my method to trisect an arbitrary angle, I hope readers can trust algebra cannot affect the successful geometrical constructions of angle trisection.

Therefore, the problems of squaring the circle, doubling the cube, and trisecting an angle have been studied for centuries and remain unsolvable with these tools to this day. As of December 2022, no mathematician has found exact solutions to classical problems such as "Doubling the Cube," "Squaring the Circle," or "Trisecting an Angle" using only a compass and straightedge.

However, in 2023, my research article, published on the SJPMS journal, [6] as an exact solution to the "Squaring the Circle" problem, provides a counter-proof to the impossibility stated by Wantzel in 1837, [4]. This article arises from such a re-evaluation and documents a new geometric approach—remaining strictly within the constraints of compass and straightedge—that claims to construct precise solutions to several of these age-old problems. Beginning with a geometric interpretation of Lao Tzu's aphorism "The Great Way is simple," the author explores the power of simplicity and concentric arrangement. Through detailed analysis, an exact method for Squaring the Circle is developed, followed by solutions to Doubling the Cube and Trisecting an Angle, each derived using geometric reasoning alone in 2023, 2024 & 2025 [6], [8] & [9].

In the past, knowledge was often considered scientific if it could be confirmed through specific evidence or experiments. However, Karl Popper, in his book *Logik der Forschung* (The Logic of Scientific Discovery), published in 1934, demonstrated that a fundamental characteristic of scientific hypotheses is their ability to be proven wrong (falsifiability). Anything that cannot be refuted by evidence is temporarily regarded as true until new evidence emerges. For instance, in astronomy, the Big Bang theory is widely accepted, but in the future, anyone who discovers a flaw in this theory will be acknowledged by the entire physics community. Furthermore, no scientific theory lasts forever; rather, it is specific research and discoveries that continually build upon one another [1].

Starting from accepted premises, without proof, one uses deductive reasoning to arrive at theorems and corollaries. With different premises, we develop different mathematical systems. For example, the premise "from a point outside a line, only one parallel line can be drawn to the given line" leads to Euclidean geometry. If we assume that no parallel lines can be drawn from that point, we enter the realm of Riemannian geometry. Alternatively, Lobachevskian geometry assumes that an infinite number of parallel lines can be drawn through that point. It is important to clarify that this does not imply a square with an equal area to a circle does not exist. If the circle has an area A, a square with a side length equal to the square root of A would have the same area. It does not imply that it is impossible to solve the problem using only a straightedge and compass. *Thus, I provided an exact solution to the "Squaring the Circle" problem without altering the premises of Euclidean geometry or the constraints of straightedge and compass [6]. In 2024, I also solved the inverse problem, titled "Circling The Square with Straightedge & Compass in Euclidean Geometry," which was published in the SJPMS [7].*

"Regular Hexagoning The Circle" refers to the process of "*constructing a regular hexagon that has the same area as a given circle and is concentric with that circle*." This concept came to me spontaneously after solving the problem of "squaring the circle." I thought, "*If one can square the circle, can one also regularly hexagon the circle using only a straightedge and compass in Euclidean Geometry?*" In other words, "Regular Hexagoning The Circle" is a new challenge problem that arose from the exact solution presented in my "Squaring the Circle" paper, published in *SJPMS* [6]. Therefore, the "*Regular Hexagoning The Circle*" challenge and its solution have not existed in the field of Mathematics until it was solved and published by this paper.

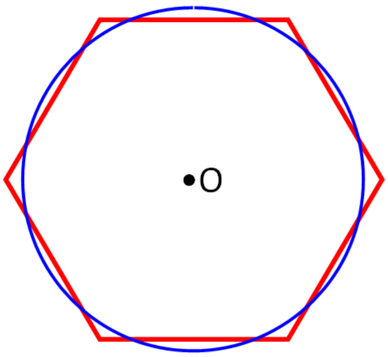
In seeking solutions to such problems, geometers developed a special technique called "ANALYSIS." They would assume the problem had been solved, and by investigating the properties of the solution, they would work backward to identify an equivalent problem that could be solved based on the given conditions. To obtain the formally correct solution to the original problem, geometers would then reverse the process: starting with the data to solve the equivalent problem derived through analysis, and then using that solution to solve the original problem. This reversed procedure is known as "SYNTHESIS." Analysis and synthesis are fundamental methods in mathematical reasoning and problem-solving. Analysis involves the process of breaking down complex mathematical problems or structures into simpler, more manageable components. It enables mathematicians to understand underlying principles, identify patterns, and isolate essential variables. Through analytical methods, one can derive conclusions, test hypotheses, and explore the logical consequences of assumptions. Conversely, synthesis entails the combination of previously understood elements to construct more complex systems or to develop general theories. It often follows analysis, using the insights gained to build new models, solve broader problems, or formulate proofs. The interplay between analysis and synthesis fosters a deeper comprehension of mathematical concepts and drives the progression of mathematical theory. Together, these complementary approaches are vital to the advancement of mathematics, underpinning both theoretical inquiry and practical application.

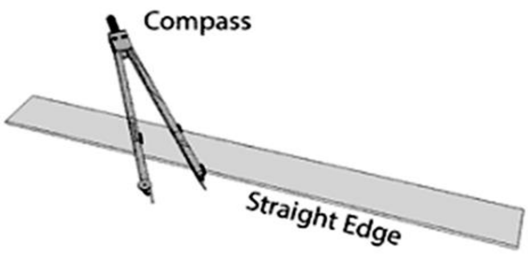
I have adopted both the "ANALYSIS" and "SYNTHESIS" techniques to solve the "Regular Triangling A Circle" problem exactly, using only a straightedge, compass, in Euclidean Geometry, without involving the irrational number π.

The inspiration for this research arose after the solution to the "Squaring the Circle" problem was published in SJPMS in 2024 [6]. If it is possible to square a circle using Euclidean geometry, the question arises: ***why is it difficult to regularly hexagon a circle?*** In this context, the given circle contains an inscribed regular dodecagon with any 2 parallel sides extending from it, leading to a regular hexagon. This ***regular hexagon*** serves as the solution to the new problem of "Regular Hexagoning The Circle." The remaining task is to prove that the area of this regular hexagon is exactly equal to the area of the given circle. This paper also introduces a new mathematical tool, the "Regular Hexagon Ruler," and provides a proof for the following:

1. a regular hexagon intersects the given circle at the 12 vertices of a special dodecagon;
2. the construction process forms a regular dodecagon inscribed in the given circle.

This paper's solution to the "Regular Hexagoning The Circle" problem naturally leads to the concept of "regular heptagoning a circle," "regular octagoning a circle," and so on.





Part I : PROOFS OF NEW PROPOSITIONS

I.1 Theorem 1:
If there exists a regular hexagon that has the same area as a given circle (O, r), then 6 sides of the hexagon cut the circle at 12 points to form an inscribed dodecagon for the circle.

PROOF:
Assume the red regular hexagon in Figure 1 below is the required shape that has the same area as area of a given circle (O, r) and concentrated with the circle (blue colour), then

- the area of this hexagon is less than the area of the circumscribed regular hexagon of the circle, obviously (red dashed triangle in Figure 1 below);
- the area of this hexagon is larger than the area of the inscribed regular hexagon in the circle, obviously (black dashed smallest triangle in Figure 1 below).

Thus, this hexagon (red colour) has 6 sides which have to cut the circle at 12 points a, b, c, d, e, f, g, h, i, j, k & l. These 12 points are vertices of a dodecagon inscribed in the given circle, as required.

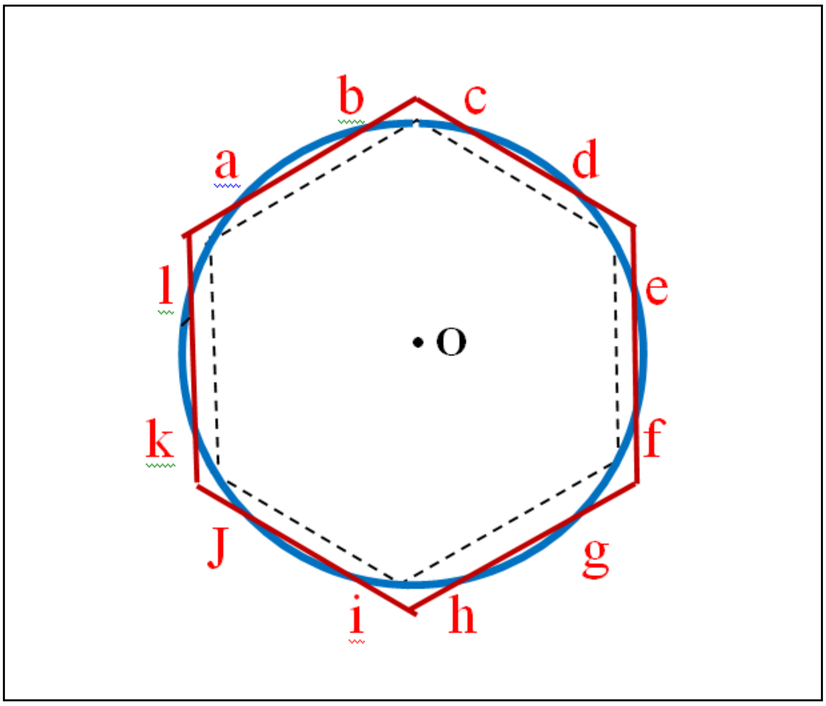


Figure 1: The given blue circle (O, r), the regular hexagon (red colour) and the inscribed regular hexagon of the circle (O, r).

I.2 Theorem 2:

If there exists a regular hexagon ABCDEF that has the same area as a given circle (O, r), then the hexagon cuts the circumference of the circle (O, r) at 12 points a, b, c, d, e & f, g, h, i, j, k & l which are 12 vertices of an inscribed regular dodecagon of the given circle.

PROOF:

Assume there exists a regular hexagon ABCDEF (red colour in Figure 2 below) that has the same area πr^2 as the area of a given circle (O, r) and is concentric to the circle.

By Theorem 1 in section I.1 above, this hexagon's sides cut the circumference of the circle at 12 points a, b, c, d, e, f, g, h, i, j, k & l (Figure 2, below). Let a circle (O, R) be the circumscribed circle of the regular hexagon ABCDEF. Extend chord al (Figure 2 below) of the circle (O, r) to meet the circumference of the circle (O, R) at points A' & F', then connect points O to A'. From point A', draw a symmetric straight line segment A' B' (the black arrow line in Figure 2 below), that cuts the circle (O, R) at B'. Then, OA' is the bisector of angle F'A'B'. Because of the symmetrical property of the lines A' F' and A'B' and circle chords al & bc (Figure 2 below), line A'B' overlaps chord bc of the circle (O, r). Similar extensions of chords de, fg, hi & jk and connections B'O, C'O, D'O, E'O & F'O and the similar symmetric proofs as above show that A'B'C'D'E'F' is also the inscribed regular hexagon of the circle (O, R). Therefore, these 2 regular hexagons are equal and their intersect area is the dodecagon abcdefghijkl (Figure 2 below), which is a regular inscribed dodecagon of the given circle (O, r). This shows the side extensions of this dodecagon intersect exactly at 6 vertices of the required regular hexagon ABCDEF or A'B'C'D'E'F', equally (Figure 2 below). By the symmetric and concentric properties of these 2 hexagons,

hexagon ABCDEF = hexagon A'B'C'D'E'F' (1).

Because (O, r) and (O, R) are the 2 concentric circles, symmetric properties, and equal distances from the centre O to 12 chords ab, bc, cd, de, ef, fg, gh, hi, ij, jk & kl, abcdefghijkl is a regular dodecagon with 12 sides as follows:

ab = bc = cd = de = ef = fg = gh = hi = ij =jk = kl = la (2).

By (2), the inscribed dodecagon abcdefghijkl of the given circle (O, r) is an identification of the required regular hexagon ABCDEF, as required.

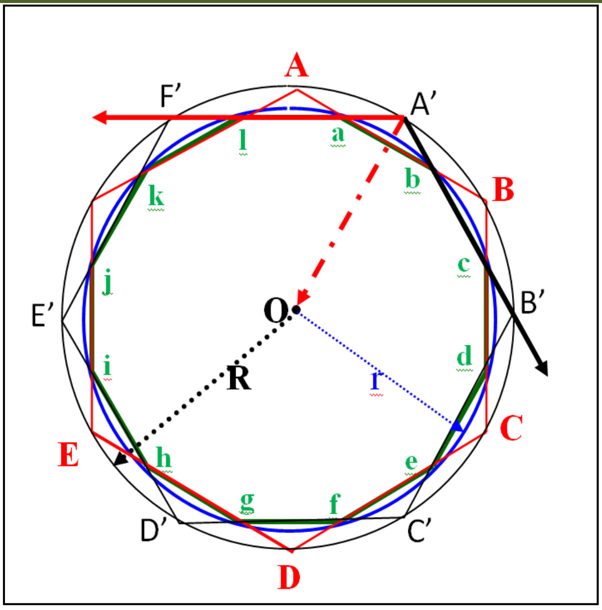


Figure 2: The given circle (O, r), the resulting regular hexagon ABCDEF and the regular dodecagon abcdefghijkl (green colours)

I.3 DEFINITION:

Given a **circle (O, r)**, area = πr^2, then any dodecagon inscribed in the circle is defined as an "**DODECAGON RULER**" of the circle (Figure 3 below).

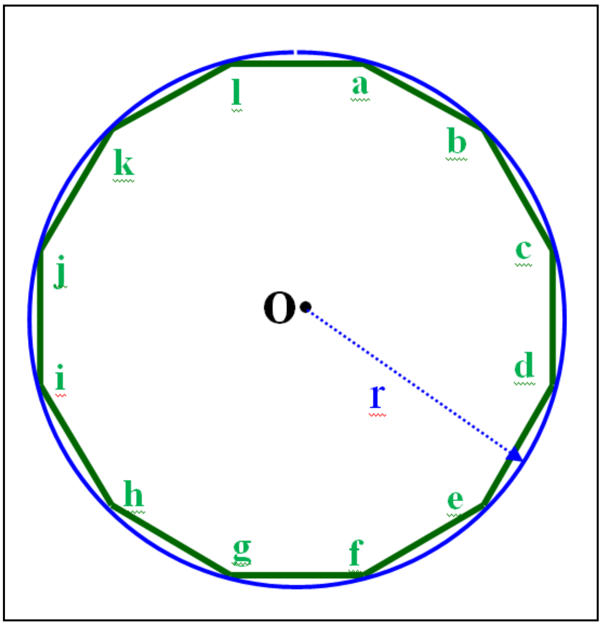


Figure 3: ***The "DODECAGON RULER" abcdefghijkl (green colour) of a given circle (O, r) is the regular dodecagon inscribed in the given Circle (O, r)***

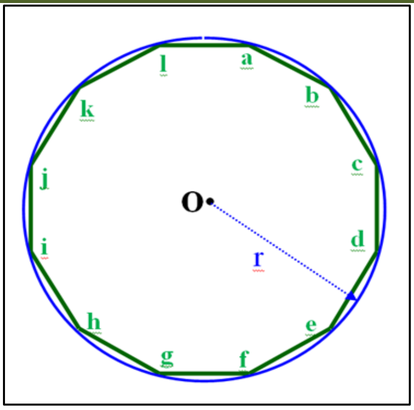
Part II: REGULAR TRIANGLING A CIRCLE

CORE THEOREM

Given a circle (O, r) then a DODECAGON RULER of the circle is a mathematics tool to construct a regular hexagon that has the same area as the area of the given circle, with a straightedge & compass in Euclidean Geometry.

PROOF:

Given a circle (O, r), area πr^2, then by the Definition in section I.3 above, there exists a regular dodecagon abcdefghijkl, inscribed in the circle, which is the Ruler, described in the following figure.



Extend 6 sides ab, cd, ef, gh, ij & kl of the regular dodecagon (Ruler) to obtain a hexagon *ABCDEF* (red colour in Figure 4 below). By Theorem 2 in Part I above, this hexagon is regular and has the same area πr^2 as the area of the circle. Therefore, the regular hexagon *ABCDEF* is the solution to the "Regular Hexagoning The Circle" challenge problem (Figure 4 below).

Note: *If one draws the concentric circle (O, R) that is the circumscribed circle of the above regular hexagon ABCDEF, then the regular hexagon A'B'C'D'E'F' (in Figure 5 below) is also equal to the resulting regular hexagon ABCDEF. Therefore, one DODECAGON RULER of this challenge problem produces 2 constructive equal solutions using only straightedge & compass in Euclidean Geometry, as required (Figure 5 below).*

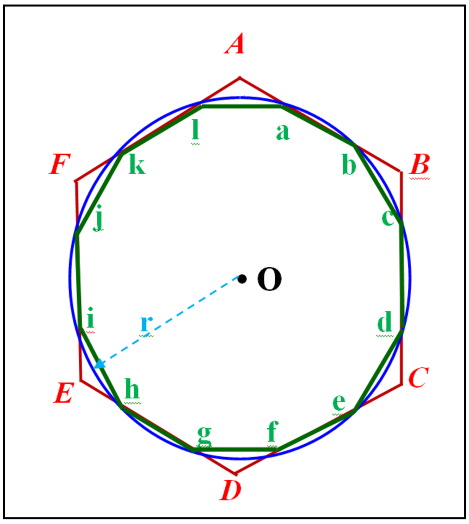


Figure 4: ***The regular dodecagon abcdefghijkl (green colour) inscribed in the given circle (O, r) and the resulting hexagon ABCDEF of the "Hexagoning The Circle" challenge problem.***

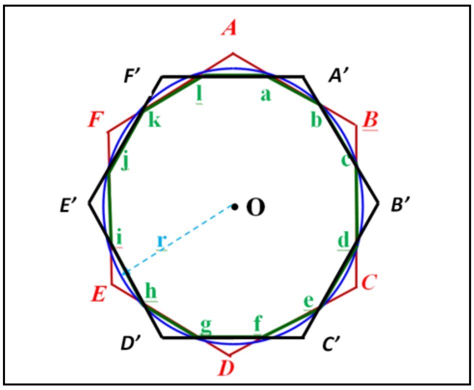


Figure 5: ***The regular dodecagon abcdefghijkl (green colour) inscribed in the given circle (O, r) results 2 solutions (the regular hexagons ABCDEF & A'B'C'D'E'F') to the "Hexagoning The Circle" challenge problem.***

Part IV

DISCUSSION AND CONCLUSION

Can mathematicians use a compass and a straightedge to construct a regular hexagon of equal area to a given circle, using only a straightedge and compass? The results of my independent research successfully get an exact solution to the ancient Greek “Squaring The Circle” problem challenge showing the idea that “**If one can do** *“squaring a circle”* then one can do regular *“hexagoning a circle”* too. This article paper proves it is certain to construct a regular hexagon that has the same area πr^2 as the area of a given circle (O, r), successfully with only straightedge & compass in Euclidean Geometry. And also, this regular hexagon has the same area πr^2 as the area πr^2 of a resulting square from my solution to the “Squaring The Circle” published on the SJPMS on 31/10/2024 [6].

This construction method is quite different from approximation and is based on using only a straightedge and a compass within Euclidean Geometry.

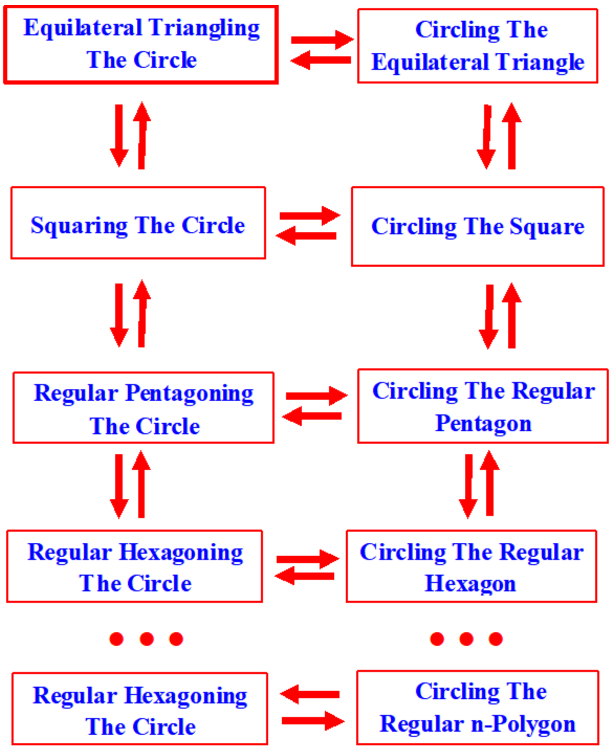
The inspiration for this research arose after the solution to the "Squaring The Circle" problem was published in SJPMS in 2024 [6]. If it is possible to square a circle using only a straightedge and compass in Euclidean geometry, the question arises: ***why is it difficult to hexagon a circle equidistantly, similar to how one squares a circle?*** *In this context, the given circle contains an inscribed regular dodecagon, with 3 pairs of non-consecutive sides extending from it, leading to a regular hexagon. This regular hexagon serves as the solution to the new problem "regular hexagoning a circle". The remaining task is to prove that the area of this regular hexagon is exactly equal to the area of the given circle. This paper also introduces a new mathematical tool, called the "Dodecagon Ruler," and provides a proof for the following statements: (1) A concentric regular hexagon intersects the given circle at the twelve vertices of a special dodecagon, with two non-consecutive sides symmetrically positioned; (2) This solution construction forms a regular dodecagon (Dodecagon Ruler) inscribed in the given circle.*

Upstream from this method of exact “Regular Hexagoning The Circle” above, we can deduce, conversely, to get a new mathematical challenge "Circling The Regular Hexagon" with a straightedge & a compass only, in Euclidean Geometry. In details, we can describe it as follows:

Given a regular hexagon with side a and area A, a & A $\subset$ R, then use a straightedge & a compass to construct an accurate circle, which has the exact area A. Then, how to solve this new geometry problem is still an open research interest, to get a circle area without using the traditional constant π.

In addition, this research result can be interpreting as further research for a new “REGULAR HEXAGONING A CIRCLE” challenge, with only “a straightedge & compass” in Euclidean Geometry.

Finally, derivatives from the Squaring The Circle problem (ancient Greek challenge) for further researches, can be described in the following diagram:



Conflicts of Interest: The author declares that there is no conflict of interest regarding the publication of this paper.

Funding Statement: No funding from any financial bodies for this research.

Acknowledgements
I greatly acknowledge the constructive suggestions by the friends and reviewers who took part in the evaluation of the developed theorems.

REFERENCES

1. Karl Popper, 21 February 2002, The Logic of Scientific Discovery, 2nd edition, page 544, London, Routledge, ISBN9780203994627, DOI:https://doi.org/10.4324/9780203994627, [Publisher link].
2. Rolf Wallisser, On Lambert's proof of the irrationality of π, Published by De Gruyter 2000, https://www.semanticscholar.org/paper/On-Lambert's-proof-of-the-irrationality-of-%CF%80-Wallisser/43f1fe3182f2233a1a9f313649547d13ea7311c7.
3. Laczkovich, M., (1997), "On Lambert's proof of the irrationality of π", The American Mathematical Monthly. 104 (5): 439–443, doi:10.1080/00029890.1997.11990661, JSTOR 2974737, MR 1447977.
4. Wantzel, L., (1837), "Recherches sur les moyens de reconnaître si un problème de géométrie peut se résoudre avec la règle et le compas" [Investigations into means of knowing if a problem of geometry can be solved with a straightedge and compass], Journal de Mathématiques Pures et Appliquées (in French). 2: 366–372.
5. T. Albertini, La quadrature du cercle d'ibn al-Haytham: solution philosophique ou mathématique?, *J. Hist. Arabic Sci.* 9 (1-2) (1991), 5-21, 132. https://www.academia.edu/9342794/_La_quadrature_du_cercle_dIbn_al_Haytham_solution_math%C3%A9matique_ou_philosophique_Ibn_al_Haythams_Quadratura_Circuli_a_mathematical_or_a_philosophical_solution_translation_and_commentary_Journal_for_the_History_of_Arabic_Science_9_1991_5_21.
6. Tran Dinh Son, 31/10/2024, “Exact Squaring the Circle with Straightedge and Compass Only”, Scholars Journal of Physics, Mathematics and Statistics | Volume-11 | Issue-10, DOI: https://doi.org/10.36347/sjpms.2024.v11i10.004, https://www.academia.edu/125965397/Scholars_Journal_of_Physics_Mathematics_and_Statistics, https://saspublishers.com/article/20927/.
7. Tran Dinh Son, 2024, “Circling the Square with Straightedge & Compass in Euclidean Geometry” by *Tran Dinh Son, in* Sch J Phys Math Stat | 54-64 DOI: 10.36347/sjpms.2024.v11i05.001, https://saspublishers.com/journal-details/sjpms/149/1453/.
8. Tran Dinh Son, 22 May 2023, “Exact Angle Trisection with Straightedge and Compass by Secondary Geometry”, *IJMTT 22 May 2023,* https://doi.org/10.14445/22315373/IJMTT-V69I5P502
9. Exact Angle Trisection with Straightedge and Compass by Secondary Geometry (ijmttjournal.org)https://www.academia.edu/103490898/Exact_Angle_Trisection_with_Straightedge_and_Compass_by_Secondary_Geometry https://www.academia.edu/ai_review/115747657.
10. Tran Dinh Son, 13/02/2025, “Exact Doubling the Cube with Straightedge and Compass by Euclidean Geometry”, *IJMTT 29 August 2023,* Exact Doubling The Cube with Straightedge and Compass by Euclidean Geometry (ijmttjournal.org) https://doi.org/10.14445/22315373/IJMTT-V69I8P506 https://www.semanticscholar.org/me/library/all, Sch J Phys Math Stat | 24-32, DOI: https://doi.org/10.36347/sjpms.2025.v12i02.001, *SJPMS 13/02/2025,* https://doi.org/10.36347/sjpms.2025.v12i02.001 file:///C:/Users/buung_000/Documents/Downloads/SJPMS_122_24-32%20(3).pdf.
Tran Dinh Son, 22/08/2024, Circling a Regular Pentagon with Straightedge and Compass in Euclidean
11. Tran Dinh Son, 16/09/2024, Pentagoning the Circle with Straightedge & Compass, Sch J Phys Math Stat ISSN 2393-8056 (Print) | ISSN 2393-8064 (Online), DOI: https://doi.org/10.36347/sjpms.2024.v11i09.001 , https://saspublishers.com/media/articles/SJPMS_119_101-107.pdf.
12. Tran Dinh Son, 15/03/2025, Regular Triangling a Circle with Straightedge and Compass in Euclidean Geometry, Scholars Journal Of Physics Mathematics And Statistics (SJPMS), DOI: https://doi.org/10.36347/sjpms.2025.v12i03.003 https://saspublishers.com/media/articles/SJPMS_123_59-65.pdf, https://saspublishers.com/article/21784/
13. Tran Dinh Son, 16/06/2025, Circling an Equilateral Triangle with Straightedge and Compass in Euclidean Geometry, Scholars Journal of Physics, Mathematics and Statistics | Volume-12 | Issue-05, Published: June 16, 2025 | 20 22, DOI: https://doi.org/10.36347/sjpms.2025.v12i05.001, Pages: 140-148, Archive link- https://saspublishers.com/journal-details/sjpms/166/1621/, Article link - https://saspublishers.com/article/22406/.
14. Peter Malcolm Johnson, January 31, 2025, An analysis of Euclid’s geometrical foundations, (arXiv:2501.17406v2 [math.MG] 30 Jan 2025),

https://www.semanticscholar.org/reader/b3fcda47c55e12621d0f4805c94bb52e902e54d0.

15. Frédéric Beatrix, 2022, Squaring the circle like a medieval master mason, Parabola Volume 58, Issue 2 (2022), https://www.parabola.unsw.edu.au/sites/default/files/2024-02/vol58_no2_2.pdf, vol58_no2_2.pdf .
16. S. Ramanujan, 1913, Squaring the circle, Journal of Indian Mathematical Society 5 (1913), 132, Published in the *Journal of the Indian Mathematical Society*, v, 1913, page 132, https://en.wikisource.org/wiki/Squaring_the_circle, ramworks.dvi.
17. H.V. Chu, 16/03/2022, Squaring the Circle Revisited, https://arxiv.org/pdf/1908.01202.pdf, 2019, *last revised 2 Feb 2025 (this version, v2),* arXiv:1908.01202 [math.GM], arXiv:1908.01202v2 [math.GM], Pi Mu Epsilon Journal 15 (2020), 139-143, https://doi.org/10.48550/arXiv.1908.01202, Squaring the Circle Revisited, Hùng Việt Chu hungchu2@illinois.edu Department of Mathematics,University of Illinois Urbana-Champaign, Urbana, IL 61820, USA.
18. Steve Nadis, February 8, 2022, An Ancient Geometry Problem Falls to New Mathematical Techniques, https://www.quantamagazine.org/an-ancient-geometry-problem-falls-to-new-mathematical-techniques-20220208/.

GEOMETRY,

1. Scholars Journal of Physics, Mathematics and Statistics, Sch J Phys Math Stat ISSN 2393-8056 (Print) | ISSN 2393-8064, DOI: https://doi.org/10.36347/sjpms.2024.v11i08.001, https://saspublishers.com/media/articles/SJPMS_118_83-88_FT.pdf.