

A Book of Abstract Algebra | (2nd Edition)



Chapter 30, Problem 6EE



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Problem

We will show that $2\pi/5$ is a constructible angle, and it will follow that the regular pentagon is constructible.

Prove that the regular pentagon is constructible.

Step-by-step solution

Step 1 of 4

Here, objective is to prove that the regular pentagon is constructible.

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Step 2 of 4

Regular n -gon has n equal length of sides and all angles are equal.

Regular n -gon is constructible if and only if the angle $\frac{2\pi}{n}$ is constructible

An angle $\frac{2\pi}{N}$ is constructible if and only if N is either a power of two or power of two and a set of Fermat points

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Step 3 of 4

Consider regular Pentagon.

Regular Pentagon is a five-sided Polygon or **5 – gon**

Number of sides $n = 5$

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Step 4 of 4

To verify $\frac{2\pi}{5}$ is constructible or not:

$$\frac{2\pi}{N} = \frac{2\pi}{5}$$

$$N = 5$$

Here, 5 can be written in the form of $2^{2^n} + 1$. That is for $n = 1$

$$2^{2^1} + 1 = 5$$

So, 5 is a Fermat prime.

Therefore, $\frac{2\pi}{5}$ is a constructible angle, which implies Regular 5-gon is constructible.

Hence,

Regular Pentagon is constructible.

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