A Book of Abstract Algebra | (2nd Edition)
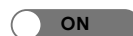
Chapter 30, Problem 5EF   Bookmark   Show all steps: **ON**

Problem

By de Moivre's theorem,

$$\omega = \cos\frac{2\pi}{7} + i\sin\frac{2\pi}{7}$$

is a complex seventh root of unity. Since

$$x^7 - 1 = (x - 1)(x^6 + x^5 + x^4 + x^3 + x^2 + x + 1)$$

ω is a root of $x^6 + x^5 + x^4 + x^3 + x^2 + x + 1$.

Prove that $2\pi/7$ is not a constructible angle.

Step-by-step solution

Step 1 of 3

Here, objective is to prove that $\dfrac{2\pi}{7}$ is a constructible angle.

Comment

An angle $\dfrac{2\pi}{N}$ is constructible if and only if N is either a power of two or product of power of two and a set of distinct Fermat primes.

Fermat prime:

It is also a prime number, which is of the form $2^m + 1$ Where $m = 2^n$; n is integer

Comment

To verify $\dfrac{2\pi}{7}$ is constructible or not:

$$\frac{2\pi}{N} = \frac{2\pi}{7}$$
$$N = 7$$

7 is not a Fermat prime.

Since 7 cannot be written in the form of $2^{2^n} + 1$

Therefore, $\dfrac{2\pi}{7}$ is not a constructible angle,

Comment

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