

# A Book of Abstract Algebra | (2nd Edition)



Chapter 30, Problem 5EE



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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  $2\pi/5$  is a constructible angle.

## Step-by-step solution

### Step 1 of 3

Here, objective is to prove that  $\frac{2\pi}{5}$  is a constructible angle.

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### Step 2 of 3

An angle  $\frac{2\pi}{N}$  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

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### Step 3 of 3

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

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

$$N = 5$$

5 is a Fermat prime.

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

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

Therefore,  $\frac{2\pi}{5}$  is constructible angle,

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