

A Book of Abstract Algebra | (2nd Edition)

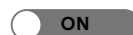


Chapter 30, Problem 4EB



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Problem

Prove each of the following:

If a point P is constructible from $\mathbb{Q} \times \mathbb{Q}$, it is constructible from $\{O, I\}$.

By combining parts 2 and 4, we get the following important fact: Any point P is constructible from $\mathbb{Q} \times \mathbb{Q}$ iff P is constructible from $\{O, I\}$. Thus, we may define a point to be *constructible* iff it is constructible from $\{O, I\}$.

Step-by-step solution

Step 1 of 4

Here, objective is to prove that if a point p is constructible from $\mathbb{Q} \times \mathbb{Q}$, then it is constructible from (I, O) .

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Step 2 of 4

Constructible point:

The point is either the end point of given unit segment or it is the intersection of two lines determined by previous constructible points is called as constructible point.

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Step 3 of 4

$\mathbb{Q} \times \mathbb{Q}$ is a set of all rational numbers

Let p, q are rational numbers. Then the point $P(p, q) \in \mathbb{Q} \times \mathbb{Q}$

Let $p = \frac{a}{b}$ (rational)

But as per the definition of D , $(a, 0)$ and $(0, b)$ are constructible from (O, I)

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Step 4 of 4

Consider the below figure:

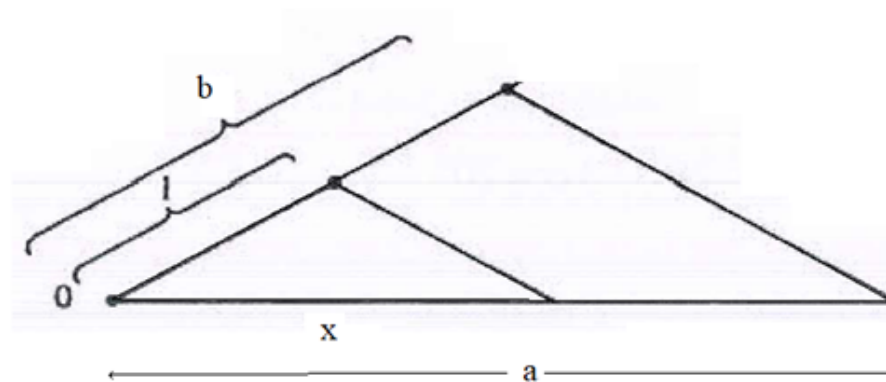


figure: construction of a/b

by observing there exist two similar triangles.

a and b are constructible lengths.

using the property of equal triangles, we have

$$\frac{b}{a} = \frac{1}{x}$$

$$x = \frac{a}{b}$$

Then,

The length $p = \frac{a}{b}$ is constructible from $\{O, I\}$

Similarly,

q is also constructible from $\{O, I\}$

Therefore, the point P is constructible from (I, O) .

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