

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



Chapter 30, Problem 3EB



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## Problem

Prove each of the following:

Every point in  $\mathbb{Q} \times \mathbb{Q}$  is constructible from  $\{O, I\}$ . (Use Exercise A5 and the definition of  $\mathbb{D}$ .)

## Step-by-step solution

### Step 1 of 4

Here, objective is to prove that every point in  $\mathbb{Q} \times \mathbb{Q}$  is constructible from  $(O, I)$ .

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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  $a, b$  are rational numbers. Then the point  $(a, b) \in \mathbb{Q} \times \mathbb{Q}$

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

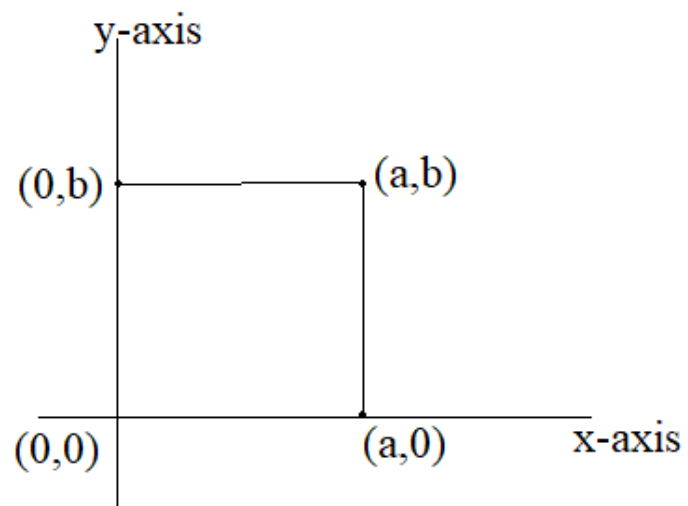


figure:construction of  $(a, b)$

By using compass we can construct the point  $(0, b)$  along y-axis.

Construct perpendicular lines to the x-axis passing through  $(a, 0)$ .

Construct perpendicular lines to the y-axis passing through  $(0, b)$ .

Then the perpendicular lines intersect at the point  $(a, b)$ .

So,  $(a, b)$  is constructible from  $(O, I)$ ,

Therefore, Every point in  $\mathbb{Q} \times \mathbb{Q}$  is constructible from  $(O, I)$ .

Hence, proved

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