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ABOUT ALGEBRAIC STRUCTURES AND THEIR RANKS

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Annotation: Concepts of group, ring and field, linear space, concepts of algebra and color of algebra were presented, rules, ideas were reviewed.

Key word: Group, ring, field, linear space, algebra, color of algebra, associative, commutative, distributive, neutral element.

Algebra and numbers theory in the chair group , ring and field concepts determined they are _ that's it of the subject main concepts is considered

forms a ring with respect to the operations ·+ and , ·there is a unit element with respect to the operation, and for any element of the ring K different from 0 there is an inverse element, then K is called a body. So, for the set K to be a body, the following conditions must be met:
1. + action associative;
2. + operation is commutative;
3. a neutral element to the action of + θ;
4. Any element of K For *a, there is -a* $\in K$, which is the inverse (opposite) of the action + ;
5. ·action is associative;
6. ·amali + distributive relative to amali;
7. In the ring K there is an element *e such that the equality* $e \cdot a = a \cdot e = a$ is fulfilled;
8. any non-0 element *a in the ring K, there is* an inverse element $a^{-1} \in K$, i.e

$a \cdot a^{-1} = a^{-1} \cdot a = e$ equality is fulfilled.
If K is a body, the following additional condition
9. ·action is commutative;

, then K is called a field. So the commutative body is a field. Depending on the number of elements in a group, ring, body and field, it is called finite or infinite.
$ax=b$ *for* any elements *a* and *b of the field* ($a \neq 0$) ; There are solutions to the equation $x \cdot a=b$ and these solutions are the same. But if these solutions exist for body elements *a* and *b , they may not be equal.*
The concept of linear space is also defined as in the course of algebra and number theory.
If L the set forms a linear space over the field $L_1 P$ *, and* the set itself ·forms a ring with respect to the operations + and , and for any $\lambda \in P$, $x, y \in L$ elements $(\lambda \circ x) \cdot y = x \cdot (\lambda \circ y)(1)$ are fulfilled, then L the set is said to form an algebra over the field P. When writing the equations (1), L the multiplication operation in the ring was denoted ·by the symbol L of the operation of multiplying $\circ$ the vector x of the linear space $\lambda \in P$ *by the scalar* .
If a set L forms an algebra over a field P, L the dimension of the linear space is called the color of the algebra.

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L If a set forms a group (or a ring, a field, a field, a linear space, an algebra) and its partial set L_1 also L forms a group (or a ring, a field, a field, a linear space, an algebra), then the L_1 partial L group (a ring, body, area, space, algebra). This case is also called an extension of L ni L_1.

Examples.

1. Show the grouping of the set of 6th degree complex roots of 1 with respect to the multiplication operation.

Solution: $C_6=\{\alpha\in C / \alpha^6=1\}$

6 be the set of all complex roots of degree 6 of 1 . The multiplication operation on this set is defined because

$\alpha\in S_6,\ \beta\in S_6,\ \alpha^6=1,\ \beta^6=1$

the equalities are appropriate, from which the fulfillment of the equality $(\alpha\cdot\beta)^6=1$ also follows. The associativity of this action is fulfilled. 1 being $\in S_6$, this element is the unit element with respect to its operation in $\cdot S_6$. *We show that* any element in αS_6 has an inverse.

$\left(\frac{1}{\alpha}\right)^6=\frac{1}{\alpha^6}=1$ also follows from the equality that $\frac{1}{\alpha}$ S_6 *belongs to the set.* So, the set S_6 is a finite group with respect to the operation of multiplication (because there are 6 elements in the set S_6) .

2. $Q(\sqrt[3]{3})=\{a+b\sqrt[3]{3}+c\sqrt[3]{9} / a,b,c\in Q\}$ show that the set forms an algebra over the field of rational numbers with respect to simple operations, and determine the color of this algebra.

Solution : $\alpha=a+b\sqrt[3]{3}+c\sqrt[3]{9}\in Q(\sqrt[3]{3})$

$\beta=a_1+b_1\sqrt[3]{3}+c_1\sqrt[3]{9}\in Q(\sqrt[3]{3})$

given the elements, $\alpha+\beta=(a+a_1)+(b+b_1)\sqrt[3]{3}+(c+c_1)\sqrt[3]{9}$ adding them with equality and $\lambda\in$ multiplying a vector with equality α for a number $\lambda\cdot\alpha=\lambda a+\lambda b\sqrt[3]{3}+\lambda c\sqrt[3]{9}$ Q *are simple operations.* With respect to these operations, $Q(\sqrt[3]{3})$ the set Q -constitutes a linear space over the field of rational numbers (linear space axioms are fulfilled). The product of any two $Q(\sqrt[3]{3})$ and β elements from the set is determined by the rule of multiplication of polynomials. α Then, $\alpha\cdot\beta=aa_1+3(b_1c+c_1b)+(a_1b+ab_1+3cc_1)\sqrt[3]{3}+(ac_1+a_1c+bb_1)\sqrt[3]{9}$ will result $Q(\sqrt[3]{3})$. $\alpha\cdot\beta\in Q(\sqrt[3]{3})$ and the set forms a commutative ring with unit element with respect to + and this multiplication operation. Now $Q(\sqrt[3]{3})$ we show that the set Q is an algebra over the field. For this, it is necessary to show that the equality $\lambda\cdot(x\cdot y)=(\lambda x)\cdot y=x(\lambda y)$ is fulfilled. But the appropriateness of these conditions is checked directly. Hence, $Q(\sqrt[3]{3})$ the set Q forms an algebra over the field. Now we determine its color, that is, the dimension of linear space.

$\alpha_1=1$

$\alpha_2=\sqrt[3]{3}$

$\alpha_3=\sqrt[3]{9}$

is a system of linear free vectors in element space. $Q(\sqrt[3]{3})$ If the system formed by adding an arbitrary $\alpha\in Q(\sqrt[3]{3})$ vector to this system is linearly connected, then the color 3 raequality of this algebra is derived. It can be verified that

$a\,\alpha_1+b\,\alpha_2+c\,\alpha_3+(-1)\,\alpha=0$

equality holds, the system of vectors $\alpha_1,\ \alpha_2,\ \alpha_3,\ \alpha$ and 4 is linearly connected. So,

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$\dim_Q Q\left(\sqrt[3]{3}\right)=3$

equality is appropriate.

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