

Mock-Exam: Algebra

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Prof. Robert Heß, Jan 18th 2012, duration: 90 Min.

Result: of 68 points Mark: points.

Problem 1 (12 points)

Prove by complete induction: $3^n > n^2$ for $n \in \mathbb{N}$

Problem 2 (10 points)

For the boolean set $B = \{0, 1\}$ express the function $f : B^3 \rightarrow B, (a, b, c) \mapsto b \wedge (a \vee c)$ in disjunctive normal form.

Problem 3 (6 points)

List the three elementary row operations that do not influence the values of unknowns of a system of linear equations.

Problem 4 (12 points)

Solve the following system of linear equations by applying Gauss-Jordan elimination.

$$2x_2 + x_3 = 2 \qquad x_1 + x_3 = -2 \qquad 2x_1 - x_2 - x_3 = 0$$

Problem 5 (16 points)

For $A = \begin{pmatrix} 0 & -1 & 2 & 1 \\ 1 & -1 & 0 & -1 \\ 2 & -1 & 1 & 2 \\ 2 & 1 & -2 & 2 \end{pmatrix}$ evaluate A^{-1} and $\det(A)$.

Problem 6 (12 points)

Find the solution behaviours of SLEs for the statements below:

1. The rank of the coefficient matrix is less than the rank of the extended coefficient matrix.
2. Let A be the coefficient matrix that maps the vector of unknowns to the vector of constants. The dimension of the kernel of A is one and the vector of constants is an element of the image of A .
3. The rank of the coefficient matrix and extended coefficient matrix equal the number of unknowns.
4. The coefficient matrix is invertible.