Question 1

1. Basic set operations and relations, pairs, tuples and Cartesian product $\times$. Theorem about the cardinality of a power set $\mathcal{P}(A)$ of a finite set A.

2. Theorem: A countable union of countable sets is countable.

3. Canonical normal forms for propositional formulas: CCNF, CDNF. Theorem about reduction to CCNF.

Question 2

1. Mappings, functions: everywhere defined, injective, surjective, bijective, inverse mapping. Theorem about cardinality of a finite Cartesian product.

2. Carrying of a function.

3. Canonical normal forms for propositional formulas: CCNF, CDNF. Theorem about conversion to CCNF.

Question 3

1. Mappings, functions: everywhere defined, injective, surjective, bijective, inverse mapping. Properties of composition of mappings, uniqueness of inverse mapping.

2. Notion of λ-term: operators of application and abstraction.

3. Correctness theorem for the propositional logic.

Question 4

1. Binary relations, composition of binary relations, associativity of composition of binary relations.

2. Reductions in λ-calculus: α-reduction.

3. Completeness theorem for the propositional logic.

Question 5

1. Inverse binary relation, connection with the inverse mapping.

2. Reductions in λ-calculus: β-reduction.

3. Structures of signature σ.

Question 6

1. Properties of binary relations: reflexivity, symmerticity, transitivity, antisymmetricity. Definition and characterization of these properties.

2. Reductions in λ-calculus: η-reduction.

3. Congruence on the structure of signature σ.

Question 7

1. Equivalence relations, examples of equivalences. Equivalence classes, properties of equivalence classes, set partitions, lemma about equivalence classes and partitions.
2. Term rewriting in lambda calculus: call-by-value and call-by-name strategies.
3. Quotient structure of structure $\mathcal{M}$ by congruence θ.

Question 8

1. Partial orders, examples of partial orders. Least/greatest, minimal/maximal elements in partial orders, upper/lower boundary, supremum/infimum of a set. Posets and losets.
2. Redexes, normal form of a λ-term. Church-Rosser theorem (without proof).
3. Homomorphisms, epimorphisms and isomorphisms of structures.

Question 9

1. Posets and losets, lattices, proposition about losets and lattices. Boolean lattices, examples of Boolean lattice.
2. Combinatory terms, combinatory calculus, theorem about completeness of SKI basis.
3. Kernel of a homomorphism, theorem about homomorphisms.

Question 10

1. Closure of a binary relation relative to some property, uniqueness of a closure.
2. Y-combinator, it's properties.
3. Substructures and superstructures.

Question 11

1. Reflexive and symmetric closures of a binary relation, their existence.
2. Church numbers: definition, successor function.
3. Predicate logic: terms and formulas of a given signature. Relation $\models$ between structures, formulas and interpretations of variables (semantics of predicate calculus).

Question 12

1. Transitive closure of a binary relation, it's existence.
2. Church numbers: addition and multiplication.
3. Predicate calculus of a given signature. Notions of linear proof and deduction tree. Provability characterization theorem.

Question 13

1. Adjacency matrix of a binary relation, Floyd-Marshall algorithm.

2. Modelling of recursion with Y-combinator.

3. Syntactical equivalence in predicate calculus, replacement theorem.

Question 14

1. Transitive closure of a binary relation, it's existence.

2. Propositional logic: propositional formulas, tautological, satisfiable and unsatisfiable formulas.

3. Prenex normal forms, theorem about conversion to PNF.

Question 15

1. Transitive closure of a binary relation, it's existence.

2. Semantically equivalent propositional formulas: distributivity, and De-Morgan laws.

3. Correctness theorem for the predicate calculus.

Question 16

1. Toposort of a binary relation. Kahn's algorithm.

2. Replacement theorem for propositional formulas (semantic).

3. Theorem about the existence of a model (without proof), the completeness theorem for the predicate calculus.

Question 17

1. Relation of equinumerosity of sets, properties of this relation.

2. Normal forms of propositional formulas: DNF, CNF. Theorem about conversion to the normal form.

3. Skolem normal form, theorem about Skolemization.

Question 18

1. Cantor-Bernstein's theorem (without proof), Cantor's theorem.

2. Zhegalkin polynomial (ANF), theorem about ANF existence and uniqueness.

3. Herbrandt normal form, theorem about Herbrandization.

Question 19

1. Sets: finite, countable, uncountable. Characterization of finite sets.
2. The sequential propositional calculus: linear proofs, deduction trees, characterization theorem about proofs.
3. Unifiers, most general unifiers.

Question 20

1. Theorem about cardinality of a Cartesian square of a countable set.
2. Syntactical equivalence $\equiv$, syntactic form of replacement theorem.
3. Horn clauses, resolution rule. Soundness theorem for the resolution rule.

Question 21

1. Inverse binary relation, connection with the inverse mapping.
2. Term rewriting in lambda calculus: call-by-value and call-by-name strategies.
3. Conditions of program correctness: partial and total. Floyd method.

Question 22

1. Closure of a binary relation relative to some property, uniqueness of a closure.
2. Y-combinator, it's properties.
3. Semantics for a programming language: semantics of data types and operational semantics.

Question 23

1. Transitive closure of a binary relation, it's existence.
2. Church numbers: addition and multiplication.
3. Hoare triples, axiomatic semantics for a programming language. Correctness and completeness of axiomatic semantic.