Problem 1
Let \((A; E_2)\) be a countably infinite structure where \(E_2\) denotes an equivalence relation with infinitely many classes of size two, and let \((A; E^2)\) be a structure where \(E^2\) denotes an equivalence relation with two infinite classes. Show that \(\text{Aut}(A; E_2)\) and \(\text{Aut}(A; E^2)\) have the same number of orbits of \(n\)-subsets, for all \(n\).

Problem 2
Show that a graph cannot be written as the disjoint union of two graphs having at least one vertex each if and only if for any two vertices \(u, v\) of the graph there exists a path from \(u\) to \(v\).

Problem 3
Consider the relational structure \(\Gamma := (\mathbb{Q}; \text{Cycl})\) where \(\text{Cycl}\) is the ternary relation \(\{(x, y, z) \in \mathbb{Q}^3 \mid x < y < z \text{ or } y < z < x \text{ or } z < x < y\}\). For the permutation group \(\text{Aut}(\Gamma)\), determine \(F(1), F(2), F(3), F(4)\), and \(f(n)\) for all \(n \in \mathbb{N}\).

Problem 4
Formulate the infinite pigeon-hole principle using the Ramsey arrow notation.