Problem 1. Using Ehrenfeucht-Fraïssé games, show that acyclicity of finite graphs is not FO-definable.

Problem 2. Equivalence of Datalog programs is undecidable (Shmueli 1993). Can you think of a sufficient, non-trivial condition for equivalence of Datalog programs that is decidable? (How?)

Problem 3. Consider a binary relation ChildOf, where the intended meaning of ChildOf(a, b) is that a is a child of b. Write a Datalog program computing the set of pairs (c, d), where c and d have a common ancestor and are of the same generation with respect to this ancestor.

Problem 4. Suppose P is some property of graphs definable by a Datalog program. Show that P is preserved under extensions and homomorphisms. That is, if G is a graph satisfying P, then (1) every supergraph of G satisfies P and (2) if h is a graph homomorphism, then h(G) satisfies P.