EVERY EXERCISE is answered here (at least briefly), and some of these answers go beyond what was asked. Readers will learn best if they make a serious attempt to find their own answers BEFORE PEEKING at this appendix.

The authors will be interested to learn of any solutions (or partial solutions) to the research problems, or of any simpler (or more correct) ways to solve the non-research ones.

1.1 The proof is fine except when \( n = 2 \). If all sets of two horses have horses of the same color, the statement is true for any number of horses.

1.2 If \( X_n \) is the number of moves, we have \( X_0 = 0 \) and \( X_n = X_{n-1} + 1 + X_{n-1} \) when \( n > 0 \). It follows (for example by adding 1 to both sides) that \( X_n = 3^n - 1 \). (After \( \frac{1}{2}X_n \) moves, it turns out that the entire tower will be on the middle peg, halfway home!)

1.3 There are \( 3^n \) possible arrangements, since each disk can be on any of the pegs. We must "hit them all, since the shortest solution takes \( 3^n - 1 \) moves. (This construction is equivalent to a "ternary Gray code," which runs through all numbers from \( 00 \ldots 0 \) to \( 22 \ldots 2 \), changing only one digit at a time.)

1.4 No. If the largest disk doesn’t have to move, \( 2^{n-1} - 1 \) moves will suffice (by induction); otherwise \( (2^n - 1) + 1 + (2^n - 1) \) will suffice (again by induction).

1.5 No; different circles can intersect in at most two points, so the fourth circle can increase the number of regions to at most 14. However, it is possible to do the job with ovals:

The number of intersection points turns out to give the whole story; convexity was a red herring.