1, Diestel 9.3: An *arithmetic progression* is an increasing sequence of numbers of the form $a, a+d, a+2d, a+3d\ldots$. *Van der Waerden's theorem* says that no matter how we partition the natural numbers into two classes, one of these classes will contain arbitrarily long arithmetic progressions. Must there even be an infinite arithmetic progression in one of the classes?

2: i) Find, with proof, a 2-coloring of the edges of $K^6 - e$ such that no K^3 subgraph is monochromatic (has all of its edges colored with one color).

ii) Show that it is possible to remove 5 edges from K^{10} and 2-color the remaining 40 edges without introducing a monochromatic K^3.

iii) Show that removing 4 (or fewer) edges from K^{10} and 2-coloring the remaining edges will always introduce a monochromatic K^3.

3, Diestel 9.9: Prove the following result of Schur: for every $k \in \mathbb{N}$ there is an $n \in \mathbb{N}$ such that, for every partition of $\{1, \ldots, n\}$ into k sets, at least one of the subsets contains numbers x, y, z such that $x + y = z$.

4, Diestel 9.13: Let $m, n \in \mathbb{N}$, and assume that $m - 1$ divides $n - 1$. Show that every tree T of order m satisfies $R(T, K_{1,n}) = m + n - 1$.

5, Diestel 9.16: Show that given any two graphs H_1 and H_2, there exists a graph $G = G(H_1, H_2)$ such that, for every edge-coloring of G with colors 1 and 2, there is either an induced copy of H_1 colored 1 or an induced copy of H_2 colored 2 in G.

6: Let V_n be the set of all binary n-tuples.

The hamming distance between a pair of n-tuples is the number of coordinates in which they differ. A right triangle is a set of 3 n-tuples such that the hamming distance between some pair is equal to the sum of the hamming distances between the other two pairs. Find, with proof, the smallest value of n such that every 2-coloring of the edges of the complete graph on V_n contains a right triangle with all three edges of the same color.