1. Prove by induction that the Binary Search algorithm given as input an array \( A[i : j] \) of \( j - i + 1 \) items in sorted order, and an item \( x \) to search for, works correctly for all integer \( n \geq 1 \).

\[
\text{BinSearch}(A, i, j, x) \quad (* j \geq i *)
\]

\[
\text{mid} = \lfloor (i + j)/2 \rfloor
\]

\[
\text{if } A[\text{mid}] = x \text{ then return(True)}
\]

\[
\text{else if } x < A[\text{mid}] \text{ and } \text{mid} > i
\]

\[
\text{then return(BinSearch}(A, i, \text{mid} - 1, x))
\]

\[
\text{else if } (* x > A[\text{mid}] \text{ and } *) \text{ mid} < j
\]

\[
\text{then return(BinSearch}(A, \text{mid} + 1, j, x))
\]

\[
\text{else return(False)}
\]

2. Let \( G = (V, E) \) be an undirected graph. To edge color \( G \) means to assign each edge a color so that any two edges with a common endpoint have distinct colors (or equivalently, the edges incident on any given vertex all have distinct colors). Let \( D \) be the maximum degree of the vertices in \( G \). Show by induction that \( 2D - 1 \) colors suffice to color \( G \) (in fact, tighter bounds are known).

Hint. Let \( u \) and \( v \) be two vertices joined by an edge. If the edge joining \( u \) and \( v \) is removed from the graph, how many colors at most can be used in coloring the edges incident on (touching) either \( u \) or \( v \)?

3. Omit.

4. Sipser text, no. 1.7b,g (2nd edition), 1.5b,f (1st edition).

5. Sipser text, no. 1.8a, 1.9a, 1.10a (2nd edition), 1.6a, 1.7a, 1.8a (1st edition).