1 Explain why the statement, ‘The running time of algorithm A is at least \( O(n^2) \) is meaningless.’ (5 points)

2 Prove \( n! = \omega(2^n) \) and \( n! = o(n^n) \). (10 points)

3 Is the function \([\log(n)]\)! polynomially bounded? Prove your claim. (15 points)

4 Which is asymptotically larger: \( \log(\log^* n) \) or \( \log^*(\log n) \)? Prove your claim. (20 points)

5 Solve the recurrence \( T(n) = 2T(\sqrt{n}) + 1 \) by making a change of variables. Your solution should be asymptotically tight. Do not worry about whether values are integral. (10 points)

6 Use a recursion tree to give an asymptotically tight solution to the recurrence \( T(n) = T(n - a) + T(a) + cn \), where \( a \leq 1 \) and \( c > 0 \) are constants. Express your answer in terms of \( T(a) \). (10 points)

7 Use the master method to give tight asymptotic bounds for the following recurrences (15 points)
   a. \( T(n) = 4T(n/2) + n \)
   b. \( T(n) = 4T(n/2) + n^2 \)
   c. \( T(n) = 4T(n/2) + n^3 \)

8 Use the master method to show that the solution to the binary-search recurrence \( T(n) = T(n/2) + \Theta(1) \) is \( T(n) = \Theta(\log n) \). (15 points)