1. Prove \( f(n) = 0.1n^3 + 7n \log n + 8n^2 = O(n^3) \).

2. For the following functions \( f(), g() \), \( f(n) = O(g(n)) \) or \( g(n) = O(f(n)) \) but not both. Determine which is true.
   (a) \( f(n) = n^2 + 3n + 4, \quad g(n) = n^3 \).
   (b) \( f(n) = 4n \log n + n, \quad g(n) = (n^2 - n)/2 \).

3. Prove \( f(n) = 3n^2 + 7n + 8 \in \Theta(n^2) \).

4. Show that \( f(n) = 3[n/2] \in \Theta(n) \).

5. Prove that \( 9999n + 635 = O(2^n) \).

6. Which is bigger asymptotically, \( n \) or \( (\log n)^{\log n} \)? Justify your answer.

7. For what constants \( a \) is the following true?
   \[ 2^n + 3^2 = O(a^n) \]

8. Analyze the running time of the following program for matrix multiplication.
   
   ```
   MATMULT(Y, Z, n)
   1 // multiply n x n matrices Y, Z
   2 for i ← 1 to n
   3 do for j ← 1 to n
   4 do X[i, j] ← 0
   5 for k ← 1 to n
   6 do X[i, j] ← X[i, j] + Y[i, k] * Z[k, j]
   7 return x
   ```

9. Analyze the running time of the following algorithm.
   
   ```
   POWER(y, z)
   1 // return y^z where y ∈ R, z ∈ N
   2 x ← 1
   3 while z > 0
   4 do if odd(z)
   5 then x ← x * y
   6 z ← [z/2]
   7 y ← y^2
   8 return x
   ```