Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on a separate sheet of paper.

1. Characterize the rate of growth of each function f below by giving a function g such that $f = \Theta(g)$. The function g should be one of the functions in the table of common functions.

   (a) $f(n) = n^8 + 3n - 4$

   (b) $f(n) = 2 \cdot 3^n$

   (c) $f(n) = 7(\log \log n) + 3(\log n) + 12n$

   (d) $f(n) = 9(n \log n) + 5(\log \log n) + 5$

   (e) $f(n) = n \log_{37} n$

   (f) $f(n) = n^2 1 + (1.1)^n$

   (g) $f(n) = 23n + n^3 - 2$

2. Give complete proofs for the growth rates of the polynomials below. You should provide specific values for c and n_0 and prove algebraically that the functions satisfy the definitions for O, Ω, and Θ.

   (a) $f(n) = (1/2)n^5 - 100n^3 + 3n - 1$. Prove that $f = O(n^5)$.

   (b) $f(n) = n^3 + 3n^2 + 4$. Prove that $f = \Theta(n^3)$.