1. Let $T(n)$ be the running time of Foo (n). Find the order of T. [10%]

   Procedure Foo (integer n):
   for i from 1 to n do
       $x = n$
       while $x > 0$ do
           $x = x - i$

2. Write a function Fastexp such that Fastexp $(x, n) = x^n$ for any real number x and for any positive integer n, using $2*\lg n$ multiplications at most. [10%]

3. What are the minimum and maximum numbers of elements in a heap of height h? [10%]

4. Build the Huffman coding tree and determine the codes for the following set of letters and weights:

A	B	C	D	E	F	G	H	I	J	K	L
2	3	5	7	11	13	17	19	23	31	37	41

   What is the expected cost length in bits of a message containing n characters for this frequency distribution? [10%]

5. Show the result of inserting the keys 1, 2, ..., 10 in ascending order into a 2-3 tree. [10%]

6. A deque, or doubly ended queue, is an abstract data type whose elements can be inserted and deleted at either end. Identify the operations of a queue and the best data structure to implement them. [10%]

7. Suppose a special programming language has stack as its built-in data type (with built-in functions for stacks) but doesn't have array as its built-in data type. Describe how one can implement arrays using stacks in this language. [10%]

8. Draw the breadth-first and depth-first spanning trees of the complete graph with 5 vertices. [10%]

9. Define hash tables and describe 2 methods for handling overflows in a hash table. [10%]

10. Prove that the value in the root of a maximum heap is the largest one in the heap. [10%]