2. Are the following true or false? (0.5 p/point)

   a) If the efficiency of the algorithm is in $O(n)$, it is for sure also in $O(n \lg n)$.
   b) If the efficiency of the algorithm is in $\Omega(n)$, it is for sure also in $\Omega(n \lg n)$.
   c) If the efficiency of the algorithm is in $\Omega(\lg n)$, it is for sure also in $\Theta(\lg n)$.
   d) If the efficiency of the algorithm is in $O(\lg n)$, it is for sure also in $\Theta(\lg n)$.
   e) If the efficiency of the algorithm is in $\Theta(n \lg n)$, it is for sure also in $\Omega(\lg n)$.
   f) If the efficiency of the algorithm is in $\Theta(n \lg n)$, it is for sure also in $O(\lg n)$.
   g) If the efficiency of the algorithm is in $\Theta(n^2)$, it is for sure also in $\Omega(n^2)$.
   h) If the efficiency of the algorithm is in $\Theta(n^2)$, it is for sure also in $O(n^2)$.
   i) Searching for an element in a chained hash table is in $\Theta(1)$
   j) Removing an element from a chained hash table is in $\Theta(1)$
   k) Searching for an element in a singly linked list is in $O(n^2)$
   l) All basic stack operations (STACK-EMPTY, PUSH, POP) have $\Theta(1)$ efficiency

3. a) Define binary tree, completely balanced binary tree, binary search tree, and heap. (1 p)
   b) Integer keys are added in a random order into a binary search tree. What is the asymptotic efficiency of the addition and search operations. (1 p)
   c) Draw a legal red-black tree that contains the keys 2, 5, 6, 8, 11, 12, 12, 13, 16, 17, 23, 23, 31, 32, 35 (and no other keys).(2 p)
   d) Show the order in which the Dijkstra's algorithm goes through the graph below. The node A is the source and the edges are handled in an alphabetical order. Write your answer in the following format: "P grey, Q grey, P black ...". (2 p)