You have 20 minutes.

Problem 1
Points: (1+1)+(3+3)

1. Give the Θ-class of the worst-case time complexity of $contains(x : Set[A], a : A) : bool$ (in terms of $|x|$) if x is represented as a

   (a) bit vector
   (b) list set

2. Consider the set $\{3, 7, 12, 25, 47, 58, 89\} \in Set[\mathbb{N}]$.

   (a) Assume it is represented as a hash set using the hash function

   $$hash : x \mapsto (\text{sum of digits of } x) \bmod 10$$

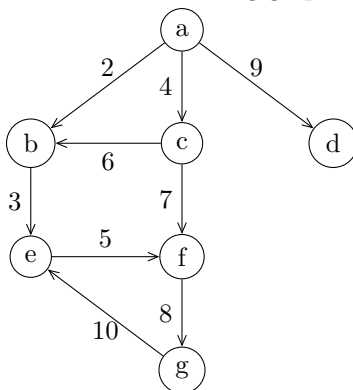   For every bucket, say which elements it contains.

   (b) Assume it is represented as a binary search tree using the ordering $\leq$. Give the binary search tree for the case where the tree is optimally balanced.

Problem 2
Points: 1+1+2+2+2+4

Consider the following graph:

1. Give the out-degree of the node a.

2. Give a cycle in this graph.

3. Give all nodes that are reachable from b.

4. Interpreting the weights as costs, give the cheapest path from a to g.

5. Interpreting the weights as capacities, give the capacity of the greatest flow from a to g.

6. Give the result of applying Kruskal's algorithm.