Foundations of Computer Science

(a) Write brief notes on reference types in ML and on control structures for imperative programming. [6 marks]

Consider the following ML datatype:

```ml
datatype 'a meal = Snack of 'a
| Lunch of 'a meal * 'a meal
| Feast of 'a meal * 'a meal * 'a meal;
```

(b) Write a function that is equivalent to `snacker` below but makes no use of references. Briefly explain why the two functions are equivalent.

```ml
fun snacker m = 
  let val l = ref []
  fun munch (Snack x) = (l := x :: !l)
  | munch (Lunch (m1,m2)) = (munch m1; munch m2)
  | munch (Feast (m1,m2,m3)) =
    (munch m1; munch m2; munch m3)
  in munch m; !l end;
```

[5 marks]

(c) Write a function `gluttony` such that `gluttony m1 m2` makes a copy of `m1`, replacing every `Snack` node with `m2`. [3 marks]

(d) Write a function `glut` such that `glut k m1 m2` makes a copy of `m1`, replacing the `k`th `Snack` node with `m2`. Nodes are counted from left to right, with the leftmost node being number one. [6 marks]