COMPUTER SCIENCE TRIPOS Part IB – 2017 – Paper 3

3 Compiler Construction (TGG)

(*a*) Explain why some programming languages require automatic memory management ("garbage collection") for program execution. [4 marks]

(*b*) At a given point in the execution of a program, what can be considered as garbage? How can garbage be located in memory? [4 marks]

(*c*) Suppose a programmer is implementing garbage collection using reference counting. Discuss whether or not they need to consider the possibility of a reference count overflowing when incremented. [4 marks]

(*d*) Suppose we are writing a compiler for an ML-like language. We want to employ the equation

```
(map f) o (map g) = map (f o g)
```

as a left-to-right rewrite rule for optimisation. The symbol `o` represents function composition — for any value `v` the expression `(f o g) v` evaluates to the value of `f(g v)`.

Discuss the merits of this idea. Is it always correct? [8 marks]