

12 Optimising Compilers (TMJ)

- (a) Describe a procedure's flowgraph and the concept of basic blocks. What language construct makes flowgraph construction imprecise? [3 marks]
- (b) Describe the principle of dominance within a flowgraph, including strict dominance, dominance trees and the dominance frontier. [4 marks]
- (c) Define data-flow equations to find each node's dominators and an algorithm to compute this. [5 marks]
- (d) Describe how to use dominance information to find loops in a flowgraph. [2 marks]
- (e) What is static single assignment (SSA) form? [1 mark]
- (f) Use the dominance frontier to place ϕ nodes into the following code and thereby convert it to SSA form.

```
b1:  LDR  x, #0xFF00
      LDR  y, #0xFF08
      BEQ  x, #0, b9
b2:  BEQ  x, #1, b4
b3:  ADD  x, x, #2
      BR   b5
b4:  ADD  x, x, y
b5:  BEQ  x, #8, b7
b6:  STR  x, #0xFFA0
      BR   b8
b7:  STR  y, #0xFFA0
b8:  ADD  x, x, y
      BR   b10
b9:  ADD  y, y, #1
b10: ADD  x, x, #1
      STR  x, #0xFF00
```

[5 marks]