

## 2004 Paper 12 Question 2

### Computer Design

It is possible to design a single instruction computer (SIC). For example, the instruction Subtract and Branch on Negative is sufficiently powerful. This instruction takes the form “A,B,C,D”, meaning “Read A, Subtract B, Store in C, and Branch to D if negative”. If a branch is not required, the address D can be set to the next instruction in the sequence so that the next instruction will be executed regardless of whether the branch is taken or not. An assembler short form for this branchless instruction is simply “A,B,C”.

- (a) Write fully commented SIC assembler which implements the following pseudo code:

```
a=1;
b=1;
for(i=1; i<n; i++) {
    a=a+b;
    b=a-b;
}
```

[9 marks]

- (b) Reduced instruction set computers typically achieve high performance by optimising the common case. In particular, a regular and simple instruction format typically allows extensive use of pipelining. What pipeline and memory structure would you recommend in order to execute SIC code quickly?

[9 marks]

- (c) How does the density of SIC machine code compare with current commercial processors?

[2 marks]