

5 Numerical Methods (DJG)

- (a) Consider integer division of one two's-complement binary number by another. Programming languages may vary in the result when one argument is negative. What differing conventions might they be following? [2 marks]
- (b) Describe carefully, or give pseudocode for, the standard binary integer long-division procedure. What common fault must it guard against? [6 marks]
- (c) Describe the iteration technique known as successive approximation by bisection. What does it have in common with standard long division? [3 marks]
- (d) Describe carefully, or give code changes to, the standard long division algorithm from part (b) so that it computes two bits of result per iteration. [3 marks]
- (e) Single-precision floating-point representation uses a sign bit, eight bits of exponent, a hidden bit and 23 bits of stored mantissa. Using a consistent encoding, similar or identical to the IEEE standard, give hexadecimal representations of the following four numbers: 1.0, 0.125, 4096.0 and  $-0.0$ . [4 marks]
- (f) Consider different versions of an optimising compiler, each of which uses IEEE standard representation for all variables. Give two reasons why they might compile a floating-point program into code that, when run, produces differing results. [2 marks]