COMPUTER SCIENCE TRIPOS Part IA – 2015 – Paper 1

6 Numerical Methods (DJG)

(*a*) (*i*) How and why is normalisation performed on a floating-point number at the end of an arithmetic operation? [4 marks]

(*ii*) Assuming both operands are normalised and nonzero, what is the maximum degree (number of shifts) of normalisation required in the result of a floating point multiplication? Ignore zero and denormal results. [5 marks]

(*b*) A watertight capsule containing scientific instruments is dropped from a high-altitude plane into the ocean where it must approach close to the sea bottom before floating up for retrieval by a boat. You are provided with subroutines that compute water and air resistance from velocity. Collision with the ocean bottom is a mission failure.

(*i*) Set up a state vector and sketch code for a finite-difference, time-domain simulation of the trajectory in one dimension. Include a check for mission failure. [5 marks]

(*ii*) What three issues will affect your choice of simulation timestep? [3 marks]

(*iii*) Your simulation is now re-coded using interval arithmetic. New subroutines for resistance are provided with interval domain and range giving a pair with the maximum and minimum resistance likely to be encountered. All input parameters are likewise coded as pairs. Summarise how this will affect the state vector and your code. [3 marks]