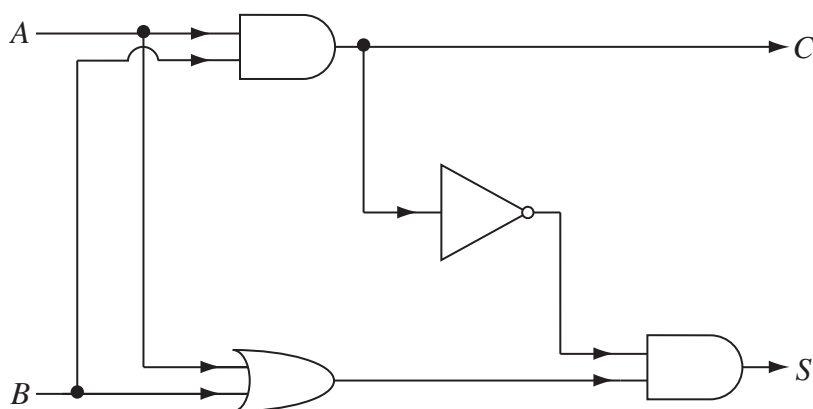


Question 25 — The Software Developer’s View of the Hardware (20 marks)

(a) The diagram shows a half-adder circuit.



- (i) Draw a truth table for this circuit. 2
 - (ii) Describe how to construct a full adder by using two half adders. 2
A diagram may be used to illustrate your answer.
- (b) Describe the differences between integer representation and floating point representation of numbers. Give an example where each would be appropriate. 4

Question 25 continues on page 20

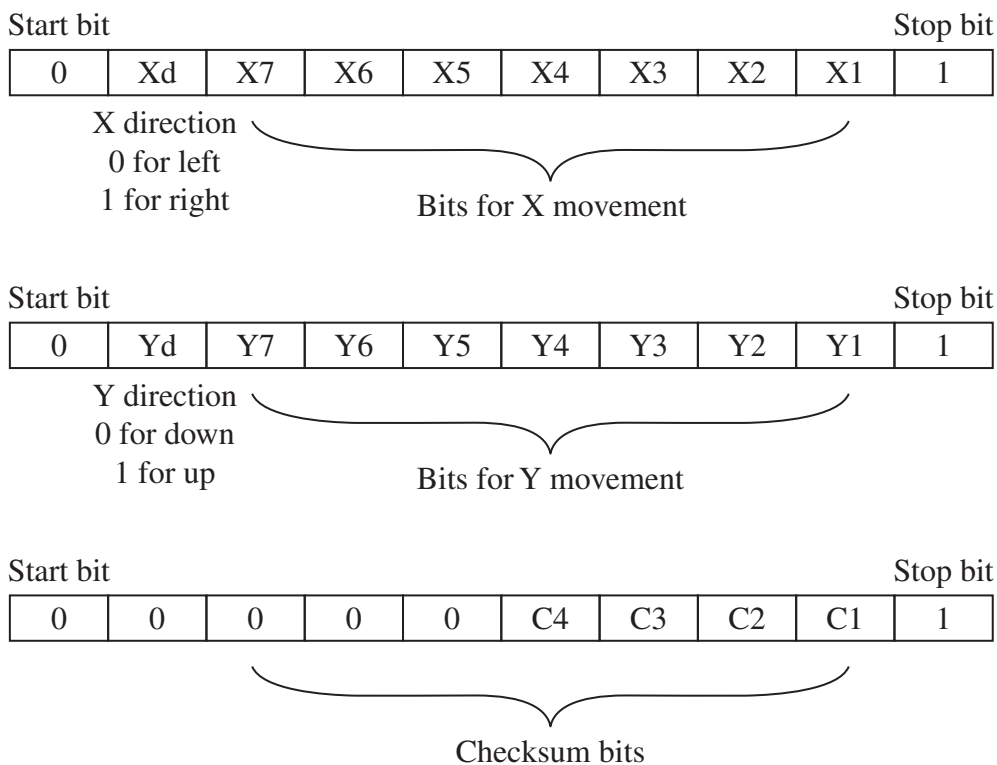
Question 25 (continued)

- (c) Uncle Bill's Toy Company is producing a computer-controlled toy car. Commands to move the car are sent via an infra-red signal from a device connected to a port on the computer. The data stream sent consists of three consecutive data packets, each of which contains a start bit, a stop bit and eight data bits.

The eight data bits for the first and second packets represent the movement of the car in the X and Y directions respectively. The first of the eight bits is an instruction for direction (0 is for left or down while 1 is for right or up). The remaining seven bits are for the movement of the car in the required direction, measured in millimetres.

The eight data bits in the third packet are used as a checksum on the first two packets. The data bits from the two packets are added, the sum is divided by 13 and then the remainder found. This is checked against the checksum packet to ensure correct transmission of the signal.

Hence the general format of the three packets in the data stream is:



Question 25 continues on page 21

Question 25 (continued)

The first two packets of one such data stream are 0101100101 0110100111.

- (i) Describe the exact movement that this sequence represents. **3**
- (ii) Calculate the remainder that will be used as the checksum for this data stream. **3**
- (iii) The software that controls the toy car's movement must first ensure that the message was received correctly. This means that the data stream needs to be of the correct length as well as having the correct checksum. **6**

The software must then extract the movement data from the input data stream and move the car accordingly.

Using pseudocode, write a structured algorithm that will correctly carry out these two tasks for an input data stream that is stored in the variable *StringIn*.

Your algorithm will need to include modules for:

- extracting the required data from the data stream;
- checking the data stream both for length and against the checksum;
- moving the toy car the correct distance in each direction.

End of paper