

1. In a particular computer system, real numbers are stored using floating-point representation with:

- 12 bits for the mantissa
- 4 bits for the exponent
- two's complement form for both mantissa and exponent.

(a) Calculate the normalised floating-point representation of +4.5 in this system. Show your working.

Mantissa	Exponent
<div style="position: absolute; left: 5px; top: 5px;">•</div>	

[3]

(b) Calculate the normalised floating-point representation of -4.5 in this system. Show your working.

Mantissa	Exponent
<div style="position: absolute; left: 5px; top: 5px;">•</div>	

[3]

(c) Calculate the denary value for the following binary floating-point number. Show your working.

Mantissa	Exponent
<div style="position: relative;"> <div style="position: absolute; left: 5px; top: 5px;">•</div> 0 0 0 1 1 0 0 0 0 0 0 0 </div>	0 1 0 1

[3]

(d) (i) State whether the floating-point number given in **part (c)** is normalised or not normalised.

[1]

(ii) Justify your answer given in **part (d)(i)**.

[1]

(e) The system changes so that it now allocates eight bits to both the mantissa and the exponent. Explain **two** effects this has on the numbers that can be represented.

[4]

2. In a multiprogramming environment the operating system includes a scheduler.

- (a) Explain the purpose of the scheduler [2]
- (b) A process will at any time be in one of three states.
 (i) Name and describe each possible state. [6]
 (ii) How will the operating system keep details about the state of all processes? [1]
- (c) Describe the objectives of scheduling in a multi-programming operating system. [3]
- (d) Describe **two** common scheduling policies. [4]
- (e) State **two** methods by which the priority of a job may be determined. [2]

3. (a) BitTorrent is a protocol used on a particular network model for the exchange of data.

- (i) State the network model used with this protocol. [1]
 (ii) State the use of BitTorrent. [1]
 (iii) Explain how applications use BitTorrent to exchange data. [4]

The TCP/IP protocol suite can be viewed as a stack with four layers.

(b) Copy and complete the stack by inserting the names of the three missing layers.

Application layer

[3]

(c) FTP is an application layer protocol. Name another application layer protocol.

[1]

(d) A router is a vital component in the structure of the Internet. In which layer of the TCP/IP protocol stack does a router operate? [1]

4. Write the following Boolean expressions in their simplest forms.

(i) $\overline{\overline{X} \cdot \overline{Y}}$

(ii) $\overline{Y + Y} \cdot \overline{C}$

(iii) $\overline{X \cdot Y + X \cdot \overline{Y}}$

(iv) $\overline{X \cdot (Y + 1)}$

[4]

5 A bank has 95 000 customers. Each customer has a unique ID.

When a customer uses an Automated Teller Machine (ATM) to obtain cash, their current balance is checked. The balance is stored in a file which has the following fields:

- the customer ID (6-digit number in the range 100000 to 999999)
- an encrypted PIN
- the current balance

The file can store a maximum of 100 000 records.

(a) Give a reason why a random organisation would be appropriate for this file.

[1]

(b) An algorithm for inserting a new record in this file uses the following hash function:

$\text{RecordKey} = \text{CustomerID} \text{ MOD } 100000$

where RecordKey is the record position in the file.

(i) Complete the table to show the values generated by the hash function for the given customer IDs.

CustomerID	RecordKey
802139	2139
700004	
689998	
102139	

[1]

(ii) State the range of possible values for RecordKey.

Minimum value of RecordKey:

Maximum value of RecordKey:

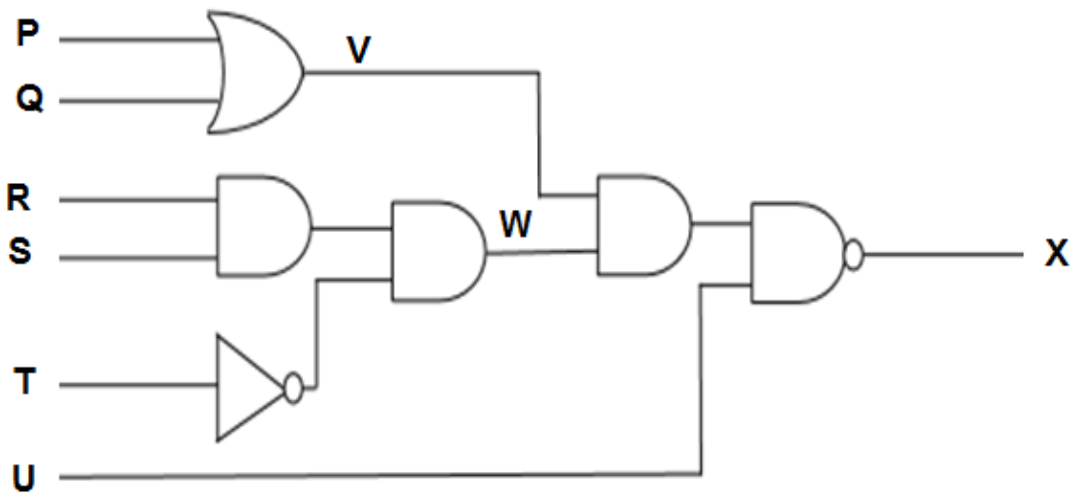
[2]

(iii) A procedure is written to insert a new record into the file.
Complete the algorithm for this procedure.

```
PROCEDURE InsertRecord (CustomerID : INTEGER)
    RecordKey ← CustomerID MOD 100000
    Success ← FALSE
    // Find position for new record and insert it
    REPEAT
        IF record at position RecordKey is .....
            THEN
                Insert new record at position RecordKey
                Success ← TRUE
            ELSE
                IF RecordKey = .....
                    THEN
                        RecordKey ← .....
                    ELSE
                        RecordKey ← ..... + 1
                    ENDIF
                ENDIF
            UNTIL Success = TRUE
    ENDPROCEDURE
```

[4]

6. The figure given below shows a logic circuit.

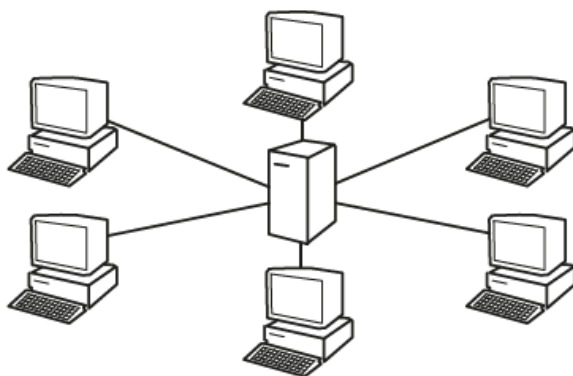


Copy and complete the truth table for the inputs that have been given.

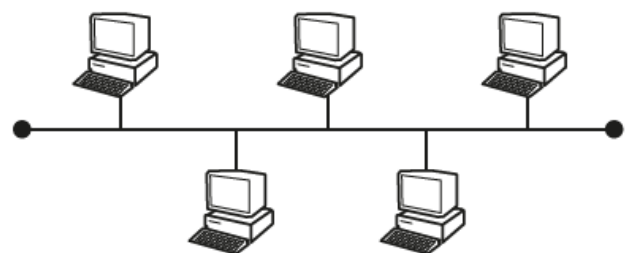
Inputs								
P	Q	R	S	T	U	V	W	X
0	0	1	1	0	0			
0	1	1	1	0	1			
1	0	1	1	1	0			
1	1	1	1	1	1			

[3]

7. Star and bus are two types of topology that can be used in a Local Area Network (LAN).



Star topology



Bus topology

- (a) (i) State **one** benefit and **one** drawback of the star topology.
 (ii) State **one** benefit and **one** drawback of the bus topology.

[2]

[2]

(b) The sequence of steps 1 to 7 describes what happens when the LAN transmits data from Computer X to Computer Y using circuit switching.

A	Computer X sends the data.
B	The sender signals node to deallocate resources.
C	Computer Y sends a receipt signal.
D	If available, Computer X sets up path between nodes.

Four statements (4 to 7) are missing from the sequence.

Copy the sequence below on your answer sheet and write **one** letter (**A** to **D**) in the appropriate space to complete the sequence.

- 1 Computer X sends a connection request to Computer Y.
- 2 Computer Y sends ready or busy signal.
- 3 If busy, Computer X waits and then resends the connection request to Computer Y.
- 4
- 5
- 6
- 7

[3]

8. A company uses a computerised payroll system. Details of the work done by employees each week are stored serially in a transaction file. This transaction file is used to create the payroll at the end of the week. It has to be sorted into the same order as the master file.

It is necessary to find and output all the records in the transaction file which relate to a worker with ID number 23714.

(a) Describe how the file can be searched serially for all records with ID number 23714.

[4]

(b) Explain how the serial search would differ if it was known that there was only one record with that ID number.

[2]

(c) Describe a more efficient search algorithm if the file is in numerical order of ID numbers.

[3]