N00/650/H(1)M

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MARKSCHEME

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COMPUTER SCIENCE

Higher Level

Paper 1

14 pages

SECTION A

1. *(Award **[1 mark]** for the idea that it (is hardware/software combination that) connects networks together; idea that it directs data to the appropriate path.)*

2. *(Award **[1 mark]** for temporary;*
*and **[1 mark]** for store/memory.)*

3. (a) *(Award **[1 mark]** for the idea that it's a data-structure whose items are added to the rear of a queue/one end;*
*and **[1 mark]** that items are removed from the front/other end.)*

Give ***[2 marks]*** for stating that it is a First-in, First-out structure (or Last-in, Last-out). Give NO marks for just stating FIFO structure!
DO NOT accept any facile comments about supermarket queues *etc*. – this is a Higher Level Computer Science exam!

(b) *(Award **[1 mark]** for a valid application, and a second mark for an attempt at a valid description:)*

- Jobs waiting to be executed by a computer, a new job is added to the end, computer executes next job from front;
- Keyboard buffer storing data whilst the processor is busy doing another task;
- Spooling output to a disk to await printing, new jobs added at the end, printer deals with jobs from front/accept idea as a print queue in general.

4. *(Award **[1 mark]** for O(n logn))*

5. (a) Two (or more) different values can give the same result from the hash algorithm. ***[1 mark]***

(b) *(Award **[1 mark]** for a valid method, and a second mark for an attempt at a valid description:)*

- Locate next free space and store data item there;
- Have an overflow area with a marker/pointer to it.

6. *(Award **[1 mark]** for a correct stage, and a second mark for a correct elaboration, up to a maximum of **[6 marks]**.)*

- Systems analysis, an investigation which leads to a precise statement of the problem;
- Software/program design, a breakdown of the problem statement into its constituent parts from which coding can take place;
- installation/operation, the introduction of the system so that it can be used by the end-user;
- maintenance, where the system is checked for errors/improvements which will lead to another cycle.

7. *(Award the marks as indicated below; up to* ***[4 marks]*** *max:)*

- A function should return one value;
- which is returned by the function name/itself;
- parameters should not change/no ‘side-effects’;
- since this would mean more than one value is returned;
- so there is no need for pass-by-reference parameters;
- which can be changed;
- unlike pass-by-value parameters (which can’t be altered);
- so pass-by-value parameters should be used;
- unless pass-by-reference parameters are used to save memory;
- and the values are not changed.

8. *(Award up to* ***[2 marks]*** *for an outline of encapsulation and up to* ***[2 marks]*** *for an outline of polymorphism:)*

Encapsulation: *(Award* ***[1 mark]*** *for each of the points indicated below; up to* ***[2 marks]*** *max:)*

- the combination of data and the operations that act on the data;
- into a single unit/object;
- allowing information/data hiding.

Polymorphism: *(Award* ***[1 mark]*** *for each of the points indicated below; up to* ***[2 marks]*** *max:)*

- The same operation can be applied to different objects;
- and the object behaves appropriately/‘differently’;
- allowing simpler/generic code.

9. *(Award* ***[1 mark]*** *for identifying a valid benefit, and up to* ***[2 marks]*** *for a clear explanation, for two benefits, giving* ***[6 marks]*** *max:)*

- many users can access the data at the same time:
- this means that users can view the data when they want;
- without having to wait if someone else is using it;
- without having to move to a central file/computer;
- because they can access it from their own terminals.

(Note the above can be separated into two points, i.e. ‘many users’ and ‘many terminals/locations’ - this is acceptable for two separate advantages.)

- data integrity is easier to maintain:
- with only one copy of the data, rather than many copies;
- any changes are recorded in the central database;
- meaning that there are not separate files with different data as individual ones are updated.

10.

A	B	AxorB	
0	0	0	***[1 mark]***
0	1	1	***[1 mark]***
1	0	1	***[1 mark]***
1	1	0	***[1 mark]***

$= \overline{A}.B + A.\overline{B}$ ***[1 mark]***

$(A + B).\ (\overline{A.B})$

$(A + B).\ A$

11. *(Award **[1 mark]** for identifying a suitable advantage other than speed-related, and **[1 mark]** for a further correct elaboration, and **[1 mark]** for identifying a suitable disadvantage, and **[1 mark]** for a further correct elaboration, up to a max of **[4 marks]**.)*

ADVANTAGES:

- Security:
  - email will only deliver to the specified address (whereas normal mail could be opened by another person); or
  - email addresses usually require a password to access it (whereas physical mail can be opened by another person);
- Economy:
  - in most countries the cost of a local call is cheaper than the international mail rate;
- Convenience:
  - the mail can be sent without having to move from the computer (unlike a letter which needs to be packaged, weighed, correct stamps bought *etc.*);

Do NOT accept:

- Multiple sendings: the same email can be sent to a group of people. (So can a document, *i.e.* photocopy it!) This idea CAN be accepted IF the candidate explains that it would save the **inconvenience** of photocopying *etc.*, because then it's the previous point!
- Attach and send replies *etc.* because this can be done with physical documents; *i.e.* don't accept tasks that are equally valid with paper documents.

DISADVANTAGES:

- The original document is not received:
  - this may be required in some cases (*e.g.* legal contracts);
- No physical items can be included:
  - additional articles cannot be included such as a product sample (or even separate handwritten notes *etc.* - see next point);
- Personalised notes may be lost:
  - although notes *etc.* can be scanned and so the original layout/format/colour maintained, this is more difficult than simply enclosing original notes/letters and so personal comments/intimations may be lost. (Accept the more concrete "this cannot be done" from a candidate, as well as the correct "more difficult").

SECTION B

12. (a) Boolean. ***[1 mark]***

(b)

HALF	MIDDLE	POSITION	SAME	COUNT	
3	4	1	true	1	***[1 mark]***
		2	false		***[1 mark]***
		3	true	2	***[1 mark]***

(c) *(Award **[2 marks]** for a complete explanation, **[1 mark]** for a partial answer.)*

Complete answers:

It counts the number of values that are equal ***[1 mark]*** at equivalent (opposite) locations from the centre ***[1 mark]***.

It tests matching entries from the centre ***[1 mark]***, counting how many are equal ***[1 mark]***.

It tests symmetrical/balancing locations ***[1 mark]*** , seeing how many are equal ***[1 mark]***.

It counts the number of entries which are the same ***[1 mark]*** mirrored about the centre/middle (of the array) ***[1 mark]*** *etc.*

Partial answers:

It counts how many entries make it a palindrome ***[1 mark]***.

It tests if it is a palindrome ***[1 mark]***.

It counts if the ends are equal ***[1 mark]***.

It looks as if it is a mirror ***[1 mark]*** *etc.*

(d) *(Award marks as follows:)*

– ***[1 mark]*** for stating that `COUNT` changes within the procedure;
– ***[1 mark]*** for the idea that it needs to be passed back to (or 'used' by) the calling routine/main program.

(e) (*Award marks as follows, up to a maximum of **[2 marks]**:)*

– ***[1 mark]*** for identifying that a function returns a single value;
– ***[1 mark]*** for stating that since this is what the algorithm does it is appropriate;
– ***[1 mark]*** since there is only one 'out' parameter;
– ***[1 mark]*** and the others are 'in' parameters;
– ***[1 mark]*** the value can be passed back via a function name.

(Check other apparently correct answers with your team leader.)

13. (a)

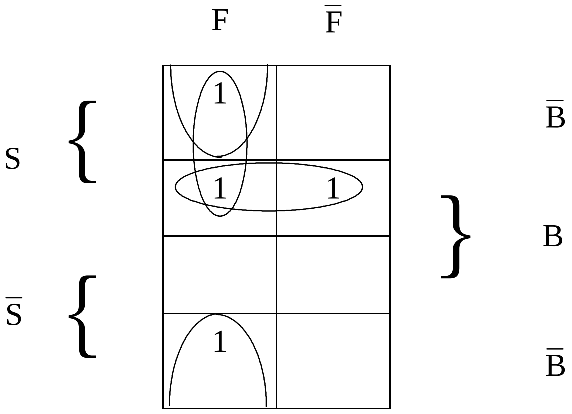
F	S	B	N
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

[1 mark] for all 8 inputs.
[3 marks] for all N correct (subtract ***[1 mark]*** for each incorrect value, do **not** award negative marks!)

(b) $N = \overline{F}SB + F\overline{S}\,\overline{B} + FS\overline{B} + FSB$ ***[1 mark]***

(or $SB + FS + F\overline{B}$)

(c) Using a Karnaugh Map:



		F	$\bar{F}$	
S		1		$\bar{B}$
		1	1	B
$\bar{S}$				B
		1		$\bar{B}$

$N = SB + F\bar{B}$

By Boolean Algebra:

$\bar{F}SB + F\bar{S}\bar{B} + FS\bar{B} + FSB$

$SB(\bar{F}+F) + F\bar{B}(\bar{S}+S)$

$=SB+F\bar{B}$

[1 mark] for any simplification by 1 level.
[2 marks] for simplifying by 2 or more levels.
[3 marks] if final solution uses 4 gates (if <u>only</u> final solution is given <u>and</u> correct, candidate gets all ***[3 marks]***).

N.B: if candidate does not attempt this part, but gave answer as $FS + F\bar{S}\bar{B} + \bar{F}SB$ in part (b), give ***[1 mark]*** here (for implicit simplification by 1 level).

(d) The number of bits available is not enough for answer ***[1 mark]*** so MSB becomes 1 indicating a negative value ***[1 mark]***.

(If candidate shows calculation and a 1 ends up in MSB give ***[1 mark]***, with explanation gets second mark.)

14. (a) (i) *(Award the marks as follows:)*

As the year changed to 2000, the date (`NOW`) would have been stored as 00; ***[1 mark]*** so subtracting a value from it would have given a negative value/wrong value ***[1 mark]***

Do NOT accept ‘millennium bug’ without an explanation.

(ii) • *(Award* ***[2 marks]*** *for a clear description (****[1 mark]*** *for a partial answer):)*

The new algorithm will work for any account that is not open for more than 99 years. There is no time limit (*i.e.* it does not stop functioning in 2100).

• *(Award a further* ***[1 mark]*** *for showing a correct calculation, and the remaining second mark for explaining how an account 100 years earlier is wrong; OR* ***[2 marks]*** *for explaining how an account opened over 100 years ago is wrong:)*

– If NOW was 2101 (*i.e.* 01) and an account was opened in 2099 (*i.e.* 99) answer should be 2. Calculation gives 01+100-99 = 2, correct. But same answer would be given for 1999 instead of 102, *i.e.* wrong.

OR

– If an account was opened in 1950, and `NOW` is 2051. The calculation would give 51-50 which gives 1 year, instead of 101.

(b) *(Award* ***[1 mark]*** *for a valid point regarding system documentation, and a second mark for an elaboration, for two points, up to* ***[4 marks]*** *max:)*

– Structure diagrams/data flow diagrams *etc.* ***[1 mark]***
show the logic of the algorithm, so it would be easy to detect where the change is needed. ***[1 mark]***

– An annotated program listing/description ***[1 mark]***
would guide a programmer to where the required calculation is located to be altered. ***[1 mark]***

15. (a) (Award ***[2 marks]*** for a complete answer, ***[1 mark]*** for a partial answer.)

If one sensor malfunctions/breaks down ***[1 mark]*** it will be detected by comparing with the other two ***[1 mark]*** (*i.e.* two will give one reading, the broken one a different reading - this would get the explanatory mark).

"In case one breaks down" gets ***[1 mark]***.
"In case it breaks down" gets ***[0 marks]***.
DO NOT accept for taking readings at different/three places. (The question states they are at **one** place.)

(b) ***[1 mark]*** for:

Analog(ue) to digital conversion. (Do **not** accept just ADC.)

(c) *(Award **[1 mark]** for any of the following points, up to **[3 marks]** max:)*

– Each sensor is monitored/read/accessed;
– in turn/on a regular basis;
– The (master) processor requests data in a "round-robin" approach;
– Data is stored from each sensor (for processing);

Accept (for full marks):
– Each sensor stores data in a(n input) buffer/after ADC data is stored in a buffer;
– The processor compares the three readings for equality before starting polling again.

(d) *(Award **[1 mark]** for each point where a comparison is valid, and a further mark for an elaboration, for two separate points, giving a maximum of **[4 marks]**:)*

– Speed of data flow ***[1 mark]***
– Because bits are sent simultaneously/at the same time in parallel, it is faster than serial where they are sent one after the other. ***[1 mark]***

"Parallel connection is faster than serial connection" is worth ***[1 mark]*** for the valid comparison point, but no more.

"Parallel is faster because the bits are sent at the same time" is worth ***[1 mark]***.

"Parallel is faster because the bits are sent at the same time but serial is one after the other" is worth ***[2 marks]***.

– Links/lines/'cables' ***[1 mark]***
Only one line is required in serial transmission (with bits sent consecutively) where many lines are required in parallel (due to simultaneous bit transmission). ***[1 mark]***

16. (a) (*Award **[1 mark]** for any of the following points up to **[3 marks]** max:)*

(NOTE: The question asks for WHY defragmentation is required NOT how!)

- As data/files are deleted and added;
- contiguous data is not physically next to each other on the disk;
- hence the disk head has to move much more to retrieve data;
- which slows down the (reading) process.

DO NOT accept answers relating to movement of records within files.

(b) *(Award **[3 marks]** for a clear description of timesharing as follows (just stating 'timesharing' or 'multitasking' gets **[1 mark]**), up to **[3 marks]** max:)*

- Using timesharing/multitasking ***[1 mark]***;
- processor time is divided between the two programs ***[1 mark]***;
- each program is given a set timeslice/period of time ***[1 mark]***;
- after which the other program is given a timeslice, and this process is repeated ***[1 mark]***;
- the switching between programs occurs so fast ***[1 mark]*** that to the user it appears that both are running simultaneously/at the same time.

(c) *(Award **[1 mark]** for each of the following points, up to **[4 marks]** max;)*

- Each email message has the address of the receiver (and of the sender);
- The message is sent around the LAN (in 'packet/s');
- The server stores the message;
- and sends a message to the secretary that email has been received;