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MARKSCHEME

November 2012

COMPUTER SCIENCE

Higher Level

Paper 1

General Marking Instructions

After marking a sufficient number of scripts to become familiar with the markscheme and candidates' responses to all or the majority of questions, Assistant Examiners (AEs) will be contacted by their Team Leader (TL). The purpose of this contact is to discuss the standard of marking, the interpretation of the markscheme and any difficulties with particular questions. It may be necessary to review your initial marking after contacting your TL. **DO NOT BEGIN THE FINAL MARKING OF YOUR SCRIPTS IN RED INK UNTIL YOU RECEIVE NOTIFICATION THAT THE MARKSCHEME IS FINALIZED.** *You will be informed by e-mail, fax or post of modifications to the markscheme and should receive these about one week after the date of the examination. If you have not received them within 10 days you should contact your TL and the IB Assessment Centre. Make an allowance for any difference in time zone before calling.* **AEs WHO DO NOT COMPLY WITH THESE INSTRUCTIONS MAY NOT BE INVITED TO MARK IN FUTURE SESSIONS.**

You should contact the TL whose name appears on your "Allocation of Schools listing" sheet.

Note:
Please use a personal courier service when sending sample materials to TLs unless postal services can be guaranteed. Record the costs on your examiner claim form.

General Marking Instructions

1. Once markscheme is received mark in pencil until final markscheme is received.

2. Follow the markscheme provided, do **not** use decimals or fractions and mark only in **RED**.

3. Where a mark is awarded, a tick (✓) should be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark.

4. Sometimes, careful consideration is required to decide whether or not to award a mark. Indeed, another examiner may have arrived at the opposite decision. In these cases write a brief annotation in the **left-hand margin** to explain your decision. You are encouraged to write comments where it helps clarity, especially for moderation and re-marking.

5. Unexplained symbols or personal codes/notations on their own are unacceptable.

6. Record subtotals (where applicable) in the right-hand margin against the part of the answer to which they refer. Show a mark for each part question (a), (b), *etc.* Do **not** circle sub-totals. Circle the total mark for the question in the right-hand margin opposite the last line of the answer.

7. Where an answer to a part question is worth no marks, put a zero in the right-hand margin.

8. **Section A:** Add together the total for the section and write it in the Examiner Column on the cover sheet.
Section B: Record the mark awarded for each of the six questions answered in the Examiner Column on the cover sheet.
Total: Add up the marks awarded and enter this in the box marked TOTAL in the Examiner Column on the cover sheet.

9. After entering the marks on the cover sheet check your addition of all marks to ensure that you have not made an arithmetical error. Check also that you have transferred the marks correctly to the cover sheet. **We have script checking and a note of all clerical errors may be given in feedback to all examiners.**

10. Every page and every question must have an indication that you have marked it. Do this by **writing your initials** on each page where you have made no other mark.

11. A candidate can be penalized if he/she clearly contradicts him/herself within an answer. Once again make a comment to this effect in the left-hand margin.

Subject Details: Computer Science HL Paper 1 Markscheme

Mark Allocation

Section A: Candidates are required to answer **all** questions. Total 40 marks.
Section B: Candidates are required to answer **all** questions. Total 60 marks.
Maximum total = 100 marks.

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for that part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each statement worth one point has a separate line and the end is signified by means of a semi-colon (;).

- An alternative answer or wording is indicated in the markscheme by a "/"; either wording can be accepted.

- Words in (…) in the markscheme are not necessary to gain the mark.

- If the candidate's answer has the same meaning or can be clearly interpreted as being the same as that in the markscheme then award the mark.

- Mark positively. Give candidates credit for what they have achieved and for what they have got correct, rather than penalizing them for what they have not achieved or what they have got wrong.

- Remember that many candidates are writing in a second language; be forgiving of minor linguistic slips. In this subject effective communication is more important than grammatical accuracy.

- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with "**FT**".

SECTION A ***Total: [40 marks]***

1. *Award up to **[2 marks max]**.*
Primary memory size;
Processor (frequency, word length);
Backing storage capacity;
I/O devices;
Cost;
Design;
etc. ***[2 marks]***

2. *Award up to **[2 marks max]**.*
Larger parts of programs from RAM could be stored in it;
Since cache memory is faster than RAM / instructions will be retrieved from cache memory faster than from RAM;
Computer will run faster; ***[2 marks]***

3. All data and programs are stored in digital form within the computer;
So all non-digital/analog values must be changed into digital form; ***[2 marks]***

4. *Award up to **[2 marks max]**.*
Prototype could be used to obtain an early feedback from the end user;
To avoid unnecessary work;

Or

Prototype could be used for investigation;
Which allows preparation of better or alternative solution; ***[2 marks]***

5. *Award up to **[3 marks max]**.*
Before sending data a parity bit is calculated from data;
To make the number of 1s an even/odd number;
This bit is added to the data and sent as an integral unit;
After receiving data number of 1s is calculated;
If it is not an even/odd number an error is indicated; ***[3 marks]***

6. *Award up to **[4 marks max]**.*

E-mail	Video conferencing
E-mail message can be quickly prepared, sent, and information is exchanged	Time consuming arrangements to make sure all staff are ready at the same time before any information is exchanged
Different time zones / if recipients are not currently available e-mail message will wait	All recipients must be available at the same time
Hard copy of correspondence available for future use	No hard copies
etc.	

[4 marks]

7. The time needed for the disk to rotate the read-write heads to move until the heads are over the searched data; ***[1 mark]***

8. (a) *Award **[1 mark]** for normalization, **[1 mark]** for mantissa and **[1 mark]** for exponent.*
$1110.011_{(2)}$ = (normalization) = $0.1110011_{(2)} \times 10^{100}{}_{(2)}$;
Mantissa 01110011;
Exponent 0100; ***[3 marks]***

(b) An error that occurs when attempting to store a number greater than the largest number that can be represented; ***[1 mark]***

9. `A B C * + D +`;
*Award **[1 mark]** for another possible conversion* `A B C * D + +`. ***[1 mark]***

10. 6; ***[1 mark]***

11. *Award up to **[2 marks max]**.*
Database/data files;
Software;
Backing storage devices;
Output devices / printer;
etc. ***[2 marks]***

12. *Award up to **[2 marks max]**.*
Fibre optic cable;
Digital line/ISDN line/ADSL;
Satellite link; ***[2 marks]***

13. *Award **[1 mark]** for all correct values on the main diagonal, **[1 mark]** for correct values in upper triangle and **[1 mark]** for correct values in lower triangle.*

1	0	0
1	2	0
1	1	1

[3 marks]

14. (a) RAM; ***[1 mark]***

(b) Program counter; ***[1 mark]***

(c) A register in the ALU;
That holds all temporary results; ***[2 marks]***

15. *Award up to* ***[3 marks max]****.*
To transfer data/instructions;
Control signals;
Addresses;
Within the CPU;
When decoding instruction;
When fetching values a and b from RAM;
Executing;
And storing result in x(RAM); ***[3 marks]***

16. *Award up to* ***[4 marks max]****.*
Award ***[2 marks]*** *for any described advantage to society,*
For example helping persons with disabilities to work.
Award ***[2 marks]*** *for any described disadvantage to society,*
For example illegal activities such as credit card fraud, piracy, *etc.* ***[4 marks]***

SECTION B ***Total: [60 marks]***

17. (a) *Award* ***[1 mark]*** *for the use and* ***[1 mark]*** *for indicating why it is better for each part.*

(i) Interview allows the analyst to ask questions in response to vague answers from interviewee which cannot be done with questionnaires; ***[2 marks]***

(ii) Questionnaire is better because it is prepared in format that allows easier/faster analysis of answers obtained from many users; ***[2 marks]***

(b) *Award up to* ***[2 marks max]****.*
Solutions could be of different cost;
So the management can select one which is in current situation better for the firm;

Or

Solutions could require different amounts of time;
So management can select one depending on the urgency of using the computer system; ***[2 marks]***

(c) *Award* ***[1 mark]*** *for the clearly explained task,* ***[1 mark]*** *for a vague answer,* ***×2****.*
Software should be fully tested with test data to make sure it is working correctly;
Staff should be trained to be ready to use the computer system;
All data files should be converted/created into a format accessible by the new software otherwise they could not be used by the system because of incompatible formats;
etc. ***[4 marks]***

Total: [10 marks]

18. (a) (i) *Award **[1 mark]** for each data type, up to **[3 marks max]**.*
Student Code: String;
Score: int / accept any numeric data type;
Passed: boolean/String; ***[3 marks]***

(ii) *Award up to **[3 marks max]**.*
An array of records/objects;
With 200 elements / size of at least 200;
Each record/object contains the three data items (code, score, passed);

Or

Three parallel arrays;
Each with 200 elements / each of size of at least 200;
String array for codes, integer / any numeric array for scores and boolean/String array for passed/failed;

Or

A linked list of records/objects;
With unlimited size ;
Each record/object contains the data field with three data items (code, score, passed);
And a link field; ***[3 marks]***

(b) *Award **[1 mark]** for device, **[1 mark]** for data preparation requirements, **×2**, up to **[4 marks max]**.*

To capture Student Code
Input device: bar code reader;
Bar codes should be prepared;

Or

Input device: keyboard;
No need for data preparation;

To capture Students' answers to questions
Input device: scanner;
Answer sheets with area to be marked/shaded should be prepared;

Passed (Yes/No) will not be captured, it will be automatically processed;
No need for data preparation; ***[4 marks]***

Total: [10 marks]

19. (a) Multi-tasking; ***[1 mark]***

(b) (i) A data structure in which items are added to the tail (one end) and removed from the head (another end); ***[1 mark]***

(ii) *Award up to **[2 marks max]**.*
Print queue;
Keyboard queue;
Accept any other job queue; ***[2 marks]***

(c) *Award up to **[2 marks max]**.*
Area within the memory (the first buffer) is reserved for data to be sent to printer;
The printer has a buffer (the second buffer) that holds data to be printed out;
When one buffer is emptied the other is filled up; ***[2 marks]***

(d) *Award up to **[4 marks max]**.*
When the printer buffer is empty an interrupt bit is set;
In the interrupt register;
The current process / execution of student's program is suspended;
Its current state saved;
Processor sends a signal to fill a printer buffer;
The interrupt bit in interrupt register is cleared;
Execution of student's program continues; ***[4 marks]***

Total: [10 marks]

20. (a) Logical representation is how we see the data and links between the data items;
Whilst physical representation is how the data is stored in computer memory (number of bytes used to represent data/links, memory addresses, *etc.*); ***[2 marks]***

(b) (i) Sequential/linear search; ***[1 mark]***

(ii) O(n); ***[1 mark]***

(c) (i) *Award marks for description of the tree / labelled diagram which includes the following, up to **[4 marks max]**.*
Node containing 2 data fields;
And 2 link fields;
Root;
Data about the student with surname less than the surname in a node/root;
Is placed in the left subtree;
Otherwise is placed in the right subtree; ***[4 marks]***

(ii) Required name is compared with the name in the root/node;
Then recursively traversing left or right subtree as appropriate; ***[2 marks]***

Total: [10 marks]

21. (a) `(n == 0) || (n == 1);` ***[1 mark]***

(b)
```
y = calculate(2 + calculate(1));
  = calculate(2 + 1) = calculate(3);
  = 3 + calculate(2);
  = 3 + 2 + calculate(1);
  = 3 + 2 + 1 = 6;
```
[5 marks]

(c) (i) `n >= 0;` ***[1 mark]***

(ii) *Award up to* ***[1 mark max]****.*
For `n < 0` recursion will never terminate;
Stack overflow error;
Run time error; ***[1 mark]***

(iii) Terminating condition could be changed to `(n <= 1)`; ***[1 mark]***

(iv) Stack; ***[1 mark]***

Total: [10 marks]

22. (a) *Award up to* ***[2 marks max]****.*
xor operation returns true if and only if two inputs are different;
False otherwise;

Award marks for the appropriate truth table.

A	B	A **xor** B
0	0	0
0	1	1
1	0	1
1	1	0

[2 marks]

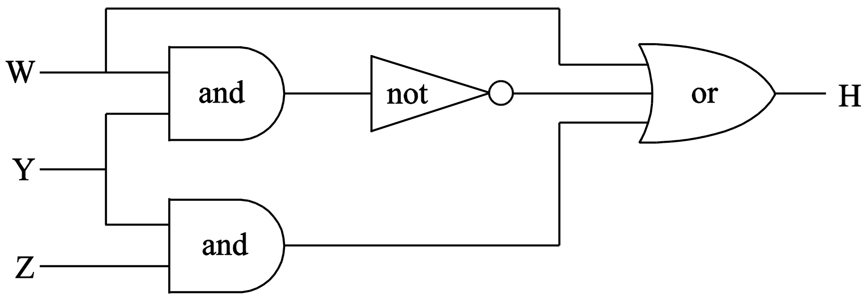
(b) (i) $X = \overline{A} \bullet B \bullet \overline{C} + \overline{A} \bullet B \bullet C + A \bullet \overline{B} \bullet \overline{C} + A \bullet \overline{B} \bullet C$
Award only ***[1 mark]*** *where there is a minor error.* ***[2 marks]***

(ii) *Award up to* ***[3 marks max]****.*

$$X = \overline{A} \bullet B \bullet \overline{C} + \overline{A} \bullet B \bullet C + A \bullet \overline{B} \bullet \overline{C} + A \bullet \overline{B} \bullet C$$
$$= \overline{A} \bullet B \bullet (\overline{C} + C) + A \bullet \overline{B} \bullet (C + \overline{C});$$
$$= \overline{A} \bullet B + A \bullet \overline{B};$$
$$= \overline{A \bullet B} \bullet (A + B);$$
$$= A \textbf{ xor } B;$$

[3 marks]

(c) *Award* ***[1 mark]*** *for each gate, up to* ***[3 marks max]****.*



[3 marks]

Total: [10 marks]