International Baccalaureate®
Baccalauréat International
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MARKSCHEME

November 2014

COMPUTER SCIENCE

Higher Level

Paper 1

Subject Details: **Computer Science HL Paper 1 Markscheme**

Mark Allocation

Section A: Candidates are required to answer **all** questions. Total 25 marks.
Section B: Candidates are required to answer **all** questions. Total 75 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**".

General guidance

Issue	Guidance
Answering more than the quantity of responses prescribed in the questions	• In the case of an "identify" question read all answers and mark positively up to the maximum marks. Disregard incorrect answers. • In the case of a "describe" question, which asks for a certain number of facts *eg* "describe two kinds", mark the first two correct answers. This could include two descriptions, one description and one identification, or two identifications. • In the case of an "explain" question, which asks for a specified number of explanations *eg* "explain two reasons …", mark the first two correct answers. This could include two full explanations, one explanation, one partial explanation *etc*.

SECTION A *Total: [25 marks]*

1. (a) *Award up to [2 marks max].*
Made up of rows and columns used to organize data;
Automatically (re)calculates results when data is entered/changed;
Helps people to get various results/many combinations quickly;
Built in graphics, charts allow easier and faster interpretation of data;
Etc. *[2 marks]*

(b) A set of programs through which a computer manages/controls its own resources; *[1 mark]*

2. Part of a processor that performs arithmetic and logical operations; *[1 mark]*

3. Binary numbers have base 2, hexadecimal numbers have base 16 (2^4=16);
Each digit (letter/number) in a hexadecimal number can be represented by the group of
four binary digits; *[2 marks]*

4. (a) A data structure;
Which can only be accessed at one end / the last (first) element in is the first (last)
one out;
Note: accept "LIFO" for the 2nd marking point. *[2 marks]*

(b) *Award up to [2 marks max].*
Used in calculations, evaluation of expressions;
Translations from one programming language to another;
Transferring control from one part of a program to another (such as storing return
addresses, running recursive processes);
Etc. *[2 marks]*

5. *Award up to [4 marks max].*
Award [1 mark] for each correct row. Accept 1/0 instead of true/false.
For all 4 correct input combinations award [1 mark].

A	B	X
true	true	false
false	true	true
true	false	true
false	false	false

[4 marks]

6. *Award up to [3 marks max].*
A large/difficult program could be divided into smaller/easier parts (sub-programs);
A sub-program could be used many times in this and other programs;
A sub-program could be written independently;
A sub-program could be tested independently;
Easier maintenance – only sub-program could be changed/modified as needed;
Etc. *[3 marks]*

7.   *Award up to [3 marks max]. Award [1 mark] for each correct output.*

K	K>1	P	output
3	true	1	**3**
2	true	2	**2**
1	false	2	**2**

   Note: candidates are not expected to produce the whole trace table, only the outputs.   *[3 marks]*

8.   A technique which allows one unit to check the status of another unit;
           At regular intervals;   *[2 marks]*

**9.**   (a)   A set of rules / standards to coordinate data transmission (between a sender and a
                  receiver);   *[1 mark]*

           (b)   *Award up to [2 marks max].*
                  To ensure data integrity;
                  To control data flow;
                  Provide error checking;
                  Minimize congestion;
                  Prevent deadlock;
                  To allow communication;
                  Etc.   *[2 marks]*

SECTION B   *Total: [75 marks]*

10. (a)   *Award up to [5 marks max]. Award [1 mark] for each labelled flow chart symbol.*
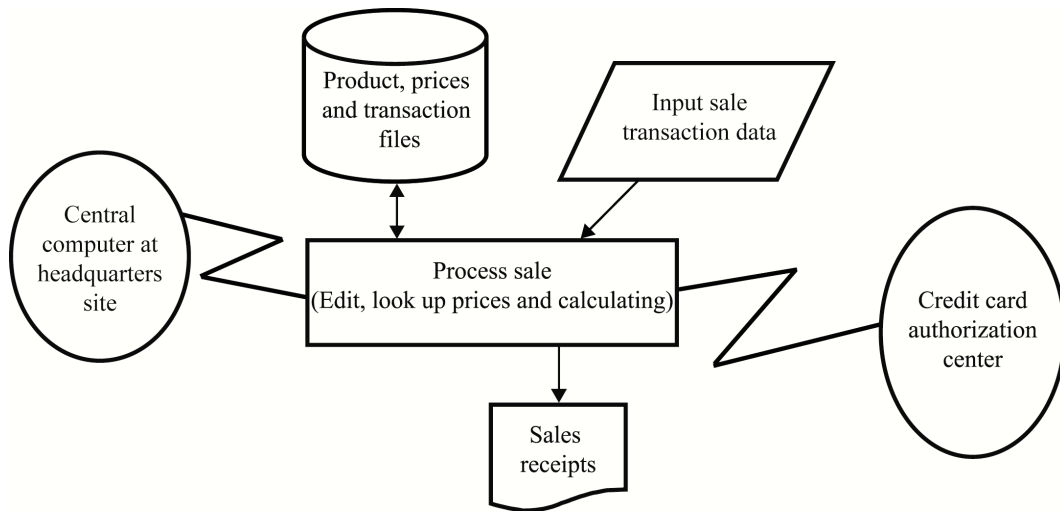
[5 marks]

(b)   *Award up to [2 marks max].*
Updating inventory database;
Storing transactions for later auditing;
Producing reports (such as transfer report, reorder report *etc*);
Re-pricing;
Batch processing takes place;   *[2 marks]*

(c)   *Award up to [3 marks max].*
Natural disasters;
Viruses;
Hackers;
Disgruntled employees;
Hard disk failure;
Server stolen;
Etc.   *[3 marks]*

(d)   *Award up to [3 marks max].*
Loss of hardware should not be a major problem and it is not too expensive for the company, if the hardware is insured then new substitute hardware could be found quickly (repurchased);
Loss of software should not be a critical problem if owner has made backup copies (reinstalled);
Loss of data could be quite expensive for the company and it could also extend to security problems – misusing information about company and individuals that are stored in the company's database;
Difficult/impossible to replace data;

Note: Accept answers that assume the user still has a copy of the "lost" data.   *[3 marks]*

(e)   *Award up to **[2 marks max]**.*
       Passwords;
       Cryptography;
       Internal controls/separation of employees functions/secured waste, *etc*;
       Antivirus programs;
       Backup systems (removable media, offsite storage);
       Strengthen physical security in company;
       Etc.   ***[2 marks]***

                                                                 Total: [15 marks]

11. (a) *Award [1 mark] for the correct loop.*
Award [1 mark] for increasing the sum for the correct value.

```
S=0
loop for K=0 to 6
    S=S+A[K, K]
end loop
```
[2 marks]

(b) *Award marks as follows, up to [8 marks max].*
Award [2 marks] for correctly calculating sum of the second diagonal:
    [1 mark] for the correct loop and [1 mark] for increasing the sum for the
    correct value.
Award [1 mark] for a correct use of the Boolean variable, MAGIC.
Award [1 mark] for correct outer loop.
Award [1 mark] for correct inner loop.
Award [1 mark] for correct calculation of the row sum.
Award [1 mark] for correct calculation of column sum.
Award [1 mark] for comparing row sum and column sum with diagonal sum.

Example:

```
MAGIC= TRUE
SD1=0
SD2=0
loop for K=0 to 5
    SD1=SD1+A[K, K]
    SD2=SD2+A[K, N-K]
end loop
if SD1 != SD2
    MAGIC = FALSE
end if
K=0
loop while (K<=5) AND MAGIC
    SR=0
    SC=0
    loop for Z=0 to 5
        SR=SR+A[K, Z]
        SC=SC+A[Z, K]
    end for
    if (SR != SD1) OR (SC!=SD1)
        MAGIC = FALSE
    end if
    K=K+1
end while
if MAGIC= TRUE
    output "The array is a magic square"
else
    output "The array is not a magic square"
end if
```
[8 marks]

(c)   *Award [1 mark] if the "off the edge" rule seen.*
        Award [1 mark] if the "off the top" rule seen.
        Award [1 mark] if the "cell already filled" rule seen.
        Award [2 marks] for whole square complete.

17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

[5 marks]

Total: [15 marks]

12. (a) *Award up to [2 marks max].*
They should specify program objectives;
They should specify program users/collect the information from the users;
They should specify output requirements;
They should specify input requirements;
They should specify processing requirements;
They should document the requirements and objectives;
Etc.   *[2 marks]*

(b) *Award [1 mark max] for any two of the following:*
Pseudocode
Program flowcharts
Structure diagrams   *[1 mark]*

(c) *Award up to [3 marks max].*
Award [1 mark] for an explanation of why beta testing is appropriate.
Award [1 mark] for an explanation of why it is not appropriate.
Award [1 mark] for contrasting the two and making a decision.

Example:
Not appropriate, as beta testing involves other people, but the timescale may not permit this;
However the involvement of other people provides increased objectivity;
Therefore alpha-testing is better;   *[3 marks]*

(d) *Award up to [3 marks max].*
Is programming language complex or easy to use / do all students know the syntax?;
Is there a good base of prewritten library functions?;
Is portability good?;
Is the compiler available over a wide range of hardware and software platforms?;
Is speed of execution good?;
Is the language appropriate to the problem?;
Is it Web-based/mobile?;
Etc.   *[3 marks]*

(e) (i) Designing algorithms and producing documentation;   *[1 mark]*

(ii) First defining the problem and then designing algorithms/coding;   *[1 mark]*

(f) *Award up to [4 marks max].*
Points may include:
It shows only if the project is on schedule;
It does not show what to do if one part of project is taking longer than expected;
It does not show who is responsible for a particular activity;
It does not show what should be done in other projects which depend on this one;
So the result might be an extension of time;
It does not identify critical activities and actions to be taken;
To make sure the project is not going over the budget;
Does not show dependence between tasks;
Etc.   *[4 marks]*

Total: [15 marks]

13. (a) *Award up to [2 marks max].*
Movement sensor;
Touch sensor / pressure;
Heat sensor (infrared); *[2 marks]*

(b) *Award [1 mark] for the method and [1 mark] for how it is delivered, up to [2 marks max].*
Flashing light / Text message;
Appears on device;

OR

Siren;
Fitted around prison; *[2 marks]*

(c) (i) Cable; *[1 mark]*

(ii) *Award up to [1 mark max].*
Satellite;
Radio;
Wi-fi transmission; *[1 mark]*

(d) Encryption; *[1 mark]*

(e) *Award up to [2 marks max].*
Security system can make sure guards are in correct place/area;
Make sure guards are moving;
See who is closest to an incident; *[2 marks]*

(f) *Award up to [6 marks max].*
Award up to [2 marks] for an argument for people carrying GPS.
Award up to [2 marks] for an argument against people carrying GPS.
Award up to [2 marks] for some comparison and conclusion.

Examples:
People who are under house arrest can be controlled/monitored by the authorities;
Allowing a curfew or restricted movement to be enforced;
Which is preferable as otherwise they would be locked up;
Children forced by parents/teachers to carry a device;
Creates a lack of trust / infringes on their liberties;

Accept appropriate conclusion based on candidate's examples. *[6 marks]*

Total: [15 marks]

14. (a) (i) *Award marks as follows, up to **[3 marks max]**.*
*Award **[1 mark]** for the external pointer to the list and no further nodes at the end.*
*Award **[1 mark]** for showing internal pointers.*
*Award **[1 mark]** for showing that each node contains data and pointer fields.*
Example diagram

[3 marks]

(ii) *Award up to **[3 marks max]**.*
Temporary pointer should be set to point to the beginning of the list;
Follow the internal pointers;
And compare the data in the node pointed to by the temporary pointer with the searched data;
If found stop searching;
If the end of the list is reached then the searched data is not on the list; *[3 marks]*

(b) (i) BORIS, JANE, IVY, ANNIE, ROBERT, MARK; *[1 mark]*

(ii) Inorder traversal; *[1 mark]*

(c) *Award up to **[4 marks max]**.*
If the name to be deleted is placed in a node which has two children then find the replacement node (the largest value in its left sub-tree / the smallest value in its right sub-tree) and its parent node;
If the replacement node is either the leaf node or has one child;
Set the data fields in the node to be deleted to the data value in the replacement node;
Delete the replacement node;
If the replacement node to be deleted is a leaf node then just set the pointer in its parent node to null;
If the replacement node to be deleted has one child then set the pointer in its parent node to point to its child; *[4 marks]*

(d) *Award up to **[3 marks max]**.*
A linked list takes n comparisons to find a name, average search time is proportional to number of elements;
When the binary tree is well balanced, it takes $\log_2 n$ comparisons to find a name (no more than n comparisons);
So, a binary tree is usually more efficient, however in extreme cases will only take as long as a linked list; *[3 marks]*

Total: [15 marks]