



MARKSCHEME

November 2006

COMPUTER SCIENCE

Higher Level

Paper 1

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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 IBCA. 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** once mar
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 part of a question.

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

- Each marking point has a separate line.
- 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 mark scheme then award the mark.
- Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising 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. Effective communication is more important than grammatical niceties.
- 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

[40 marks]

Answer ***all*** questions.

1. Award **[1 mark]** for each valid point.

For example:

optimise the operation of the brakes (or words to that effect – not just “to operate the brakes”);
warning message if seat belts are not fastened;
(possibly) warning if too close to car in front;
warning if car passes maximum speed limit;
+ any other use that relates specifically to safety;

[2 marks max]

2. (a) updating a customer’s account after a withdrawal;

[1 mark]

(b) processing bank cheques;

[1 mark]

(c) ATM operation, Internet banking;

[1 mark]

3. cache memory is a part of the main memory;

faster than the rest of the main memory;

sections of programs are copied from main memory into cache to reduce processing time;

processor can faster access / store data from/to cache than from/to the rest of main memory;

[3 marks max]

4. For example:

OCR software is a software **[1 mark]** that allows the user to convert image **[1 mark]** (obtained as result of scanning text **[1 mark]**) into a text file which can be later edited **[1 mark]**. **[3 marks max]**

5. (a) Award **[2 marks]** for correct explanation that includes interaction between a user and a computer, **[1 mark]** for a vague answer.

For example:

interaction between a user and a computer.

method by which the user commands computer what to do and the computer responds.

[2 marks]

- (b) Award **[1 mark]** for each of the following up to **[3 marks max]**.

a statement in a natural language can have multiple meanings;

depending on its context;

or manner in which is communicated;

decoding the meaning of a statement in a natural language requires syntactic analysis;

semantic analysis;

contextual analysis;

whilst a statement in computer language has only meaning and only one grammatical

structure;

[3 marks max]

6. Award **[1 mark]** for each valid point.

For example:

to improve on the present software (better algorithms *etc.*);
to adapt the software to changing needs of the company;
to correct errors that have previously gone undetected;
note: answers must refer specifically to the software cycle.

[2 marks max]

7. (a) (i) $01111111_{(2)} = 127_{(10)}$ **[2 marks]**

(ii) $10000000_{(2)} = -128_{(10)}$ **[2 marks]**

- (b) $7F_{16} + 1B_{16} = 9A_{16}$ **[2 marks]**
overflow, the sum is greater than the most positive number that can be represented in 8-bit register; **[3 marks]**

8. (a) a tree in which a node can have at most 2 children;
and a node's left child must have a key less than its parent;
a node's right child must have a key greater than or equal to its parent; **[2 marks max]**

- (b) the node to be deleted is a leaf (has no children);
the node to be deleted has one child;
the node to be deleted has two children; **[3 marks]**

9. Award **[3 marks]** for correct analysis of loops and **[1 mark]** for $O(n^3)$.

first loop n times;
second loop n^2 times;
inner loop n^3 times;
time requirements considered;
operation that dominates algorithm is addition;
number of additions: $n * (1 + n * (1 + n * 2))$;
number of copies: $5 + n * (1 + n * (1 + n * 2))$;
the algorithm is $O(n^3)$;

[4 marks max]

10. (a) use of passwords;
different permissions for different users;
any example of physical security;
etc. **[2 marks max]**

- (b) fire wall;
encryption; **[1 mark max]**

11. *Award **[1 mark]** for each valid point.*

For example:

a number is added to (each block of) the data sent;

which is the sum of the bytes in that block;

this value is recalculated by the receiving device and compared to the checksum;

if the values are different the data will be re-sent;

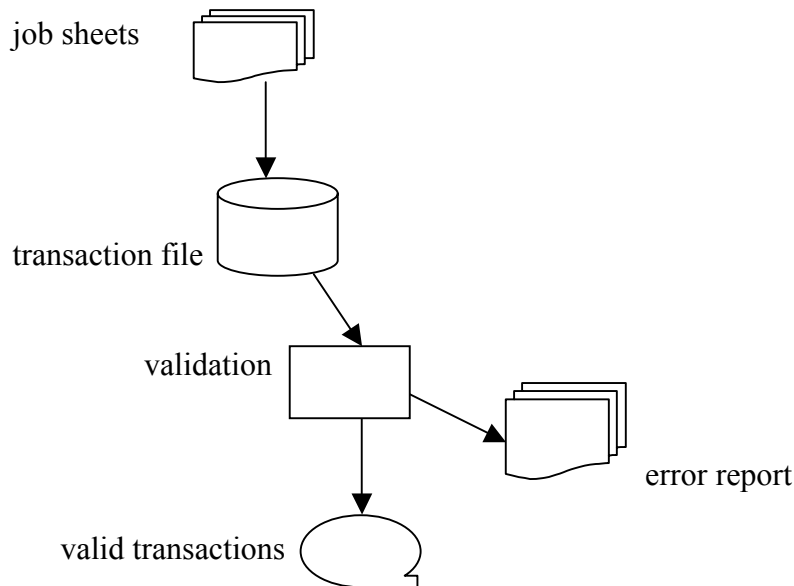
[3 marks max]

SECTION B

[60 marks]

Answer **all** questions.

12. (a) Award **[1 mark]** for each labelled flowchart symbol.



[5 marks max]

- (b) Award **[1 mark]** for any listed job.

analyse data processing requirements;
 specify how the current system should be modified;
 specify hardware and software requirements;
 be responsible for the system implementation;
etc.

[3 marks max]

- (c) Award **[1 mark max]** for any reasonable strength, **[1 mark]** for weakness.

For example:

strength

faster than spending time in observation;
 cheaper than preparing questionnaires;

weakness

employees affected by introducing a new computer system are not always cooperative;

[2 marks max]

13. (a) recursion is a programming technique in which a method calls itself. **[2 marks]**

(b) (i)

```
a=1
k=1 a=2
  mystery(2)
    mystery(1) [1 mark]
      output 1
    output 2 [1 mark]
```

```
k=2 a=3
  mystery(3)
    mystery(2)
      mystery(1)
        output 1 [1 mark]
      output 2
    output 3 [1 mark]
```

```
k=3 a=4
  mystery(4)
    mystery(3)
      mystery(2)
        mystery(1)
          output 1 [1 mark]
        output 2
      output 3
    output 4 [1 mark]
```

output:

```
1
2
1
2
3
1
2
3
4
```

[5 marks max]

Award [2 marks] for showing only the output produced.

(ii) local variable is a variable defined and accessible only within one method. **[2 marks]**

(iii) a, k; **[1 mark]**

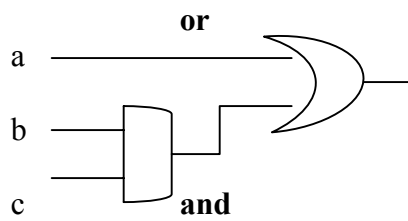
14. (a) Award **[2 marks]** for all correct input combinations, **[1 mark]** for 6 or 7 correct input combinations, **[1 mark]** for each correct output column, **[1 mark]** for the statement that expressions are equivalent.

A	B	C	X	Y
0	0	0	1	1
0	0	1	1	1
0	1	0	1	1
0	1	1	1	1
1	0	0	1	1
1	0	1	1	1
1	1	0	1	1
1	1	1	0	0

Expressions $X = \text{not } (A \text{ and } B \text{ and } C)$ and $Y = \text{not } A \text{ or not } B \text{ or not } C$ are equivalent.

[4 marks max]

- (b) Award **[2 marks]**, **[1 mark]** if the circuit corresponds to expression $(A \text{ or } B) \text{ and } C$.



[2 marks]

- (c) $A \text{ or } B \text{ and } (\text{not } A \text{ or } B) \text{ or } A \text{ and } (A \text{ or } B) =$
 $= A \text{ or } B \text{ and not } A \text{ or } B \text{ or } A \text{ or } A \text{ and } B;$
 $= A \text{ or } B \text{ and } (1 + \text{not } A) \text{ or } A \text{ and } (1 \text{ or } B);$
 $= A \text{ or } B \text{ or } A;$
 $= A \text{ or } B;$

[4 marks]

15. (a) device *[1 mark]* that interconnects computer components *[1 mark]* along which data is sent from one to another component *[1 mark]* together with the addresses of locations from/to data is transferred. *[3 marks]*

- (b) fetch;
decode;
execute;
store;

Award [2 marks] for fetch-execute, [1 mark] for decode, store, [1 mark] for correct order up to [3 marks max].

program counter is a register in the CPU that holds the address of the next instruction *[1 mark]* to be fetched *[1 mark]*. *[5 marks max]*

- (c) number of bits in each memory location: 8;
max number of memory locations available: 2^8 ; *[2 marks]*

16. (a) (i) put item on top of stack (increment top and insert item). **[2 marks]**
- (ii) take item from top of the stack (access item, decrement top). **[2 marks]**
- (b) (i) -1 ; **[1 mark]**
- (ii) $\text{maxsize}-1$; **[1 mark]**
- (c) (i) $5\ 6 + 4\ 3 * 9 + /$ **[2 marks]**
Award [2 marks], [1 mark] for minor error.
- (ii) -12 **[2 marks]**
Award [2 marks], [1 mark] for result 12.

17. (a) (i) an organized collection of data. **[2 marks]**

(ii) delete;
rename;
copy;
paste;
etc. **[2 marks max]**

(iii) JPG;
BMP; **[1 mark max]**

(iv) Data to be stored/transmitted is compressed so storage requirements are decreased, the transmission is faster and cheaper. **[2 marks]**

(b) Award **[1 mark]** for each row.

Partially indexed	Fully indexed
Ordered records	Unordered records
Sequential access to index	Sequential access to index
Direct access to the first record in group and then sequential access	Direct access to the record

[3 marks]
