# MARKSCHEME

# May 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.   client: Award *[1 mark]* for equivalent of: process or desk top computer or terminal that make
     requests from a server in a network. Accept clear examples that show understanding, *e.g.* email
     client on a PC or workstation.
     *Do not accept answers that imply a client is a human.*

     server: Award *[1 mark]* for equivalent of: computer system (hardware and software) that controls
     and co-ordinates client requests to use or access a major function on a network. Accept clear
     examples that show understanding, *e.g.* email server controlled requests from email clients to send
     and receive email.                                                        *[2 marks max]*

     *Accept any definition which makes clear the relative rules of client and server.*

2.   For each award *[1 mark]* for correct name of error and *[1 mark]* for correct outline or example:

     Syntax: mistake in structural rules of grammar, *e.g.* misspelling a keyword
     Logic: mistake in the logic of the programs algorithm
     Run-time: I/O and processing errors that result in fatal conditions that crash the executing program,
     eg input letters for numbers.                                             *[6 marks]*

3.   $10111_2$          $-16 + 4 + 2 + 1 = -9$                                 *[2 marks]*

     *Award [1 mark] for –16, and [1 mark] for correct answer.*

4.   A utility program that brings together the object modules, operating system routines and other
     utility software (*[1 mark] for any of these points up to [1 mark max]*) to produce a complete
     executable program (*[1 mark for reference to producing final executable code]*).    *[2 mark]*

5.   *Award [1 mark] for a clear statement that the argument value is passed to the parameter of the
     function by the function call.*

     *Award [1 mark] for a clear statement that the parameter appears on the function definition line or
     that the parameter allows data values to enter the function.*              *[2 marks]*

6.    *Award **[2 marks]** for a full definition and **[1 mark]** for a partial definition.*

      For example:

      Virtual memory is the use of secondary memory as if it were primary memory.
      The paging of secondary memory so that it can be addressed in the same way as primary memory.
      *                                                                                  **[2 marks]***

7.    *Award **[1 mark]** for any of the following or like.*
      collect data about the existing system;
      requirement definition;
      feasibility study;
      interview users;
      study comparable systems;                                                   ***[2 marks max]***
      *etc*.
      *Accept any sensible activity that is likely to be undertaken.*
      *Do not accept answers associated with program development.*

8.    (a)    *Award **[1 mark]** for array, do not accept list, accept vector.*              ***[1 mark]***

      (b)    *Award **[1 mark]** for use of the correct INDEX.*                              ***[1 mark]***
             e.g. A[3], using an index of 3

      (c)    *Award **[1 mark]** for reference to calculating the byte offset.*
             *Award **[1 mark]** for reference to enabling direct access.*                  ***[2 marks]***

             A complete answer is as follows:

             The array name holds the memory address of the start of the array i.e. the base memory
             address, as each member of the data set is the same data type the indexed offset can be easily
             calculated by adding the position*byte length to the base.
             *Accept answers that refer to the restrictions imposed by the Java language over and above
             byte length grounds.*

9.    *Award **[1 mark]** for each function.*
      control the error checking;
      control the structure of the bit packets *e.g.* length;
      control the error correction;
      *etc*.                                                                          ***[2 marks max]***

10.   *Award **[1 mark]** for name and **[1 mark]** for reasonable outline.*
      parallel: run both new and old system side by side.
      direct: immediate conversion i.e. replace the existing with the new.
      phased: gradually implement the whole by implementing the parts in sequence.   ***[6 marks]***

11.  *Award [1 mark] for each correct answer.*

    (a)   online or interactive;                                                                  *[1 mark]*
            *Do not accept multi-tasking, multi user etc.*
    (b)   real time;                                 *[1 mark]*
    (c)   batch;                                 *[1 mark]*
            *Allow off-line.*

12.  *Award [1 mark] for each.*

    (a)   Linear Search of an array O(N);                          *[1 mark]*
    (b)   Binary Search $O(\log_2 N)$;                           *[1 mark]*

13.  *Award [2 marks] for correct answer, no working is required.*

    $F D_{16} + A B_{16}$     1 A 8                                        *[2 marks]*

14.  *Award [1 mark] for understanding of digital.*
    *Award [1 mark] for understanding of analog.*
    *Award [1 mark] for understanding of need to convert.*

Computer systems operate internally by use of digital logical and digitally represented data using the binary number system.

External quantities such as sound, temperature, light intensity, water levels etc are represented using continuous analog measurements.

In order to store these measurements as data within a computer the analog values needed to be converted to an equivalent digital format.                        *[3 marks]*

**SECTION B**                                            *[60 marks]*

*Answer **all** questions.*

15.  (a)  *Award **[1 mark]** for any of the following.*
          real number;
          floating point;
          double;                                        *[1 mark]*
          *Do not accept integer.*

     (b)  *Award **[1 mark]** for statement that indicates validation is a reasonableness check of data at
          input time or prior to processing.*                *[1 mark]*
          *Do not accept checking correctness or accuracy of data.*

     (c)  *Award **[1 mark]** for data type of function.*
          *Award **[1 mark]** for correct parameter.*
          *Award **[1 mark]** for correctness of the condition used.*
          *Award **[1 mark]** for correct use of return.*

          Sample answer could be.

          ```
          boolean validate(double h)
              {
                  if (h<4.50 or h>23.45)
                      {return false}
                  return true
              }
          ```
                                                            *[4 marks]*

     (d)  *Award **[1 mark]** for correctness of condition for loop.*
          *Award **[1 mark]** for correct re-use of* getValue( )

          ```
          value = getValue( )
          while (!validate(value))
          {
              output("Invalid please enter again")
              value = getValue()
          }
          ```
                                                            *[2 marks]*

     (e)  *Award **[1 mark]** for any of the following.*
          double entry could be used;
          each input could be verified;
          each entry compared;                             *[2 marks max]*

16. (a) (i)  minimum = -64;                                           *[1 mark]*
        (ii) maximum = 63;                                            *[1 mark]*
        *Award [1 mark] each for correct answer, no working required.*

    (b) $1111011_2$                                                  *[2 marks]*
        *Award **[2 marks]** for all 7 bits correct.*

    (c) Award **[1 mark]** for statement of overflow and **[1 mark]** for explanation. e.g. An overflow error has occurred  award **[1 mark]**, the two 7 bit values are positive i.e. MSB = 0 and thus when added must give a positive result. Here the MSB has been set to 1 and causes an overflow error that is not detected. Award **[1 mark]** for reasonable explanation.      *[2 marks]*

    (d) Error can cause a fatal run-time error that will crash the program or will produce erroneous results. Award **[2 marks]** for either answer. Award **[1 mark]** for a specific answer for this single case i.e. In this case the overflow error would go undetected.      *[2 marks]*

    (e) Trap and detect an overflow exception error if reported award **[1 mark]**. Check on the results of calculations to see if odd results have occurred e.g. negative values award **[1 mark]**.
                                                                      *[2 marks]*

17. (a)

| A (S1) | B (S2) | C (S3) | Stop |
|--------|--------|--------|------|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |

*Award **[1 mark]** for correct B C entries, award **[2 marks]** for fully correct Stop, award **[1 mark]** if only one incorrect entry in Stop.*                                        ***[3 marks]***

(b)   Stop $= \bar{A}.\bar{B}.C + \bar{A}.B.C + A.\bar{B}.C + A.B.\bar{C} + A.B.C$

*Award **[1 mark]** if one miniterm missing, otherwise award **[2 marks]** for fully correct.*
***[2 marks]***

(c)   *Award **[1 mark]** for each correct line of working up to **[3 marks max]**.*

**Algebraic method**

Stop $= \bar{A}.C.(\bar{B}+B) + A.C.(\bar{B}+B) + A.B.\bar{C}$

$=\quad \bar{A}.C + A.C + A.B.\bar{C}$ ;

$=\quad C + A.B.\bar{C}$ ;

$=\quad C + A.B$ ;

K-Map



| | BC | $\bar{B}C$ | $B\bar{C}$ | $\bar{B}\bar{C}$ |
|---|---|---|---|---|
| A | | | 1 | |
| $\bar{A}$ | 1 | | | |

Stop $=\quad C + A.B.\bar{C}$

$=\quad C + A.B$ ;

**Inspection of the truth table**

Students may simply investigate the truth table and observe that C is common and arrive at the correct answer.

*Award [1 mark] for C, [1 mark] for A.B.$\overline{C}$ and [1 mark] for simplification to A.B.*

*Award [2 marks] if the student simply states the simplified Boolean expression but shows no working or provides no explanation.*                                       *[3 marks]*

*Either algebra / k-map / truth table.*

(d)    *Award [1 mark] for correct OR gate and [1 mark] for correct AND gate.*          *[2 marks]*
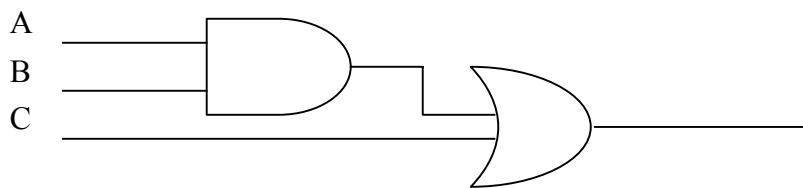
18.   (a)   Sequential file organisation;                              *[1 mark]*
              *Accept serial*, *do not accept text file*.

      (b)   Sequential access;                                    *[1 mark]*

      (c)   (i)    36 bytes = 6 + 30;                            *[1 mark]*

            (ii)   *Award [1 mark] for 36,000,000 bytes or other correct formats for dimension.*  *[1 mark]*

      (d)   (Note: it is not necessary for the student to mention end of record marker, it can be assumed to be placed by the file system)

           The program will have to iterate sequentially through the file *[1 mark]*, to count the number of records starting with a particular name *[1 mark]*.

           Students may also mention searching for the "http" and looking at the previous 6 characters to determine the user name i.e. record length not relevant *[2 marks]*.        *[2 mark max]*

      (e)   *Award [1 mark] for any of the following.*

           privacy of person data;
           legal issues to do with unauthorised disclosure;
           need to gain permission from user;
           user would need to be able to view details;                    *[4 marks max]*
           *Accept any other reasonable points*.

19.   (a)   *Award **[1 mark]** for stating that direct access involves accessing records without reference to other records in the file.*                                      ***[1 mark]***

(b)   *Award **[1 mark]** to enable start position of record to be calculated, award **[2 marks]** for more complete answer i.e. record position can be calculated by multiplying the required record position by the length of a record.*                                      ***[2 marks]***

(c)   *Award **[1 mark]** for userID and record position, award **[1 mark]** for BOTH left and right pointers/references.*

class node
{
        int recordPos;
        int userID;
        node left;
        node right;
}                                                                                        ***[2 marks]***

(d)   *Award **[1 mark]** for correct root.*
*Award **[2 marks]** for remainder of nodes correctly placed.*
*Award **[1 mark]** only if no more than one incorrectly placed node.*
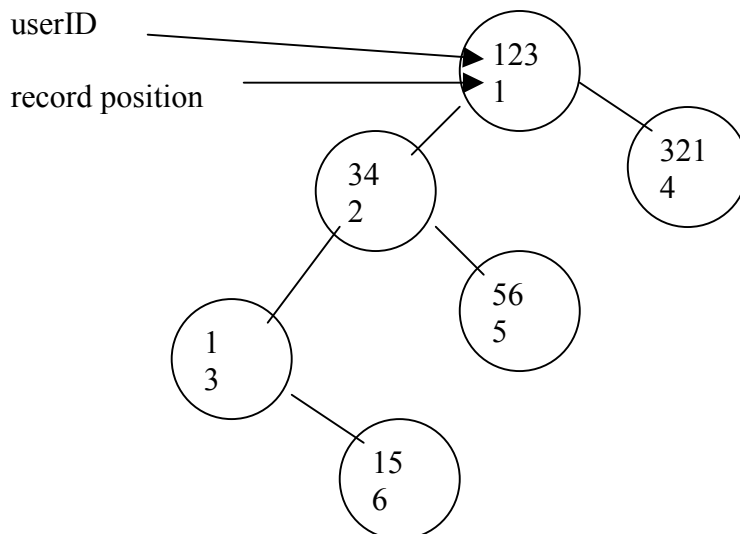


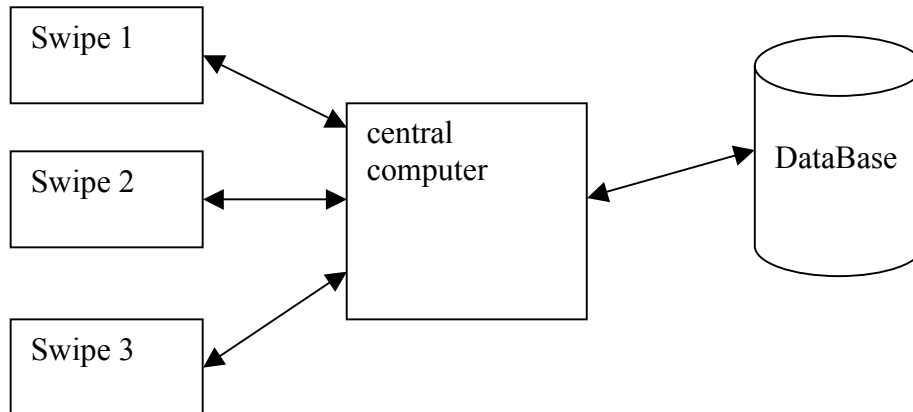                                                                                         ***[3 marks]***
*Accept mirror image.*

(e)   *Award **[1 mark]** binary tree searched to find record position or similar vague answers.*

*Award **[2 marks]** for more complete answers e.g. required userID used to search the binary tree, on match the associated record position is used to seek or directly access the file to read the required record.*                                      ***[2 marks]***

20.    (a)



*Award **[1 mark]** for swipe readers correctly identified.*
*Award **[1 mark]** for DataBase correctly identified and connection two way.*
*Award **[1 mark]** for other correct interconnections.*                    ***[3 marks]***

(b)    Polling requires the computer to actively interact with each swipe device and will waste processing time in this case ***[1 mark]***.

Interrupt requires the device to flag the computer and hence the computer's time is not wasted whilst the device is idle ***[1 mark]***.

Interrupt would be preferred option as it would be most efficient in terms of the central computer's time and still allow an effective security system to operate ***[1 mark]***.    ***[3 marks]***

Note: In general, polling would not be considered to be 'most suitable'.

*Award up to **[2 marks]** for polling solutions that the candidate has justified.*

For example polling could identify a non-functioning door/swipe reader whereas the failure to generate an interrupt would not flag a malfunction.  If the processor is not a busy one, the inefficiencies of polling may not be an issue.

(c)    A biometric device: finger print or eye scanner.
Eye scanner uses a camera to scan the iris.
Computer compares scanned image to data base
etc.                                                                            *[2 marks max]*
*Award [1 mark] for each relevant characteristic.*

(d)    *Award [1 mark] for an advantage and [1 mark] for a disadvantage.*

Advantage: Eye scanner
Fast, more secure, etc.

Disadvantage: Eye scanner
More expensive, can break                                                       *[2 marks]*