



MARKSCHEME

May 2013

COMPUTER SCIENCE

Higher Level

Paper 1

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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**”.

NOTE: The notation used in question parts 16(b) and 16(c) is off-syllabus, and after analysis during the standardisation process it has been decided to discount these question parts. Please only award NR for these question parts regardless of working.

SECTION A

Total: [40 marks]

1. *Award up to [2 marks max] for max two forms.*

Barcode scanner;
OCR/OMR scanner;
MICR reader;
Voice recognition;
Directly-interfaced sensors, *eg* a temperature probe;
Smart Card reader;

[2 marks]

2. *Award up to [4 marks] as follows:*

[1 mark] for a stated advantage and ***[1 mark]*** for an expansion relevant to protest groups.

[1 mark] for a stated disadvantage and ***[1 mark]*** for an expansion relevant to protest groups.

Example of answers:

Advantages / Disadvantages:

Pervasiveness;
Immediacy;
Accessibility;
Anonymity
Visibility;
Multimedia nature of social networks;
Information stored on the server;

Expansion:

Help the group in organizing themselves quickly/broadly;
Contribute spreading the reasons of the protest;
Gain of visibility on media/political level;
Support publishing multimedia files that can document the protest, and these can be used in several different ways (including defensive one or to gain consensus from public opinion);

Allows members with different objectives (undercover agents, radical exponents, or those opposed to the groups aims) to monitor the activities of the group;

Compromise the identity of the group members;
Misdirect the group to thwart them from the original purposes;

[4 marks]

3. Award [1 mark] for each use (two uses) up to [2 marks max]. Accept any software tool used to develop a large project which is composed of multiple components/sub-systems.
- Summarise requirements;
 - Developing flow diagrams;
 - Scheduling tasks in development;
 - Preparing documentation;
 - Controlling system versions;
 - Developing code;
 - A statement that indicates a recognition that these tools are for coordinating the design and development of multiple subsystems/parts within a larger project; [2 marks]
4. (a) Award up to [2 marks max].
- Controls fetching instructions from memory;
 - Controls/directs transfer of data within the CPU;
 - Via the memory data and address buses;
 - Interprets instructions;
 - Controls/directs execution of instructions;
 - Controls/directs storing data in memory; [2 marks]
- (b) Award up to [2 marks max].
- Registers hold memory addresses;
 - The larger register can address a larger number of distinct memory locations;
 - Size of memory is 2^n where n is the number of bits in the register; [2 marks]
 - Do not accept “if one is bigger, the other is bigger” unless fully explained.
5. Award [1 mark] for naming the disadvantage and [1 mark] for an explanation up to [2 marks max].
- Possible answers (there may be others)
- Performances drop;
- Because of the time to switch among applications;
 - The time to search/access files on the hard disk;
 - Access speed of secondary memory versus primary;
- May require more HW;
- Because part of the hard disk is reserved to virtual memory, hence additional storage space might be necessary;
- Increase power consumption;
- Because the overall processing time slows down; [2 marks]
6. Award up to [2 marks max].
- Scan files searching for viruses;
 - Remove the viruses / alerts the user;
 - Scan incoming files to detect if they contain known virus; [2 marks]

7. Award **[2 marks max]** for **one** difference, in terms of both ASCII and Unicode.

Possible answers:

ASCII uses 7 bit;

Unicode extends it to 8/16/32 bit;

Hence Unicode requires more disk space;

ASCII encodes only 128 characters by assigning numbers;

Unicode may use different and more sophisticated representation;

ASCII American English alphabet+ control;

Unicode tries to include all possible existing alphabets;

[2 marks]

8. (a) Award **[1 mark]** for the correct answer;
Award **[1 mark]** for the conversion up to **[2 marks max]**;

$$(189)_{10} = (16^1 * 11 + 16^0 * 13)_{10} \\ = (BD)_{16}$$

[2 marks]

- (b) Award **[1 mark]** for correct result;
Award **[1 mark]** for correct working up to **[2 marks max]**;

$$\begin{array}{r} 1110 \quad 1011 \\ 1010 \quad 1100 \quad 1111 \\ \hline 1011 \quad 1011 \quad 1010 \end{array} = (BBA)_{16}$$

(or similar guidelines if conversion to decimal is used)

[2 marks]

- (c) Award up to **[3 marks max]**.
It introduces the idea of exponent;
Significance of number of bit in the exponent;
Extends the range of large and small (positive/negative exponents);
The candidate provides an example to illustrate this;

[3 marks]

9. Award **[1 mark]** for correct column x.
Award **[1 mark]** for correct column y.
Award **[1 mark]** for the correct final value (5) returned.

x	y	return
15	20	GCD(20,15)
20	15	GCD(15,5)
15	5	GCD(5,0)
5	0	5

[3 marks]

10. Award [1 mark] for identifying the purpose and [1 mark] for a description, up to [2 marks max].

It is used to detect the position in memory of the specific interrupt handling code, as follows;

IR is updated with the offset position for the (appropriate) handling program;

Interrupt handling code address = base address + Interrupt register;

[2 marks]

11. Award [2 marks max] for each type, up to [4 marks max].

Storing:

A dynamic data structure has no predefined fixed size, different from a static one;

A dynamic data structure can grow/decrease at run-time, different from a static one;

A dynamic data structure's elements are stored in memory locations that are (chained together but) not necessarily physically contiguous, different from a static one;

Access:

Elements in dynamic data structures are linked through pointers, possibly more than one;

A static data structure does not use pointers, and obeys the specific operations of the data structure;

Elements in a static data structure (array) can be either directly or sequentially accessed;

Elements in a dynamic linked list cannot be directly accessed;

Elements in a dynamic linked list can only be sequentially accessed;

[4 marks]

12. Key fields (primary key or combination of keys) are used to uniquely search/identify a record;

And for classifying records (secondary key);

[2 marks]

13. Award [2 marks max] for each type, up to [4 marks max].

Truncation error:

A real value is assigned to an integer variable;

Only the integer part of the value will be stored, giving a loss of accuracy;

Overflow error:

We try to store a number that is too big to be represented in the allocated number of bits;

For example, an integer in two's complement, or a floating-point where the exponent exceeds the allowed range of representation;

Underflow error:

We try to store a number that is too small, usually it is assimilated to zero;

It can cause run-time errors (division by zero) or trivialize calculations to zero;

[4 marks]

SECTION B

Total: [60 marks]

- 14.** (a) (i) A computer (and its software) that provides services available through the network; **[1 mark]**
- (ii) A computer/terminal (and its software) used to access the services in a network, by sending requests to the server; **[1 mark]**
- (b) It passes data packets from input channels;
To all output channels; **[2 marks]**
- (c) (i) *Award up to [2 marks max].*
Assign different access rights to the files/parts of the file system;
To different groups of users; **[2 marks]**
- (ii) Patients should log-on with a password or create an account;
They should only have access to their own medical records;
If they have access, it should be read only;
They should have read/write access to the appointments/bookings in order to check/change their appointments; **[4 marks]**

Total: [10 marks]

- 15.** (a) The interface of a device with a computer, for data entry and/or exit; **[1 mark]**
- (b) Sender sends a request of communication on a channel to receiver;
Receivers replies with parameters/protocol/certificate ready to accept;
Sender verifies certificate and uses the given parameters for the transmission; **[3 marks]**
- (c) Peripheral devices are often slow whereas CPU is fast;
CPU fills the buffer so that the fax can access the data at its own speed;
Allowing the CPU to work on other tasks; **[3 marks]**
- (d) Through Direct Memory Access peripherals are connected directly to memory;
And CPU is bypassed;
Therefore CPU can be used (simultaneously and independently) for other processing; **[3 marks]**

Total: [10 marks]

16. (a) *Award [1 mark] for three correct and complete RGB input columns;*
Award [1 mark] for correct output;

R	G	B	Output
0	0	0	undefined
0	0	1	B
0	1	0	G
0	1	1	C
1	0	0	R
1	0	1	M
1	1	0	Y
1	1	1	W

[2 marks]

- (b) *Award [1 mark] for final correct result;*
Award [1 mark] for correct De Morgan;
Award [1 mark] for correct use of tautology rule;
Award [1 mark] for correct intermediate algebraic laws (associativity, unity, absorption);

$$\left(\overline{(R \cdot \bar{G} \cdot B)} + \overline{(R \cdot G \cdot \bar{B})} \right) + (R \cdot \bar{G} \cdot \bar{B}) = (\text{DeMorgan})$$

$$\left((\bar{R} + G + \bar{B}) + (\bar{R} + \bar{G} + B) \right) + (R \cdot \bar{G} \cdot \bar{B}) = (\text{assoc})$$

$$(\bar{R} + \bar{R} + G + \bar{G} + B + \bar{B}) + (R \cdot \bar{G} \cdot \bar{B}) = (\text{absorption and tautology})$$

$$(\bar{R} + 1 + 1) + (R \cdot \bar{G} \cdot \bar{B}) = (\text{unit})$$

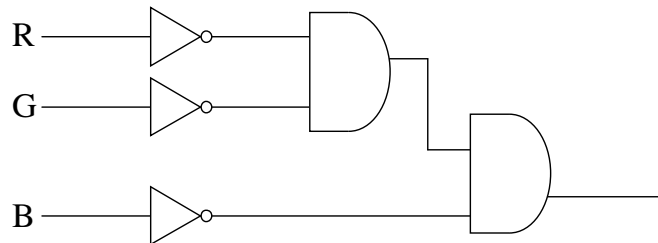
1

[4 marks]

continued ...

Question 16 continued

- (c) (i) Award marks as follows, up to **[2 marks max]**.
Award **[1 mark]** for 3 not gates.
Award **[1 mark]** for 2 and gates.

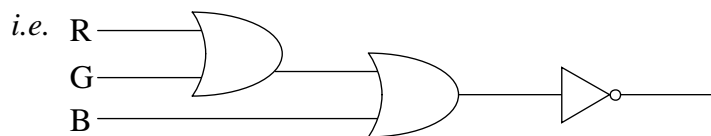


[2 marks]

- (ii) Award up to **[2 marks max]**.
Example:
Simplify/minimize the expression E;
By applying Boolean algebra rules and laws (apply De Morgan's law);
And create the corresponding circuit;

OR

Apply De Morgan's law;
Consider the equivalent formula $\overline{R + G + B}$;
Its circuit contains a total of 3 gates (2 or and one negation);



[2 marks]

Total: [10 marks]

17. (a) *Award up to [2 marks max].*

Requirements;
Costs;
Benefits;
Estimates of the time for developing the project;
Possible difficulties and alternative solutions;
Risk analysis (costs/technical/legal);
Review of previously proposed solutions;

[2 marks]

(b) *Award [1 mark] for identifying a factor and [1 mark] for an expansion that relates that factor to commercial or customized software up to [4 marks max].*

Example factors to be considered:

Cost;
Time to develop/deploy;
Availability of documentation and training materials;
Suitability of the software for the task;

Example expansions:

Cost – Commercial software is usually cheaper to purchase than developing customized software;
Suitability – Commercial software is usually designed to appeal to a large group of potential customers and may not contain specialized features needed by the company / may contain needlessly complex tools to support functions not needed by the company;

[4 marks]

Accept other realistic factors and expansions.

(c) The customer could ask for modifications;
Adding some new/different features that affect the current design;
And that could affect the feasibility report in several ways;
Such as costs, delivery time, technical requirements;

[4 marks]

Accept these points if put in the context of “repeated analysis and design”.

Total: [10 marks]

18. (a) $923 * +$; *[1 mark]*

OR

$23 * 9 +$;

(b) Pre-order; *[1 mark]*

(c) $+ * 329$; *[1 mark]*

(d) Perform post-order traversal on the tree;
Use a stack to put $+ * 329$;
Pop from stack (to reverse it) and get the postfix representation;

OR

Perform post-order traversal on the tree;
Store the data in a queue;
Dequeue and get the postfix expression;

[3 marks]

(e) A binary tree is structurally self-referential (by definition of binary tree);
Because each node in the tree is a root to a binary tree of smaller size, or
a node without descendants (leaf);
The traversal algorithm exploits the structural definition of binary trees and
can easily be implemented recursively;
Because a recursive method operates by calling a function from within the
function itself (left/right subtrees) and needs a termination condition
(leaf node);

[4 marks]

Total: [10 marks]

19. (a) Data that can be represented by a continuous function; *[1 mark]*
- (b) Conversion is necessary before transmission;
Because a network is used to transmit further digital data to a control centre (computerized centre);
Data in digital form can only be stored/processed by the computer; *[2 marks]*
- (c) *Award up to [4 marks max].*
Polling allows the centre to better use its processing resources;
And to perform more significative data collection, with respect to the subsequent analysis;
For example, the centre can decide to poll the devices;
In times of lower use of its processing units;
Or in specific times when the quality of the air is known to be worse; *[4 marks]*
- (d) *Award up to [3 marks max].*
(RAM insufficient to store data, data are in disk)
Use sort-merge strategy/external sort to sort data in disk;
Portions of data are sorted and stored in temporary files;
Temporary files are merged afterwards; *[3 marks]*

Total: [10 marks]
