

Markscheme

November 2019

Computer science

Standard level

Paper 1

13 pages

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Subject details: Computer science SL 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 45 marks.

Maximum total = 70 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	<ul style="list-style-type: none"> • 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 <i>eg</i> “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 <i>eg</i> “explain two reasons ...”, mark the first two correct answers. This could include two full explanations, one explanation, one partial explanation <i>etc.</i>

Section A

1. (a) *Award [1 max].*
Retrieve;
Compare;
Store;
Add; [1]
- (b) *Award [2 max].*
Fundamental operation requires one machine instruction cycle/do not require the processor to go through many machine instruction cycles to reach a result;
A compound operation is complex / it is an operation that involves a number of other operations to reach the result;
For example, find the largest number in an array/ sort the array in ascending order *etc*; [2]
2. (a) *Award [1 max].*
Any malicious activity;
Natural disasters;
Human error; [1]
- (b) *Award [2 max].*
Internet backup service could automatically back up (all important) data files; to a remote server that could be accessed/controlled over the internet;

Copies of all important data files (backup) could be placed on two separate hardware devices;
which are placed in two different physical locations;

A remote file server could be set up;
for uploading all important data files; [2]

3. (a) *Award [1 max].*

It decodes the instructions and controls all the other internal components of the CPU to make it work;

[1]

(b) *Award [3 max].*

Cache memory is a memory that a computer microprocessor can access more quickly than it can access regular RAM;
It is integrated directly with the CPU chip or placed on a separate chip which has a separate bus interconnect with the CPU;
and stores frequently used data only until a computer is powered down;
Thus, when a processor requests data that already has an instance in the cache memory; it does not need to go to the main memory or the hard disk to fetch the data;

Cache memory is a small-sized type of volatile computer memory; that provides high-speed data access to a processor; and stores frequently used computer programs, applications and data; Cache memory can be primary or secondary cache memory, where primary cache memory is directly integrated to the processor; And secondary cache memory is a reserved portion on a disk stores and provide access to frequently accessed data/applications from the disk.

[3 max]

4. (a) **Award [1 max]**
Hexadecimal numbers are used for shorter representation of data because a (modern) byte can be represented exactly by two hexadecimal digits;
Hexadecimal numbers are used for shorter representation of data, because computers store and handle binary digits, and four binary digits make one hexadecimal digit; [1]

(b) **Award [1 max]**
24; [1]

(c) **Award [1 max]**
 $256 \times 256 \times 256 / (2^8)^3 / 2^{24}$;
 256^3 ;
16 777 216; [1]

5. **Award [4 max]**
Award [1] for all 8 input values correct;
Award [1] for correct X column;
Award [1] for correct Y column;
Award [1] for correct Z column;
Allow follow through from incorrect columns X or Y.

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

[4]

6. Award **[3 max]**

Abstraction allows us to create a general idea of what the problem is and how to solve it;

Abstraction removes all specific detail, and any patterns that will not help in solving a problem. This helps in forming a “model” (If designers don’t abstract they may end up with the wrong solution to the problem they are trying to solve);

Abstraction is widely used because there exist a number of “patterns” in programming that keeps repeating in every application/program;

The pattern corresponding to an issue can be found, then the abstract solution to it can be found and implemented, and the problem is solved;

Most programming languages provide some built-in abstract patterns, which are easy to use (some API provides more advanced patterns);

Abstraction is the process of taking away or removing characteristics from something in order to reduce it to a set of essential characteristics;

In object-oriented programming, abstraction is one of three central principles (along with encapsulation and inheritance);

Through the process of abstraction, a programmer hides all but the relevant data about an object in order to reduce complexity and increase efficiency;

The resulting object itself can be referred to as an abstraction, meaning a named entity made up of selected attributes and behavior specific to a particular usage of the originating entity. Abstraction is related to both encapsulation and data hiding;

[3 max]

7. Award **[5 max]** as follows:

Award **[1]** for a trace table with at least three columns (headings *K*, *N*, *M*, $K < 5$ and output);

Award **[1]** for each correct output up to **[4 max]**

K	N	M	K<5	OUTPUT
1	1	2	TRUE	1 2
2	3	4	TRUE	3 4
3	5	8	TRUE	5 8
4	7	16	TRUE	7 16
5	9	32	FALSE	

[5 max]

Section B

8. (a) **Award [2 max]**
User roles / the organization restructure their workflow;
Technology issues / issues of software compatibility / hardware compatibility; **[2 max]**
- (b) **Award [5 max].**
Direct changeover:
is the cheapest and quickest/the old system is completely switched for the new one;
this is straight forward but also the most risky / nothing to fall back on;
no need to keep data duplicates;
it allows the organization to change the system when most convenient;
the employees have very little time in order get use to the new system as the change is instantaneous;
there is a period of time when neither systems are operational;
- Phased conversion:**
method where the old system is still in use but parts of the new system or modules are introduced, involves bringing in the new system one step at a time;
less risky than direct changeover; less risky that the whole system will go wrong/if something happens, it will only affect the specific part;
takes a lot of time;
employees have enough time for training/to get use to the new system / are introduced to the changes in small stages;
Employees/users could ask for changes which then hold up the installation of the next phase which helps improving the system; **[5]**
- (c) (i) **Award [1 max].**
User acceptance test;
Beta testing; **[1 max]**
- (ii) **Award [3 max].**
Can lead to software which is not appropriate for the purpose it was intended/can lead to the system not meeting user requirements;
Can lead to (undiscovered) bugs in software/errors in the system;
Can lead to end user dissatisfaction;
Can lead to reduced (employee) productivity;
Can lead to decreased reliability of the organization; **[3 max]**

- (d) *Award [4 max].*
Personal/professional development of all employees must be considered;
Physical safety (of all users);
Ergonomic standards (human-computer components);
Human dignity of all users;
The new system might be designed to replace some staff;
Code of ethics (system resources should not be used without approval); **[4 max]**

9. (a) *Award [4 max].*
File sharing/resource sharing;
instead of using a disk or USB key to carry files from one computer to another
files can be shared directly using a network/all computers in the network can
share resources such as printers, scanners;
- Communication;
students/teachers can communicate with people around the world via the
network;
- Interactive teamwork;
software (like Microsoft Office) enables many users to contribute to a document
concurrently;
- Flexible access;
network allows students to access files from different computers (throughout the
network) (one can begin work on a project on one computer and finish up on
another);
- Software cost;
software products are available for networks at a substantial savings in
comparison to buying individually licensed software;
- Software management;
load software on the server saves time compared to installing and tracking files
on independent computers/upgrades are also easier because changes only have
to be done once on the file server instead of on individual computers;
- Improved network security;
if the school has its own network, it can monitor network traffic / can create a
security culture (everyone who has a username and password is responsible for
keeping data secure);
- Mark as [2] and [2].* **[4 max]**

(b) (i) *Award [2 max].*

A network router is a hardware device that is connected to multiple channels for different networks;
through an interface that is situated on each network;

Router acts as a processing unit for information packets;
it duplicates information packets for use during transmission from one network to another;

The router uses a protocol or set of rules;
to determine which information packets are to be routed to certain interfaces within the network;

[2 max]

(ii) *Award [2 max].*

Network interface cards are used to connect each computer to the network;
so they can communicate with the network router to receive information packets;

Interface cards determine the infrastructure of a local area network (LAN);
and allow all of the computers to connect to the network;

[2 max]

(c) *Award [2 max].*

Protocols define the rules that govern network communication (for example, packet format, type and size, what happens when an error occurs, and which part of the network is supposed to handle the error and how);

Computer networks consists of various types of equipment (such as routers, switches, hubs and network interface cards) and the equipment comes from different vendors, but they must all work together or the network does not operate correctly;

Protocols work in layers (the highest being what the user sees, and the lowest being the wire that the information is transferred along) and these layers communicate with each other according to the rules (allowing communication to occur accurately and efficiently);

[2 max]

(d) *Award [1 max].*

Data encryption refers to calculations/algorithms that transform plain text into a form that is non-readable to unauthorized parties (authorized recipient of an encrypted text uses a key and the algorithm to decrypt the data/ to transform it to the original plain text version);

[1 max]

(e) *Award [4 max].*

Each (wireless network) adapter has a unique label called a MAC address;

Routers uses these addresses to identify/authenticate computers (routers include an option to whitelist or blacklist certain devices based on MAC addresses, so access could be restricted to any device which is not in the whitelist);

One disadvantage is that the whitelist should be amended any time a new device is purchased / when access to guests should be granted;

Also this method is useless against hackers who use programs which intercept data passing through network and report the MAC address of any device communicating on the network;

[4 max]

10. (a) **Award [3 max].**

$$X = 372 \text{ div } 100 = 3;$$

$$Y = 3 + 10 * (372 \text{ mod } 100 \text{ div } 10) = 3 + 10 * ((372 \text{ mod } 100) \text{ div } 10) = 3 + 10 * (72 \text{ div } 10) = 3 + 10 * 7 = 73;$$

$$Z = 73 + (372 \text{ mod } 10) * 100 = 73 + 2 * 100 = 273;$$

Award FT marks if working is shown.

Award 1 mark only for each correct value if no working shown, up to 3.

$$X = 3;$$

$$Y = 73;$$

$$Z = 273;$$

Allow FT marks.

[3]

(b) **Award [8 max].**

Award [1] for reset/starting from the first item in the collection and for initialization and correct increasing of the array index (K)

Award [1] for the while loop through the collection

Award [1] for retrieving a number from the collection

Award [1] for if statement- checking whether the number retrieved is a three-digit number

Award [1] for correctly calculated digits in retrieved number,

Award [1] for each

Award [1] for if statement which compares the three digits of the retrieved number

Award [1] for correctly placing ITEM into the array THREE

Award [1] for the correct output message

Example answer:

```
K=-1
NUMBERS.resetNext()
loop while NUMBERS.hasNext()
    ITEM=NUMBERS.getNext()
    if ITEM>99 and ITEM<1000 then
        F=ITEM DIV 100
        S=ITEM MOD 100 DIV 10 //or S= ITEM DIV 10 MOD 10
        T=ITEM MOD 10
        if F<S and S<T then
            K=K+1
            THREE[K]=ITEM
        end if
    end if
end loop
if K==--1 then
    output('No such numbers')
endif
```

[8]

(c) *Award [4 max].*

The selection sort algorithm starts by finding the **minimum/smallest** value in the array THREE (containing K elements);
and moving it to the beginning of the array THREE (element at the first position is THREE[0]) / exchanges it with the element in the first position;
the correct entry is in the first place in the array and the process is repeated on the remaining entries / this step is then repeated for the second lowest value, then the third, and so on;
once this has been repeated K-1 times;
the K-1 smallest entries are in the first K-1 places which leaves the largest element in the last place (the array is sorted in ascending order);

[4]