8825 – 6407M

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2025

Computer science

Standard level

Paper 1

16 pages

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	• 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

1. *Award [2 max].*

fixed vocabulary/ a set of words (keywords) of computer languages is constrained (and standardised);
consistent grammar/ the way different elements (statements, keywords, operators, punctuation) are combined is precisely stated/ordered (so that when are combined they create meaningful instructions/ always act in the same way);
consistent syntax/ the arrangement of various elements (statements, keywords, operators, punctuation) in code is uniform (and predictable)/ unique rules that control the structure of the code;
unambiguous meaning/ each method(function/statement) has one clear meaning/ corresponds to a single specific operation (that can be uniquely recognised by the computer);

2. *Award [2 max].*

The failover system is a mirror image of the primary system/ is a standby/ backup/redundant system; that is always ready to automatically switch into action when the primary system fails/is shut down for servicing;
ensuring continuous operation / minimizing downtime;

3. *Award [2 max].*

A data flow diagram uses standardized symbols/notation to show the way information flows through a process/ system;

It specifies the software, hardware, files, and people involved in an information flow / it includes data inputs and outputs, data stores, and the various subprocesses the data moves through;

A data flow diagram describes various entities and their relationships using standardized symbols;
It specifies what information is being transmitted/what entities are receiving that info/ what general processes occur, etc.;

4. (a) *Award [1 max].*
2^8 / 256;

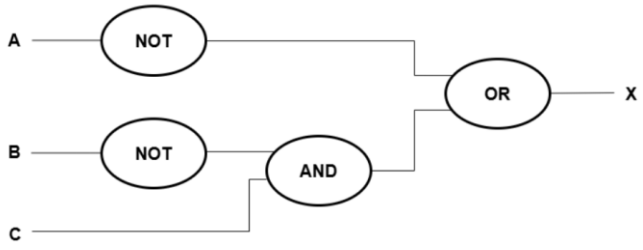
(b) *Award [1 max].*
01111010;

(c) *Award [1 max].*
1C;

5. *Award [5 max].*
Award [1] for the correct column K and NUM[0]
Award [1] for the correct column NUM[1]
Award [1] for the correct column NUM[2]
Award [1] for the correct column NUM[3]
Award [1] for the correct column NUM[4]

K	NUM[0]	NUM[1]	NUM[2]	NUM[3]	NUM[4]
0	(7)	(1)	(5)	(9)	(6)
1		8			
2			13		
3				22	
4					28
	35				

6. *Award [4 max].*
*Award 1 mark for each correctly placed logic gate, **x4**.*



7. *Award [2 max].*

voice recognition;
touch screen;
text-to-speech;
Braille keyboard;

Note: Reward other correct answers, for example provision of keyboard navigation or provision of text description for non-text content.

8. *Award [1 max].*

to hold data that will be stored into or fetched from the primary memory;

9. *Award [2 max].*

reliable/ strong signal transfer/ signals traveling via a fibre optic cable are immune from (electromagnetic/ radiofrequency/ high voltage) interference;
fast transfer of data;
high transmission rate and bandwidth;
huge data capacity;
less maintenance;
transmit data as pulses of light;
low latency;
secure transmission;
difficult to install (more difficult than other types of cables (such as copper cables));
expensive (more expensive than other types of cables (such as UTP cable));

10. *Award [2 max].*

More suitable/ effective;
App to be tested is compiled into the language of the virtual machine and this can be interpreted into the language of the host machine/ an app can be tested in multiple operating systems on a single machine;

Cost effective;
Reduced hardware costs/ reduced the costs associated with licenses and storage;

Less time consuming;
Than having to test app on several computers with different OS;

Faster deployment times for apps;
multiple virtual environments can be quickly created (and used in testing);

Increased security;
due to the isolation of virtual instances (e.g., when testing unapproved software solutions);

Improved scalability of apps;
virtual machines are able to utilize much more computing power since they are not bound to specific hardware (whereas a physical machine is limited by the hardware it contains);

Scalable resource allocation;
resources can easily be added or removed depending on the demands of the app;

Portability;
apps may be tested/executed/used on any platform/ in multiple operating systems;

Legacy System Support;
Apps can be tested on older OS versions that may no longer be supported on modern hardware/ maintaining backward compatibility;

Efficient debugging;
Bugs that occur only on specific OS versions can be caught by running the app in multiple VMs;

Note*: mark the answer in pairs.*

Section B

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

Wireless router;
Wireless access points (WAP) *Accept access point (AP);*
Wireless antennas;
Client wireless adaptors / Network interface cards (NICs);
Wireless bridge/ repeater;
Wireless controller;
Network switches;

***Note**: the word wireless in front of the name of the component may not appear in candidates' answers.*

(b) *Award [4 max].*
*Award [1] for stating an advantage and award [1] for a suitable expansion, **x2**.*

Flexibility / mobility within the office;
Office-based employees can work without sitting at dedicated computers/ allow employees to remain online even if they move their laptop/ allow employees use of other mobile devices around the office/building;

Access/ availability;
Employees can communicate while on the move/ enable employees to share the network and hardware/ WLAN 'hotspots' offering guests access to internet/ employees can bring their own devices (and use full functionality of the network);

Increased collaboration;
employees can be located anywhere in the office and still access key documents and information/ can easily work in teams/groups;

Cost savings/ wireless networks can be cheaper to install / cheaper to extend;
because no need for buying additional hardware or cables to access the network / allows network access to areas where cabling was not cost-effective/ practical;

Simpler infrastructure/office organization/ office layout;
Desk locations are not dictated by wires and cables;

Scalability;
New employees can be added to the network easily and quickly;

***Note:** Reward other reasonable responses.*

(c) *Award [4 max].*
Accept answers on protecting data as it moves from network to network (or, for example, from a local storage device to a cloud storage device)
and answers on protecting data stored on any device.

Use of encryption keys;
so that only devices with the correct key can communicate with access points (Wired Equivalent Privacy (WEP));

Use the most up-to-date wireless encryption protocol (accept Wi-Fi Protected Access/WPA2/WPA3);
to protect internet traffic on wireless networks;

Media Access Control (MAC) addresses attached to each device can be filtered;
to limit connection to access points/ use of trusted/authorised devices;

Service Set Identifiers (SSIDs);
to prevent connection to access points (unless a device uses a given identifier correctly);

Multi-factor verification;
the login process by requiring the user to verify their identity with a text message/email/an authenticator app;

Authentication (user ID + password/ biometric) should be used on all devices/ data files;
to verify the identity of the user;

Strong password (that includes special characters, numbers, and uppercase and lowercase characters/ that is changed regularly/ never shared);
To prevent data breaches / to prevent brute-force attacks (systematically guessing passwords until the correct one is found);

Encryption/ encoding data in such a way that it cannot be read by anyone;
except for the intended recipient with decryption key;

Activate firewall protection (software or hardware) to protect the system/network from unauthorized access;
by controlling the incoming and outgoing traffic/data;

(Buy and) use a high-quality data intercept security software;
that protects the sensitive data from being intercepted by hackers/ helps to protect against viruses, malware, spam;

Keep software and firmware up to date;
to patch any security vulnerabilities;

Use a VPN;
to encrypt communication between devices and network;

Segment network;
to limit access to sensitive data;

Intranet and extranet could be implemented;
extranet is accessible to all users / extranet provides limited access from outside the WLAN for all users/ the intranet (private/secure network) is restricted to group of users /employees;

Authorization;
To specify actions an authenticated user is permitted to perform/ to specify role access rights (to resources and operations);

Install antivirus software;
to identify, block and protect against malicious software/ infected links/suspicious activity;

(d) *Award [4 max].*

VPN ensures that only authorized users can connect using authentication;
Tunnel established between the employee's device and the organization's network;
All data passing through this tunnel is encrypted, even if someone intercepts it, they cannot understand it;
Gives the employee access to internal resources (files, databases, printers, or applications) as if they were physically connected to the company's LAN;
Masks the employee's IP address making the data origin untraceable;
Uses multiple exit nodes making it hard to trace the data path;

12. (a) (i) *Award [2 max].*
Award [1] mark for identifying an advantage of using direct observation to the system analyst, ***x2****.*

The system analyst can gather data at the time they occur/ where activity is occurring/ can obtain direct/ first-hand information about the system / can observe how processes are really carried out;

The analyst does not rely on users' willingness to provide information/ does not have to ask users about their behaviour (can observe users' actions/expressions/reactions);

The analyst can reveal system issues that the users are unable to identify/ are not aware of;

The analyst can conduct his/her study over a longer period/ analysis can be detailed;

the analyst can gain information that is more reliable/less biased/more accurate (than data collected by other methods);

Note*: Reward other reasonable answers.*

(ii) *Award [1 max].*

interview;
surveys/questionnaires;
focus groups/ brainstorming;

(iii) *Award [2 max].*
Award [1] mark for identifying an advantage to the system analyst, ***x2****.*
Note: The response should match the method identified in (ii).

Example (*advantages of interviews to the system analyst*):

Allows the system analyst
to obtain original/unique data directly from the end users/ key stakeholders;
to quickly obtain direct/ in-depth information about a subject or situation by asking accurate questions;
to detect non-response/ spontaneity/ biased responses / non-verbal clues/ body language of the interviewee;
to modify/change questions in personal face-to-face interviews to obtain the required information;

Example (*advantages of surveys to the system analyst*):

Allows collecting data from a large number of respondents;
Numerous questions can be asked about processes in a short period of time/ a broad range of data can be collected quickly;
Allows different question types that helps to collect both quantitative and qualitative data;
Relatively easy to administer/ can be administered remotely via mobile devices, mail or telephone;
Can be conducted remotely (can reduce geographical dependence);
Can use survey software to analyse survey data to determine validity/reliability/ statistical significance;
A broad range of data can be collected (e.g. attitudes, opinions, behaviour, factual);
cost/time effective to create/distribute/analyse;

Example (*advantages of focus groups to the system analyst*):

The system analyst can interact with the end-users, which allows for follow-up questions; information is provided more quickly than if end-users were interviewed separately;
Discussion among participants would bring out insights/ better understanding of the system;
Can explore the degree of consensus on system/ get feedback;

(b) (i) *Award [2 max].*
Award [1] for an advantage and award [1] for a reasonable expansion.

the final computer system is more successful/better meets the user's requirements;
as feedback is provided by the users during the development process/ as different prototypes can be tried out/ due to the users' active participation in the development process;

costs savings;
best design decided upon early so total cost (and duration) is decreased / prototype (model) can be reused for more complicated (or similar) computer systems in the future;

time savings;
feedback avoids spending time (and money) on later changes/ missing functionality or errors can be found/detected/resolved early;

better communication among stakeholders;
visual models bridge gaps between technical teams and non-technical clients;

reduced risk of failure;
by testing early, the company can avoid investing heavily in flawed designs;

(ii) *Award [2 max].*
Award [1] for a disadvantage and award [1] for a suitable expansion.

Prototyping expense / model is costly;
in terms of hardware/software/development time;

Final computer system can be of less than highest quality/ users may not be satisfied;
because of demand the actual product to be delivered soon after seeing an early prototype;

Increased development time;
users might start to ask for features to be included which were never in the original user requirements or specifications/ producing more than one prototype takes time;

Difficulty in scaling;
a prototype that works well in a small test environment may not scale effectively to full production;

(c) *Award [6 max].*
***Note**: Award marks for an account of similarities and differences between local and cloud storage referring to both of them throughout.*
Award up to 2 marks for cost, up to 2 marks for security/privacy and up to 2 marks for accessibility/availability.

***Cost: (**example differences/similarities)*

Local storage	**Cloud storage**
- hardware/ infrastructure costs are high (pay for cooling systems to ensure that servers are running efficiently, for electricity to run the servers 24/7, or for hardware maintenance, etc.); - Adding more storage space creates extra costs; - a dedicated employee/ an IT team that can maintain software/ backups for the company's data, etc.;	-cloud storage is usually cheaper than local storage/ low cost of maintenance; -the company doesn't have to purchase/ maintain any hardware; -a subscription fee should be paid to use cloud storage/ a subscription fee depends on the space needed; - is automatically backed up at specific intervals (no need for human intervention);

Privacy/security: (*example differences/similarities)*

Local storage	**Cloud storage**
-the company has full control over the data (how data is stored, who has access, and information security protocols); - access levels are set up in the company/ can be added or removed easily within the company; - employees directly concerned can be able to read data/ less people should be able to edit it; - devices can be removed from the company's network at any time (for protection); -encryption or firewall can be implemented; - physical access to servers should be controlled; -security requires trained IT staff or outsourcing; - backup needs to be planned/ implemented;	-a third-party provider controls the company's data; -cloud relies on encryption to secure data; - cloud service providers protect their own servers; - cloud service providers implement stronger backup mechanisms; -possibility of data getting breached (even providers could access sensitive data without authorization)/ data can be intercepted during transmission over public network;

Accessibility/Availability: (*example differences/similarities)*

Local storage	**Cloud storage**
-a device (removable disks or similar) for moving the data between machines is needed; - data is harder to share with other colleagues when needed; - no need for an internet connection to access data; - access to data stored on local storage can be faster than cloud storage;	-access to data from anywhere (only an internet connection and credentials needed)/ any device that has an internet connection; -cloud storage is exclusively online/ if internet goes down, employees cannot access data; - access is slower as it is over the public network/ limited with internet connection's speed; - in cases of hardware failure/ infrastructure breakdown/natural disasters, data recovery in the cloud is a lot easier;

13. (a) *Award [2 max].*

A collection is a term used to describe a data structure designed to contain multiple elements of any type;
and the set of methods that are common to all elements;

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

Because of the second use of getNext() (inside the while loop);
The algorithm outputs every other element starting from the second element instead of outputting every element in the collection/ outputs 30 20 100 50 instead of 100 30 10 20 50 100 250 50 / logical error ;

when the number of elements in the collection PLTNT is an odd number and the last element in the collection have been accessed;
then the next use of getNext() will not return a valid element/ the algorithm will crash/ run-time error;

(ii) *Award [2 max].*

Example 1:
Award [1] for deleting `X = PLTNT.getNext()`*, and award [1] for the correct remaining part of the algorithm/ not making any other changes.*

```
PLTNT.resetNext()
while PLTNT.hasNext()
    output (PLTNT.getNext())
end loop
```

Example 2:
Award [1] for replacing `PLTNT.getNext()` *with* `X` *in the output statement, and award [1] for the correct remaining part of the algorithm/ not making any other changes.*

```
PLTNT.resetNext()
while PLTNT.hasNext()
    X = PLTNT.getNext()
    output (X)
end loop
```

(c) *Award [9 max]*

Award [1] for starting from the first element in the collection
Award [1] for initializing MINC and MAXC
Award [1] for the correct loop
Award [1] for getting a value from the collection
Award [1] for initializing and increasing sum
Award [1] for initializing and increasing counter
Award [1] for correct comparison and change of MAXC (if needed)
Award [1] for correct comparison and change of MINC (if needed)
Award [1] for calculating and outputting the average
Award [1] outputting MINC and MAXC

Example 1:

```
PLTNT.resetNext()
MINC = 500  //or any value greater than 500
MAXC = 0     //or any value smaller than 0
C = 0  // counter
S = 0  // sum
while PLTNT.hasNext()
    X = PLTNT.getNext()
    S = S + X
    C = C + 1
    if MAXC < X
        then
            MAXC = X
        else
            if MINC > X
                then
                    MINC = X
            endif
    endif
end loop
output ('The maximum pollutant concentration: ', MAXC)
output (('The minimum pollutant concentration: ', MINC)
output ('The average pollutant concentration: ', S/C)//Accept S DIV C
```

Example 2:

```
PLTNT.resetNext()
if not PLTNT.isEmpty()
    then
        X = PLTNT.getNext()
        MINC = X
        MAXC = X
         C = 1  // counter
         S = X  // sum
         while PLTNT.hasNext()
             X = PLTNT.getNext()
             S = S + X
             C = C + 1

             if MAXC < X
                 then MAXC = X
             endif
             if MINC > X
                 then MINC = X
             endif
         end loop
         A = S / C  //Accept S DIV C
         output ('Maximum: ', MAXC)
         output (('Minimum: ', MINC)
         output ('AVERAGE: ',A)
else
    output('PLNT is empty')
endif
```