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CAMBRIDGE
International Education

Cambridge International AS & A Level

COMPUTER SCIENCE **9618/12**

Paper 1 Theory Fundamentals **May/June 2026**

MARK SCHEME

Maximum Mark: 75

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

This document consists of **17** printed pages.

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General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: • the specific **content** defined in the mark scheme • the specific **skills** defined in the mark scheme or in the level descriptions • the **standard of response** required as exemplified by the standardisation scripts.
2	Examiners must award **whole marks** (not half marks, or other fractions).
3	Examiners must award marks **positively**. This means that: • marks are not deducted for errors or omissions • marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate • the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and **must not** award marks with grade thresholds or grade descriptions in mind.

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Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	Correct
	Incorrect
	To indicate where a key word/phrase/code is missing.
	Not relevant or used to separate parts of an answer.
	Indicates a part of the answer that is incorrect.
Highlighter	To draw attention to a particular aspect or to indicate where parts of an answer have been combined.
	Too vague.
	Repetition
	No examples or not enough.

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Annotation	Meaning
BOD	Benefit of Doubt.
NAQ	Not Answered Question.
SEEN	Indicates that work or a page has been seen including blank answer spaces and blank pages.
FT	Follow through.
I	Ignore

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Question	Answer	Marks	Guidance
1(a)	**1 mark** for a correct tick • The smallest element of an image that can be one colour	**1**	Correct answer only
1(b)	**1 mark** for each correct answer • Image resolution is the number of **pixels wide** by **pixels high** that form the image and screen resolution is the number of **pixels wide** by **pixels high** that can be **displayed** on a screen. • If screen resolution is not as high as image resolution the quality of the image is worsened. // Image resolution can be changed, but screen resolution has a physical limit	**2**	Accept horizontal and/or vertical for wide and/or high Just number of pixels for either or both is NE Do not accept bits or characters for pixels
1(c)	**1 mark** for a correct answer For example: • File size • File type • Dimensions of the image // image size • Compression type • Data offset – bytes from the beginning of the file to the actual pixel data	**1**	Mark the first answer given Do not accept resolution or colour depth, they are given in the question Do not accept a description of a file header or metadata Accept height and/or width for dimensions BOD
1(d)(i)	**1 mark** for: • Two // 2	**1**	Correct answer only

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Question	Answer	Marks	Guidance
1(d)(ii)	**1 mark** for each correct point to **max 2** • Run Length Encoding (RLE) can be used • A series of **consecutive** pixels of the **same colour //** a **sequence** of the **same colour** pixel is stored as a single copy of the colour and the number of **consecutive** occurrences **1 mark** for a suitable reference **to the given image** • RLE: e.g. R2 // W4 // 2R4W // R2W4	**3**	Take care that the answers are compressing pixels not anything else Do not accept bits or characters or elements etc. for pixels If no reference to the diagram included in the answer, please check the diagram for annotations

Question	Answer	Marks	Guidance
2(a)	**1 mark** for method **1 mark** for correct matching description (*** 2**) • Visual check • The entered data is **compared with the original** by a person • Double entry • Enter the data twice and the computer automatically **compares** if they match	**4**	Note: Question asks for methods of data **verification** not validation Accept examples of visual checks, such as printing a copy and comparing the printout **to the original** Data as intended is NE. It is the comparison to the original that is important

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Question	Answer	Marks	Guidance
2(b)	**1 mark** for two correct names of methods **1 mark** for each correct matching use to **max 2** • Presence check • The Date of Birth (DoB) field cannot be left blank • Range check • DoB must be after one date **and** before another date // between specific dates – must include both ends • Limit check • DoB must be after or before a specific date – must be only one end • Format check • DoB must be dd/mm/yyyy • Length check • DoB must be **exactly** 10 characters • Type check • The data type must be DATE or DATE/TIME	**3**	Note: Question asks for methods of data **validation** not verification Mark the first answer in each box The use must match the example given in the question 05/07/2010 Do not accept range and limit as two different checks Take care that answers do not just repeat the method, must be applied in some way. The use must match the method If no methods are given read the uses which must be applied to the DoB. For format check accept mm/dd/yyyy
2(c)(i)	**1 mark** for correct description of a virus • **Description:** **malicious** software that replicates on the computer and can fill storage or delete/corrupt/change data - cause harm is NE **1 mark** each for a correct method and matching description, **2 marks** • **Method:** Anti-virus software // anti-malware software • **Description:** The software scans files/downloads/device and compares against database of known viruses, and quarantines/deletes/alerts the user if a match found	**3**	The description of the method must match the method chosen

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Question	Answer	Marks	Guidance
2(c)(ii)	**1 mark** for correct description of a hacker • **Description:** person who gains **unauthorised access** to a computer system **1 mark** each for a correct method and matching description, **2 marks** For example: • **Method:** Firewall • **Description:** The firewall monitors all incoming and outgoing data compares it to stored criteria and blocks transmissions that are not allowed • **Method: Multi-factor** authentication • **Description:** A second form of verification such as biometrics or use of an authenticator app is required for logging in • **Method:** Strong passwords • **Description:** • The password contains a mixture of different types of characters and is at least a set number of characters and is not something connected to the individual such as a date of birth • **Method:** Encryption • **Description:** Scramble/encode the data/turn into ciphertext so that even if it is accessed it will not be **understood/useable** without the decryption key	**3**	The description of the method must match the method chosen Just malicious intent is NE for unauthorised access Accept two-factor for multi-factor If firewall is the candidate's answer for **question 2(c)(i)** ensure it is not repeated here Just authentication is NE for multi-factor authentication Map biometrics/use of biometric password as the method to strong password **Description:** Uses features of an individual that are unique and which are almost impossible to duplicate

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Question	Answer	Marks	Guidance
3(a)	**1 mark** for each correct relationship • The relationship between `PLAYER` and `CHARACTER` is one to many /1:M // one player can have many characters, **but** each character can only be created by one player • The relationship between `GROUP` and `CHARACTER` is many to many / M:M // one group can have many characters, **and** one character can be in many groups	**2**	The second option in each case needs both 'halves' Accept a m:m relationship between `PLAYER` and `GROUP` Accept user for player Mark the writing first, but accept accurate E-R diagram(s), if needed for clarification
3(b)(i)	**1 mark** for each correct line number **and** the appropriate correction • Line 02 • `CharacterID` **`VARCHAR`**, // `CharacterID` **`VARCHAR(5),`** • Line 05 • **`Level`** `INT,` • Line 08 • `PRIMARY KEY(CharacterID)` • Line 09 • `FOREIGN KEY(PlayerID)` **`REFERENCES PLAYER(PlayerID)`**	**4**	Ignore extra `NOT NULL` on line 02 but not on line 05 or line 08

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Question	Answer	Marks	Guidance

3(b)(ii)	**1 mark** for each correct point
	
	• Selecting the player's name and counting a field
	• Using an appropriate name
	• Linking or joining the correct tables
	• Grouping the results
	• Ordering in descending order by player ID
	
	Example 1:
	`SELECT PlayerName, COUNT(CHARACTER.CharacterID)` MP1
	`AS TotalCharacters` MP2
	`FROM CHARACTER, PLAYER`
	`WHERE CHARACTER.PlayerID = PLAYER.PlayerID` MP3
	`GROUP BY PlayerName` MP4
	`ORDER BY PLAYER.PlayerID DESC;` MP5
	
	Example 2:
	`SELECT PlayerName, COUNT(CharacterID)` MP1
	`AS TotalCharacters` MP2
	`FROM CHARACTER INNER JOIN PLAYER`
	`ON CHARACTER.PlayerID = PLAYER.PlayerID` MP3
	`GROUP BY PlayerName` MP4
	`ORDER BY PLAYER.PlayerID DESC;` MP5
		5	Accept any correct method of joining the tables, but no mix and match between methods
			
			The only attribute that needs a table reference is the PlayerID. Ignore other table references as long as the correct table is used
			
			Take care with the DESC

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Question	Answer	Marks	Guidance
3(c)	**1 mark** for **two** data dictionary examples For example: • data types **of individual fields/attributes** • type of validation • primary key • foreign key **1 mark** for each remaining term (**4 marks**) • data dictionary • logical • access rights • developer interface The **data dictionary** stores data about the data in the database. The table names, field names and relationships will be stored. Two other examples that will be stored are **example 1** and **example 2** When designing a database, the **logical** schema is the design of the database tables, fields and relationships independent of any Database Management System (DBMS). A DBMS provides security features to protect the data. **Access rights** are used to give user accounts permission to read data, some to read and write data and others may be unable to read the data. When creating a database a **developer interface** provides tools to create visual components for example forms and reports.	**5**	Mark the first answer in each space Do not accept table names or field names or relationships, they are given in the question There are many answers for the examples, the list is suggestions only Do not accept metadata as an example or instead of data dictionary Just ‘key’ is NE for primary or foreign keys Just data type is TV for the second example

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Question	Answer	Marks	Guidance
4(a)	**1 mark** for: • The sound wave is measured **44100** times **each** second // **44100** samples are taken **every** second	**1**	Accept appropriate alternative words for measured including 'sampled' Accept 44.1 thousand instead of 44100
4(b)	**1 mark** each to **max 3** • The resolution of 2 bytes (16 bits) will have more **bits per sample** • … which will result in a larger file size • … but the digital sound will be more accurate to original • … because a greater range/more exact amplitudes can be recorded • … with smaller quantisation errors	**3**	Must be clear which resolution is being described Allow reverse arguments e.g. The resolution of 8 bits will have fewer bits per sample … which will result in a smaller file size etc.

Question	Answer	Marks	Guidance
5(a)	**1 mark** for each correctly completed value	**4**	

denary	unsigned binary	hexadecimal	Binary Coded Decimal (BCD)
160	10100000	A0	**0001 0110 0000**
289	100100001	121	001010001001
2486	**1001 1011 0110**	9B6	0010010010000110
35123	1000100100110011	**8933**	0011010100010010011

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>5(b)</td><td>1 mark for each correct answer

<table>
<tr><th>statement</th><th>answer</th></tr>
<tr><td>The smallest 12-bit two's complement binary number</td><td>1000 0000 0000</td></tr>
<tr><td>The denary value represented by the 8-bit unsigned binary number 01100010 after a logical right shift of 2 places has been applied.</td><td>24</td></tr>
<tr><td>The binary value after a cyclic left shift of 4 places has been applied to the binary number 10010101</td><td>0101 1001</td></tr>
</table></td><td>3</td><td>Note: The first answer must be 12 bits and a binary value

Note: The second answer must be in denary.</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>6(a)</td><td>1 mark for each correct point to max 3

• It only has one function, to monitor health
• All the hardware such as sensors and a microprocessor is dedicated to the task of monitoring health
• The firmware cannot be easily amended or updated because its function is preset</td><td>3</td><td></td></tr>
<tr><td>6(b)</td><td>No mark for the choice.
1 mark for each correct point to max 2

Monitoring:
• The system only records/transmits the data
• It does not make use of feedback // it does not change the environment
• The output does not affect the next input
• It does not contain an actuator</td><td>2</td><td>Not performing an action is NE for the no actuator mark</td></tr>
</table>

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Question	Answer	Marks	Guidance
6(c)	**1 mark** for each correct point to **max 2** • RAM can be changed; ROM cannot be changed // RAM can be read from and written to, ROM can only be read • RAM is volatile, ROM is non-volatile // RAM is temporary, ROM is permanent • RAM stores currently running data/instructions, ROM stores boot-up/firmware	**2**	The question asks for differences, so answers must refer to both RAM and ROM Do not accept the expansion of the acronyms, it is given in the question
6(d)	**1 mark** for each correct point to **max 4, max 3** if only either benefits or drawbacks discussed, not both For example: • The data can be accessed anywhere with internet access // without internet access the data cannot be accessed • The health monitor and smart phone can be mobile and still upload data • The data is shareable with medical professionals • Storing data in the cloud reduces the need for large amounts of internal storage on the phone • The user can upgrade/change their device and retain old data // the data can be accessed from different appropriate devices • The user has no control over security // There could be security issues with storing the data on the cloud • The data could be sold or misused by the cloud owner	**4**	Note: The mark points are examples only. Accept any sensible benefit or drawback Any answer about cost must be suitably qualified. Answers about no control need to be qualified Do not award two marks for a benefit and it's reverse as a drawback Just easier for hackers is NE

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Question	Answer	Marks	Guidance
7(a)(i)	**1 mark** for each correct point to **max 2** • Efficient allocation of resources to processes • Moving processes between states • Allocating time slices to processes • Scheduling processes // An example of a scheduling algorithm • Resolution of conflicts when two processes require the same resource • Allows communication between processes	**2**	Do not accept allows multi-programming – that is a benefit not a task resource management is NE Accept checking priorities as scheduling Take care that answers do not refer to tasks done by the kernel or by memory management.
7(a)(ii)	**1 mark** for each correct point to **max 2** • Dynamically allocates RAM to processes • Frees up memory when the process closes • Makes sure two processes do not access the same memory • Accesses data from RAM when needed	**2**	Accept software or applications for processes in first mark point Take care that answers do not refer to tasks done by process management or by file management
7(a)(iii)	**1 mark** for each correct point to **max 3** • With continued use **files** can be split and stored in different locations on the disk so time is spent by the disk head moving between locations to access all parts of file • Defragmentation software moves split **files** into contiguous blocks // defragmentation software collects all the free space into a • contiguous block • … which means that the disk head does not need to move as much to access the next part of the file // … which means that the disk head does not need to move as much when writing a file • After defragmentation data **access/read/write** takes less time, so performance is improved	**3**	Note: The question asks how defragmentation improves computer performance. So just a description of the process is NE

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Question	Answer	Marks	Guidance
7(b)(i)	**1 mark** for each correct point to **max 4,** mark in pairs • (Single) Stepping • …the student runs one line of code at a time **and** looks at the output/results/flow before moving to run the next line • Breakpoints • …These are inserted in the code to stop the code at a specific point **so that** the student can check the flow/values / test sub-sections of the code • (Variable) Watch window • …the student can view how/when the variables change during execution	**4**	Take care that the answer says how the student **uses** the tools and doesn't just describe each tool Award a maximum of two marks for names of debugging tools with no further suitable explanation Just check for errors is not enough for an explanation, that is what debugging means
7(b)(ii)	**1 mark** for each correct point to **max 2** • Partially compiled programs can be used on different platforms as they are interpreted when run • The code is optimised for the CPU as machine code is generated at run time • It is more efficient to run as the source code does not need recompiling	**2**	Note: Candidate responses need to answer the question why?

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>8(a)</td><td>1 mark for A column and 1 mark for B column

<table>
<tr><th>X</th><th>Y</th><th>Z</th><th>Working space</th><th>A</th><th>B</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td></td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td></td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td></td><td>0</td><td>0</td></tr>
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<tr><td>1</td><td>1</td><td>1</td><td></td><td>1</td><td>0</td></tr>
</table></td><td>2</td><td></td></tr>
<tr><td>8(b)</td><td>1 mark for a correct answer

• NOT (A XOR B)
• NOT A XOR B // NOT B XOR A
• NOT (A OR B) OR (A AND B) // (NOT A AND NOT B) OR (A AND B)
• (NOT A AND NOT B AND NOT C) OR (NOT A AND NOT B AND C) OR (A AND B AND NOT C) OR (A AND B AND C)
• A AND B OR (A NOR B)</td><td>1</td><td>Accept any correct Boolean notation

For example:
$\bar{A}.\bar{B}.\bar{C} + \bar{A}.\bar{B}.C + A.B.\bar{C} + A.B.C$
Or
A’B’C’ + A’B’C + ABC’ + ABC</td></tr>
</table>

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