



GCE A LEVEL MARKING SCHEME

SUMMER 2022

**A LEVEL
COMPUTER SCIENCE - UNIT 4
1500U40-1**

INTRODUCTION

This marking scheme was used by WJEC for the 2022 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

WJEC GCE A LEVEL COMPUTER SCIENCE - UNIT 4

SUMMER 2022 MARK SCHEME

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|---------------------------------------|--|-----|-----|-------|
| 1. (a) | <p>1 mark for folders or grouping, 1 mark for example of common operations, 1 mark for other use</p> <ul style="list-style-type: none"> • A computer program that helps the user to group related files into folders. • Common operations / uses include creating, opening, deleting, renaming, moving, copying, sorting and searching for files • Other uses include modifying file attributes / file properties / file permissions. | 1 1 1 | 1b 1b 1b | | | 6 |
| (b) | <p>1 mark for valid purpose up to a maximum of 3 marks.</p> <ul style="list-style-type: none"> • A hashing algorithm is a calculation for transforming a string of characters into a usually shorter fixed-length value or key. • Hashing is used to index and retrieve items in a data structure / database. • It saves time as it is faster to find an item using the shorter hashed key than to find it using the original value. • It is also used in many encryption algorithms to provide data security. • It can deal with collisions should they arise e.g. overflow area | 1 1 1 1 1 | 1b 1b 1b 1b 1b | | | |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|---|------------------|----------------------|-----|-----|-------|
| 2. (a) | <p>1 mark for any one of the following</p> <p>Description of high priority interrupt involving any of:</p> <ul style="list-style-type: none"> • Impending data loss • Impending hardware / software failure • Detection of imminent power failure <p>Allow run time error</p> | 1 | 1b | | | 4 |
| (b) | <p>1 mark for each stage of the process to a maximum of 3 marks</p> <ul style="list-style-type: none"> • The O/S suspends current interrupt routine • The O/S stores the address of the current interrupt • It runs the new higher priority interrupt routine • The O/S returns to original interrupt routine and continues | 1 1 1 1 | 1b 1b 1b 1b | | | |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|---|-----|-----|---|-------|
| 3. | <p>1 mark for each correct instruction, as outlined</p> <p>1 mark for input of number</p> <p>1 mark for: loop and JMP command creating a loop</p> <p>1 mark for: subtracting code value (Y) from input (X)</p> <p>1 mark for JZE command jump to correct</p> <p>1 mark for outputting 2 if incorrect</p> <p>1 mark for outputting 1 if correct</p> <p>Indicative content</p> <pre> Loop INP {input 4 digit number} STA X {store 4 digit number} LDA X {load 4 digit number} SUB Y {subtract stored code} JZE correct Jump to correct if result is zero} OUT 2 {output 2} JMP loop {loop} Correct OUT 1 {output 1} HLT {stop} </pre> | <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> | | | <p>3b</p> <p>3b</p> <p>3b</p> <p>3b</p> <p>3b</p> <p>3b</p> | 6 |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|------------------|----------------------|-----|-----|-------|
| 4. | <p>1 mark for each correct point to a maximum of 2 marks per application to a maximum of 8 marks.</p> <p>Podcast</p> <ul style="list-style-type: none"> • A series of digital media files (either audio or video) that are released episodically and often downloaded through web syndication. • The mode of delivery differentiates podcasting from other means of accessing media files over the Internet, such as direct download, or streamed webcasting. • A list of all content is maintained on the distributor's server as a web feed. The user employs special client application software known as a podcatcher that can access this web feed, check it for updates, and download any new files in the series. • This process can be automated so that new files are downloaded automatically. Files are stored locally on the user's computer or other device ready for offline use at a later date, giving simple and convenient access to episodic content. <p>Blog</p> <ul style="list-style-type: none"> • A type of web site usually maintained by an individual with regular entries of commentary, descriptions of events, or other material such as graphics or video. • Entries are commonly displayed in reverse-chronological order. • Most blogs reflect the thoughts, opinions, and biases of the individual or corporation that runs the blog. • Most are also interactive, allowing visitors to leave comments and even message each other via widgets on the blogs. This interactivity distinguishes them from other static web sites. | 1 1 1 1 | 1b 1b 1b 1b | | | 8 |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|---|------|-----|-----|-----|-------|
| | Instant messaging | | | | | |
| | <ul style="list-style-type: none"> • A form of real-time direct text-based communication between two or more people. | 1 | 1b | | | |
| | <ul style="list-style-type: none"> • Messages are usually encrypted to maintain privacy | 1 | 1b | | | |
| | <ul style="list-style-type: none"> • More advanced instant messaging software clients also allow enhanced modes of communication, such as live voice or video calling. | 1 | 1b | | | |
| | <ul style="list-style-type: none"> • IM falls is a form of online chat, but is distinct in that it is based on clients that facilitate connections between specified known users whereas online 'chat' also allow communication between anonymous users in a multi-user environment. | 1 | 1b | | | |
| | <ul style="list-style-type: none"> • Differs from e-mail due to the perceived synchronicity of the communications | 1 | 1b | | | |
| | Webcast | | | | | |
| | <ul style="list-style-type: none"> • Broadcasting over the Internet. | 1 | 1b | | | |
| | <ul style="list-style-type: none"> • A webcast is a media file distributed over the Internet using streaming media technology. | 1 | 1b | | | |
| | <ul style="list-style-type: none"> • Distribution of a single content source to many simultaneous listeners/viewers. | 1 | 1b | | | |
| | <ul style="list-style-type: none"> • May either be distributed live or on demand. | 1 | 1b | | | |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|------------------|----------------|----------------------|-----|-------|
| 5. (a) | 1 mark for each correct stage 7.1875 = 111.0011 Mantissa 01110011 Exponent 0000011 | 1 1 1 | | 2b 2b 2b | | 12 |
| (b) | 1 mark for each correct part. The closest representation of 19.3_{10} possible using the specified format is: Mantissa 01001101 Exponent 00000101 | 1 1 | | 2b 2b | | |
| (c) | 1 mark for each correct stage. 01001101 00000101 has a value of 19.25_{10} Absolute error= original value – rounded value = $19.3 - 19.25 = 0.05$. Relative error = absolute error / original value = $0.05 / 19.3$ = 0.0026 Accept percentage values | 1 1 1 1 | | 2b 2b 2b 2b | | |
| (d) | 1 mark for each correct point. <ul style="list-style-type: none"> set number of bits for mantissa and exponent / trade-off between accuracy v range. for larger mantissa leading to greater accuracy larger exponent leading to greater range of numbers being represented. Indicative content There will always be a trade-off between accuracy and range when using floating point notation, as there will always be a set number of bits allocated to storing real numbers: <ul style="list-style-type: none"> increasing the number of bits for the mantissa will improve the accuracy of a floating point number increasing the number of bits for the exponent will increase the range of numbers that can be held | 1 1 1 | 1b 1b 1b | | | |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|---|-------------|-----|----------------|-----|-------|
| 6. (a) | <p>1 mark for correct path cost and 1 mark for correct cost to a maximum of 2 marks.</p> $2 + 10 + 2 = 14$ $14 \times (1.2 + 1.2) = 33.6$ | 1 1 | | 2b 2b | | 6 |
| (b) (i) | <p>1 mark for correct path cost and 1 mark for correct delay factor to a maximum of 2 marks.</p> $A - B - F (5 + 14)$ $\times 1.2 = 22.8$ | 1 1 | | 2b 2b | | |
| (ii) | <p>1 mark for each correct point to a maximum of 2 marks</p> <ul style="list-style-type: none"> • The upgrade will supersede the link from node B to node F. • The lowest cost route from A to F will become 21.6. • Link C to D is central to the network and therefore most costs will be reduced. | 1 1 1 | | 2b 2b 2b | | |

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|----------|--|---|--|-----|-----|-------|
| 7. (a) | <p>1 mark for each correct point to a maximum of 2 marks</p> <ul style="list-style-type: none"> • A path or means by which a hacker can gain access to a computer or network server • in order to deliver malware or effect a malicious outcome, such as obtaining personal information. | 1 1 | 1b 1b | | | 6 |
| (b) | <p>1 mark for correct vector, 1 mark for associated description to a maximum of 4 marks</p> <ul style="list-style-type: none"> • Drive-by-download (Accept Watering hole) Malware being inadvertently downloaded from a legitimate, but compromised website without any further action from the user. • Domain shadowing Diverting requests to legitimate websites to bogus copies of the website that will offer what appear to be genuine links, but to malware downloads. • Malvertising Malware downloads from infected adverts placed on popular websites. • Accept Distributed Denial-of-Service Flooding the targeted system with bogus requests to overload the system making it unavailable for its intended use. • SQL injection. Used to attack data driven applications where a malicious SQL statement is inserted into an entry field which, when executed, will transfer the data content to the attacker | 1 1 1 1 1 1 1 | 1b 1b 1b 1b 1b 1b 1b | | | |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|--|--|-----|-----|-------|
| 8. (a) | <p>1 mark for correct statement to a maximum of 1 mark.</p> <p>Penetration testing / ethical hacking is the process of testing a computer system, or network, to</p> <ul style="list-style-type: none"> • find vulnerabilities an attacker could exploit • test the effectiveness of an organisations security policies. | 1 1 | 1b 1b | | | 7 |
| (b) | <p>1 mark for strategy, and 1 mark for suitable description to a maximum of 6 marks.</p> <p>Indicative content</p> <p>Targeted Testing</p> <ul style="list-style-type: none"> • The internal IT team working with external professionals to determine the vulnerability of the company's systems and find solutions to strengthening the systems to prevent potential attacks. <p>Internal Testing</p> <ul style="list-style-type: none"> • Testing systems to establish the extent to which a dissatisfied employee may go to in accessing unauthorised information. <p>External Penetration Testing</p> <ul style="list-style-type: none"> • Testing to establish the vulnerability to external attackers of an organisations external devices and servers such as firewalls, email-servers and web servers. <p>Blind Pen (penetration) Testing</p> <ul style="list-style-type: none"> • An authorised imitation of a real cyber-attack where an ethical hacker is tasked with gaining access to an organisation's systems. <p>Double Blind Penetration Testing</p> <ul style="list-style-type: none"> • Similar to blind testing, but to determine how fast and effective the security team is on identifying and responding to real attacks. <p>Accept alternative categorisations of tests such as;</p> <ul style="list-style-type: none"> • Network service tests. Testing security of internal and external access points. • Web application tests. Targeted testing of areas such as web applications, browsers, plug-ins. • Client side tests. Testing applications being used. • Wireless network tests. Testing of devices, protocols and access points. • Social engineering tests. Such as testing employees' reactions to phishing emails. | 1 1 1 1 1 1 1 1 1 1 | 1b 1b 1b 1b 1b 1b 1b 1b | | | |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|---|------------------|-----|-----|----------------------|-------|
| 9. (a) | <p>1 mark for each of the following, to a maximum of 4 marks.</p> <ul style="list-style-type: none"> • Correct construct (CREATE TABLE with brackets in correct places) • Identifying PRIMARY KEY • NOT NULL on key field • Correct data types and sizes for itemNo and customerID <p>Indicative content</p> <pre>CREATE TABLE Customer (customerID char(6) NOT NULL, surname char(20) NOT NULL, orderDate datetime, itemNo char(7), orderQuantity int, PRIMARY KEY (customerID));</pre> <p>or</p> <pre>CREATE TABLE Customer (customerID char(6) NOT NULL PRIMARY KEY, surname char(20) NOT NULL, orderDate datetime, itemNo char(7), orderQuantity int);</pre> | 1 1 1 1 | | | 3b 3b 3b 3b | 7 |
| (b) | <p>1 mark for INSERT and VALUE and 1 mark for all fields in correct order.</p> <p>Indicative content</p> <pre>INSERT INTO Item VALUES ("CT00111", 13, "Earrings", 97);</pre> <p>Do not penalise inclusion of field names</p> | 2 | | | 3b | |
| (c) | <p>1 mark for correct update</p> <p>Indicative content</p> <pre>UPDATE Item SET price = 93 WHERE itemNO = "CT00016"</pre> | 1 | | | 3b | |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|----------------------------|----------------------------------|-----|-----|-----------|
| 10. (a) | <p>1 mark for description and 1 mark for expansion to a maximum of 2 marks.</p> <p>Indicative content</p> <ul style="list-style-type: none"> • A set of formally described tables - from which data can be accessed or reassembled in many different ways without having to reorganise the database tables. • A complex data structure to hold variety of different data. Where data items are related to each other they are linked together by pointers (relations). • Powerful method of storing data in tables that makes no assumptions about how application programs will access the data. Therefore, does not restrict the queries to access data from more than one table. | 1 1 1 1 1 1 | 1b 1b 1b 1b 1b 1b | | | 12 |
| (b) | <p>1 mark for advantage and 1 mark for expansion to a maximum of 4 marks;</p> <ul style="list-style-type: none"> • Advantage - Reduced data redundancy: • In each level of normalisation data redundancy / duplication is reduced removed decreasing the size (volume) of stored data, • Advantage - Increased data integrity: • Once the redundancy is removed, it is easy to change / limits errors as the data is present in only one place. • Normalisation splits an entity into a smaller number of entities, so you will have more smaller tables, so it is easier for sorting, indexing and searching. | 1 1 1 1 1 | 1b 1b 1b 1b 1b | | | |
| (c) | <p>1 mark per correct one-to-many relationship</p> <p>Accept Dentist 1:M Appointment</p> | 3 | | 2b | | |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|------|-----|-----|-----|-------|
| (d) | <p>1 mark for each foreign key field identified in Dentist, Patient and Appointment tables</p> <p>Indicative content:</p> <ul style="list-style-type: none"> • Surgery (SurgeryID[P], HouseNo, Postcode, TelephoneNo) • Dentist (DentistID [P], SurgeryID[F], Name, Qualificatons) • Patient (PatientID [P], DentistID[F], Name, Address) • Appointment (AppointmentID [P], PatientID [F] Date, Time) <p>Ignore additional fields</p> | 3 | | 2b | | |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|---|----------------------------|-----|----------------------------|-----|-------|
| 11. (a) | <p>1 mark for each correct calculation for $P = 0.5$ and $P = 0.9$ to a maximum of 4 marks.</p> <ul style="list-style-type: none"> Calculation of increase in speed for $P = 0.5$ 10 processors, increase = 1.82 1000 processors, increase = 1.99 Calculation of increase in speed for $P = 0.9$ 10 processors, increase = 5.26 1000 processors, increase = 9.91 | 1 1 1 1 | | 2b 2b 2b 2b | | 7 |
| (b) | <p>1 mark for each correct point to a maximum of 3 marks.</p> <p>Indicative content</p> <p>At 50% the significant increase in the number of processors produces a relatively small increase in speed.</p> <p>At 90% the same increase in number of processors provides a much greater relative increase in speed.</p> <p>At a low % of parallel processing there is limited benefit in increasing the number of processors as the 50 % serial fraction is significant and limits the potential of parallelisation.</p> <p>At higher % of parallel processing the benefits are much greater, but there are practical limitations that will marginalise benefits arising from using very large numbers of processors</p> <p>The level of parallelisation achieved in the software is generally more significant than the number of processors used. The significance increases as the level of parallelisation achieved in the software increases.</p> | 1 1 1 1 1 1 | | 2b 2b 2b 2b 2b | | |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|---|---|---|-----|-----|-------|
| 12. | <p>1 mark for each advantage and 1 mark for an associated description to a maximum of 4 marks</p> <p>Modular Development</p> <ul style="list-style-type: none"> If the system needs to be expanded, the work simply requires adding new computers and local data for the new site and then connecting them to the distributed system, with no interruption in current functions. <p>More Reliable</p> <ul style="list-style-type: none"> In case of database failures, the total system of centralised databases comes to a halt. However, in distributed systems, when a component fails, the functioning of the system continues. As data may be replicated so that it exists at more than one site, the failure of a node or a communication link does not necessarily make the data inaccessible. <p>Better Response</p> <ul style="list-style-type: none"> If data is distributed in an efficient manner, then user requests can be met from local data itself, thus providing faster response. <p>Lower Communication Cost</p> <ul style="list-style-type: none"> In distributed database systems, if data is located locally where it is mostly used, then the communication costs for data manipulation can be minimised. <p>Local autonomy</p> <ul style="list-style-type: none"> Users have local control of the data, and they can establish and enforce local policies regarding the use of this data. | <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> | <p>1b</p> <p>1b</p> <p>1b</p> <p>1b</p> <p>1b</p> <p>1b</p> <p>1b</p> <p>1b</p> | | | 4 |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|---|------|-----|-----|-----|-------|
| 13. | <p>1 mark for an advantage and 1 mark for suitable expansion to a maximum of 6 marks.</p> <ul style="list-style-type: none"> Asymmetric algorithms have two keys - a public key (sender) and a private key (receiver) Asymmetric algorithms do not require a shared key to be exchanged - over an insecure medium such as the Internet as it does in symmetric encryption Asymmetric encryption can be used to encrypt the key for a symmetric encryption - to increase security Asymmetric encryption is best used for sensitive data - such as keys, digital signatures, bank details In many cases, the public and private key pairs in an asymmetric system can remain intact for many years - without compromising the security of the system. | | | | | 6 |
| | | 1 | 1b | | | |
| | | 1 | 1b | | | |
| | | 1 | 1b | | | |
| | | 1 | 1b | | | |
| | | 1 | 1b | | | |
| | | 1 | 1b | | | |
| | | 1 | 1b | | | |
| | | 1 | 1b | | | |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|---|------|-----|-----|-----|-------|
| 14. | <p>1 mark up to a total of 9 marks awarded by application of mark bands</p> <p>Indicative content:</p> <p>Background.</p> <ul style="list-style-type: none"> Context. For medical laboratories, privacy is a paramount concern. Medical laboratories have a legal and ethical obligation to protect patients' confidentiality. The information present in these laboratories is sensitive, and the repercussions of stolen information can be far-reaching. Two biometric properties are used for authentication. Physical biometrics include DNA, fingerprints, facial recognition, and eye scans (iris, retina). Behavioural biometrics include voice recognition and handwritten signatures. A biometric device is a security identification and authentication device. Such devices use automated methods of verifying or recognising the identity of a living person-based characteristics, such as fingerprints, facial images, iris and voice recognition. <p>Stages</p> <ul style="list-style-type: none"> Measurement, signal processing, pattern matching, and decision making. Measurement involves sensing biometric characteristics and is necessary both for the creation of the reference model and for each authentication trial. Example, voice verification involves recording one's voice through a microphone. Then the digital data are mathematically modelled. When the user wants to be authenticated, the device compares the received data to the user model and makes a decision. <p>Accuracy</p> <p>Not 100% accurate. There are two types of errors in a typical biometric system.</p> <ul style="list-style-type: none"> A false reject (FR) error is the rejection of an authorised person. A false accept (FA) error is the acceptance of a person who is not in fact who they claim to be. Advantages include Improved security, better user experience, passwords cannot be forgotten, or access cards lost. | 9 | | 2b | | 9 |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|------|-----|-----|-----|-------|
| | <ul style="list-style-type: none"> • Disadvantages include that the environment and usage can affect measurement, that systems are not 100% accurate and require integration and/or additional hardware <p>Types</p> <p>Fingerprint recognition.</p> <ul style="list-style-type: none"> • Good at identifying a unique individual because a fingerprint is unique to each person. • False negative readings may arise from: age, dirt, and cosmetics, such as band-aids. • Modern systems which have sensors capable of detecting blood flow in a finger, thus making fake (non-fingers) and severed fingers fail to be read. • In general, the rate of errors while using a fingerprint scanner is low compared to other biometric devices. <p>Facial recognition</p> <ul style="list-style-type: none"> • The use of a camera, or sensor to uniquely identify ones face by matching a face to a stored image in a database <p>Iris scanners</p> <ul style="list-style-type: none"> • Authenticate a user by reading the surface of the iris - nearly as unique as fingerprints. • Have a high acceptance rate compared to other biometric devices. <p>Retinal scanners</p> <ul style="list-style-type: none"> • Similar to iris scanners but read the layer of the blood vessels behind the eye. They are considered to be highly effective. • Improvement over iris scanners is that retinal scanners are capable of authenticating those who are blind, or those who have lack of pigment in the iris. • Invasive in nature as they require the person who is being authenticated to be very close to the device itself, <p>Voice print recognition.</p> <ul style="list-style-type: none"> • Considered a behavioural based biometric device because typically the focus of voice recognition is on how a person speaks, and not what they say. • These devices often measure pauses, accents, as well as what the person says. • Typically used in situations which only have a few authenticated users. • Subject to errors arising from several factors, including background noise. | | | | | |

| Band | Q15 Max 9 marks |
|------|--|
| 3 | <p style="text-align: center;">7–9 marks</p> <p>The candidate has:</p> <ul style="list-style-type: none"> • written an extended response that has a sustained line of reasoning which is coherent, relevant, and logically structured • shown clear understanding of the requirements of the question and a clear knowledge of the topics as specified in the indicative content. • addressed the question appropriately with minimal repetition and no irrelevant material • has presented a balanced response and justified their answer with examples • effectively drawn together different areas of knowledge, skills and understanding from all relevant areas across the course of study • used appropriate technical terminology confidently and accurately. |
| 2 | <p style="text-align: center;">4–6 marks</p> <p>The candidate has:</p> <ul style="list-style-type: none"> • written a response that has an adequate line of reasoning with elements of coherence, relevance, and logical structure • shown adequate understanding of the requirements of the question and a satisfactory knowledge of the topics as specified in the indicative content. • presented a response with limited examples • drawn together different areas of knowledge, skills and understanding from a number of areas across the course of study • used appropriate technical terminology. |
| 1 | <p style="text-align: center;">1–3 marks</p> <p>The candidate has:</p> <ul style="list-style-type: none"> • written a response that that lacks sufficient reasoning and structure • produced a response which is not well developed • attempted to address the question but has demonstrated superficial knowledge of the topics specified in the indicative content • used limited technical terminology. |
| 0 | Response is not credit worthy or not attempted. |