GCE AS MARKING SCHEME

SUMMER 2022

AS
COMPUTER SCIENCE - COMPONENT 1
B500U10-1

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.

Guidance for examiners

Positive marking

It should be remembered that learners are writing under examination conditions and credit should be given for what the learner writes, rather than adopting the approach of penalising him/her for any omissions. It should be possible for a very good response to achieve full marks and a very poor one to achieve zero marks. Marks should not be deducted for a less than perfect answer if it satisfies the criteria of the mark scheme.

For questions that are objective or points-based the mark scheme should be applied precisely. Marks should be awarded as indicated and no further subdivision made.

For band marked questions mark schemes are in two parts.

Part 1 is advice on the indicative content that suggests the range of computer science concepts, theory, issues and arguments which may be included in the learner's answers. These can be used to assess the quality of the learner's response.

Part 2 is an assessment grid advising bands and associated marks that should be given to responses which demonstrate the qualities needed in AO1, AO2 and AO3. Where a response is not credit worthy or not attempted it is indicated on the grid as mark band zero.

Banded mark schemes

Banded mark schemes are divided so that each band has a relevant descriptor. The descriptor for the band provides a description of the performance level for that band. Each band contains marks.

Examiners should first read and annotate a learner's answer to pick out the evidence that is being assessed in that question. Once the annotation is complete, the mark scheme can be applied.

This is done as a two stage process.

Stage 1 – Deciding on the band

When deciding on a band, the answer should be viewed holistically. Beginning at the lowest band, examiners should look at the learner's answer and check whether it matches the descriptor for that band. Examiners should look at the descriptor for that band and see if it matches the qualities shown in the learner's answer. If the descriptor at the lowest band is satisfied, examiners should move up to the next band and repeat this process for each band until the descriptor matches the answer.

If an answer covers different aspects of different bands within the mark scheme, a 'best fit' approach should be adopted to decide on the band and then the learner's response should be used to decide on the mark within the band. For instance if a response is mainly in band 2 but with a limited amount of band 3 content, the answer would be placed in band 2, but the mark awarded would be close to the top of band 2 as a result of the band 3 content. Examiners should not seek to mark candidates down as a result of small omissions in minor areas of an answer.

Stage 2 – Deciding on the mark

Once the band has been decided, examiners can then assign a mark. During standardising (marking conference), detailed advice from the Principal Examiner on the qualities of each mark band will be given. Examiners will then receive examples of answers in each mark band that have been awarded a mark by the Principal Examiner. Examiners should mark the examples and compare their marks with those of the Principal Examiner.

When marking, examiners can use these examples to decide whether a learner's response is of a superior, inferior or comparable standard to the example. Examiners are reminded of the need to revisit the answer as they apply the mark scheme in order to confirm that the band and the mark allocated is appropriate to the response provided.

Indicative content is also provided for banded mark schemes. Indicative content is not exhaustive, and any other valid points must be credited. In order to reach the highest bands of the mark scheme a learner need not cover all of the points mentioned in the indicative content but must meet the requirements of the highest mark band. Where a response is not creditworthy, that is contains nothing of any significance to the mark scheme, or where no response has been provided, no marks should be awarded.

Question	Answer	Marks	AO1	AO2	AO3	Total
1.	**Award one mark for each of the following up to a maximum of two marks for input and two marks for output:** • describing the use each input device in the chosen application • describing the use each output device in the chosen application	4	1a			4
2.	(see table below)	5		2a 2 2b 3		5

A	B	C	$\overline{A}$	$\overline{C}$	$\overline{A} \oplus B$	$B + \overline{C}$	P
0	0	0	1	1	1	1	1
0	1	0	1	1	0	1	1
1	0	0	0	1	0	1	1
1	1	0	0	1	1	1	1
0	0	1	1	0	1	0	1
0	1	1	1	0	0	1	1
1	0	1	0	0	0	0	0
1	1	1	0	0	1	1	1

Award one mark for each of the following:
• Correct A, B and C columns
• Correct $\overline{A}$ and $\overline{C}$ columns
• Correct $A \oplus B$ column
• Correct $B + \overline{C}$ column
• Correct P column

Question	Answer	Marks	AO1	AO2	AO3	Total
3. (a)	**Award one mark for each of the following up to a maximum of four marks:** • Simplex o Sending data input from a keyboard • Half-duplex o Using a parallel interface to send data to a printer • Full duplex o Sending data across a network using a switch. **Accepted but not expected**: serial and parallel transmission	4	1a 2 1b 2			4
(b)	**Award one mark for the following:** • Multiplexing is a method by which multiple analogue or digital signals are combined into one signal over a shared medium.	1	1b			1
(c)	**Award one mark for each of the following:** • Data collision occurs when two sets of data are detected on the network simultaneously • Once detected, a computer waits for a short (random) time then sends again.	2	1b			2
4. (a)	**Award one mark for each correct column:** (see table below)	6		2b		6
(b)	**Award one mark for each of the following:** • The ALU will perform an addition during the second cycle at the execute stage • The addition results in 5_{10}. **Accept correct addition of MDR contents plus 1**	2		2b		2

Table for 4. (a):

CU	PC	MAR	MDR	CIR	ACC
	0001	0001	0001 0101	0001 0101	
0001					
	0010	0101	0000 0100		0000 0101
	0010	0010	0011 0110	0011 0110	
0011					
	0011	0110	0011 0110		0000 0101

Question	Answer	Marks	AO1	AO2	AO3	Total
(c)	**Award one mark for the following:** • Memory location **0110** will change to **0000 0101** **Accept correct storage of accumulator in location 0110**	1		2b		1
5.	**Award one mark for each simplification:** • $X \cdot Z + X \cdot \overline{Y} + Y \cdot Z + Y \cdot \overline{Y} + X \cdot Y + Z \cdot \overline{X}$ • $X \cdot Z + X \cdot \overline{Y} + Y \cdot Z + 0 + X \cdot Y + Z \cdot \overline{X}$ • $X \cdot Z + X \cdot \left(\overline{Y} + Y\right) + Y \cdot Z + Z \cdot \overline{X}$ • $X \cdot Z + X + Y \cdot Z + Z \cdot \overline{X}$ • $Z \cdot \left(X + \overline{X}\right) + X + Y \cdot Z$ • $Z + X + Y \cdot Z$ • $Z \cdot (1 + Y) + X$ • $Z + X$ **DO NOT** award credit for solutions with truth tables.	8		2b		8
6. (a)	**Award one mark for each of the following:** • Binary Number: 11.001 • Mantissa: 011001 • Exponent: 010	3		2a		3
(b)	**Award one mark for each of the following:** • Increase the size of the exponent at the expense of the mantissa Example • Mantissa: 0.1111 • Exponent: 0111 • New largest value: 1111000_2 / 120_{10}	4		2b		4
(c)	**Award one mark for each of the following up to a maximum of two marks:** • Numbers are stored accurately • Less complex processing • Exact representation of zero. **Award one mark for each of the following up to a maximum of two marks:** • Very large/small numbers can be stored • Larger range of numbers can be represented • Fractions/decimal places can be represented.	4	1b			4

Question		Answer	Marks	AO1	AO2	AO3	Total
7.	(a)	**Award one mark for the following:** • Binary search **Acce't** 'recursive algori'hm'.	1		2b		1
	(b)	**Award one mark for each of the following:** • DIV finds the quotient or t'e 'whole number of ti'es' a divisor can be divided into a number (rather than a real number from dividing) • This ensures that the elements in the array can be accessed. (only whole numbers can be accessed).	2		2b		2

	(c)	**Award one mark for each parameter and one mark for a corresponding purpose, up to a maximum of 4 marks:**
		• myArray
		   o the list to be searched
		• searchValue
		   o the item being searched for
		• start
		   o the lower end of the list / sub-list
		• end
		   o the upper end of the list / sub-list.
			4		2a 2
					2b 2
							4

Question	Answer	Marks	AO1	AO2	AO3	Total
8.	**Award one mark for each of the following up to a maximum of six marks:** • Event-driven programs are used when there is a heavy reliance on user interaction • A program will sit in a loop waiting for the user to perform an action • An event, e.g. click a command button, initiates a sequence of code to be executed • User actions include mouse clicks / key presses, sensor outputs, or messages from other programs or threads • When a user interacts with an input device, the OS will process it in the usual way and then send then the event to the applications event queue • The event processor will then process the event and send it to the relevant listener • Events tend to take the form of an object or some specialised data structure • Developers are responsible for creating the code for the listeners and selecting which ones they are interested in processing • The mechanism of the event processor is normally abstracted away from the developer • The event processor, in the simplest form, will be a nested loop structure which uses either IF or select/case statements to direct the event to the correct listener • The outer loop will listen until the user asks the program to quit • The inner loop will iterate over the event queue and act upon the events that the program is interested in • The actual processing of the events occurs in the listener functions • Event-driven programming requires the developer not to think of their code in a linear fashion but rather as a set of actions triggered by the user • Graphical user interfaces and games will always make use of the event-driven paradigm. • Code written for certain events can be re-used / have already been tested and debugged	6	1b			6

Question	Answer	Marks	AO1	AO2	AO3	Total
9.	**Indicative content** ``` • Start Procedure • declare binaryNo [0 to 3] as string • denaryNo is integer • divisor is integer • • divisor = 8 • • input denaryNo • • binaryNo = ["0", "0", "0", "0"] • • if denaryNo > 15 then • output "error message" • else • for i = 0 to 3 • • if denaryNo >= divisor then • binary[i] = "1" • denaryNo = denaryNo – divisor • end if • • divisor = divisor / 2 • next i • output binaryNo • end if • • End Procedure ``` **Award one mark for each of the following:** • Initialise variables / declare array • Input denary number • Validation check on denary number to ensure number is <= 15 • Validation check on denary number to ensure number is >= 0 • Ensure binary number is string / maintain initial 0s (could be in an array) • Loop / Correctly allocate bits • output binary number	7			3b	7

Question	Answer	Marks	AO1	AO2	AO3	Total
10. (a)	**Award one mark for each of the following up to a maximum of four marks:** Study the existing system documentation • Team can see how current system 'should' be operating • Inexpensive method of gathering lots of information fairly quickly • Can identify storage requirements. Carry out a questionnaire of staff • Relatively cheap to produce for a large number of people • Can be distributed worldwide • Could be completed on-line so results can be available very quickly • Gather a large number of responses in a short time. Interview staff / focus groups • Can gather large amount of detailed information • Can make judgements on validity of information from personal contact or body language • Can ask 'follow up' or 'open ended' questions to gather more detailed information in selected areas. Observe the current system in practice • Can actually see what is really happening and do not have to rely on what people tell you what they think is happening. **Award one mark for each of the following up to a maximum of four marks:** Study the existing system documentation • Staff may not be following procedures in documentation and may be using system in their own way • Documentation may be out of date and not updated to reflect system changes. Carry out a questionnaire of staff • Have to be designed by experts or • information could be unusable • Limited responses • People are 'too busy' and may not complete • People may not give correct answers. Interview staff / focus groups • Time consuming and expensive to carry out • Has to be carried out by trained interviewer or closed questions written by experts • Difficult to analyse large amount of information • Difficult to analyse wide variety of information. Observe the current system in practice • Very time consuming and therefore expensive to carry out • Staff may feel like they are being watched and therefore behave differently so do not actually see what goes on every day • Cost of sending analysts around the world.	8	1b			8

Question	Answer	Marks	AO1	AO2	AO3	Total

(b)	**Award one mark for each of the following up to a maximum of six marks:**
	
	• A generation file backup system
	  ○ This involves storage of three of the most recent versions of master file. (grandfather – father - son)
	  ○ Useful if one version is corrupted: the previous version(s) is still available.
	  ○ Data should be stored off site in case of a disaster.
	• Incremental backup
	  ○ Initial full backup
	  ○ Only backs up data that has changed and writes over older back ups
	  ○ Useful as it saves storage space and is faster than full backup
	  ○ Only allows the user to restore the most recent backup.
	• Delta change backup (accepted not expected)
	  ○ Initial full backup
	  ○ Only data changed since the previous backup is backed up
	  ○ The original backup is also maintained in case data needs to be restored
	  ○ Useful as it is faster than creating a complete backup
	
	• External hard drive or memory sticks can be used to store back-up files through copying and pasting.
	  ○ This method is useful of backing up small personal data such as documents and photos. Data can be overwritten with new backups.
	• CD / DVD can be used to store back-up files but are limited to the amount of space that is available.
	  ○ This method of back-up can be used for archiving data due to its read-only nature. Can be used for archiving files and documents.
	• Magnetic tapes can be used to store and routinely backup network data.
	  ○ This method is used for backing up user network data and shared data including roaming profiles and intranet services.
	• A dedicated back-up server could be used to either mirror a main storage server or routinely back-up network data.
	• Cloud storage solutions can be used to routinely back-up data online and allows for synchronous version management of online files.
	  ○ This method for backup can be used to back up personal files that need to be access from many different devices.
	
	Recovery routines:
	• Buying new hardware
	• Recovery after disaster – restoring databases/files
	• General backup procedures
	  ○ Test if backups work/can be restored
	  ○ Frequency of backup
	  ○ Timing, e.g. overnight
	  ○ Staff member with responsibility for ensures suitable back-up
		6	1b			6

Question	Answer	Marks	AO1	AO2	AO3	Total
11.	**Award one mark for each of the following up to a maximum of two marks:** Open source • Free licence / General Public licence • Relaxed / non-existent copyright restrictions • Built using community co-operation • Code is available for all to view, debug, rewrite, etc. • Free from commercial pressures • Frequent integration with other software packages • Several versions • High modularisation. **Award one mark for each of the following up to a maximum of two marks:** Bespoke • Tailored to you. The software is developed and built to meet your specific requirements • More flexible. A bespoke system can evolve over time to match your changing requirements • No per-user fees. If you own the software, you won't have to extra per-user fees as your business grows • Not tied in. You own the intellectual property, so you are not tied to a specific vendor that could potentially disappear at any time • Competitive advantage. As your competitors won't have the same software, it could give you a competitive edge • Higher initial costs. It will cost more at the beginning, as you have to pay the development costs • Takes longer. Depending on the size and complexity of the software, it may take months or even years to develop. **Award one mark for each of the following up to a maximum of two marks:** Off-the-shelf • Cheaper than bespoke. The development costs are spread across a large number of users, so you pay much less than it would cost to build the same software from scratch • Available immediately. The development work has already been done, so all you need to do is set up the software and start using it • Lower training costs. If it is a commonly used package, users and I.T. staff may already be familiar with it, saving on learning time and training costs. Or, there may be pre-existing training materials and courses that you can leverage • Community support. If the software is popular, there may be books, articles, forums and online communities offering support and advice to help you learn or resolve any issues	6	1b			6

Question	Answer	Marks	AO1	AO2	AO3	Total
	• More functionality. Off-the-shelf software often has more functionality, because the developers try to meet the requirements of as many users as possible • The vendor will continue to develop the software, so you will likely get upgrades for free or at a reduced cost, whereas in bespoke software you don't get anything new unless you pay for it to be built • You may have to compromise on your requirements – it is unlikely you will find ready-made software that does everything you need it to, exactly how you want it to • May be overly complicated. The software may include functionality that you don't need, as it is trying to meet the different requirements of a number of users. This can make it more difficult to learn and use • You are not in control. The vendor's plans for the future may not always fit with your own. As a single customer amongst many, you may not be able to get the features you want implemented • May be general e.g. Word Processing or specific e.g. Stock Control.					

12.	**Award one mark for each of the following up to a maximum of two marks:**
	• Malicious damage is when data is amended or deleted on purpose
	  o Hacker could access and change data / plant virus
	  o Disgruntled bank employees could damage data to hurt bank
	  o Customer change data about themselves or other customers
	
	Award one mark for each of the following up to a maximum of two marks:
	• Accidental damage is when data is amended or deleted without malicious intention.
	  o Customer deleting information such as statements
	  o Bank employees deleting information by accident
	  o Computer server crash / system failure
	  o Computer damage due to fire / flood
	  o Money lost / gained during electronic transfer
		4	1b			4

Question	Answer	Marks	AO1	AO2	AO3	Total
13	**Indicative content** **Expert systems** **Contexts** • Medical diagnosis • Car fault diagnosis • Automatic pilots in aeroplanes • MYCIN is an expert system for diagnosing and recommending treatment of bacterial infections of the blood • PROSPECTOR is an expert system which was designed for decision making problems in mineral exploration. **Function** • Using a knowledge-based system, a user can interrogate a vast knowledge base to find a solution • The user enters the information he or she already has, and the knowledge-based system infers an answer • If the system cannot reach a conclusion, it requests more information • This process is continued until either the system has a high degree of confidence that it knows what the solution is, or it is sure that, having exhausted every line of inquiry, it does not know the solution. **Social and economic changes** • They don't stop / can work 24/7 / no need for sleep / they don't get ill / there is no need for breaks • The system can be used at a distance over a network. So rural areas or even poorer third world countries have access to experts • Some people prefer the privacy of talking to a computer • Over reliance upon computers • Some employees could be de-skilled by over dependence upon computer advice • Fewer medical staff could be needed • Lacks the 'human touch'! – lack of personal contact • Dependent upon the correct information being given. If data or rules wrong the wrong advice could be given • No human available if you do not know what to do. **Robotics** **Contexts** • Used in dangerous environments, e.g. inspection of radioactive materials, bomb detection and deactivation • Manufacturing processes • Where humans cannot survive e.g. in space, underwater, in high heat • Healthcare - surgical assistants and nursing robots.	12	1b			12

Question	Answer	Marks	AO1	AO2	AO3	Total
	Function • Robotics integrates computer science and engineering. • Robotics involves design, construction, operation, and use of robots • Robotics develops machines that can substitute for humans and replicate human actions which are automated • Robots attempt to replicate walking, lifting, speech, cognition, or any other human activity. **Social and economic changes** • Jobs - increases capability to deal with difficult, complex and even dangerous tasks that are currently done by humans • Increase in technological growth rate - AI potentially help us 'open doors' into new and more advanced technological breakthroughs • They don't stop / can work 24/7 / no need for sleep / they don't get ill / there is no need for breaks • No risk of harm - when we are exploring new undiscovered land or even planets, when a machine gets broken or dies, there is no harm done • Almost limitless function • They will make fewer mistakes. • Over reliance on Artificial Intelligence • Lack of common sense, human touch and lacks human senses • Over reliance on the software • Loss of human jobs • Misuse - this level of technology in the wrong hands can cause mass destruction, e.g. robot armies could be formed.					

Band	AO1.1b Max 12 marks
3	**9–12 marks** The candidate has: • 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 indicative content. Clear knowledge is defined as a response that provides nine to twelve relevant detailed points which relate to an extensive amount of the indicative content for **<u>both</u>** expert systems and robotics • addressed the question appropriately with minimal repetition and no irrelevant material • has presented a balanced discussion and justified their answer with examples • used appropriate technical terminology referring to the indicative content confidently and accurately.
2	**5–8 marks** The candidate has: • 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 as specified in the indicative content. Satisfactory knowledge is defined as a response that provides five to eight points as signalled in the indicative content for **either** expert systems or robotics • has presented a discussion with limited examples • used appropriate technical terminology referring to the indicative content.
1	**1–4 marks** The candidate has: • written a response that that lacks sufficient reasoning and structure • produced a discussion which is not well developed • attempted to address the question but has demonstrated superficial knowledge of the topics specified in the indicative content. Superficial knowledge is defined as a response that provides one to four points as signalled in the indicative content for **either** expert systems or robotics • used limited technical terminology referring to the indicative content.
0	**0 marks** Response not credit worthy or not attempted.