GCE AS MARKING SCHEME

AUTUMN 2020

AS
COMPUTER SCIENCE - COMPONENT 1
B500U10-1

INTRODUCTION

This marking scheme was used by WJEC for the 2020 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.

GCE AS COMPUTER SCIENCE - COMPONENT 1

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Q	Answer	Marks	AO1	AO2	AO3	Tot
1. (a) (i)	• $C = \overline{A}.\overline{B}$	1		1b		1
(a) (ii)	• $Z = X.Y + \overline{Y}$	1		1b		1
(b)	(see table below)					5

Q	R	S	$\overline{Q}$	$\overline{S}$	$R.\overline{S}$	P
0	0	0	1	1	0	1
0	0	1	1	0	0	1
0	1	0	1	1	1	1
0	1	1	1	0	0	1
1	0	0	0	1	0	0
1	0	1	0	0	0	0
1	1	0	0	1	1	1
1	1	1	0	0	0	0

Award one mark for each of the following:
* Correct Q, R and S columns — 1 — 1b
* Correct intermediate columns ($\overline{Q}$, $\overline{S}$, and $R.\overline{S}$) — 1 — 1b
* Correct P column — 1 — 1b

Q	Answer	Marks	AO1	AO2	AO3	Tot
2. (a)	Award one mark for each of the following up to a maximum of four. • Cache memory is faster than RAM and is also volatile • Used to store frequently used data / instructions from main memory • Used by the processor to avoid having to slow down to the speed of the RAM all the time • Used to store intermediate results to calculations • Different levels of cache memory which denote speed and characteristics • Von Neumann bottleneck solution	4	1b			4

(b)	Award one mark for each of the following up to a maximum of five:
	• Parallel processing is a form of computation in which many calculations are carried out simultaneously
	• Parallel processing uses multiple cores
	• It operates on the principle that large problems can often be divided into smaller ones, which are then solved concurrently
	• Parallel processing in computer programs is more complex to design and to write than sequential computer programs
	• Communication and synchronisation between the different subtasks are typically some of the greatest obstacles to getting efficient parallel program performance
	
	Accepted not expected:
	• The maximum possible speed-up of a single program as a result of parallelisation is known as Amdahl's law:
	   ○ $T(n) = T(1)(B + \frac{1}{n}(1 - B))$
	   ○ $Where$:
	      ■ $T(n) = time\ taken\ on\ n\ threads$
	      ■ $n = number\ of\ threads$
	      ■ $B = $
	         $fraction\ of\ algorithm\ that\ is\ sequenti$
		5	1b			5

Q	Answer	Marks	AO1	AO2	AO3	Tot
	• Example: If a program has a runtime of 10 hours when using a single core processor. If 80% (8 hours) of this program can be parallelised, then clearly a multi-core processor will reduce the runtime required. However, regardless of the number of cores used to execute this program, the minimum runtime cannot be less than the time taken to execute the non-parallelised 20% (2 hour). The remaining 20% will still be processed sequentially • Using the formula above with one thread (n=1) we get: ○ $T(n) = T(1)(B + \frac{1}{n}(1 - B)$ ○ $T(1) = 10 \; hours \; \times (0.2 + \frac{1}{1}(1 - 0.2) = 10 \; hours$ ○ $T(1) = 10 \; hours$ • The speedup of a program using multiple processors in parallel computing is limited by the time needed for the sequential fraction of the program • Using the formula above with one thousand threads (n=1000) we get: ○ $T(n) = T(1)(B + \frac{1}{n}(1 - B)$ ○ $T(1000) = 10 \; hours \; \times (0.2 + \frac{1}{1000})$					

Q	Answer	Marks	AO1	AO2	AO3	Tot
3. (a)	Serial transmission: • Data is sent one bit at a time along the same data line	1	1b			4
	Advantage (any one of) • Requires only two wires compared with 8 or 16 in parallel • serial can travel longer distances than parallel • simpler interface / circuit board / fewer lines required	1	1b			
	Parallel transmission: • All bits in a byte are sent simultaneously along separate lines	1	1b			
	Advantage • Transmission is faster than serial transmission	1	1b			
(b)	Award one mark for each of the following: • Simplex: Data can only travel in one direction ○ Plus suitable example e.g. Keyboard • Half-duplex: Data can travel in both directions but only in one direction at any given time ○ Plus suitable example e.g. walkie talkie • Full duplex: Data can travel in both directions at the same time ○ Plus suitable example e.g. broadband	1 1 1 1 1 1	1b 1b 1b 1b 1b 1b			6
4.	Award one mark for identifying each of the following constructs and line and one mark for usage up to a maximum of six. • Selection Line 6 – 8 ○ To set the new highest mark if the new mark entered is higher than the highest mark so far. • Repetition Line 3 – 10 ○ Repeatedly input the next exam mark until the new mark is less than 0 or highest mark is 100 • Rogue value Line 10 ○ Terminate the loop if the new mark entered is less than 0 • Logical operator / OR Line 10 ○ Terminate the loop if the new mark is less than 0 or highest mark is 100 • Variable ○ To store the highest number or the new mark	6		1b		6

Q	Answer	Marks	AO1	AO2	AO3	Tot
5. (a) (i)	Award one mark for each of the following: Two's Complementation • Smallest value 10000000 01111111 flip the bits <u> 1</u> add 1 10000000 = -128_{10} • Largest value 10000001 01111110 flip the bits <u> 1</u> add 1 01111111 = 127_{10}	1 1 1 1		1b 1b 1b 1b		6
(a) (ii)	• Two's Complementation Range -127_{10} to 128_{10} Sign/magnitude • Smallest value 11111111 = -127_{10} 01111111 = 127_{10} • Sign / magnitude range -127_{10} to 127_{10}	1 1		1b 1b		
(b)	Award one mark for each of the following: • Mantissa = 0.1111111 • Exponent = 0111 • Largest Number = 1111111.0 = 127_{10}	1 1 1	1a 1a 1a			3
6.	Award one mark for each of the following: $X.(Y + X) + \overline{X}.(\overline{Y} + Y) + Z.(Y + \overline{Z})$ $X.(Y + X) + \overline{X}.(1) + Z.(Y + \overline{Z})$ $X.(Y + X) + \overline{X} + Z.(Y + \overline{Z})$ $X.Y + X.X + \overline{X} + Z.Y + Z.\overline{Z}$ $X.Y + X.X + \overline{X} + Z.Y + 0$ $X.Y + X + \overline{X} + Z.Y + 0$ $X.Y + 1 + Z.Y$ 1 • Accept alternative methods of simplification • **DO NOT** accept truth tables • Award full marks if correct answer only given	1 1 1 1 1 1 1		1b 1b 1b 1b 1b 1b 1b		7

Q	Answer	Marks	AO1	AO2	AO3	Tot
7.	**Indicative content**					7
| | ```
1  num is integer
2
3  input num
4
5  if num < 1 OR num > 10 then
6     output "Please enter a
      number between 1-10"
7  else
8     for i = 1 to 12
9          output i
10         output " x "
11         output num
12         output " = "
13         output num * i
14    next i
15 endif
``` | | | | | |
| | Award one mark for each of the following up to a maximum of 7:
• Initialise variables
• Input num
• Validation check on num
• Second validation check on num
• Loop
• Terminating condition
• Calculate output
• Correct formatting | 7 | | | 1b | |

Q	Answer	Marks	AO1	AO2	AO3	Tot
8. (a)	Award one mark for each of the following: • A data structure is a group / set / collection of related data items / elements	1	1b			2
	• Convenient / best way of organising data relating to a real problem / may be efficient to deal with various elements as one item	1	1b			
(b) (i)	Award one mark for each of the following up to a maximum of two marks: • an array is a data structure which is a set of data elements of the same type • has its elements accessed via index(es), subscript(s), row/column names • has a fixed/pre-determined number of elements	2	1b			3
	Award one mark for suitable example: Either: Jan Feb Mar … Product 153 | .. .. .. Product 156 | .. .. .. ….. | .. .. .. Or Sales of each product number by month etc.	1		1b		
(b) (ii)	Award one mark for each of the following: • A record is a set of data items all related to a single individual / entity etc	1	1b			3
	• It can contain data of different types	1	1b			
	Example (data about one product) Either: • Product Id, Product Description, Product Price, Number in Stock etc… Or: • 153, Hard Disk Drive, £74.99, 23, etc…	1		1b		

Q	Answer	Marks	AO1	AO2	AO3	Tot
9. (a) (i)	Award one mark for each of the following: • Starting at the beginning of myArray / element 0 • SearchValue is compared to every consecutive item in myArray • Until the SearchValue is found in element 4.	1 1 1		1b 1b 1b		3
(ii)	Award one mark for each of the following: • Starting with middle element of myArray / element 3 • A comparison is made to see if SearchValue is bigger or smaller than the item in element 3 • Element 0-2 is discarded and the search method is repeated for the remainder of the array • Until SearchValue is found in element 4	1 1 1 1		1b 1b 1b 1b		4
(b)	Award one mark for each of the following up to a maximum of two: • Linear search doesn't require data to be in order • Linear search only requires equality comparisons • Linear search only requires sequential access (this can be very important - it means a linear search can stream data of arbitrary size) • If there wasn't a lot of data – it's easier to program	2	1b			2

Q	Answer	Marks	AO1	AO2	AO3	Tot
10.	Award one mark for each of the following up to a maximum of 8: • Alpha testing is conducted by a team of highly skilled testers at development stage / beta testing is always conducted in real-time environment by customers or end users at their own site • Alpha testing requires lab environment or testing environment / beta testing doesn't require any lab environment or testing environment • Alpha testers are always high skilled professional testers / beta testers can be inexperienced or proficient end users of software product • Alpha testing involves both black box testing as well as white box testing / beta testing is always a black box testing or functional testing • Alpha testing is conducted in the presence of developers and in the absence of end users / for beta testing this is exactly reversed • Reliability and security testing are not performed in-depth alpha testing / reliability, security, robustness are checked during beta testing • Alpha testing provides better view about the reliability of the software at an early stage • Beta testing provides an opportunity to get an application into the hands of users prior to releasing it to the general public • Beta testers can discover issues with an application that alpha testing have not noticed, such as confusing application flow, and even crashes • Beta testing will often involve a larger group of people who can test the program's functionality • Reduces product failure risk via customer validation • Improves product quality via customer feedback • Cost effective compared to similar data gathering methods • Creates goodwill with customers and increases customer satisfaction.	8	1b			8

Q	Answer	Marks	AO1	AO2	AO3	Tot
11.	Award one mark for each of the following up to a maximum of 4: • Uses objects and classes - include both data and associated processing • Applies the principles of encapsulation, inheritance and polymorphism to aid programming • Enables production of buttons / icons etc. - useful in a visual environment • A class defines the methods properties (data) for a group of similar objects • Once an object is created, knowledge of its implementation is not necessary for its use. • Objects control how other objects interacts with themselves, preventing other kinds of errors, e.g. a programmer cannot set the width of a window to -500 • In some languages, the programmer places objects on forms. These are event-driven languages • An event, e.g. click a command button, initiates a sequence of code to be executed • Objects created using object oriented languages can easily be reused in other programs	4	1b			4

Q	Answer	Marks	AO1	AO2	AO3	Tot
12.	Award one mark for each of the following up to a maximum of 6: • Can store more knowledge than one person. • Can easily be kept up to date. • Helps to give a more accurate decision. • Does not get ill, retire, go on holiday, etc. • Gives a second opinion. • Available 24/7. • Allows access to an expert where not available locally. • Provide significant clerical time and labour savings. • Increase competitive advantage / Improve company efficiency / significantly increase company profitability. • Used to centralise decision making (more consistency). • Allow lower management levels to make decisions / • Allow better use of management time. • Allow broader distribution of expertise throughout the company. • A good expert system explains its decision / gives probabilities so that a user can decide whether to accept the decision or not • Expert systems can learn from experience • Allows employees to learn from the system	6	1b			6

Q	Answer	Marks	AO1	AO2	AO3	Tot

13.	**Indicative content of areas that could be descriptively covered**
	
	• Network consists of a number of computer systems connected together
	  o Advantages:
	    ▪ Share hardware
	    ▪ Share software
	    ▪ Share data/files
	    ▪ Easier for internal communication/can send email
	    ▪ Central backup
	    ▪ Easier to monitor network activity
	    ▪ Centrally controlled security
	    ▪ Can access data from any computer
	  o Disadvantages:
	  o A network manager may need to be employed – expensive
	  o Security problems – files sent between computers could spread a virus
	  o Hackers can gain access to data more easily
	  o If the server is down, all workstations on the network are affected
	  o Initial cost of servers, communication devices, etc. can be expensive
	
	• LANs
	  o A LAN is a network in which the computer systems are all located relatively close to each other, for example, in the same building or on the same site, such as a school.
	
	• WANs
	  o A WAN is a network in which the computers systems are all located relatively distant from each other, for example, in different buildings all over the country or in different countries. The Internet is an example of a WAN. You will note that many LANs could be linked using a WAN.
	
	• Topologies
	  o Bus
	    ▪ Advantages
	      • Easy to implement and add more computer systems to the network
	      • Quick to set up – well suited for temporary networks
	      • Cost-effective – less cabling
		12	1b			12

Q	Answer	Marks	AO1	AO2	AO3	Tot
	▪ Disadvantages • It is difficult to troubleshoot the bus • Limited cable length and number of stations – performance degrades as additional computers are added • If there is a problem with the main cable or connection, the entire network goes down • Low security – all computers on the bus can see all data transmissions • Proper termination is required • Data collisions are more likely, which causes the network to slow down. A collision is when two computers try to send a packet at the same time o Ring ▪ Advantages • Data is quickly transferred without a bottleneck – consistent data transfer speeds • The transmission of data is relatively simple as packets travel in one direction only • Adding additional nodes has very little impact on bandwidth • It prevents network collisions. ▪ Disadvantages • If any of the computer systems fail, the ring is broken and data cannot be transmitted efficiently • If there is a problem with the main cable or connection, the entire network goes down • It is difficult to troubleshoot the ring • Because all nodes are wired together, to add a another you must temporarily shut down the network o Star ▪ Advantages • Good performance/fast network speed • Easy to set up • Possible to add more computer systems without taking the network down • Any non-centralised failure will					

Q	Answer	Marks	AO1	AO2	AO3	Tot
	have very little effect on the network					
	• Minimal network collisions					
	• Better security					
	▪ Disadvantages					
	• Expensive to install – more cabling required					
	• Extra hardware required, such as a hub					
	• Protocols:					
	o A protocol is an agreed upon format which allows two devices to communicate.					
	▪ FTP – Transferring files over the internet					
	▪ IMAP - Internet standard for electronic mail (email) transmission					
	▪ HTTP - Transfers webpages over a network					
	▪ DHCP - Assigns dynamic IP addresses to devices on a network.					
	▪ SMTP - Internet standard for electronic mail (email) transmission					
	▪ TCP/IP					
	• Handshaking					
	o When a computer system establishes a devices readiness to communicate					
	• Collisions					
	o The transmitting nodes waits a random amount of time before trying to resend the packet					
	• Packet switching:					
	o Data is split into packets					
	o Each packet has a destination address					
	o Packets are analysed by each node					
	o Packets are sent down the most appropriate path (lowest cost / traffic) to reach its destination					
	o Each node maintains a routing table					
	o Packets may take different routes.					
	o Packets are reassembled at their destination					
	• Typical contents of a packet					
	• Network devices:					
	o Bridge (for linking network between two buildings)					

Q	Answer	Marks	AO1	AO2	AO3	Tot
	▪ Joins together two networks that use the same base protocols, ▪ Links similar types of networks ▪ Links LAN to LAN o Gateway (for linking network to supplier network / internet) ▪ Joins together two networks that use different base protocols ▪ Links different types of networks ▪ Links LAN to WAN ▪ Allows a LAN to connect to the internet o Switch ▪ A switch looks at each packet of data and then sends it to the computer it was intended for / routes data /directs data between computers on the network. o Router ▪ Device which stores the addresses of computers on the network. ▪ Transfer data between devices.					

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 • 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. • 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 • used limited technical terminology referring to the indicative content.				
0	**0 marks** Response not credit worthy or not attempted.				
Total		100	57	36	7	100