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# **GCE A LEVEL MARKING SCHEME**

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**SUMMER 2019**

**A LEVEL (NEW)  
COMPUTER SCIENCE - UNIT 4  
1500U40-1**

## **INTRODUCTION**

This marking scheme was used by WJEC for the 2019 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.

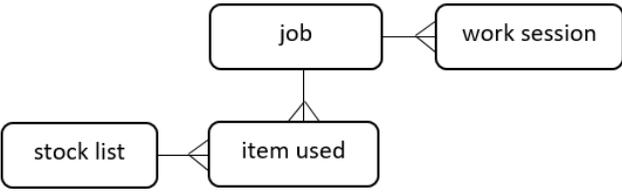
WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

**GCE A LEVEL (NEW)  
COMPUTER SCIENCE - UNIT 4**

**SUMMER 2019 MARK SCHEME**

Question	Answer	Mark	AO1	AO2	AO3	Total
1 (a) (i)	Buffering is the temporary storage of data (1) during input, output or internal transfer of data in a computer system.(1)	2	1.1b			12
(ii)	<p><b>1 mark for the definition plus one for a valid example up to a maximum of 2 marks.</b></p> <ul style="list-style-type: none"> <li>• Buffering is required because components of a computer system operate at different speeds.</li> <li>• Fast components (such as the CPU) can carry out other tasks whilst waiting for data to be transferred through the buffer to a slow device (such as a hard drive).</li> </ul>	2	1.1b			
(iii)	<p><b>1 mark for each of the following up to a maximum of 2 marks.</b></p> <ul style="list-style-type: none"> <li>• A double buffer is more efficient than a single buffer.</li> <li>• One buffer can be filling whilst the other is emptying.</li> </ul>	2	1.1b			
(b) (i)	<p><b>1 mark for each of the following up to a maximum of 2 marks:</b></p> <ul style="list-style-type: none"> <li>• An interrupt is a signal to the CPU that attention is required.</li> <li>• Interrupts may be generated by hardware devices or by software processes.</li> </ul>	2	1.1b			

Question	Answer	Mark	AO1	AO2	AO3	Total
(ii)	<p><b>1 mark for each example of an interrupt plus one mark for the action of to a maximum of 4 marks.</b> To gain both marks, both the source of the interrupt and its effect should be stated.</p> <p><b>Indicative content</b>            Many possibilities, including:</p> <ul style="list-style-type: none"> <li>• keyboard key press, causing the CPU to accept characters which may be transferred to a word processing document, spreadsheet...</li> <li>• mouse click, causing the program to activate a menu choice...</li> <li>• printer completed processing data, causing the CPU to transfer the next block of data to the printer.</li> <li>• disk drive completed transferring data, causing the CPU to initiate transfer the next block of data.</li> <li>• a running process has completed, so the CPU can reallocate resources</li> <li>• a process has timed-out, so can be terminated by the CPU.</li> <li>• a program has requested data, so the CPU initiates a data input from a disk file.</li> <li>• a file error has occurred, so the CPU suspends the data transfer and displays a warning message on screen.</li> <li>• the user has requested a process to close, so the CPU updates the screen display and reallocates resources.</li> </ul>	4	1.1b			

Question	Answer	Mark	AO1	AO2	AO3	Total
2 (a)	<p>Entity-relationship diagram</p>  <pre> graph TD     job --- 1:n  work_session[work session]     job --- 1:n  item_used[item used]     stock_list[stock list] --- 1:n  item_used   </pre> <p><b>1 mark for each correct 1:n relationship up to a maximum of 3 marks</b></p>	3		2.1b		9
(b)	<p><b>Indicative content</b></p> <p>JOB (JobNumber <b>[P]</b>, Description)</p> <p>WORK SESSION (WorkSessionID (<b>P</b>), JobNumber <b>[F]</b>, Date, HoursWorked)</p> <p>STOCK LIST (StockCode <b>[P]</b>, Description, UnitPrice)</p> <p>ITEM USED (ItemUsedID (<b>P</b>), JobNumber <b>[F]</b>, StockCode <b>[F]</b>, Quantity)</p> <p><b>1 mark for four tables</b>, including a table ITEM USED linking JOB and STOCK LIST</p> <p><b>2 marks</b>, 1 for each <b>primary key field [P]</b> suitably identified in JOB and STOCK LIST tables.</p> <p><b>3 marks</b>, 1 for each <b>foreign key field [F]</b> suitably identified in WORK SESSION and ITEM USED tables.</p> <p><b>Ignore additional fields</b></p>	1 2 3		2.1b 2.1b 2.1b		

Question	Answer	Mark	AO1	AO2	AO3	Total
3 (a)	<b>1 mark for:</b> SELECT CourseTitle, Degree FROM COURSE	1			3.1b	1
(b)	<b>1 mark for:</b> SELECT ModuleTitle FROM MODULE WHERE CourseID = '427'	1			3.1b	1
(c)	<b>1 mark for:</b> UPDATE MODULE SET YearStudied = '3' WHERE ModuleTitle = 'Freshwater Biology'  Accept: UPDATE MODULE SET YearStudied = '3' WHERE ModuleID = '1022'	1			3.1b	1
(d)	<b>Method 1:</b> SELECT ModuleTitle, YearStudied FROM MODULE WHERE CourseID = (SELECT CourseID FROM COURSE WHERE CourseTitle = 'Modern Languages' AND Degree = 'BA')  <b>1 mark for</b> SELECT ModuleTitle, YearStudied FROM MODULE WHERE CourseID =(...)  <b>1 mark for</b> SELECT CourseID FROM COURSE WHERE CourseTitle = 'Modern Languages' AND Degree = 'BA'  <b>Method 2: (accepted not expected)</b> SELECT ModuleTitle, YearStudied FROM (COURSE JOIN MODULE ON ModuleID) WHERE CourseTitle = 'Modern Languages' AND Degree = 'BA'  <b>1 mark for joining the two tables in a query.</b> <b>1 mark for selecting both course title and degree.</b>	1  1   1  1			3.1b  3.1b  3.1b  3.1b	2
(e)	<b>2 marks for:</b> SELECT ModuleTitle, StudentsEnrolled FROM MODULE WHERE (StudentsEnrolled < 20) OR (StudentsEnrolled > 40)  <b>1 mark</b> for specifying less than 20 and more than 40 students enrolled.  <b>1 mark</b> for correct OR operation and output of ModuleTitle and StudentsEnrolled fields.	2			3.1b	2

Question	Answer	Mark	AO1	AO2	AO3	Total		
4 (a)	$5.75 = $ <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="padding: 2px 10px;">0101 1100 00</td> <td style="padding: 2px 10px;">0000 11</td> </tr> </table>  <b>1 mark</b> for method of obtaining the binary fraction $5.75 = 101.11$ <b>1 mark</b> for Mantissa = 0101 1100 00 <b>1 mark</b> for exponent = 0000 11	0101 1100 00	0000 11	1 1 1		2.1a 2.1a 2.1a		3
0101 1100 00	0000 11							
(b) (i)	Accurate answer: $25.5 \times 5.75 = 146.625$  <b>1 mark</b> for: Method 1: Round then multiply: $26 \times 6 = 156$ <b>absolute error = 9.375</b>  <b>1 mark</b> for: Method 2: Multiply then round: 147 <b>absolute error = 0.375</b>  <b>1 mark</b> for: Method 3: Multiply then truncate: 146 <b>absolute error = 0.625</b>	1 1 1		2.1a 2.1a 2.1a		6		
(ii)	<b>One mark for each of the following up to a maximum of three.</b>  <b>1 mark</b> for Method 2 is most accurate.  <b>1 mark</b> for Method 1 is least accurate.  <b>1 mark</b> for Method 3 is neither most nor least.  <b>1 mark</b> for rounding is always as good as truncating, and will often be better.  <b>1 mark</b> for concept that greatest overall accuracy is achieved by completing all stages of a calculation to maximum available decimal places, with rounding or truncation only carried out after obtaining the final result.	3		2.1b				

Question	Answer	Mark	AO1	AO2	AO3	Total
(c)	<b>1 mark for:</b> Using 16 bits: +152 = 0000 0000 1001 1000	1		2.1a		2
	<b>1 mark for:</b> Obtaining the two's complement: -152 = 1111 1111 0110 1000	1		2.1a		

Question	Answer	Mark	AO1	AO2	AO3	Total
5	<p><b>Indicative Content</b></p> <pre> LOD R, 0      {initialise count of readings} LOD S, 0      {initialise total of readings} LOOP: IN T    {input data value}       JNG T, FINISH {end if negative rogue value}       INC R      {increase reading count by 1}       ADD S, T    {add reading to total}       JMP LOOP   {return to start of the loop} FINISH: OUT S  {output total}       OUT R      {output count} </pre> <p><b>1 mark</b> for initialising total and count to zero</p> <p><b>2 marks</b> for correct operation of the loop: Award 1 mark for jump which ends the loop when rogue value entered. Award 1 mark for jump which continues the loop.</p> <p><b>1 mark</b> for correct calculation of total, including ignoring rogue value in total</p> <p><b>1 mark</b> for correct calculation of count, including ignoring rogue value in count</p> <p><b>1 mark</b> for input of readings, and output of total and count</p>					6
		1			3.1b	
		2			3.1b	
		1			3.1b	
		1			3.1b	
		1			3.1b	

Question	Answer	Mark	AO1	AO2	AO3	Total
6 (a)	<p><b>1 mark</b> for each of 5 actions:</p> <ul style="list-style-type: none"> <li>• Create a second level index block with entries from 3000 to 3900. Link to pointer from 3000 in the first level index to the start of this block.</li> <li>• Create a third level index block with entries from 3800 to 3890. Link to pointer from 3800 in the second level index to the start of this block.</li> <li>• Create a data block, for records 3890 to 3899</li> <li>• Store the two records 3892 and 3893 in sequential order in that data block.</li> <li>• Link the pointer from 3890 in the third level index to the start of the new data block on disk.</li> </ul>	5		2.1b		5
(b)	<p><b>1 mark</b> for:</p> <ul style="list-style-type: none"> <li>• Begin at the first level index, then follow the pointer from '3000' to the second level index block.</li> </ul> <p><b>1 mark</b> for:</p> <ul style="list-style-type: none"> <li>• Follow the pointer from '3800' to the third level index block.</li> </ul> <p><b>1 mark</b> for:</p> <p>Follow the pointer from '3890' to the data block on disk, then load the data block into the RAM memory. Extract the required record 3893 from the data block in RAM. Accept: Follow the pointer from '3890' to the data block on disk. Locate and load the required record 3893.</p>	3		2.1b		3
7 (a)	<p><b>One mark for each up to a maximum of two</b></p> <p>Fixed length records:</p> <p><b>1 mark</b> for: each record will require 22 bytes.</p> <p>file size = 6 000 x 22 = 132 000 bytes</p> <p><b>1 mark</b> for: file size = 132 000 / 1024 = 128.9 kb Accept 132 000 / 1000 = 132kb</p>	2		2.1b		4
(b)	<p><b>One mark for each up to a maximum of two</b></p> <p>Variable length records:</p> <p><b>1 mark</b> for:</p> <p>records will have an average size of (7 characters + end marker) = 8 bytes.</p> <p>file size = 6 000 x 8 = 48 000 bytes</p> <p><b>1 mark</b> for: file size = 48 000 / 1024 = 46.9 kb Accept 48 000 / 1000 = 48 kb</p>	2		2.1b		



Question	Answer	Mark	AO1	AO2	AO3	Total
9	<p><b>1 mark for each of the following up to a maximum of 4 marks</b> for examples of data validation</p> <p>Examples must be identified as validation, and a description given.</p> <ul style="list-style-type: none"> <li>• Presence check, e.g. to ensure input has not been left blank.</li> <li>• Type check, e.g. to ensure data is of a set type.</li> <li>• Format check, e.g. to ensure the data contains a valid pattern of letters and digits.</li> <li>• Range check, e.g. to data is within allowed bounds.</li> <li>• Lookup check, e.g. to ensure that a data item is a valid category.</li> <li>• Length check, e.g. to ensure that a field conforms to a specific field length</li> </ul>	4	1.1a			4

Question	Answer	Mark	AO1	AO2	AO3	Total
10 (a)	<p><b>1 mark for each of the following up to a maximum of 3 marks</b> for descriptions of malicious software:</p> <p>Indicative content</p> <ul style="list-style-type: none"> <li>• Viruses. Viruses are programs that can replicate themselves and be spread from one system to another by attaching themselves to host files. They are used to modify or corrupt information on a targeted computer system.</li> <li>• Worms. Worms are self-replicating programs that identify vulnerabilities in operating systems and enable remote control of the infected computer.</li> <li>• Spyware. Installed by opening attachments or downloading infected software. Spyware can be used to collect stored data without the user's knowledge.</li> <li>• Trojans. A Trojan is a program that appears to perform a useful function, but also provides a 'backdoor' that enables data to be stolen.</li> </ul> <p><b>1 mark for each of the following up to a maximum of 3 marks</b> for identifying actions to protect against malicious software:</p> <ul style="list-style-type: none"> <li>• Virus and spyware checking software should be installed and kept up to date.</li> <li>• A firewall can protect against unauthorised access to the computer system.</li> <li>• E-mail attachments should not be opened unless from a trusted source.</li> <li>• Users should be cautious of fraudulent e-mails asking for passwords, or fraudulent telephone callers asking for particular web pages to be loaded.</li> <li>• Password hierarchy</li> <li>• Access levels</li> <li>• User policies</li> </ul>	6	1.1b			10
(b)	<p><b>1 mark for each risk and one mark for the minimisation of the following up to a maximum of 4 marks</b></p> <p>Indicative content</p> <ul style="list-style-type: none"> <li>• Data sent over the internet may be intercepted. (1) Sensitive data should be encrypted. (1)</li> <li>• Data is particularly at risk if sent or received at public Wi-Fi locations. (1) Password protection should be used. (1)</li> <li>• Data sent by post (e.g. on a DVD or on a USB memory stick) may be intercepted. (1) The storage medium should be password protected. Sensitive data should be encrypted. (1)</li> </ul>	4	1.1b			

Question	Answer	Mark	AO1	AO2	AO3	Total
11 (a)	<p><b>1 mark for each of the following up to a maximum of 3 marks</b> for example of input/output in the context of an automated train system.</p> <p><b>Indicative Content</b></p> <ul style="list-style-type: none"> <li>Monitoring speed, then applying power or braking as necessary.</li> <li>Monitoring geographical location, and applying brakes on entering a station.</li> <li>Monitoring the track ahead, and applying brakes if an obstruction is detected.</li> <li>Monitoring the state of the carriage doors, and not moving from the platform if doors are open.</li> <li>Monitoring fire warning systems and taking emergency action if a fire is detected.</li> </ul>	3	2.1b			6
(b)	<p><b>1 mark</b> for the concept: A safety critical system is one in which a malfunction or failure of computer hardware or software could potentially put persons at risk of injury.</p> <p><b>1 mark for each of the following up to a maximum of 4 marks</b> for example of steps to manage and minimise risk:</p> <ul style="list-style-type: none"> <li>Exhaustive testing of systems must be carried out before they are brought into service.</li> <li>Systems should have redundancy where possible (e.g. a backup computer can be brought into use immediately if the main computer fails).</li> <li>Systems should be designed to be fail-safe (e.g. a train will safely come to a halt if a malfunction is detected).</li> <li>Regular maintenance and testing should be carried out (e.g. of outdoor cabling which might be affected by rainwater, or control equipment on a train which might be affected by vibration)</li> <li>High levels of security must be maintained, to guard against malicious attacks.</li> </ul>	1  4	1.1a  1.1b			

Question	Answer	Mark	AO1	AO2	AO3	Total
12	<p><b>1 mark</b> for the definition of a multi-programming, multi-user operating system: a single computer has a number of separate users, running separate processes from different terminals.</p> <p><b>1 mark</b> for the concept of time-slicing with each process receiving small amounts of processor time, repeated as necessary.</p> <p><b>1 mark</b> for the concept that active processes may be running (currently receiving processor time), runnable (able to run when the processor is available) or suspended.</p> <p><b>1 mark</b> for an example of a suspended process: e.g. awaiting completion of data input/output, awaiting linking of a DLL code module...</p> <p><b>1 mark for each of the following up to a maximum of 3 marks</b> for other valid points describing the architecture or operation of a mainframe computer:</p> <ul style="list-style-type: none"> <li>• Description of two different designs of scheduler: single queue with equal job priority, multiple job queues, e.g. with small fast jobs given priority over large slow jobs.</li> <li>• Use of polling, to check when suspended jobs are ready to re-join the job queue.</li> <li>• Storage protection ensures that programs in RAM do not interfere with each other.</li> <li>• Backing store disks provide virtual memory to extend the job queue.</li> <li>• A separate spooling system handles input/output operations, with connections to individual terminals.</li> <li>• A large mainframe computer will have multiple processors, and may run a number of process threads simultaneously.</li> </ul>	1  1  1  3	1.1b  1.1b  1.1b  1.1b			7

Question	Answer	Mark	AO1	AO2	AO3	Total
13	<p><b>1 mark</b> for the concept: Distributed processing is the technique of carrying out a large computing task by sharing the processing between computers in different locations.</p>	1	1.1a			6
	<p><b>1 mark</b> for the concept: Each computer will run its own programs and have its own store of data, but will share data with other computers in the distributed processing network as necessary.</p>	1	1.1b			
	<p><b>1 mark</b> for each valid point, <b>up to a maximum of 4 marks</b>, describing distributed processing in the context of a chosen application.</p> <p><b>Indicative Content:</b> A patient record system for a health authority.</p> <p>Points worth 1 mark each:</p> <ul style="list-style-type: none"> <li>• Computers will be located in health centres and hospitals. These will be linked in a wide area network.</li> <li>• Each computer will have the software necessary to carry out database operations on patient records, and to display any included images (e.g. ultrasound scans, graphs of heart function...).</li> <li>• Patient records will generally be held locally at the GP surgery, but additional records may also be held in a hospital when treatment is provided.</li> <li>• Doctors and other medical staff may access and update information about a patient at any of the locations by means of the network.</li> <li>• The overall system may provide summary data for the health authority (e.g. the number of patients receiving treatment for particular illnesses, or the waiting times for treatments).</li> <li>• The system will be able to inform GP's of the outcomes of hospital treatments carried out on their patients, and any follow-up actions needed.</li> </ul>	4	1.1b			