National
Qualifications
2023

2023 Computing Science

Advanced Higher

Finalised Marking Instructions

General marking principles for Advanced Higher Computing Science

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this paper. These principles must be read in conjunction with the detailed marking instructions, which identify the key features required in candidate responses.

(a) Marks for each candidate response must **always** be assigned in line with these general marking principles and the detailed marking instructions for this assessment.

(b) Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted.

(c) If a candidate response is not covered by either the principles or detailed marking instructions, and you are uncertain how to assess it, you must seek guidance from your team leader.

(d) Award marks regardless of spelling, as long as the meaning is unambiguous. This applies to all responses, including code. Award marks as per the detailed marking instructions, regardless of syntax errors, if the intention of the coding is clear.

(e) For questions where candidates are asked to design or write code, a sample response is shown in the detailed marking instructions. This will not be the only valid response. You must use the detailed marking instructions and additional guidance to ensure that you consider alternative approaches and nuances of different programming languages. If in doubt you should refer to your team leader.

(f) If a candidate scores through a response and makes a further attempt, you should only mark the further attempt. If no further attempt is made and the original is legible, you should mark the original response.

(g) Where an incorrect response is carried forward and used correctly in a following part of the question, you should give credit for subsequent responses that are correct with regard to the original error. Candidates should not be penalised more than once for the same error.

(h) Only award marks for a valid response to the question asked. Where candidates are asked to:

- **Identify**, **name**, **give** or **state,** they need only name or present in brief form.
- **describe**, they must provide a statement or structure of characteristics and/or features. This will be more than an outline or a list. It may refer to, for example, a concept, process, experiment, situation, or facts, in the context of and appropriate to the question. Candidates must make the same number of factual/appropriate points as there are marks available in the question.
- **explain**, they must relate cause and/or effect and/or make relationships between things clear, in the context of the question or a specific area within the question.
- **write code,** they must write recognisable code, not prose nor a diagram.
- **design,** they must use a design technique appropriate to the problem. Award marks as per the detailed marking instructions, regardless of errors in the exemplification of the technique, if the intention of the design is clear.

(i) In the detailed marking instructions, if a word is underlined then it is essential; if a word is in brackets() then it is not essential. Words separated by / are alternatives.

Marking instructions for each question

Section 1

Question			Expected response	Max mark	Additional guidance
1.			DECLARE gameBoard AS ARRAY OF ARRAY OF CHARACTER INITIALLY < 12 x 8 >	**1**	Award 1 mark for 2D character array with correct dimensions. Accept string array. Accept dimensions 11 x 7. Accept 8x12 and 7x11 if correct data type indicated.
2.	(a)		The list simply needs to move in one direction, starting from the first node on the list and working backwards though each item in the list. Once the first item has been processed, it is removed from the list and the next item is processed. There is never any need to move forwards.	**1**	Award 1 mark for explanation that indicates that traversing in one direction is all that is needed.
	(b)	(i)	The Head of the list will now point to memory location 241, and the node with AmyR is removed from the list.	**1**	Award 1 mark for updating head.
		(ii)	The pointer from the node at memory location 241 is changed to point at memory location 325 and the node with ClaraL is removed.	**1**	Award 1 mark for updating pointer for node 241.
		(iii)	A node at memory location 227 is created. The pointer from the node at memory location 115 is changed to point to the new node at memory location 227. The pointer from this new node is set to point to Null.	**1**	Award 1 mark for updating pointer for node 115 and setting pointer of new node to Null.

Question			Expected response	Max mark	Additional guidance
3.	(a)		Database to store event details is needed.	**1**	Award 1 mark for database actor
	(b)		The include relationship shows a use case that must be carried out in order to complete the base case (in this situation, a title must be provided for any new event) whereas the extend relationship shows an optional use case that adds more functionality to the base case (in this situation, users can enter a location or set a reminder, but they don't have to).	**1**	Award 1 mark for correctly describing the difference between the mandatory and optional nature of the include and extend relationships. Accept alternative wording for mandatory and optional but explanations must be round the correct way.
4.	(a)		• This code is instantiating a new object of the `Player` class • It will assign the `nationality` and `username` using the parameters provided • The constructor code will assign the value 1 to all other properties	**3**	Award 1 mark for creation of new object or instance (of the `Player` class) Award 1 mark for instantiating the object by assigning values Award 1 mark for assignment details Note: list of assigned values on its own – Award 1 mark only

	(b)		`PROCEDURE calcPower()`
			`SET THIS.power TO`
			`(THIS.speed + THIS.jump +`
			`THIS.shoot + THIS.size) / 4`
			`END PROCEDURE`
				2	Award 1 mark for use of correct properties in calculation and assignment
					
					Award 1 mark for method coded as a procedure.
					
					Accept answers that don't make use of THIS.

	(c)	(i)	This code creates an array of objects belonging to the `Player` class and sets the first element of the array to the `newPlayer` object.	**2**	Award 1 mark for creation of array of `Player` objects Award 1 mark for assignment of first element in the array

Question			Expected response	Max mark	Additional guidance

4.	(c)	(ii)	Line 2003
			`WHILE swapped (AND numPlayers >=`
			
			Line 2006
			`IF league[loop].getPower() < league[loop+1].getPower() THEN`
			
			Line 2010
			`SET swapped TO True`
				3	Award 1 mark for Line 2003 and Line 2010 both correct
					
					Award 1 mark for correct comparison in Line 2006. Accept `IF league[loop+1].getPower() ≥ league[loop].getPower() THEN` as an alternative comparison. This mark can be awarded if even method has not been used.
					
					Award1 mark for correct use of `getPower()` method in Line 2006

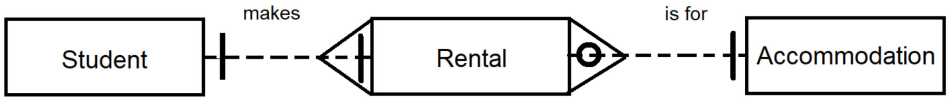
	(d)	(i)	Inheritance is when a hierarchy of classes that share core properties and methods can be defined. The parent or superclass becomes the blueprint for all related subclasses. In this situation, the `Fireball` and `Multiball` subclasses automatically inherit all properties and methods defined for the `Ball` superclass with the `Multiball` class having 2 additional properties.	**1**	Award 1 mark for accurately referring the classes in the UML class diagram with superclass `Ball` with subclasses `Fireball` and `Multiball` both inheriting all the properties and methods of the `Ball` superclass.
		(ii)	Polymorphism	**1**	Award 1 mark for polymorphism Accept also overriding

Question			Expected response	Max mark	Additional guidance
5.	(a)	(i)	See one possible algorithm below.	**3**	Award 1 mark for traversing readings array Award 1 mark for identifying unique value in readings array Award 1 mark for storing each unique LA found in an appropriate position of the rainfall array
			1. set readings position = 0 2. set numLAFound = 0 3. while numLAFound < 32 4. if LA for current reading is not already stored in the rainfall array then 5. store LA in rainfall array at numLAFound position 6. add 1 to numLAFound 7. end if 8. add 1 to readings position 9. end while		
		(ii)	Line 6 (position > 0) and (temp < rainfallArray[position-1].local) do Line 7 set rainfallArray[position].local = rainfallArray[position-1].local Line 10 set rainfallArray[position].local = temp	**3**	Award 1 mark for complex condition at Line 6. Note: Accept while(position > 0) and rainfallArray[position-1].local > temp as an alternative answer. Award 1 mark for moving larger values to the next position in the array at Line 7 Award 1 mark for inserting current value in gap created by move at Line 10

Question			Expected response	Max mark	Additional guidance
5.	(a)	(iii)	See possible algorithm below.	**4**	Award 1 mark for loop needed to process each LA average (loop of 32) Award 1 mark for traversing readingsArray to find each occurrence of unique local authority names Award 1 mark for updating of counter to record number of readings for each local authority. Award 1 mark for calculation of average with rounding to the nearest integer. Note: no mark should be awarded for the use of the INT function.
			1. for loop1 = 0 to 31 do 2. set total = 0 3. set average = 0 4. set count = 0 5. for loop2 = 0 to 499 do 6. if rainfallArray[loop1].local= readingsArray[loop2].authority then 7. set total = total + readingsArray[loop2].rainfall 8. set count = count + 1 9. end if 10. end loop 2 11. set average = round(total / count) 12. set rainfallArray[loop1].averageRainfall = average 13. end loop 1		
			Note: Candidates need to: Initial total and number of readings Traverse the readingsArray to find unique LA names Add the matching rainfall figure to the running total Update number of readings found Calculate and round the average Store in the rainfallArray array		

Question			Expected response	Max mark	Additional guidance
5.	(b)		See possible algorithm below.	**6**	Award 1 mark for asking user to enter 4 local authorities **AND** displaying bar chart heading Award 1 mark for correctly initialising and updating found and mid needed for the binary search Award 1 mark for conditional loop needed for the binary search Award 1 mark for correctly initialising and updating low and high needed for the binary search Award 1 mark for using result of binary search in the display (equivalent of Line 21) Award 1 mark for displaying location name together with stars used to represent the average rainfall for each selected LA.
			1. display bar chart heading 2. for user = 1 to 4 do 3. ask user for the name of a local authority 4. store value entered in location 5. set low = 0 6. set high = 31 7. found = false 8. while not(found) and low <= high 9. set mid = (low + high)/2 10. if rainfallArray[mid].local = location then 11. set found = true 12. end if 13. if rainfallArray[mid].local < location then 14. set low = mid + 1 15. end if 16. if rainfallArray[mid].local > location then 17. set high = mid – 1 18. end if 19. end while loop 20. display location 21. for stars = 0 to (rainfallArray[mid].averageRainfall – 1) do 22. display "*" on same line as location 23. end stars loop 24. display new line 25. end user loop		

Section 2

Question			Expected response	Max mark	Additional guidance
6.	(a)		See answer below	**3**	Award 1 mark for weak/strong entities correct Award 1 mark for correct relationship participation between Student and Rental Award 1 mark for correct relationship participation between Rental and Accommodation Note: do not penalise cardinality Note: accept double-edged box as indication of weak entity.
					
	(b)		The key values are formed by combining a student's initials and their courseID. If a student changes their name (or course) at some point in the future, the primary key values would need to be updated accordingly. Also, if two students on the same course have the same initials, this will be problematic. This can be resolved by adding a surrogate key that stores an auto generated integer value as details of a student are added the Student table.	**2**	Award 1 mark for description of problem resulting from the need to update the primary key values at some point in the future. Award 1 mark for identifying that a surrogate key could be used to resolve the problem. Accept adding a new field that makes use of auto increment and making that the primary key field, while still retaining the data listed in the studentID field.

Question			Expected response	Max mark	Additional guidance
7.	(a)		Adaptive		
	(b)		For example: Efficiency: The Gantt chart provided gives no indication of the duration of any of the tasks. This would make it difficult for the project manager to monitor progress and ensure that the work was carried out on schedule. Efficiency: The Gantt chart indicates that two of the tasks can be carried out at the same time. This is helpful when assigning personnel to the tasks to ensure that staff are available when they are needed and once finished, are then free to work on other developments. Resources: The Gantt chart provided indicates 4 different tasks requiring different skills. This would be helpful for the project manager when assigning people to the individual tasks to ensure that the correct skills sets are available. Resources: There will be no impact of the management of resources since there is no indication of any specific hardware or software that will be needed to complete the design tasks listed.	**2**	Award 1 mark each for a discussion of efficiency and management of resources. Discussion must make reference to the section of Gantt chart provided.

Question			Expected response	Max mark	Additional guidance
7.	(c)		See below.	**3**	Award 1 mark for primary key Award 1 mark for foreign key Award 1 mark for check Accept use of OR rather than IN for CHECK clause.

			`PRIMARY KEY orderID,`
			`FOREIGN KEY (custID) REFERENCES Customer(custID),`
			`CHECK (orderSent IN ("y", "Y", "n", "N"))`		

	(d)		`WHERE price NOT BETWEEN 200 AND 400`	**2**	1 mark for correct use of NOT 1 mark for correct use of BETWEEN
	(e)		For every product in the `Product` table, the subquery checks whether the `prodID` appears in the `OrderProduct` table. When the `prodID` is found, the subquery then checks whether the relevant order was placed in April 2023. When this is the case, 1 is added to the total number of orders found. `HAVING` is used to check that only products that have been ordered fewer than 12 times will be returned by the subquery. Since the subquery does generate matching rows, `EXISTS` returns the value `TRUE` and the outer query displays the required results.	**3**	Award 1 mark for description of how subquery is used to check for `prodID` in orders placed in April 2023. Award 1 mark for description of use made of `HAVING`. Award 1 mark for description of use made of `EXISTS`.

	(f)		`AND make IN ("Cell", "Race", "Sung")`
			`GROUP BY type`
			`HAVING COUNT(*) < 5;`
				2	1 mark for correct use of IN
					1 mark for correct use of HAVING

	(g)	(i)	Final testing As a member of the development team, Jill must check that all aspects of the updated system is working correctly before it is released for end-user testing.	**1**	Award 1 mark for correct type of testing together with suitable supporting statement
		(ii)	End-user testing As an existing customer, Ben is an end-user of the updated system and tests the system to check its usability.	**1**	Award 1 mark for correct type of testing together with suitable supporting statement

Section 3

Question			Expected response	Max mark	Additional guidance
8.			On screens with a display of 767 pixels or less, images will be displayed with a width of 100%; on all other screen widths, images will be displayed with a width of 50%.	**2**	Award 1 mark for explanation of the max-width Award 1 mark for explanation of how images will be displayed
9.	(a)		The `mysqli_num_rows()` function at Line 42 is used to check that `$result` contains at least 1 row	**1**	

	(b)	(i)	`Line 44:`
			`$row=`
			`mysqli_fetch_array($result)`
				1	Award 1 mark for correct use of `mysqli_fetch_array()` in line 44
					Note: parameter must be correct

		(ii)	`Line 46:`
			`echo"<tr><td>".$row["pupilID"]."</td><td>".`
			`$row["firstName"].`
			`"</td><td>".$row["lastName"]."</td></tr>";`
				1	Award 1 mark for correct use of `<tr>`, `<td>`, `</td>` and `</tr>` in line 46

Question			Expected response	Max mark	Additional guidance
10.	(a)		Adaptive	**1**	
	(b)		For example: Efficiency: The Gantt chart provided gives no indication of the duration of any of the tasks. This would make it difficult for the project manager to monitor progress and ensure that the work was carried out on schedule. Efficiency: The Gantt chart indicates that two of the tasks can be carried out at the same time. This is helpful when assigning personnel to the tasks to ensure that staff are available when they are needed and once finished, are then free to work on other developments. Resources: The section of Gantt chart provided indicates 3 different tasks requiring different skills. This would be helpful for the project manager when assigning people to the individual tasks to ensure that the correct skills sets are available. Resources: There will be no impact of the management of resources since there is no indication of any specific hardware or software that will be needed to complete the design tasks listed.	**2**	Award 1 mark each for a discussion of efficiency and management of resources. Discussion must make reference to the section of Gantt chart provided.

Question			Expected response	Max mark	Additional guidance

10.	(c)	(i)	`<select name="ComputerType">`
			`  <option value`
			`  ="desktop">Desktop</option>`
			`  <option value`
			`  ="laptop">Laptop</option>`
			`  <option value`
			`  ="tablet">Tablet</option>`
			`</select>`
				2	Award 1 mark for correct use of `select` with name attribute (variable name used is irrelevant)
					
					Award 1 mark for correct use of value attributes

		(ii)	`<?php`
			`  session_start();`
			`  $make =`
			`  $_post['ComputerMake'];`
			`?>`
			
			`<p> Computer type selected:`
			`<?php`
			`  echo`
			`  $_session["compType"];`
			`?>`
			`</p>`
			`<p> Computer make selected:`
			`<?php`
			`  echo $make;`
			`?>`
			`</p>`
				3	Award 1 mark for correct use of `session_start()`
					
					Award 1 mark for assignment and display of input value for make to PHP variable using name attribute (NB do not penalise for use of `$_get`). Note that both the `$_post` and `echo` statements must be stated in the solution. Also, accept
					• `echo $_post['ComputerMake'];` as alternative to `echo $make;`
					• `$make` assigned to a session variable which is later used to display the make
					
					Award 1 mark for displaying content of PHP session variable `$_session['compType']`
					
					Note: do not penalise for use of alternatives to `p` tag
					
					Accept any suitable session variable name for computer type and also for posted variable used for computer make.

Question			Expected response	Max mark	Additional guidance

10.	(c)	(iii)	`$server="ComputerSales_Host";`
			`$username="visitor";`
			`$password="Comp5A135";`
			`$database="ComputerSales";`
			
			`$conn = mysqli_connect($server, $username, $password, $database);`
			
			`$result = mysqli_query($conn,$query);`
				3	Award 1 mark for correct assignment use of details provided in question (password, server, database and user). This may be indicated as separate assignment statements (as in the sample solution) or as parameter values of the `mysqli_connect()` function.
					
					Award 1 mark for correct use of `mysqli_connect()` function in connection code (with correct 4 parameters.
					
					Award 1 mark for correct use of `mysqli_query()` function (using the PHP variable `$query`)

		(iv)	HTML: The data would be displayed using the HTML `SELECT` element. The individual models within the statement would be the `values` of the HTML `option` element. PHP: A while loop would be used with the PHP `mysqli_fetch_array()` function to process each individual row of the array containing the query results and the PHP `echo` statement would be used to display the individual models.	**2**	Award 1 mark for explanation of how relevant HTML elements would be used. Award 1 mark for explanation how relevant PHP constructs and functions would be used.
	(d)	(i)	Final testing As a member of the development team, Jill must check that all aspects of the updated system is working correctly before it is released for end-user testing.	**1**	Award 1 mark for correct type of testing together with suitable supporting statement
		(ii)	End-user testing As an existing customer, Ben is an end-user of the updated system and tests the system to check its usability.	**1**	Award 1 mark for correct type of testing together with suitable supporting statement

[END OF MARKING INSTRUCTIONS]