Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2021

Marking Scheme

Computer Science

Ordinary Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

Marking Scheme – Section C

Structure of the marking scheme for Section C (Programming)

Candidate responses are marked according to different scales, depending on the types of response anticipated. Scales labelled A divide candidate responses into four categories (correct response, almost correct response, partially correct response, and response of no substantial merit), and so on. The scales and the marks that they generate are summarised in this table:

Scale Label	A	B	C
No. of categories	4	5	6
5 mark scale	0, 2, 3, 5	0, 2, 3, 4, 5	
10 mark scale	0, 3, 7, 10	0, 3, 5, 8, 10	0, 2, 4, 6, 8, 10

A general descriptor of each point on each scale is given below. More specific directions in relation to interpreting the scales in the context of each question are given in the scheme, where necessary.

Marking scales – level descriptors
A-scales (4 categories)
- response of no substantial merit
- response with some merit
- almost correct response
- correct response

B-scales (5 categories)
- response of no substantial merit
- response with some merit
- response about half-right
- almost correct response
- correct response

C-scales (6 categories)
- response of no substantial merit
- response with some merit
- response about half-right
- response more than half-right
- almost correct response
- correct response

Answer any six questions.

Question 1   **5 marks**

Column A Variable Assignment	Column B Data Type
a = 5	Integer
b = "Hello World"	String
c = True	Boolean
d = ["apple", "banana", "orange"]	List
e = 2.718	Float

Each correct item   1 mark

Question 2   **5 marks**

1   1   0   1
2^3 2^2 2^1 2^0
8 + 4 + 0 + 1 = 13

Correct	5 marks
Small calculation error	4 marks
Half correct	3 marks
Any correct step	2 marks

Question 3   **5 marks**

- **Unicode can represent a greater range of character sets than ASCII. e.g emojis etc.**
- **Unicode represents most written languages in the world while ASCII does not.**
- **ASCII has its equivalent within Unicode.**
- **Or similar positive benefit of Unicode or ASCII.**

Any one of the above:

Very good explanation - clear understanding demonstrated	5 marks
Good explanation - clear information, lacking full understanding	3 marks
Fair explanation - limited understanding	1 mark

Question 4   **5 marks**

Any valid example	2 marks

Explanation:

Very good explanation - clear understanding demonstrated	3 marks
Fair explanation - limited understanding	2 mark

Question 5   **5 marks**

Answer: online banking, ecommerce, Spotify, Netflix, email, online booking, school/office PC network, etc or similar where client communicates with server

Any valid example	5 marks

Question 6   **2+3 marks**

(a)   What is HTTP?

the language used to program web pages	☐
the method for encoding data securely	☐
the web browser	☐
the protocol for transferring hypertext for webpages	☑

Correct   2 marks
(Incorrect if more than 1 box is ticked)

(b)   Describe **one** difference between the World Wide Web (WWW) and the Internet.

The internet is a global system of interconnected computers (uses TCP/IP).
The world wide web is online content (webpages) – formatted in HTML and uses the HTTP
protocol.

Very good description - clear understanding demonstrated	3 marks
Fair description - limited understanding	2 mark

Question 7   **5 marks**

Digital input signals are used to represent items that only have two (2) states, such as ON
(binary 1) or OFF (binary 0) states. Analog signals are variable, they have multiple states. Analog
input signals can represent such items as temperature or light levels, etc.

Very good description - clear understanding demonstrated	5 marks
Good description - clear information, lacking full understanding	3 marks
Fair description - limited understanding	1 mark

Question 8   **5 marks**

Answer:

10
9
8
7
6
5

OR

10 9 8 7 6 5

Correct	5 marks
Prints all values between 10 and 6/4 inclusive in descending order	3 marks
Any valid number output	1 mark

Question 9   **3+2 marks**

Step	a	b	a < 4
1	1	2	True
2	2	4	True
3	3	7	True
4	4	11	False

Answer: 11

Each correct row/column 1 mark (max 3 marks)
Any one value correct   1 mark (total)

Correct output   2 marks

Question 10   **3 + 2 marks**

(a)   **x = 21**
     Answer: 2

(b)   **x = 3**
     Answer: item not found

     Both correct   5 marks
     Any one correct   3 marks

Question 11   **5 marks**

Examples such as robots for social company, robotics for assisting in mobility/household tasks, technology to alert someone of a fall, automation in houses such as smart lights, heating, etc or similar examples where technology provides an assisting role.

Very good description - clear understanding demonstrated	5 marks
Good description - clear information, lacking full understanding	3 marks
Fair description - limited understanding	1 mark

Question 12   **3+2 marks**

- **check that the email address is actually there (not left blank).**
- **check that the email address does not contain spaces (or other illegal characters).**
- **check that the email address contains the @ symbol.**
- **check that the email address contains no more than 256 characters in total .**
- **check that the email address has a valid domain name e.g. info@test.com**
- **Or similar email validation check.**

First correct	3 marks
Second correct	2 marks

Section B	Long Questions	30 marks

Question 13   **30 (16, 6, 8) marks**

(a)   **16 (6,10) marks**

    (i)   **6 marks**

Example Activities:
- **Unit Testing – to test the functionality of each part of the system.**
- **System testing – to test the functionality of the entire system.**
- **User testing – to test the functionality from an end user perspective.**
- **Beta Testing – early release testing to small group.**
- **Black box testing – testing of system as a black box.**
- **Whitebox testing – testing every line of code for code coverage.**
- **Non-functional testing e.g. Performance testing – to test the performance impacts on mobile phones.**
- **User survey – to get users feedback.**
- **Or similar testing/validation.**

    For each activity:
    Very good description - clear understanding demonstrated   3 marks
    Fair description - limited understanding   2 marks

    (ii)   **10 marks**

Software Developer, Project Manager, Team Leader, Product Manager/Owner, Graphic Designer, Tester, Subject Matter Expert (e.g. on infectious diseases) or similar role.

    For each role:
    Name   2 marks
    Very good description - clear understanding demonstrated   3 marks
    Fair description - limited understanding   2 marks

(b) **6 marks**

Any reason related to GDPR requirements.
Any ethical reason.
Or similar.

For each explanation:
Very good explanation - clear understanding demonstrated   3 marks
Fair explanation - limited understanding   2 mark

(c) **8 marks**

Accept principles of universal design or UI design.

Principles of universal design
Principle 1: Equitable Use
Principle 2: Flexibility in Use
Principle 3: Simple and Intuitive Use
Principle 4: Perceptible Information
Principle 5: Tolerance for Error
Principle 6: Low Physical Effort
Principle 7: Size and Space for Approach and Use

Good UI design:
Place users in control of the interface.
Make it comfortable to interact with a product.
Reduce cognitive load.
Make user interfaces consistent.

Visibility of system status, match between system and the real world, user control and freedom, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency of use, aesthetic and minimalist design, help users recognize, diagnose, and recover from errors, help and documentation

Or principles as per Don Norman: Visibility, Feedback, Constraints, Mapping, Consistency, Affordance.

For each principle:
Very good description - clear understanding demonstrated   4 marks
Fair description - limited understanding   2 mark

Question 14   **30 (10, 10, 10) marks**

(a)   **10 (3, 3, 4) marks**

  (i)   **3 marks**

It works by recursively breaking down a problem into sub-problems of the same or related type, until these become simple enough to be solved directly. Binary sort takes each half and then break each half again and so on until the item is found.

Very good description - clear understanding demonstrated	3 marks
Fair description - limited understanding	2 marks

  (ii)   **3 marks**

- **Linear search has to go through each position until found.**
- **Binary search breaks the problem down by splitting in half each time.**

Very good description - clear understanding demonstrated	3 marks
Fair description - limited understanding	2 marks

  (iii)   **4 marks**

No, because the list is not sorted.

No	2 marks
Needs to be sorted	2 marks

(b)   **10 (6,4) marks**

  (i)   **6 marks**

    The List is repeatedly divided in two with one half being dismissed.

    Algorithm identifies low, mid and high values on each step until 8 is found.

    Step 1: Low = 1, High = 12, Mid =6

    Step 2: Low = 7, High = 12, Mid = 9

    Step 3: Low = 8, High = 9. Found

    Note that in step 1 the mid value could be 7 and this will change the subsequent steps.

Fully worked solution including repeated divisions of list	6 marks
Identifies repeated division of list with error	4 marks
Identifies single division of list	2 marks
Any correct step (e.g. identify low, high)	1 marks

(ii)   **4 marks**

Step 1: 30 number
Step 2: 15 numbers
Step 3: 8 numbers
Step 4: 4 numbers
Step 5: 2 numbers
Step 6: 1 number

Answer: 6

| Correct answer | 4 marks |
| Some correct steps in calculation | 2 marks |

(c)   **10 marks**

Advantage:
- Algorithm treats everyone the same.
- Avoids any subconscious bias – race and socio-economic factors are ignored.

Disadvantage
- Removes human feelings from decision-making.
- If it was incorrectly coded it could incorrectly leave someone in jail.
- The algorithm was designed by humans so may have bias built into it.
- Algorithm could ignore important factors such as positive changes to the person's life recently.

For each advantage/disadvantage:
Very good explanation	5 marks
Good explanation	3 marks
Fair explanation	2 mark

Question 15   **30 (8, 10, 6, 6) marks**

(a)   **8 marks**

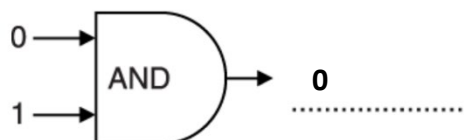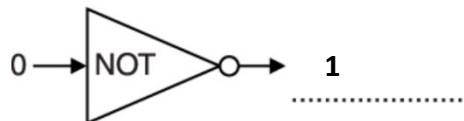**Processor, RAM, Graphics Card, Wireless, Networking.**

For each item:
Valid item   1 mark
Very good explanation   3 marks
Fair explanation   2 mark

(b)   **6 marks**

(i)

Both correct   6 marks
One correct   3 marks

(ii)   **4 marks**

INPUTS		OUTPUTS
A	B	A OR B
0	0	**0**
0	1	**1**
1	0	**1**
1	1	**1**

Each row correct – 1 mark

(c)   **6 marks**

- **The hardware layer is the lowest layer in the layered operating system architecture. This layer interacts with the system hardware and coordinates with all the peripheral devices used such as printer, mouse, keyboard, scanner etc.**
- **The operating system (OS) manages computer hardware, software resources, and provides common services for computer programs.**
- **The application layer is the layer that actually interacts with the operating system or application whenever the user uses an application.**
- **The user layer contains the user interface that users interact with.**

For each of the 2 chosen layers:
Very good description - clear understanding demonstrated   3 marks
Fair description - limited understanding   2 marks

(d)   **6 marks**

Name valid development   2 marks

Very good description - clear understanding demonstrated   4 marks
Fair description - limited understanding   2 marks

Section C	Programming	50 marks

Question 16   **50 marks**

(a)   **50 (5, 10, 5, 5, 10, 5, 10) marks**

Possible solution:

```python
1   # Question 16(a)
2   # Examination Number:
3
4   pin = "1579"
5   loggedIn = False
6   failedAttempts = 0
7
8   while not loggedIn and (failedAttempts < 3):
9       #input command is asking the user for a PIN
10      userTry = input("Enter PIN:")
11
12      if userTry == pin:
13          print("Welcome")
14          loggedIn = True
15      else:
16          print("Incorrect PIN")
17          failedAttempts += 1
18
19  if failedAttempts >= 3:
20      print("You have entered the PIN incorrectly", failedAttempts, "times.")
```

(i)   **5 marks (A-5 scale)**

5 marks	**Correct response** Correct implementation using solution above or similar.
3 marks	**Almost correct response** Comment in inappropriate location.
2 mark	**Response with some merit** Any reasonable attempt at inserting a comment.

(ii)   **10 marks (A-10 scale)**

10 marks	**Correct response** Correct implementation using solution above or similar (included `else` and a `print` statement).
7 marks	**Almost correct response** Almost correct implementation using solution above or similar (included else and print statement) but with minor syntax error.
3 mark	**Response with some merit** Attempted use of `print` that shows output to user indicating incorrect pin.

15

(iii) **5 marks (A-5 scale)**

5 marks	**Correct response** Correct implementation using solution above or similar.
3 marks	**Almost correct response** Correct implementation using solution above or similar but with minor syntax or semantic error.
2 mark	**Response with some merit** Attempt that indicates limited knowledge of Boolean.

(iv) **5 marks (A-5 scale)**

5 marks	**Correct response** Correct implementation using solution above or similar.
3 marks	**Almost correct response** Correct implementation using solution above or similar but with minor syntax or semantic error.
2 mark	**Response with some merit** Attempt to set the Boolean variable but with logical error e.g. in the wrong place.

(v) **10 marks (A-10 scale)**

10 marks	**Correct response** Correct implementation using solution above or similar.
7 marks	**Almost correct response** Correct implementation using solution above or similar but with minor syntax or semantic error. Correct implementation using solution above or similar but output is incorrect e.g. does not state incorrect PIN or ask user to enter PIN.
3 mark	**Response with some merit** Attempted to use a loop but with some logical errors and syntax errors in its implementation.

(vi)   **5 marks (A-5 scale)**

5 marks	**Correct response** Correct implementation using solution above or similar.
3 marks	**Almost correct response** Correct implementation using solution above or similar but with minor syntax or semantic error.
2 mark	**Response with some merit** Attempt to set the variable but with logical error e.g. in the wrong place.

(vii)   **10 marks (B-10 scale)**

10 marks	**Correct response** Correct implementation using solution above or similar for <u>both</u> cases (successful login or total many attempts).
8 marks	**Almost correct response** Correct implementation using solution above or similar for <u>both</u> cases (successful login or total many attempts) but with minor syntax error. Any three of: • `while` loop modified • `failedAttempts` incremented • `if` statement line 19 • `print` statement
5 marks	**Response about half-right** Attempted calculation of number of failed attempts. Any two of: • `while` loop modified • `failedAttempts` incremented • `if` statement line 19 • `print` statement
3 mark	**Response with some merit** Any one of: • `while` loop modified • `failedAttempts` incremented • `if` statement line 19 • `print` statement

Coursework (90 marks in total)

Description		Marks
Presentation of report	Quality of report structure and layout; evidence of student's adherence to the principles of good user interface design when creating the website.	**5**
A rationale for the approach to the brief		
Research	Shows evidence of research and investigation of the context and the task.	**10**
Response to the brief	Clearly explains choices made; offers clear rationale behind the overall design approach.	
The artefact (design, development and operation)		
Meeting the brief	The artefact is consistent with the context and theme of the brief. The requirements of the brief are met; identified end-user needs are met.	**10**
Iterative design process	Presents a design timeline with justification of key decisions; explains the iterative design approach adopted.	**15**
Computational thinking and problem solving	The construction of the artefact shows skills such as abstraction, decomposition, algorithmic thinking, evaluation and testing. The ability to systematically address and solve problems thrown up in the implementation of the design are clearly demonstrated.	**15**
Programming skills	Fundamental skills are demonstrated, such as using a modular approach, using high level data structures, testing and debugging, minimal duplication of code, readability, effective use of commenting.	**15**
Use of computing technologies and awareness of social impacts	Shows an awareness of adaptive technology; creative and appropriate use of technology; an awareness of core computer science concepts. Demonstrates an awareness of the end-user(s) and potential social impacts.	**10**
Evaluation		
Reflection	Explains the extent to which the artefact meets the design ambition; how well the needs of the envisaged end user are met.	**10**
Future development	Describes with justification how the artefact could be modified and improved.	
References		
References	You must also include references and/or a bibliography.	**0**
Summary word count		
Summary word count	Include a summary of the word count of the report, including the total word count.	**0**

Higher grade	Ordinary grade	Reference Mark	Higher Mark	Ordinary Mark
1		81 – 90	81 – 90	90
2		72 – 80	72 – 80	90
3		63 – 71	63 – 71	90
4		54 – 62	54 – 62	90
5	1	45 – 53	45 – 53	81 – 90
6	2	36 – 44	36 – 44	72 – 80
7	3	27 – 35	27 – 35	63 – 71
8	4	23 – 26	23 – 26	54 – 62
8	5	18 – 22	18 – 22	45 – 53
8	6	14 – 17	14 – 17	36 – 44
8	7	9 – 13	9 – 13	27 – 35
8	8	0 – 8	0 – 8	0 - 26

COURSEWORK – conversion from reference mark to Ordinary-level mark

For Ordinary-level candidates, the final mark is found from the reference mark as follows:
- If the reference mark is 54 or more the final mark is 90.
- If the reference mark is at least 27 but less than 54, then add 36 to the reference mark to get the final mark.
- If the reference is at least 1 but less than 27, then double the reference mark and add 9 to get the final mark.
- If the reference mark is 0 the final mark is 0

Reference Mark	Conversion
54 or more	Award 90 marks
27 – 53	Add 36 marks
1 - 26	Multiply the reference mark by 2 and add 9 marks
0	0