Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2021

Marking Scheme

Computer Science

Higher 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
15 mark scale		0, 2, 5, 10, 15	

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

Section A — Short Answer Questions — 30 marks

Answer any six questions.

Question 1 **5 marks**

Output
`x is 3`
`7 3`
`6 8`
`y is y`

First full correct response 2 marks
Each additional correct response 1 mark

Question 2 **3 + 2(1,1) marks**

(a)

- **The circuits in a computer's processor are made up of transistors. A transistor is a switch that is activated by the electronic signals it receives. Signals can be 0V or 5V. The digits 1 and 0 used in binary reflect the on and off states of a transistor.**
- **As there are only two possible states, binary is more reliable than any other number systems.**

Very good explanation - clear understanding demonstrated 3 marks
Fair explanation - limited understanding 1 mark

(b)

(i) $\mathbf{2^4 = 16}$ **unique pieces of information can be represented using four-bits.**

Correct 1 mark

(ii) $\mathbf{\log_2 8 = 3}$ **bits can represent 8 unique pieces of information.**

Correct 1 mark

Question 3 **2(1,1) +3 marks**

(a)

- **RAM can be written, whereas ROM is read-only.**
- **RAM chips can be read faster than ROM.**
- **ROM is non-volatile storage (does not require a constant source of power to retain information stored on it) whereas RAM is volatile and requires a constant source of power to retain information.**
- **Data/information in ROM is permanent whereas RAM is used to store temporary information.**
- **CPU cannot access data that is stored in ROM directly – must be transferred to RAM first.**
- **ROM is used primarily in the start-up process of a computer, whereas RAM is used in the normal operations of a computer after starting up and loading the operating system.**
- **Capacity. RAM can store multiple gigabytes (GB) of data (typical range is 1-256GB per chip). ROM typically stores only several megabytes (MB) of data, typically 4-8MB per chip.**
- **Physically RAM chips are bigger than ROM chips (of the same capacity).**
- **The cost of RAM chips tends to be higher than ROM.**
- **Or any similar relevant difference.**

Each correct response 1 mark

(b)

- **More RAM means more applications can be loaded in RAM at the same time. This means the CPU spends less time loading RAM from secondary storage and/or paging/thrashing. This in turn means that the CPU can spend more time running user applications.**
- **Better performance means applications run faster / quicker response times for user.**

Very good explanation - clear understanding demonstrated 3 marks
Fair explanation - limited understanding 1 mark

Question 4 **2+3 marks**

(a)

- **The method does not work because the contents of x are overwritten (lost) after the first assignment.**
- **A temporary variable is needed.**

Good description - clear information 2 marks

(b)

- **Use a temporary variable**
  temp = x
  x = y
  y = temp
- **or, use Python's canonical swap**
  x, y = y, x
- **or, use addition/subtraction operators**
  x = x + y
  y = x - y
  x = x - y
- **or, use multiplication/division operators**
  x = x * y
  y = x / y
  x = x / y
- **or any other valid solution**

Very good description - clear understanding demonstrated	3 marks
Fair description - limited understanding	1 mark

Question 5 **3 + 2 marks**

(a)

n	total	count
0	0	0
7	**7**	**1**
3	**10**	**2**
8	**18**	**3**

First correct column	2 marks
Second column correct	1 mark
OR	
Each correct row	1 mark
OR	
One correct value	1 mark

(b) **18/3=6**

Full correct response	2 marks

Question 6 **5 marks**

- **Family discount should be allowed for situations where only 1 parent (adult) is travelling with a child. Could be perceived to discriminate against single-parent families.**
- **You could have any number of children travelling and only a single adult and get no discount.**
- **If num_adults >= 10 and num_children > 0 (could be 99 children) the discount is family - should be large group discount (as opposed to family discount).**
- **Children don't contribute to large or small group discounts.**
- **Any valid scenario.**

Scenario 1 (best scenario). Good description – clear understanding	3 mark
Scenario 2 (2nd best scenario). Good description – clear understanding	2 marks

Question 7 **2+3 marks**

(a)

- **HTTP is unsecured while HTTPS is secured.**
- **HTTP sends data over port 80 while HTTPS uses port 443.**
- **HTTP operates at application layer, while HTTPS operates at transport layer.**
- **No SSL certificates are required for HTTP, with HTTPS it is required that you have an SSL certificate and it is signed by a CA.**

Good description - clear information	2 marks

(b)

TCP breaks messages into chunks called packets and then passes these chunks onto the IP layer. At the receiving end the TCP software reassembles the packets into the correct order (based on an assigned sequence number). Reliability is achieved by a system of acknowledgments and timeouts. If an acknowledgement is not received within the required timeout the TCP software resends individual packets or the entire message.

Very good explanation - clear understanding demonstrated	3 marks
Fair explanation - limited understanding	1 mark

Question 8 **2+3 marks**

(a)

- **ASCII is a 7-bit system – cannot represent more than 128 characters. Extended ASCII uses an extra bit meaning it can cater for up to 256 different characters. ASCII was invented in the 1960's (first published in 1963) and designed to include the characters that were most commonly used for communication between devices at that time. These included the digits 0-9, upper and lower case letters from the English alphabet (a-z, A-Z), punctuation symbols and a number of non-printing control codes used by old teletype machines.**
- **Since emoji characters were not 'invented' at the time ASCII was introduced they were not considered for inclusion as part of the ASCII character set.**
- **Emoji characters are represented using Unicode.**

Good explanation - clear information 2 marks

(b) 0001 1111 0100 0100 1101

Correct	3 marks
Half correct	2 marks
Response with some merit	1 mark

Question 9 **2+3 marks**

(a)

- **An OS is the software that controls the hardware of a computer.**
- **Acts as an interface between other software and the hardware.**
- **Acts as an interface between the user and the machine.**

Good description - clear information 2 marks

(b)

- **I/O Management**
  - **Controls the user interface (handles graphics, screen sizes, resolutions etc.).**
  - **Provides access to peripheral devices (through device drivers).**
- **File System**
  - **Keeps track of where files are located (e.g. maintains the file allocation table in FAT systems).**
  - **Controls access to files (e.g. sequential vs direct access).**
  - **Handles file security.**
  - **Implements disk scheduling policy (e.g. first-come, first-served).**
- **Memory Management**
  - **Allocation of RAM.**

- **Loads data in from secondary to primary storage.**
- **Swaps data out from primary to secondary.**

- **Processor Scheduling**
  - **Decides which job to run next and for how long (e.g. first-come, first-served, shortest job first, round robin).**
  - **Maintains the state of each process (e.g. ready/waiting/running/ended).**
  - **Deadlock avoidance.**
  - **Handles multitasking.**
  - **Handles multiple users.**

For each layer up to a total possible maximum of 3 marks:
Good explanation - clear information 2 marks
Fair explanation - limited understanding 1 mark

Question 10 **2+3 marks**

(a)

- **To agree requirements with customer.**
- **To ensure system/project is delivered on time and within budget.**
- **To oversee project schedule – planning - set key dates/milestones.**
- **To resource project – staffing, equipment, finance etc.**
- **To assign tasks related to design, implementation, testing etc.**
- **To communicate with and motivate team and ongoing liaison with customer.**
- **To monitor project progress.**
- **Any relevant task.**

For each correctly stated task 1 mark

(b)

- **High level languages such as Python and JavaScript use English like words e.g. while, if. Programs written in these languages are translated into machine code using a compiler or interpreter. High level languages are machine independent.**
- **Low level languages are used to write code for a specific processor architecture. The instruction is constrained by a processor's instruction set. Examples are assembly languages and machine code (code written only using 1's and 0's).**

Very good description - clear understanding demonstrated 3 marks
Fair description - limited understanding 1 mark

Question 11 **2+3 marks**

(a)

- **To test the feasibility of some idea (i.e. testing ideas before committing to them. Refinements can be made more quickly, more safely and for less money e.g. is it worthwhile to vaccinate?**
- **To make predictions/demonstrate emergent behaviour (e.g. population growth, the spread of a virus, infection rates) so that decisions can be better informed (e.g. where to build hospitals, roads, schools or whether it is necessary to vaccinate against the spread of a virus).**
- **To run simulations and be used as a basis for discussion and gaining a better understanding of a phenomena.**
- **To enable solutions to problems that are difficult to solve analytically (e.g. because of scale or complexity).**
- **Or similar.**

For each correctly stated benefit 1 mark

(b)

- **Agent-based modelling (ABM) for COVID 19 could have behavioural rules corresponding to infection conditions and also include an individual profile for each agent, which defines its main social characteristics and health conditions used during its interactions.**
- **ABMs can be used to predict outcomes for certain scenarios thereby allowing policy makers to make informed decisions such as those relating to social distancing, washing hands, setting lockdowns, easing restrictions, levels 1-5, crowd controls, indoor vs. outdoor activities, foreign travel etc.**

Very good explanation - clear understanding demonstrated	3 marks
Fair explanation - limited understanding	1 mark

Question 12 **2+3 marks**

(a)

The value of a primary key (PK) must be unique:

- **`dog_name` would not be a good PK because a duplicate value exists i.e. *fido.***
- **`breed` would not be a good PK because duplicates *could* exist.**
- **both fields could potentially contain duplicates.**

For each correctly stated reason 1 mark

(b)

- **A foreign key(FK) links two tables. It provides the relationship between two tables. In this case if the table shown was split into two separate tables – one for owners and one for dogs – the owner_id could be used as the PK in the owners table and the FK in the dogs table. The schema is shown below.**

owner_id	owner_name	address
1	Joe Murphy	1 main street
2	Ada Traore	9 park ave.
3	James Tidy	7 bond st.

dog_id	dog_name	breed	dob	microchip	owner_id
1	rover	labrador	22/11/2011	Y	1
2	fido	poodle	02/02/2020	Y	1
3	fido	jack russell	15/06/2015	N	2
4	champ	greyhound	01/01/2010	Y	1
5	spot	dalmation	24/08/2007	N	2
6	buddy	rottweiler	21/10/2012	Y	3

Very good explanation - clear understanding demonstrated 3 marks
Fair explanation - limited understanding 1 mark

Section B	Long Questions	30 marks

Question 13 **30 (3, 15, 12) marks**

(a) **3 (1, 1, 1) marks**

(i) **1 mark**

- **The second character ('A') is not a digit.**
- **Any other valid reason.**

(ii) **1 mark**

- **The routing key must be 3 characters (and not 4).**
- **The unique ID must be 4 characters (and not 3).**
- **The unique ID must be after the routing key .**
- **Any other valid reason.**

(iii) **1 mark**

- **The first character ('8') is not a letter.**
- **The second character ('X') is not a digit.**
- **The third character ('T') is not a digit.**
- **Any other valid reason.**

(b) **15 (2, 2, 4, 2, 5) marks**

(i) **2 marks**

A validation check is a test carried out by a program to make sure data is in the correct format. In the context of Eircode, a validation check will make sure it conforms to the rules for the Routing Key and the Unique Identifier provided at the start of the question.

Good explanation - clear understanding demonstrated 2 marks

(ii) **2 marks**

A test case would be any value passed into the function.
The test case e.g. 123 4568 would be passed into the function and the result would be compared to an expected result.
If the Eircode was valid the result of the test case would be True; False otherwise.

Good explanation - clear understanding demonstrated 2 marks

(iii) **4 marks**

Unit Testing

- **Usually carried out by the programmer.**
- **The purpose of unit testing is to test specific units of code.**
- **Test cases are designed to trigger all execution paths in the code.**
- **Typically automated.**
- **A form of white box testing (as testers are familiar with the code being tested).**

System Testing

- **Usually carried out by testers.**
- **The overall aim of system testing is to determine that the system meets the user requirements (i.e. it does what it is supposed/designed to do).**
- **System testing includes testing how the system operates under certain abnormal conditions e.g. after a power cut, by cutting off internet access, under stressed conditions.**
- **Typically carried out by testers (proxies for end-users).**
- **A form of black box testing (as testers are unfamiliar with the code being tested).**

For each of Unit Testing/System Testing
Good explanation - clear understanding demonstrated 2 marks

(iv) **2 marks**

- **The function only looks at the first three characters and the last four characters – it does not check for length or look for any characters in between .**

Very good explanation - clear understanding demonstrated 2 marks

(v) **5 marks**

Regression testing is important because it ensures that a change to the code does not result in breaking some pieces of code that had already been tested. It ensures that no new bugs are introduced as a result of implementing a software update.

Good explanation - clear understanding demonstrated 5 marks

(c) **12 (2, 4, 3, 1, 2) marks**

(i) **2 marks**

The Python code checks whether the first character of the Eircode passed in is a letter or not. If it is not a letter (A-Z or a-z) the condition will be True and the function will return False

Good explanation - clear understanding demonstrated 2 marks

(ii) **4 marks**

P	Q	not P	not Q	not P or not Q
False	False	**True**	**True**	**True**
False	True	**True**	**False**	**True**
True	False	**False**	**True**	**True**
True	True	**False**	**False**	**False**

1 Mark per correct row
OR
2 Marks for 1st fully correct column
1 Mark for 2nd and 3rd correct column
OR
1 mark for more than 2 correct values in each column

(iii) **3 marks**

P	Q	P and Q	not (P and Q)
False	False	**False**	**True**
False	True	**False**	**True**
True	False	**False**	**True**
True	True	**True**	**False**

Every value correct 3 marks
1 mark for each correct row (up to a max. of 2)
1 mark for more than 2 correct values in each column
1 mark for any correct value

(iv) **1 mark**

```
if not (test_eircode[1].isdigit() and test_eircode[2].isdigit()):
```

OR

```
if not (P and Q):
```

Correct response 1 mark

(v) **2 marks**

Slicing could be used to extract the 2nd and 3rd characters and test them together (as a slice) for digits (as opposed to testing them individually).

OR

```
if not (test_eircode[1:3].isdigit()):
```

Very good explanation - clear understanding demonstrated 2 marks

Question 14 **30 (12, 13, 5) marks**

(a) **12 (2, 2, 2, 2, 2, 2) marks**

(i) **2 marks**

3 is a losing position because the only options are to take 1 or 2 matchsticks. Both options leave opponent in a winning position as follows:

- **If player takes 1, it leaves 2 for my opponent (who can then take these 2 to win).**
- **if player takes 2, it leaves 1 which is also a winning position for my opponent.**

Very good explanation - clear understanding demonstrated 2 marks

(ii) **2 marks**

4 is a winning position because player can take 1 matchstick to leave their opponent with 3, which is a losing position (as per part (i) of the question).

Very good explanation - clear understanding demonstrated 2 marks

(iii) **2 marks**

5 is winning positon as a move to take two matchsticks leaves the next player in a losing position.
6 is a losing position as any move (take 1 or 2) places the next player in a winning position

No. of matchsticks remaining	0	1	2	3	4	5	6
Position (W or L)	L	W	W	L	W	**W**	**L**

Each correct response 1 mark

(iv) **2 marks**

Decision: I would ask my opponent to go first. (I would go second.)
Reason: 0, 3, 6, 9 etc. are losing positions. All multiples of 3 are losing positions. Since 21 is a multiple of 3 it is a losing position.

Correct decision 1 mark
Justification/Reason 1 mark

(v) **2 marks**

My strategy would be to leave my opponent with a multiple of 3 matchsticks on every turn. My initial move would therefore be to take 2 matchsticks as this would leave my opponent with 18 matchsticks.
In other words, my strategy would be to start by taking 2 and then for the rest of the game I would keep taking the opposite number of matches to my opponent i.e. if opponent takes 1 I would take 2; if opponent takes 2 I would take 1.

Very good explanation - clear understanding demonstrated 2 marks

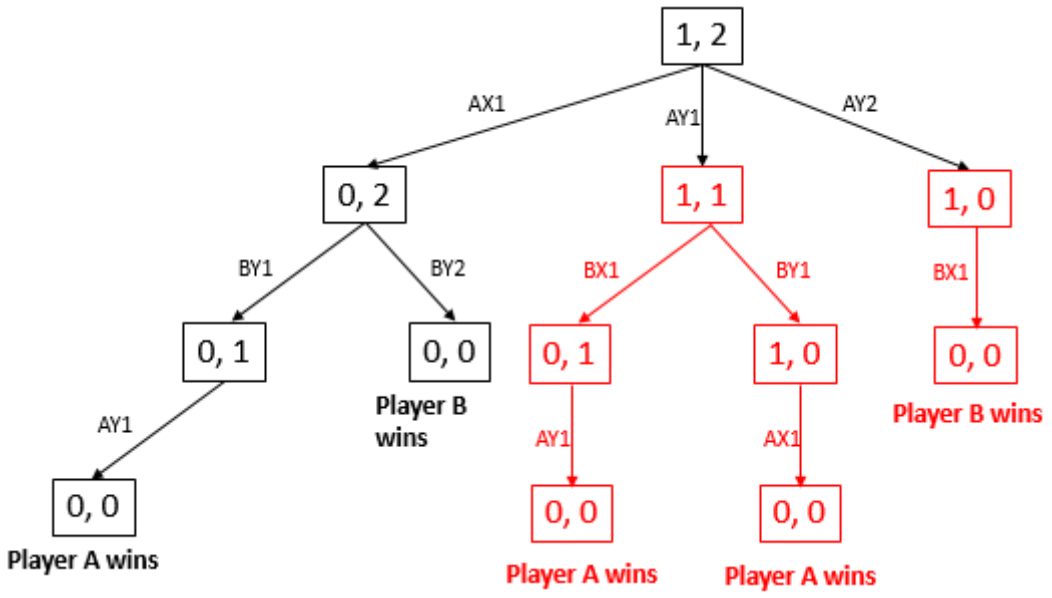
(vi) **2 marks**

No. of matchsticks remaining	0	1	2	3	4	5	6	7	8	9
Position (W or L)	L	**W**	**W**	**W**	**L**	**W**	**W**	**W**	**L**	**W**

All W's and L's correct 2 marks
4 correct responses OR all W's or L's correct 1 mark

(b) **13 (5, 2, 2, 2, 2) marks**

(i) **5 marks**



Full correct solution 5 marks

3 marks as follows:
1 mark for any one correct pair in path 1,1 → 0,1 → 0,0 → player A wins
1 mark for any two correct pairs in path 1,1 → 1,0 → 0,0 → player A wins
1 mark for any one correct pair in path 1,0 → 0,0 → player B wins

2 marks for 1st full correct path
2 marks for 2nd full correct path
1 mark for 3rd full correct path

(ii) 2 **mark**

AY1 is the best move for player A as it is the only move that leads to certain victory for A.

Best move	1 mark
Reason	1 mark

(iii) **2 marks**

A winning move for player A from state (2, 3) would be AY1.
This move leaves the opponent – player B - in state (2,2).
From (2,2) B can BX1 → (1,2) certain victory for A (as per part (ii)).
From (2,2) B can BY1 → (2,1) also certain victory for A.
From (2,2) B can also BX2 → (0,2) or BY2 → (2,0) both certain victories for A.

Very good description - clear understanding demonstrated 2 marks

(iv) **2 marks**

A winning strategy from state (n, m) where $n \neq m$ would be to even the piles. Leave (n, n) or (m, m).
For $m > n$ this means take $m - n$ matchsticks.
For $m < n$ take $n - m$ matchsticks.

Very good description - clear understanding demonstrated 2 marks

(v) **2 marks**

Since (n, n) is a winning position a winning strategy would be to remove one of the piles.

Very good description - clear understanding demonstrated 2 marks

(c) **5 marks**

Abstraction

- **By ignoring other details, we can focus on one e.g. when faced with (1,2) we play out AX1 without considering other moves.**
- **Abstraction allows use to use representations for physical actions / objects e.g. (1,2) represents 1 match in pile X and 2 matches in pile Y. A and B represent players. AX1 represents player A taking 1 matchstick from pile X. Even numbers are abstractions e.g. 1 represents a single physical matchstick. The win/loss tables and the tree diagrams are themselves also abstractions for piles of matchsticks. The matchsticks could also be abstractions for other objects e.g. coins, pieces of paper, stocks, shares, commodities etc.**
- **Any relevant example.**

Decomposition

- **We can see how by breaking the problem down it is possible to work out every possible outcome. This makes it possible to decide upon a best move.**
- **In the initial matchstick game if we break the problem down to zero matchsticks and recognise this as a losing position and build up from this we can develop a winning strategy.**
- **Any relevant example.**

Pattern recognition

- **By seeing that multiples of 3 are losing positions in the matchstick game it becomes possible to devise a winning strategy.**
- **By realising that if we always keep the same number of matchsticks in both piles we can generalise to get a winning strategy for (n,n). Further generalisation can be used to develop a winning strategy for 3 piles such as (n, n, n) or even (l, m, n) and possibly 4 or more piles.**
- **Any relevant example.**

For multiple answers award marks for best answer

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

Question 15 **30 (14, 8, 8) marks**

(a) **14 (6, 2, 2, 2, 2) marks**

(i) **6 marks**

Hardware is the physical components of a computer system – computer components.
Examples processor, memory, storage devices, any input or output device, peripherals, registers, logic gates etc.
Software is the general term used to describe programs/instructions that are executed by the processor.
Examples: Any named application or system software package.

For each hardware/software	
Good explanation	1 mark
Each relevant example	1 mark + 1 mark

(ii) **2 marks**

Digital sensor: pushbutton, switch, keypad, keyboard or similar.
Analogue sensor: temperature sensor, PIR sensor, accelerometer, humidity, sound, light, CO2 or similar.

Example of digital sensor	1 mark
Example of analogue sensor	1 mark

(iii) **2 marks**

Digital input:

- **Have two discrete values (1/0 or ON/OFF).**
- **In electrical circuits these states are represented by voltages (5V = ON and 0V = OFF).**

Analogue input:

- **Have any value within a certain range.**
- **Values continuously vary.**
- **Used to represent continuous data.**


Analog Signal


Digital Signal

Difference between digital and analogue	1 mark
Diagram of both	1 mark
Definition and diagram of either (but not both)	1 marks

(iv) **2 marks**

Real time systems are those that respond to some external stimuli within a stated/minimum time. For example, an alarm will sound immediately (or a light will switch on) when a PIR sensor detects movement.

Very good description - clear understanding demonstrated 2 marks

(v) **2 marks**

- **Cost – ES are generally cheaper.**
- **Speed – ES typically run on a dedicated micro-controller.**
- **Reliability – often less complex and therefore more reliable.**
- **Automated – once an ES is started it requires minimal user intervention.**
- **Portability.**
- **Or similar.**

For each relevant advantage (max 2) 1 mark

(b) **8 (2, 2, 4) marks**

(i) **2 marks**

ES that runs on a smartphone/tablet:

- **Camera**
- **GPS**
- **Voice recognition systems**
- **Microphone**
- **Any similar named example accepted.**

Each correct example (max 2) 1 marks

(ii) **2 marks**

User interface on mobile devices are often touchscreen, respond to swipes and gestures as well as input from a virtual keyboard and voice.
Universal design refers to design principles that are universally recognised and understood. Refers also to accessibility, adaptive technology and overall user experience.

For each part (UI and UD):
Good description - clear understanding demonstrated 1 mark

(iii) **4 marks**

Principles of universal design:
Principle 1 – Equitable in use – design is useful to people with diverse abilities.
Principle 2 – Flexibility in use. It should be possible to configure the ES so that it can be used in multiple ways.
Principle 3 – Simplicity to use – easy to understand.
Principle 4 – Perceptible information - The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
Principle 5 - Tolerance for Error The design minimizes hazards and the adverse consequences of accidental or unintended actions.
Principle 6 - Low Physical Effort The design can be used efficiently and comfortably and with a minimum of fatigue.
Principle 7 - Size and Space for Approach and Use Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

For each principle	2 marks
Principle identified	1 mark
Good description - clear understanding demonstrated	1 mark

(c) **8 marks**

Relevant stakeholders include end-users/citizens – industry/business owners – government etc.
Potential positive impacts:
on society in areas such as … → use of social media to communicate/socialise, healthcare/medicine, crime/justice, transport, education, housing, agriculture, environment/climate change, science, exploration
Alternative perspectives:
right of an individual to privacy, misuse of data, profiling, equality, digital divide, use of surveillance tech., polarisation of opinions, democracy/elections, impact on employment (will AI take our jobs), military uses etc.

For each stakeholder	4 marks	
Stakeholder identified	1 mark	
Impact of ES on stakeholder	3 marks	
Very good description - clear understanding demonstrated		3 marks
Fair description – limited understanding		1 mark

Section C Programming 50 marks

Question 16

(a) **50 (5, 5, 5, 10, 10, 15) marks**

Possible solution:

```
# Question 16(a)
# Examination Number:

# function definition used in part (v)
def is_anagram(w1, w2):
    if sorted(w1) == sorted(w2):
        return True
    else:
        return False

word1 = input("Enter the first word: ")
word2 = input("Enter the second word: ") # Solution (i)

# test whether the sorted strings are the same as each other
# if the sorted strings are the same then they must be anagrams
if (sorted(word1.upper()) == sorted(word2.upper())): # (iv)
    print(word1, "is an anagram of", word2) # (ii)
else:
    print(word1, "is NOT an anagram of", word2) # (iii)

# (v)
if (is_anagram(word1.upper(), word2.upper())):
    print(word1, "is an anagram of", word2)
else:
    print(word1, "is NOT an anagram of", word2)


# Part (vi)
phrase = input("Enter a phrase: ")
phrase_no_spaces = phrase.replace(" ", "")
if (is_anagram(word1.upper(), phrase_no_spaces.upper())):
    print(word1, "is an anagram of", phrase)
else:
    print(word1, "is NOT an anagram of", phrase)

if (is_anagram(word2.upper(), phrase_no_spaces.upper())):
    print(word2, "is an anagram of", phrase)
else:
    print(word2, "is NOT an anagram of", phrase)
```

(i) **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 syntax error. Attempted use of `input` function in an assignment statement Minor error in string.
2 marks	**Response with some merit** Any other reasonable attempt.

(ii) **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 syntax error. Attempted use of `print` function with both variables (`word1` and `word2`). Minor error in construction of string.
2 marks	**Response with some merit** Any other reasonable attempt.

(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 syntax error (allow use of `else`, `elif` or a separate `if` statement). Attempted use of `print` function with both variables (`word1` and `word2`). Minor error in construction of string.
2 marks	**Response with some merit** Any other reasonable attempt.

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

10 marks	**Correct response** Correct implementation using solution above or similar.
8 marks	**Almost correct response** Correct implementation using solution above or similar but with syntax or semantic error.
5 marks	**Response about half-right** Attempt to convert the case of either variable.
3 marks	**Response with some merit** Any other reasonable attempt.

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

10 marks	**Correct response** Correct implementation using solution above or similar (even if the case is ignored).
8 marks	**Almost correct response** Any 3 of: • A call to the function `is_anagram` • Passing in the correct arguments to `is_anagram` • Correct processing of `return` value • Display result.
5 marks	**Response about half-right** Any 2 of: • A call to the function `is_anagram` • Passing in the correct arguments to `is_anagram` • Correct processing of `return` value • Display result.
3 marks	**Response with some merit** Any other reasonable attempt.

(vi) **15 marks (B-15 scale)**

15 marks	**Correct response** Correct implementation using solution above or similar.
10 marks	**Almost correct response** Any 3 of: • Phrase correctly read • Spaces removed • Processing for `word1` anagram of phrase • Processing for `word2` anagram of phrase.
5 marks	**Response about half-right** Any 2 of: • Phrase correctly read • Spaces removed • Processing for `word1` anagram of phrase • Processing for `word2` anagram of phrase.
2 marks	**Response with some merit** Any other reasonable attempt.

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
	5	18 – 22	18 – 22	45 – 53
	6	14 – 17	14 – 17	36 – 44
	7	9 – 13	9 – 13	27 – 35
	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

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