L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2024 MAIN SESSION

SUBJECT:	**Computing**
PAPER NUMBER:	I
DATE:	21st May 2024
TIME:	4:00 p.m. to 6:05 p.m.

Directions to Candidates

Write your index number were indicated at the top of the page.

Answer **ALL** questions in the spaces provided. You are not allowed to use extra sheets other than those provided in this booklet.

Good English and orderly presentation are important.

The use of flowchart templates is permitted. The use of calculators is **not** permitted.

This paper carries 85 marks of the examination.

Question Number	1	2	3	4	5	6	7	8	9	10	**FOR MARKERS' USE**
For Markers' use only **MARKS**	Total number of Marks or Grade obtained by candidate										

1. A software development company is commissioned to develop an Employee Management System for a large corporation. The system includes a database to store records related to the employee details, attendance, sick leave, vacation leave, and be able to generate payroll and other type of reports.

a. Define the term 'serial access' in the context of data retrieval.

_____

_____(1)

b. Tick whether the below situations require a serial or direct data access.

   i. Generate a detailed attendance report for all employees for the month of January.

   ☐ Direct Access   ☐ Serial Access   (1)

   ii. Select employees who have an administrative role.

   ☐ Direct Access   ☐ Serial Access   (1)

   iii. Update the address of a particular employee.

   ☐ Direct Access   ☐ Serial Access   (1)

c. List **THREE** tables that are found in the database.

_____(3)

d. Describe why data integrity is important in such management systems.

_____

_____(1)

e. Describe how data validation assist in data integrity.

_____

_____(1)

(Total: 9 marks)

2. AMD recently launched the Ryzen 9 7950X, its most powerful CPU to date, with a clock speed of 5.5 GHz.

a. Explain the term 'clock speed'.

_____(1)

b. Name and briefly describe **ONE** other feature, other than clock speed, that can impact CPU performance.

_____

_____(2)

c. Number the steps of the Fetch and Execute Cycle in the appropriate order. *One has been provided as an example.*

	Control Unit (CU) places opcode in Instruction Register (IR).
	CU increments Program Counter (PC) to point to next instruction.
	CU activates necessary circuits to execute instruction.
6	Repeats from the beginning.
	CU fetches the opcode from memory location indicated by PC.
	CU fetches any required operand.

(5)

d. The Fetch and Execute Cycle refers to a machine instruction in terms of opcode and operand.

   i. Distinguish between opcode and operand.

_____(1)

   ii. What is the term used to refer to all instructions that a CPU can process?

_____(1)

(Total: 10 marks)

3. A marketing manager was hired by the local council to plan a fundraising event. To effectively manage the event, the marketing manager planned to integrate the use of a web authoring tool, wordprocessor, spreadsheet and a graphics software package.

a. Which one of the above-mentioned software is used to perform the following tasks:

   i. Create a document involving all the event proposals: _____ (½)

   ii. Keep a budget management: _____ (½)

   iii. Develop a website: _____ (½)

   iv. Create a poster and social media ads of the event: _____ (½)

b. Are the above-mentioned software considered as 'System' or 'Application' software? Explain.

_____

_____(2)

This question continues on the next page.

c. The local council hires the services from CyberSolv, an IT company that specialises in offering IT related services to other companies. Outline **ONE** task assigned to the IT personnel mentioned below by the local council. Answers should relate to the context given.

i. IT Trainer

_____

_____(1)

ii. Software Developer / Programmer

_____

_____(1)

iii. Data Entry Clerk

_____

_____(1)

iv. Web Master

_____

_____(1)

v. Technician

_____

_____(1)

(Total: 9 marks)

4. The following is a partially completed algorithm for a patient monitoring system to generate an alarm signal if the patient's heart rate is below 60 beats per minute or above 120 beats per minute.

Step 1: The system reads the _____.

Step 2: If the heart rate is less than 60 beats per minute, an alarm signal is generated, and

the monitor displays the warning message _____.

Step 3: Otherwise, if the _____, it signals an

alarm and the monitor displays "Heart rate above 120 beats per minute".

Step 4: The heart rate monitor keeps on monitoring the heart rate until it is switched off.

a.   Define the term 'algorithm'.

_____(1)

b.   Complete the above algorithm by filling in the missing lines.

   Step 1: _____(1)

   Step 2: _____(1)

   Step 3: _____(1)

c.   The system also includes blood pressure monitoring. The alarm signals (A=1) if at least one of the below conditions are true:

   - Heart Rate is not within acceptable range (H = 1).
   - Blood Pressure is not within acceptable range (P = 1).

   Complete the truth table shown below that represents the above algorithm.

H	P	Alarm
0		
	1	
	0	
1		

(3)

d.   Draw the logic gate that represents the truth table in part (c).

(2)

(Total: 9 marks)

5.   A research library is going to digitise its vast collection of books, particularly those that are in poor condition or have become unavailable due to discontinued publication. This initiative aims to preserve books for future generations and make them accessible to everyone.

a.   Mention the peripheral device needed to digitise the books.

_____ (1)

b.   It was decided to update the design of the digitised books. Mention the software that should be used to have an editable digitised version of the books.

_____ (1)

This question continues on the next page.

c. The library would like to purchase an output device to print the digitised books on demand. Should they choose a laser printer or a plotter? Justify your choice.

_____

_____ (2)

d. The digitisation of books can assist individuals with special needs in reading. Mention **ONE** software and **ONE** hardware designed to provide such assistance.

Assistive Software: _____(1)

Assistive Hardware: _____ (1)

e. In addition to general information about each book, the library also stores an image of the book cover, which is uploaded on the library's website.

   i. Would the images be stored as raster or vector images? Explain.

_____

_____(2)

   ii. During testing, it was observed that the inclusion of the book cover image causes the web page to load slowly. Explain why this happens.

_____(1)

   iii. Tick **ONE** way in which images can be stored to improve webpage loading times.

   ☐ Store the uncompressed image format.
   ☐ Store images in their original, high-resolution state.
   ☐ Store images to lower pixel dimensions.
   ☐ Increase the colour depth of the images. (1)

(Total: 10 marks)

6. To save battery consumption, smartphones have a dark-mode feature, in which it uses a light-intensity sensor to turn the screen into black and white colour mode when the ambient light is low.

a. From the scenario above, identify **ONE** input and **ONE** output component required for the dark-mode feature.

Input: _____(1)

Output: _____(1)

b. The reading from the light-intensity sensor is converted to digital signals using a 10-bit Analogue-to-Digital Convertor (ADC). What range of values can the ADC provide?

_____(1)

c. Analyse the Java code snippet shown below and tick the correct answer for the questions that follow.

```
if(lightIntensity < 300){

    darkMode = True;

}
```

i. What is the data type of variable `lightIntensity`?
☐ char
☐ boolean
☐ String
☐ int   (1)

ii. What does the condition `lightIntensity < 300` represent?
☐ Dark mode is enabled
☐ Dark mode is disabled
☐ Light intensity is greater than 300
☐ Light intensity is less than 300   (1)

iii. What is the data type of the variable darkMode?
☐ int
☐ boolean
☐ String
☐ float   (1)

iv. If the value of `lightIntensity` is 250, what will be the value of darkMode?
☐ True
☐ 0
☐ False
☐ 1   (1)

d. The dark-mode feature turns the screen into black and white mode also if the battery life is less than 20%. If the percentage of the battery life is stored in a variable called `battLife`, update the above JAVA code.

_____

_____

_____(2)

(Total: 9 marks)

Please turn the page.

7. Computers and other digital devices are widely used in various real-life applications. Complete the table below by identifying the term that relates to the situations, or by providing a situation that relates to the given term.

a.	A taxpayer files their income tax return using the online available services.		(1)
b.		**CAD**	(1)
c.	An employee receives their paycheck directly in the bank account through the company's payroll system.		(1)
d.		**Simulation**	(1)
e.	A CNC machine operator to program the machine to cut precise shapes from wood.		(1)
f.		**GPS**	(1)
g.	A restaurant personnel taking orders, process payments, and manage inventory.		(1)
h.		**CAL**	(1)

(Total: 8 marks)

8. The American Standard Code for Information Interchange (ASCII), is an 8-bit character representation system used for text-based data compatibility across different digital devices.

a. Calculate the binary value of the lowercase letter 'g', if the lowercase 'a' is represented with the decimal value of 97.

(2)

b. The school's secretary is entering the students' details in a database for record keeping. The following list shows the particulars to be stored for each student and the maximum space allowed for each.

- Name and Surname (24 characters)
- Address (36 characters)
- Contact Number (8 characters)

i. Mention the software used to store and manage the students' records.

_____(1)

ii. The address of the students includes the house name, street name and locality. An address example is: 'Our Nest, Republic Street, Zejtun'.

Can the secretary query the database to list all students who reside in Valletta? Justify your answer.

_____

_____(2)

iii. If the 8-bit ASCII is the coding system being used, what is the storage space required for each student record in bytes?

_____ (1)

iv. If the list contains 1000 students, what is the approximate storage space required?

☐ 66 GB
☐ 66 KB
☐ 66 MB   (1)

(Total: 7 marks)

9. NASA Space Apps Challenge is a competition that challenges teams of students to develop innovative solutions to real-world space challenges. A group of students are planning their mission for this competition.

a. The following are stages in the development of the students' system:

| Step 1:	Translating the program's specifications into code.
Step 2:	Testing the code functionality before submitting it.
Step 3:	Clearly outline the program's objectives and functionalities.

This question continues on the next page.

State whether the following statements are True or False.

i. The steps above are in the correct order: _____(1)

ii. Step 2 is part of the Programming and Documentation phase: _____ (1)

iii. A program trace table is normally done in step 3: _____ (1)

b. The students plan to develop a temperature control system for the Galileo satellite which probes around Jupiter. The system is designed to work as follows:
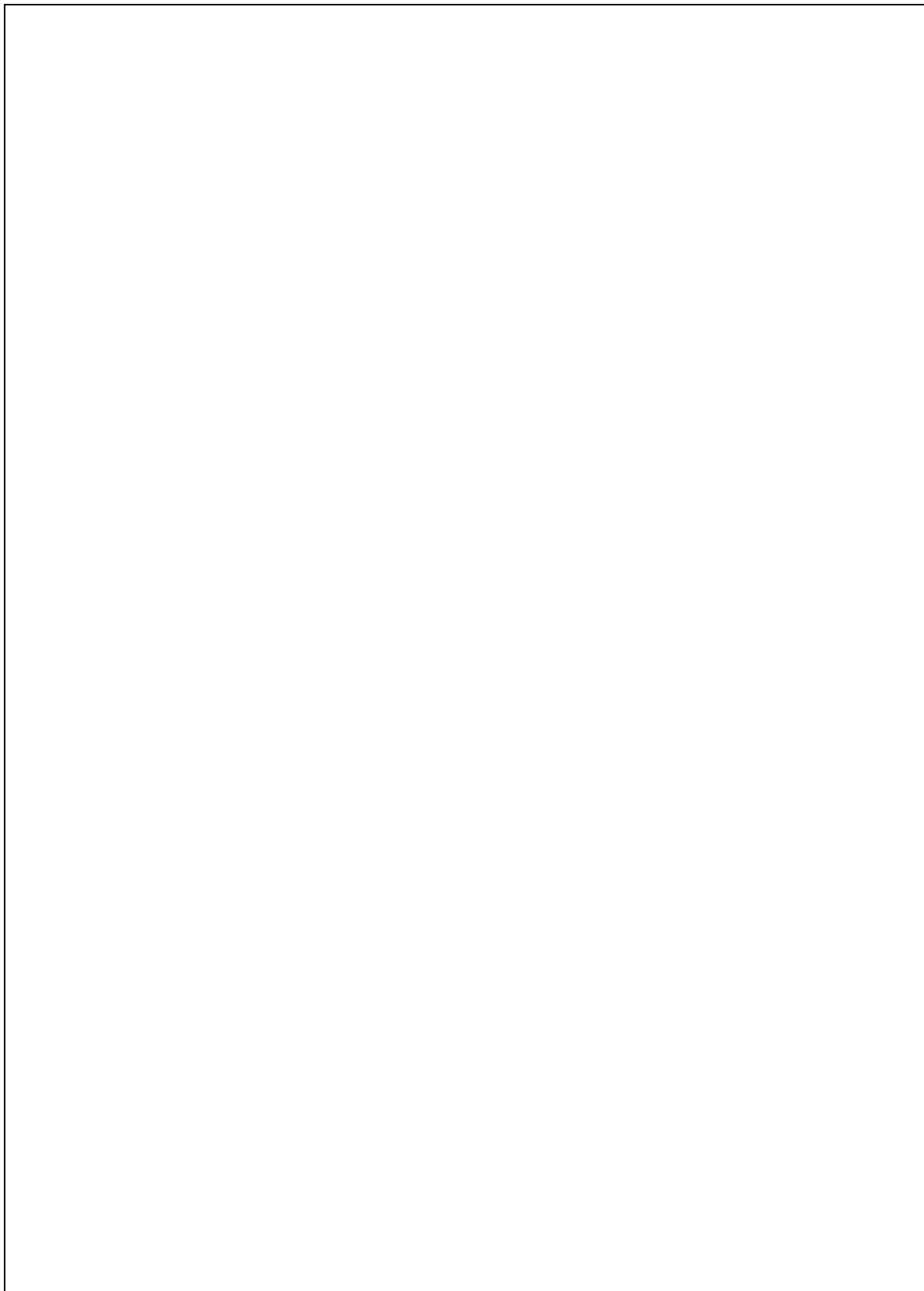
- continuously reads the temperature on Galileo via a temperature sensor.
- displays the temperature on the LCD display.
- maintains the temperature at 30°C by switching the Heater and the Cooler ON or OFF as required.
- displays the status of the Heater and the Cooler on its LCD display, such as the one shown on the right:

```
Temperature:
28°C

Heater: ON
Cooler: OFF
```
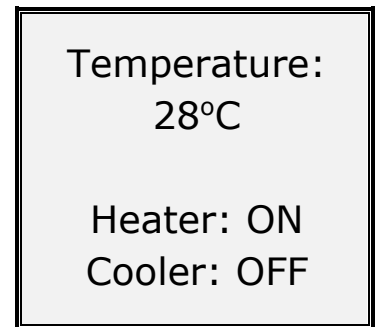
Before writing their code, the students plan their system using the flowchart shown below.
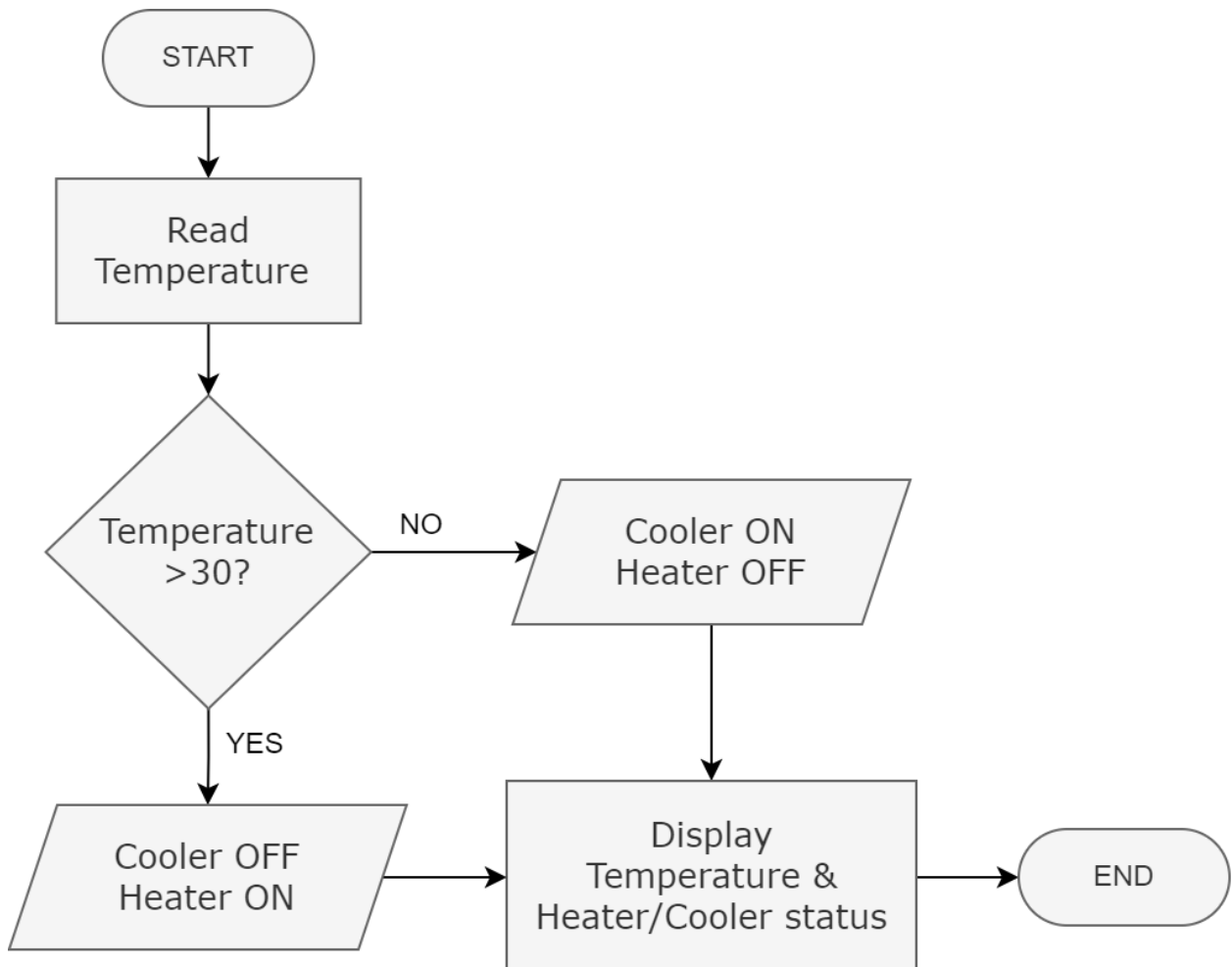
During testing, it was noted that the flowchart has five (5) mistakes. Re-draw the flowchart to fix these issues.

(5)

(Total: 8 marks)

Please turn the page.

10. Linux is an open source Operating System (OS). This means developers can look at, and use the OS source code to make new OSs based on Linux. For example, Android OS is made using Linux. But, MS Windows OS and Apple macOS are not open source. This means regular users can only use the executable files.

a. Define the terms 'source code' and 'executable code'.

Source Code: _____ (1)

Executable Code: _____ (1)

b. What is the main purpose of an OS?

_____

_____(1)

c. An OS offers various basic functions and built-in system utilities.

i. Define 'System Utilities'.

_____(1)

ii. Mention and describe the use of **ONE** system utility.

_____

_____(2)

(Total: 6 marks)

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

**SECONDARY EDUCATION CERTIFICATE LEVEL
2024 MAIN SESSION**

SUBJECT:	**Computing**
PAPER NUMBER:	IIA
DATE:	22nd May 2024
TIME:	4:00 p.m. to 6:05 p.m.

Directions to Candidates

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Question Number	1	2	3	4	5	**FOR MARKERS' USE**
For Markers' use only **MARKS**	Total number of Marks or Grade obtained by candidate					

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1. A digital camera's processor with a 4-Byte word length enables the processing of high-resolution images up to 45 megapixels and 12-bit colour depth. The camera has an internal storage capacity of 256 GB and supports external storage expansion.
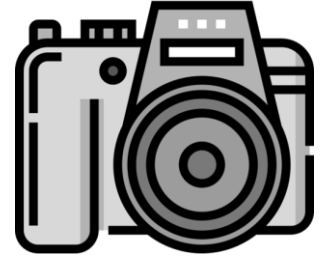
a. What type of internal storage component is commonly used in digital cameras? Explain.

Image taken from: freepik.com

_____

_____(2)

b. Mention the size of the data bus of the above-mentioned digital camera.

_____(1)

c. Mention the effect that the size of the data bus has on system performance.

_____(1)

d. Mention the effect of a wider address bus on the addressable space.

_____

_____(1)

e. Define the term pixel.

_____(1)

f. A less expensive camera can process images up to 20 megapixels with an 8-bit colour depth.

   i.   Mention **ONE** advantage of using a lower-resolution camera.

_____(1)

   ii. Mention **ONE** drawback of using a lower-resolution camera.

_____(1)

   iii. Mention **ONE** implication of a lower colour-depth.

_____

_____(1)

g. The camera runs on a tailor-made Operating System (OS), called MEOS. Is MEOS stored on the camera's external storage? Explain.

_____

_____(2)

h. Is MEOS a multi-user type of OS? Explain.

_____

_____(2)

i. The camera utilises a disk filing system called exFAT. Explain why a disk filing system is necessary.

_____

_____(1)

j. The camera's image sensor captures the light that passes through the lens which is then processed and stored as an image. Provide an example of data and information in relation to the digital camera.

Data: _____ (1)

Information: _____ (1)

(Total: 16 marks)

2. FreshMart®, a local supermarket, plans to introduce a 'Loyalty Scheme' in which for every euro spent, one loyalty point is accumulated. Clients can then exchange points for cash discounts. A Systems Analysis process is usually carried out to develop such systems.
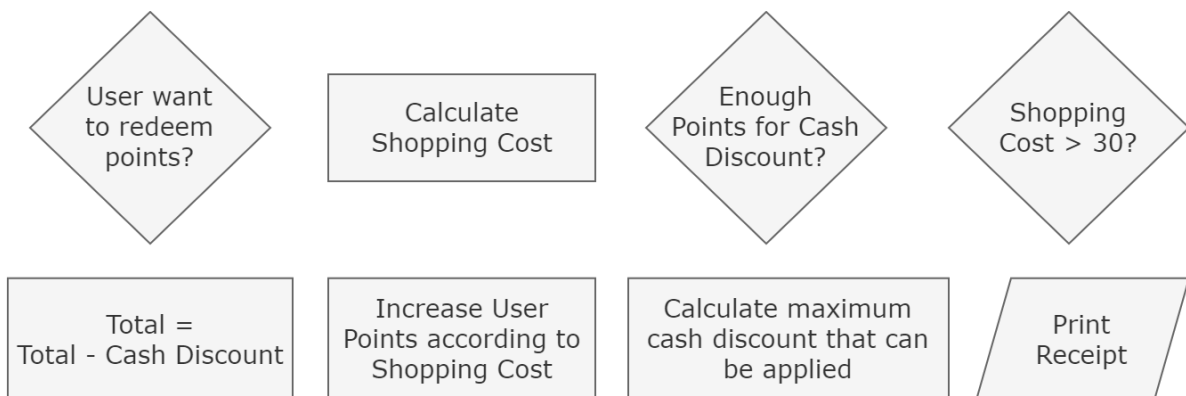
a. One step of the System Analysis is the 'Implementation and Changeover' step. Explain why in this case, the Changeover step will **not** be implemented.
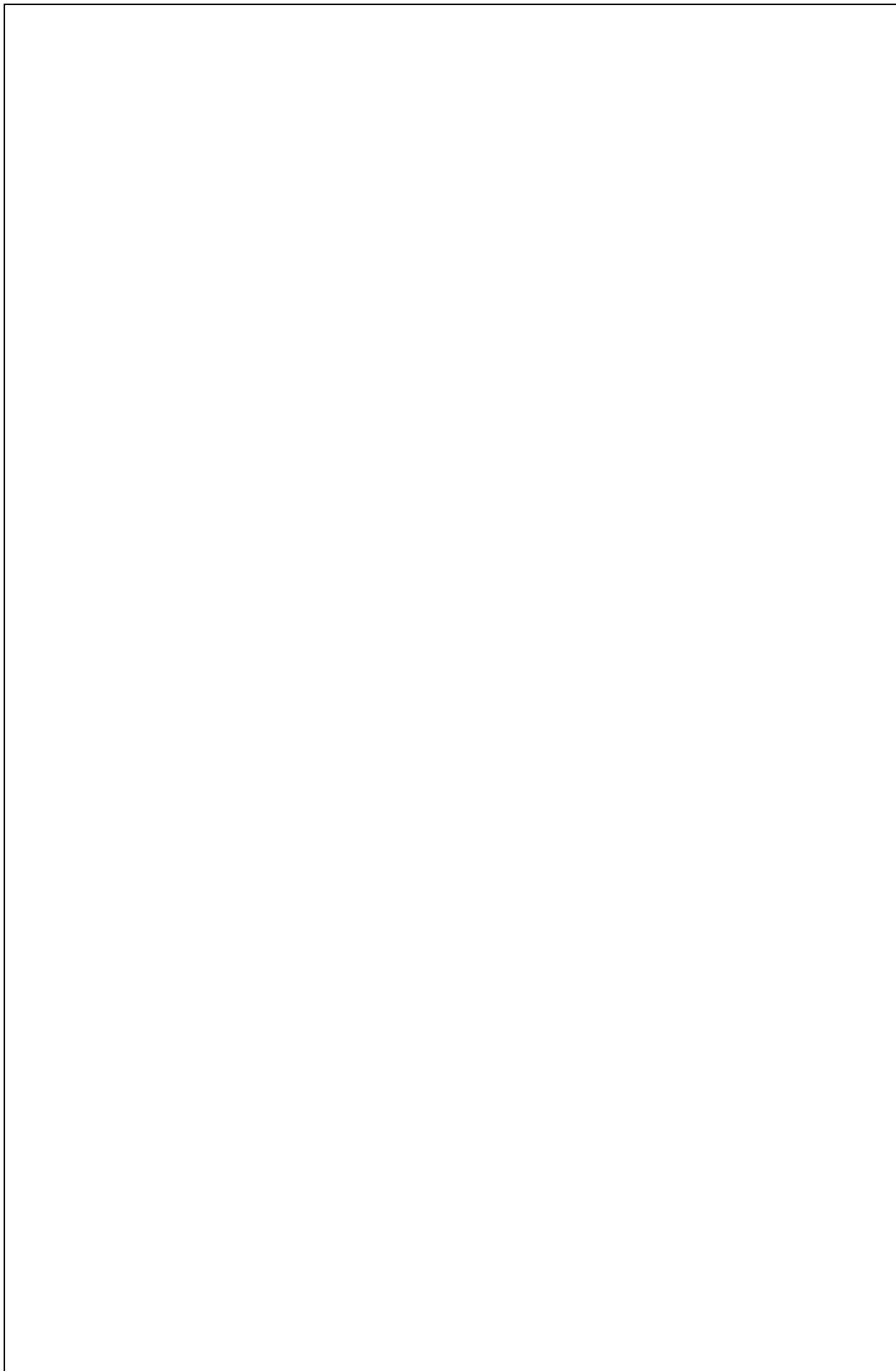
_____

_____(1)

b. The loyalty scheme works as follows:

- For every 10 points, clients can receive a €1 discount.
- Points can only be redeemed for cash discounts for purchases exceeding €30.
- The maximum discount is half the total expense.

Using the symbols provided below, draw a flowchart that represents how the loyalty scheme works.

User want to redeem points?	Calculate Shopping Cost	Enough Points for Cash Discount?	Shopping Cost > 30?
Total = Total - Cash Discount	Increase User Points according to Shopping Cost	Calculate maximum cash discount that can be applied	Print Receipt

This question continues on next page.

(6)

c. If clients' points are stored in variable called `clientPoints`, write the equivalent Java instruction to the flowchart step shown on the right.

Enough Points for Cash Discount?

_____(1)

d. The Java instruction `usedPoints = (int)(shoppingCost/2)*10;` is calculating the maximum points that can be redeemed for cash discount.

   i.   Why is the shoppingCost being divided by 2?

_____(1)

   ii.   What would be the value stored in variable usedPoints if the shopping cost is €84.66?

_____(1)

e. Shortly after the Implementation phase, it was noted that the Loyalty Scheme is not functioning as intended. When a client exchanges points for cash discounts, the discount is given but the client's points are not deducted.

   i.   Mention the System Analysis step in which this error observed.

_____(1)

   ii.   Mention the name of such programming error.

_____(1)

   iii.   Using the variables `clientPoints` and `usedPoints`, write the missing JAVA instruction to fix this error.

_____(1)

   iv.   While addressing this problem, the developers check their documentation. Mention the type of documentation that they should look into.

_____(1)

   v.   Mention **TWO** items you expect to find in this documentation.

_____

_____(2)

   vi.   For certain parts of the code, developers had to dry run the code to find the errors. Define the term 'Dry Run'.

_____(1)

(Total: 17 marks)
Please turn the page.

3. A football electronic substitution board uses large LED digits controlled by a microcontroller. For example, the figure on the right shows that player with number 13 will be substituted by player with number 5.
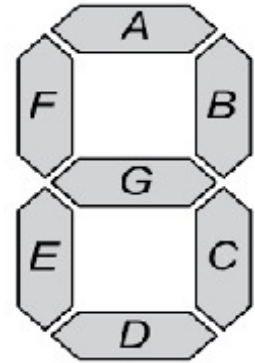

Image taken from: freepik.com

Each digit is formed from a seven-segment LED display labelled A, B, C, D, E, F, G.

a. Is this a general-purpose or a dedicated system? Explain.

_____

_____(2)

b. Explain why this system process data only in binary.

_____

_____(1)

Seven-Segment
LED display

c. The incomplete truth table shown below displays the binary numbers equivalent to the numbers displayed on the seven-segment display. It only includes the numbers from 0 to 7.

Number displayed on the 7-segment display	Binary Equivalent			Segments						
	X	Y	Z	A	B	C	D	E	F	G
0	0	0	0	1	1	1	1	1	1	0
1	0	0	1	0	1	1	0	0	0	0
2	0	1	0							
3	0	1	1	1	1	1	1	0	0	1
4	1	0	0	0	1	1	0	0	1	1
5	1	0	1							
6	1	1	0	0	0	1	1	1	1	1
7	1	1	1	1	1	1	0	0	0	0

Write the missing segment patterns to display digits 2 and 5 in the lines provided below.

Digit 2: _____ (1)

Digit 5: _____ (1)

d. A simplified Boolean expression for segment F is:

$$F = \left(\overline{Y}.\overline{Z}\right) + \left(X.\overline{Z}\right) + \left(X.\overline{Y}\right)$$

Draw the Logic Circuit for segment F.

(6)

e. The electronic substitution board has two buttons that change the displayed number. The UP button shows the next number, and the DOWN button shows the previous number.

This functionality is implemented in JAVA, as shown in the code snippet below.

```
Line 1:    public int updateDigit(int currentDigit) {
Line 2:        String[] digitsBinaryPattern = {
                   "1111110", "0110000", "1101101",
                   "1111001", "0110011", "1011011",
                   "0011111", "1110000", "1111111",
                   "1110011"};
Line 3:
Line 4:        if (upButtonPressed() == true) {
Line 5:            if (currentDigit == 9) {
Line 6:                currentDigit = 0;
Line 7:            } else {
Line 8:                currentDigit++;
Line 9:            }
Line 10:       } else if (downButtonPressed() == true) {
Line 11:           if (currentDigit == 0) {
Line 12:               currentDigit = 9;
Line 13:           } else {
Line 14:               currentDigit--;
Line 15:           }
Line 16:
Line 17:       return digitsBinaryPattern[currentDigit];
Line 18:   }
```

i. Considering that the current displayed number is 9, write the line of JAVA code required to call the method 'updateDigit'.

_____(1)

This question continues on the next page.

    ii.   If the current digit is 9, provide the number that will be shown when the UP button is pressed.

_____(1)

    iii. Describe the use of array `digitsBinaryPattern` in the code above.

_____

_____(1)

    iv. `updateDigit` is declared in line 1 as an integer method. Explain the error in this declaration and suggest the appropriate data type for method `updateDigit`.

_____

_____(2)

(Total: 16 marks)

4. Homes today have "Smart" devices like sensors, air conditioners, and lights, all connected through a central hub. This hub collects data from these devices, storing it in a database that includes three tables as shown below. For example, users can set an automation rule, like activating the air conditioner's "dehumidifier mode" when humidity exceeds 60%.

Device Table		
Field	**Data Type**	**Description**
device_id	Number	Identifier for each device.
device_name	Text	Name of the device.
device_type	Text	Type of the device, such as light, thermostat, door lock, etc.

Sensor Reading Table		
Field	**Data Type**	**Description**
reading_id	AutoNumber	Identifier for each data reading from sensors.
device_num	Number	Referencing to 'device_id' field in the 'Device' table.
timestamp	DATE/TIME	Date and time of the sensor reading.
sensor_data	Float	Data read from the sensors.

Automation Rule Table		
Field	**Data Type**	**Description**
rule_id	AutoNumber	Identifier for each automation rule set by the user.
trigger	Text	Condition that triggers the automation rule, such as temperature above or below a certain threshold.
action	Text	Action performed when the trigger condition is met, such as turning on a light or switching on the water heater.

a. Why is the field 'trigger' in table 'Automation Rule' **not** set as primary key?

_____(1)

b. Suggest the field in table 'Sensor Reading' which should be set as primary key.

_____(1)

c. Tables 'Device' and 'Sensor Reading' are related to one another.

   i.   Which field is used to relate the two tables together?

_____(1)

   ii. What type of relationship exists between these two tables? Explain.

_____

_____(2)

d. Suggest **ONE** query that can be used to extract specific records.

_____

_____(1)

e. Using a smartphone software app users can access the smart devices and the central hub. The app allows users to configure device settings, check database records, establish automation rules, and more. All this information is stored on the manufacturer's server, hence connecting both the smartphone app and the smart devices to it.

   i.   Many of the app's features are free to use, but users need to pay to use some advanced features. Does this app fall under the category of freeware licensing? Explain your answer.

_____

_____(2)

   ii. Mention **ONE** authentication method in which the software app prevents unauthorised users to access the system.

_____(1)

   iii. Communication between the smartphone app, the smart devices, and the server is done in 'serial' mode. How is this data transfer mode different than 'parallel' mode?

_____

_____(1)

   iv. The communication is encrypted. Explain.

_____

_____(1)

----

v. Explain why a Local Area Network (LAN) is **not** used to connect the smart devices with the manufacturer's server?

_____

_____(1)

vi. Suggest the type of network needed.

_____(1)

vii. Name **ONE** advantage and **ONE** drawback of having the system linked to a server.

_____

_____(2)

viii. Suggest how the manufacturer can ensure that the stored data on the server is **not** lost.

_____(1)

f. The 'User Manual' specifies that the system requires a minimum bandwidth of 10 Mbps for real-time automation and control, and 25 Mbps if the system includes high resolution smart cameras.

i. Define 'bandwidth'.

_____

_____(1)

ii. Explain why a higher bandwidth is required for real time control of smart cameras.

_____

_____(1)

(Total: 18 marks)

5. A Check Digit is a validation check used to ensure that numbers entered in a computer system are correct. The check digit in the barcode shown on the right is still unknown.

225469872312x

a. Mention **ONE** other validation check besides the Check Digit and provide an example for its use.

_____

_____(2)

b. The Assembly code snippet below finds the check digit of the above barcode. Analyse it and answer the questions that follow.

```
Line 1:     LDA #2          ; Load value 2 in accumulator AX.
Line 2:     ADD #5          ; Add 5 to the contents of AX.
Line 3:     ADD #6          ; Add 6 to the contents of AX.
Line 4:     ADD #8          ; Add 8 to the contents of AX.
Line 5:     ADD #2          ; Add 2 to the contents of AX.
Line 6:     ADD #1          ; Add 1 to the contents of AX.
Line 7:     MUL #3          ; Multiply the contents of AX by 3.
Line 8:     STA num         ; Store contents of AX in register named num.
Line 9:     LDA #2          ; Load value 2 in AX.
Line 10:    ADD #4          ; Add 4 to the contents of AX.
Line 11:    ADD #9          ; Add 9 to the contents of AX.
Line 12:    ADD #7          ; Add 7 to the contents of AX.
Line 13:    ADD #3          ; Add 3 to the contents of AX.
Line 14:    ADD #2          ; Add 2 to the contents of AX.
Line 15:    ADD num         ; Add value in num to the contents of AX.
Line 16:    MOD #10         ; Divide value in accumulator by 10 and store its
                              remainder.
Line 17:    JZE 0           ; Jump to Line 19 if contents of AX is 0.
Line 18:    SUB #10         ; Subtract the contents of AX from 10.
Line 19:    STA checkDigit  ; Store contents of AX in register named checkDigit.
Line 20:    HLT             ; End of Program.
```

i. Describe the function of the accumulator.

_____(1)

ii. Is the ALU involved in line 8? Explain.

_____

_____(2)

iii. Give **ONE** example of symbolic addressing.

_____(1)

iv. Give **ONE** example of immediate addressing.

_____(1)

---

v. By 'dry running' the above assembly code, find the check digit 'x' of barcode 225469872312x.

Instruction	AX	num	checkDigit
LDA #2			
ADD #5			
ADD #6			
ADD #8			
ADD #2			
ADD #1			
MUL #3			
STA num			
LDA #2			
ADD #4			
ADD #9			
ADD #7			
ADD #3			
ADD #2			
ADD num			
MOD #10			
JZE 0			
SUB #10			
STA checkDigit			
HLT			

(3)

vi. Complete the steps shown below which are involved in obtaining the check digit.

Step 1: Add all the digits in the _____ positions.

Step 2: _____ the answer in STEP 1 by three.

Step 3: Add all the digits in _____ positions.

Step 4: _____ the results of steps 3 and 2.

Step 5: Divide the result in Step 4 by _____ and take the _____.

Step 6: If the remainder is not _____, the Check Digit is the answer when you

subtract the remainder from _____. Otherwise, the Check Digit is 0.   (8)

(Total: 18 marks)

L-Università
ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

**SECONDARY EDUCATION CERTIFICATE LEVEL
2024 MAIN SESSION**

SUBJECT:	**Computing**
PAPER NUMBER:	IIB
DATE:	22nd May 2024
TIME:	4:00 p.m. to 6:05 p.m.

Directions to Candidates

Write your index number were indicated at the top of the page.

Answer **ALL** questions in the spaces provided. You are not allowed to use extra sheets other than those provided in this booklet.

Good English and orderly presentation are important.

The use of flowchart templates is permitted. The use of calculators is **not** permitted.

This paper carries 85 marks of the examination.

Question Number	1	2	3	4	5	**FOR MARKERS' USE**
For Markers' use only **MARKS**	Total number of Marks or Grade obtained by candidate					

1. A digital camera's processor with a 32-bit word length enables the processing of high-resolution images up to 45 megapixels. The camera has a 1.5 GB memory buffer, a 256 GB internal storage capacity, and supports external storage expansion.
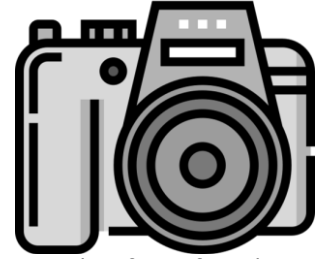
a. Identify which type of internal storage component is commonly used in digital cameras.

Image taken from: freepik.com

Pen Drive	**Hard Disk Drive**	**Flash Memory**	**Floppy Disk**	**DVD**

_____ (1)

b. The camera's memory buffer acts as Random Access Memory (RAM).

   i.   State **TWO** differences between the RAM and the internal storage.

_____

_____(2)

   ii. Explain why a 1.5 GB RAM is enough for a digital camera but **not** appropriate for a gamers' desktop computer.

_____

_____(2)

c. Provide the size of the data bus of the above-mentioned digital camera.

_____(1)

d. Describe the purpose of the data bus.

_____

_____(1)

e. Identify **TWO** other buses that coordinate the movement of data between the camera's internal components. Tick the correct answers.

   ☐ Instruction Bus
   ☐ Program Bus
   ☐ Control Bus
   ☐ Address Bus   (1)

f. Briefly explain the use of the buses chosen in part (e).

_____

_____

_____(2)

g. The camera runs on a tailor-made Operating System (OS), called MEOS. Explain why the camera manufacturer chose to develop a tailor-made OS rather than using an off-the-shelf OS like MS Windows.

_____

_____ (1)

h. The camera's image sensor captures the light that passes through the lens which is then processed and stored as an image. State whether the below are considered as Data or Information.

Image shown on the camera's display: _____ (1)

Light captured by the camera lens: _____ (1)

i. A less expensive camera can process images up to 20 megapixels. State whether the below statements are True or False.

		True or False
i.	High-resolution images have a smaller file size than low-resolution images.	
ii.	Low-resolution images are more suitable for large prints.	
iii.	Low-resolution images are typically processed faster.	
iv.	Low-resolution images have fewer fine details compared to high-resolution images.	
v.	High-resolution images are better suited for online sharing and social media.	

(1)

(1)

(1)

(1)

(1)

(Total: 18 marks)

2. A Check Digit is a validation check used to ensure that numbers entered in a computer system are correct. The check digit (x) in the barcode shown on the right is still unknown.

225469872312x

a. Mention the input device used for scanning barcodes in a Point-of-Sale (POS) system.

_____ (1)

b. Mention **ONE** other validation check besides the Check Digit and provide an example for its use.

_____

_____ (2)

This question continues on next page.

c. Verification and Validation are two different types of data entry checks. Classify the following situations as either Verification or Validation.

		Verification OR Validation	
i.	Compare a user's entered password with the stored password.		(1)
ii.	Ensure that an email address follows a valid format.		(1)
iii.	Review a document to ensure it has no spelling and grammar mistakes.		(1)
iv.	Confirm that all mandatory fields in a form are filled out.		(1)
v.	Ensure that a reasonable date of birth is entered (e.g., not in the future).		(1)

d. Calculate the check digit of barcode 225469872312 by following the validation algorithm steps shown below. Use the working space provided below.

Step 1: Add all the digits in the odd positions, starting from right.

Step 2: Multiply the answer in STEP 1 by three.

Step 3: Add all the digits in even positions, starting from right.

Step 4: Sum the results of steps 2 and 3.

Step 5: Divide the result in Step 4 by 10 and take the remainder.

Step 6: If the remainder is not 0, the Check Digit is the answer when you subtract the remainder from 10. Otherwise, the Check Digit is 0.

Working space

(6)

e. If the answer of Step 4 is stored in a variable named 'result', convert Step 5 into **ONE** Java instruction, storing the remainder in the same variable.

(1)

(Total: 15 marks)

3. FreshMart®, a local supermarket, is offering discounts on groceries based on the total shopping cost. The incomplete flowchart below outlines this process based on the following discount rules:

- If the total shopping cost is more than €50, apply a 10% discount.
- If the total shopping cost is more than €100, apply a 20% discount.
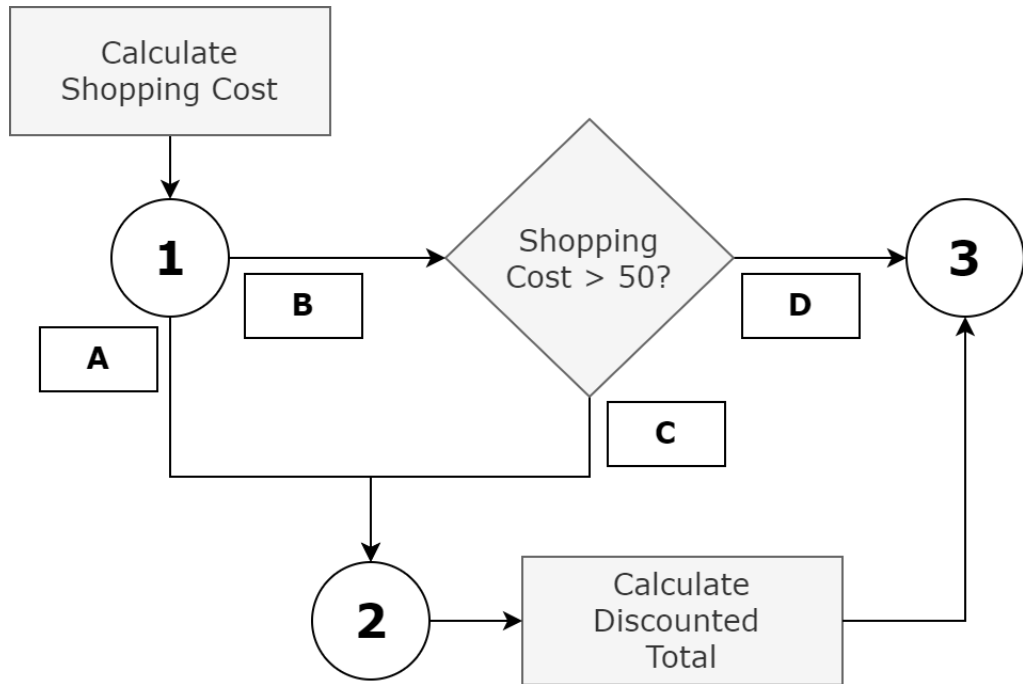
a. Complete the flowchart by filling in the three missing steps (1, 2, 3) and the four missing labels (A, B, C, D). The three missing steps are given below.

1 _____ (1)

2 _____ (1)

3 _____ (1)

A _____ B _____ (1)

C _____ D _____ (1)

This question continues on next page.

b. Analyse the Java code snippet shown below.

```
Line 1:   double discountedTotal = 0;
Line 2:   int discount = 0;
Line 3:
Line 4:   if (total > 100){
Line 5:       // calculate discount (20%) in line 6
Line 6:       _____;
Line 7:       // calculate discountedTotal in line 8
Line 8:       _____;
Line 9:   }
Line 10:
Line 11:  System.out.println("Original Total: " + total);
Line 12:  System.out.println("Discount: " + discount);
Line 13:  System.out.println("Discounted Total: " + discountedTotal);
```

Identify **ONE** line that has:

i. a conditional statement: _____ (1)

ii. a variable initialisation: _____ (1)

iii. an inline comment: _____ (1)

c. Determine whether the following statements are True or False:

i. This code includes three numeric variables: _____ (1)

ii. Line 11 is asking the user for input: _____ (1)

iii. This program is using one loop: _____ (1)

iv. This program displays 'No discount' if the total is less than 100: _____ (1)

d. Complete the JAVA code by filling in line 6 and 8 in the space provided below.

Line 6: _____ (1)

Line 8: _____ (1)

e. Considering a shopping cost of €114.75, the calculated 20% discount would be €22.95. However, value 22 is stored in variable `discount`. Explain why?

_____ (1)

f. Shortly after the Changeover and Implementation phase, it was noted that no discount is given if the shopping cost is €65.

   i. Provide the name of such programming error.

_____(1)

   ii. Provide the System Analysis step in which this error is observed.

_____(1)

   iii. Briefly describe how would the error would be fixed.
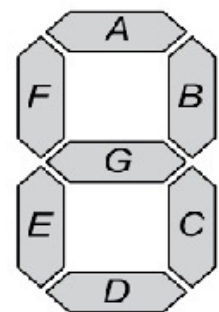
_____

_____(1)

(Total: 18 marks)

4. A football electronic substitution board uses large LED digits controlled by a microcontroller. For example, the figure on the right shows that player with number 13 will be substituted by player with number 5.

   Each digit is formed from a seven-segment LED display labelled A, B, C, D, E, F, G.

Image taken from: freepik.com

Seven Segment
LED display

a. Is this a general-purpose or a dedicated system? Explain.

_____

_____

_____ (2)

b. Explain why this system process data only in binary.

_____

_____(1)

This question continues on next page.

c. The table below shows the different segment patterns used to display numbers 1 and 3. A value of 1 indicates that the segment is switched on, and a value of 0 means the segment is switched off.

Segments							Number displayed
A	B	C	D	E	F	G	
0	1	1	0	0	0	0	1
1	1	1	1	0	0	1	3

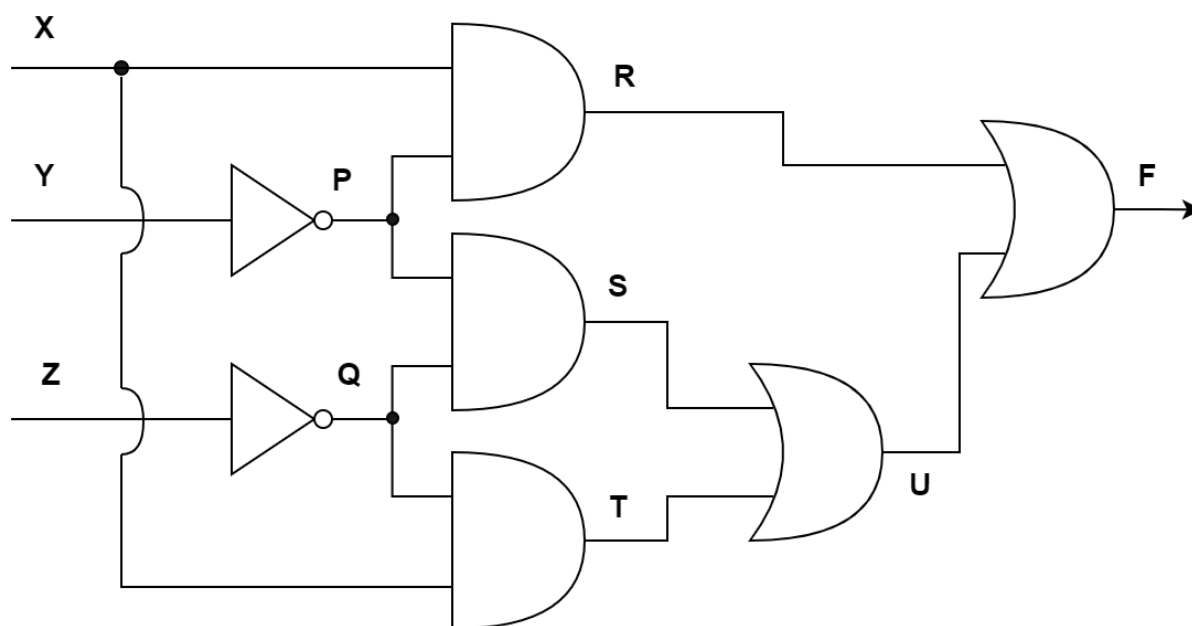i. Write the segment pattern to display digit 5.

_____(1)

ii. Which number will be displayed if all segments are switched on?

_____(1)

iii. What is the result if all segments are 0?

_____(1)

d. Each segment of the display is made up of a logic circuit. For example, segment F has the logic circuit shown below.

DO NOT WRITE ABOVE THIS LINE

----

    i. How many inputs, AND gates, OR gates, and NOT gates are there in this circuit?

Input/s: _____ (1)

AND Gate/s: _____ (1)

OR Gate/s: _____ (1)

NOT Gate/s: _____ (1)

    ii. Complete the truth table representing this circuit?

X	Y	Z	P	Q	R	S	T	U	F
0	0	0	1						
0	0	1	1						
0	1	0	0						
0	1	1	0						
1	0	0	1						
1	0	1	1						
1	1	0	0						
1	1	1	0						

(6)

    iii. The logic circuit given above utilises 3 bits. Is this enough to cater for all the digits that can be displayed on the seven-segment display? Explain.

_____

_____(2)

(Total: 18 marks)

5. Homes today have "Smart" devices like sensors, air conditioners, and lights, all connected through a central hub. This hub collects data from these devices, storing it in a database.

For example, users can set an automation rule, like activating the air conditioner's "dehumidifier mode" when humidity sensor reading exceeds 60%.
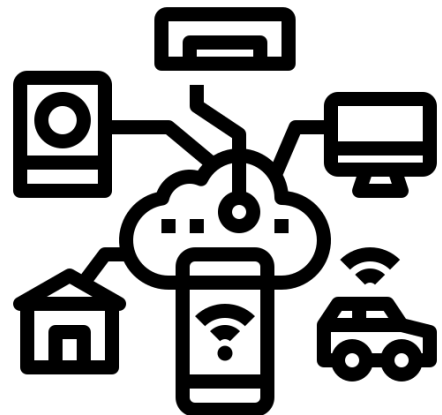
Image taken from: freepik.com

This question continues on next page.

a. The database has three tables as shown below. Fill in the missing data types.

Device Table

Field	Description	Data type
device_id	Identifier for each device.	Text
device_name	Name of the device.	Text
device_type	Type of the device, such as light, sensor, lock, etc.	Text

Sensor Reading Table

Field	Description	Data Type
reading_id	Unique number for each of the sensors' data reading. It is incremented by 1 after every reading.	AutoNumber
device_num	Referencing to 'device_id' field in the 'Device' table.	
timestamp	Date and time of the sensor reading.	
sensor_data	Actual data readings from the sensors.	

(1)

(1)

(1)

Automation Rule Table

Field	Description	Data Type
rule_id	An auto-incremented unique number for each automation rule set by the user.	
type	Condition that triggers the automation rule, such as temperature above or below a certain threshold.	Text
action	Action performed when the trigger condition is met, such as turning on a light or switching on the water heater.	Text

(1)

b. Suggest the field in table 'Sensor Reading' which should be set as primary key.

_____(1)

c. Devices of type 'sensor' can send more than one reading, and every sensor reading pertains to one sensor.

   i. What type of relationship exists between tables 'Device' and 'Sensor Reading'?

_____(1)

ii. Provide the field that relates the 'Device' and the 'Sensor Reading' tables together.

_____(1)

d. Is the 'Automation Rule' table related to another table? Justify your answer.

_____(2)

e. Suggest **ONE** query that can be used to extract specific records.

_____

_____(1)

f. Using a smartphone software app, users can access the central hub from anywhere. The app allows users to configure device settings, check database records, establish automation rules, and more.

  i. Many of the app's features are free to use, but users need to pay to use some advanced features. Tick the correct software license.

  ☐ Shareware license
  ☐ Freeware license
  ☐ Site license   (1)

  ii. Mention **ONE** authentication method that the smartphone software app can use to prevent unauthorised users to access the system.

_____(1)

  iii. Can the user connect with the central hub from the office through a Local Area Network (LAN)? Explain.

_____

_____(2)

g. The 'User Manual' documentation specifies the minimum system requirements needed by the system to function. For example, it states that the system requires a minimum network speed of 10 Mbps for real-time automation and control.

  i. Besides, the 'Minimum System Requirements', mention **ONE** other item you expect to find in the User Manual.

_____(1)

  ii. Mention **ONE** other type of documentation.

_____(1)

(Total: 16 marks)

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