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TOTAL MARKS

INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
NOVEMBER 2024

COMPUTER SCIENCE: PAPER II

EXAMINATION NUMBER

Time: 3 hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 26 pages and an Insert of 2 pages (i–ii). Please check that your question paper is complete.
2. Read the questions carefully and make sure that you answer all parts of all the questions.
3. **Answer on the question paper. Please make sure that you write your examination number in the blocks above and on the Insert, and hand both documents in at the end of the examination.**
4. Show all working where applicable.
5. A non-programmable calculator may be used.
6. It is in your interest to write legibly and to present your work neatly.
7. Two blank pages (pages 25 and 26) are included at the end of the paper. If you run out of space for a question, use these pages. Clearly indicate the question number of your answer should you use this extra space.

FOR MARKER'S USE ONLY

Question	1	2	3	4	5	6	7	8	**Total**
Marks	6	29	28	13	19	17	14	24	**150**
Marked									
Moderated									

SECTION A SHORT QUESTIONS

QUESTION 1 DEFINITIONS

The following definitions, in bold, contain incorrect terms/words. Identify the incorrect term/ words and explain why it is incorrect. Alternatively, provide the correct term/words.

1.1 The **dark web** contains indexed web pages hidden from standard search engines.

Incorrect term:

Explanation:

(2)

1.2 **Ransomware** is malicious software that allows access to a computer system until a sum of money is paid.

Incorrect term:

Explanation:

(2)

1.3 The main purpose of **identity theft** is obtaining a user's financial information to impersonate them on social media.

Incorrect words:

Explanation:

(2)

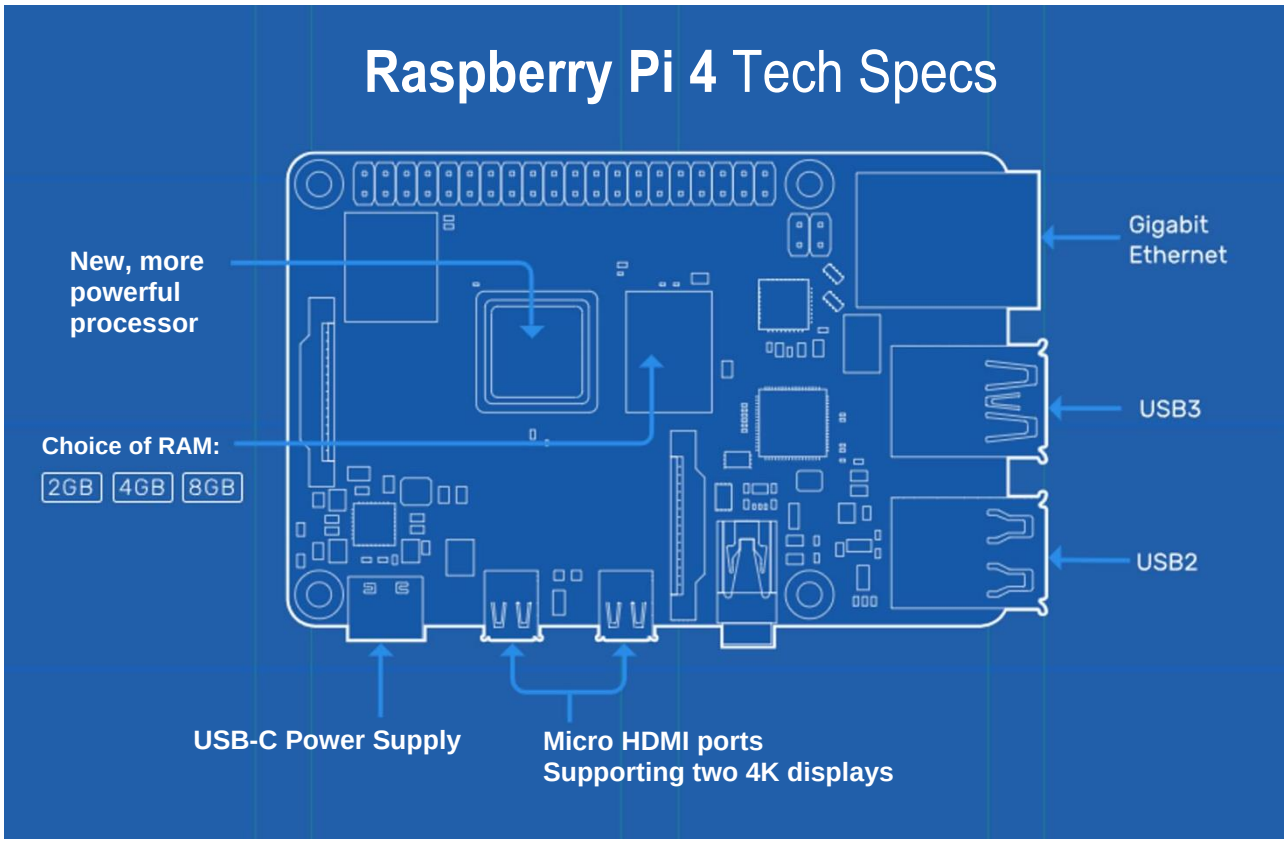
6 marks

SECTION B SYSTEM TECHNOLOGIES

QUESTION 2

SCENARIO

Your school's Geography department is considering making a weather station. They researched using the Internet, and found a site that uses weather sensors and a Raspberry Pi system-on-a-chip device.



[<https://www.raspberrypi.com/products/raspberry-pi-4-model-b/specifications/>]

The Raspberry Pi 4 has the following specifications:

Processor and graphics	Quad-core 64-bit 1.8Hz Built-in GPU to handle all input/output
RAM	2 GB, 4 GB or 8 GB DDR4 SDRAM
Secondary Storage	Micro-SD card slot for program and data storage 8 GB to 32 GB
Connectivity	2.4 GHz and 5.0 GHz 802.11ac wireless Bluetooth 5.0 Gigabit Ethernet
Ports	2 USB 3.0 ports 2 USB 2.0 ports 2 × micro-HDMI® ports Power supply USB-C connector
Operating System	Raspberry Pi OS

2.1 The processor is a quad-core 64-bit processor.

2.1.1 Define *multiprocessing*.

(2)

2.1.2 Define *registers*.

(2)

2.1.3 The processor is NOT hyperthreaded.

(a) Will the processor execute more or fewer instructions – without hyperthreading even though it is a quad-core?

Select the correct answer.

More instructions ☐ Fewer instructions ☐

(1)

(b) Explain your answer.

(2)

2.2 The processor is described as 64-bit.

2.2.1 Describe ONE implication for the processor design.

(1)

2.2.2 Describe ONE implication for motherboard design.

(1)

2.3 The RAM is specified as Synchronised Dynamic Random Access Memory (SDRAM).

2.3.1 Name the physical characteristic of DRAM that makes it slower than Static Random Access Memory (SRAM).

(1)

2.3.2 Define *latency*.

(2)

2.3.3 Explain how synchronising DRAM will improve memory latency.

(2)

2.4 The Raspberry Pi processor has level 1, 2 and 3 cache.

2.4.1 Define *processor cache*.

(2)

2.4.2 Give TWO reasons why level 1 processor cache is faster than DRAM.

Reason 1:

Reason 2:

(2)

2.5 The Raspberry Pi has 7 ports. These ports will be connected to devices since the sensors are connected to pins on the motherboard. Name ONE device that will be connected to each of the ports:

Port	Device
USB 3.0 port	
USB 2.0 port	
Micro-HDMI port	

(3)

2.6 The Raspberry Pi uses the Raspberry Pi operating system adapted from Linux and optimised for Raspberry Pi hardware.

2.6.1 Where will the operating system be stored?

(1)

2.6.2 Give TWO advantages of using Linux as an operating system.

Advantage 1:

Advantage 2:

(2)

2.7 The Raspberry Pi is intended to execute a weather station program to generate a large volume of daily data.

There is not enough storage space on the Raspberry Pi to store this large volume of data.

Suggest TWO possible solutions for storing large volumes of data given the Raspberry Pi's specifications.

Solution 1:

Solution 2:

(2)

2.8 The weather station software is coded in Python. Python is described as an interpreted, object-orientated high-level language. Define each of the following terms:

2.8.1 *Interpreted*

(1)

2.8.2 *Object-oriented*

(1)

2.8.3 *High-level language*

(1)

29 marks

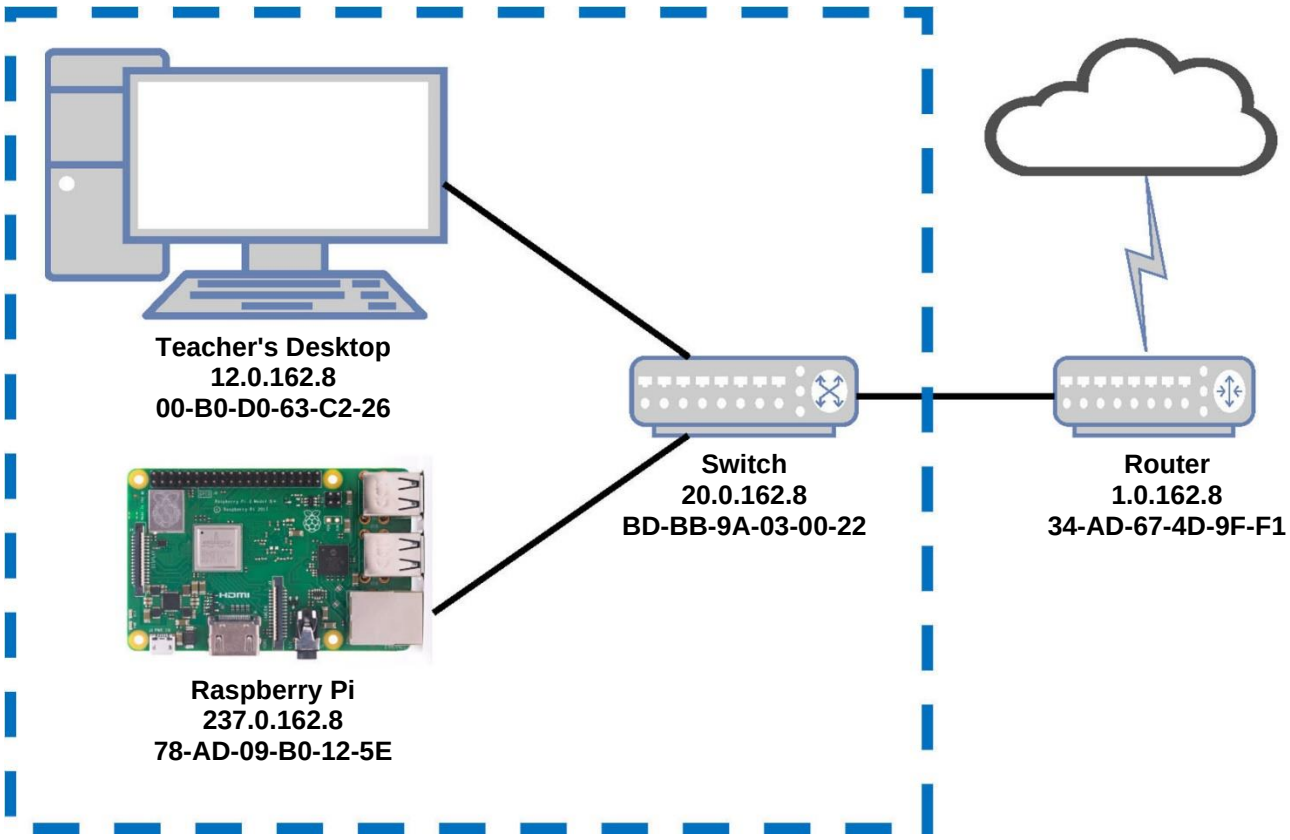
SECTION C NETWORKING

QUESTION 3

The weather station will be placed in the Geography teacher's classroom (indicated by the blue dashed line) shown in the following network diagram.

- The Raspberry Pi is connected to the classroom switch using a UTP cable.
- The teacher's laptop is connected to the switch with a UTP cable.
- The switch is connected to the school's router with a UTP cable.
- The school router is connected to the Internet.

The router is outside the classroom.



3.1 The Raspberry Pi is connected to the switch using a copper UTP cable.

3.1.1 Give THREE disadvantages of using UTP copper cables to connect devices in a LAN network.

Disadvantage 1: _____

_____

Disadvantage 2: _____

_____

Disadvantage 3: _____

_____

(3)

3.1.2 Name the LAN network topology in the Geography classroom.

(1)

3.1.3 Give TWO reasons why connecting the Raspberry Pi to the switch using a cable connection is better than using a Wi-Fi or wireless connection.

Reason 1:

Reason 2:

(2)

3.2 When the Raspberry Pi is connected to the network, it is automatically assigned an IP address.

3.2.1 Explain why the IPv4 address 234.0.1.400 is incorrect.

(2)

3.2.2 Complete the following table showing the relationship between IP addresses and MAC addresses with related devices.

Address Type	Circle Packet OR Frame	Name an associated Network Device
IP Address	Packet / Frame	
MAC Address	Packet / Frame	

(4)

3.3 The IP address of the Raspberry Pi changes each time it is connected to the LAN network.

3.3.1 If the IP address changes daily, name the protocol responsible for assigning an IP address to the Raspberry Pi.

_____

(1)

3.3.2 Name the protocol responsible for relating the current IP address to the Raspberry Pi's MAC address.

_____

(1)

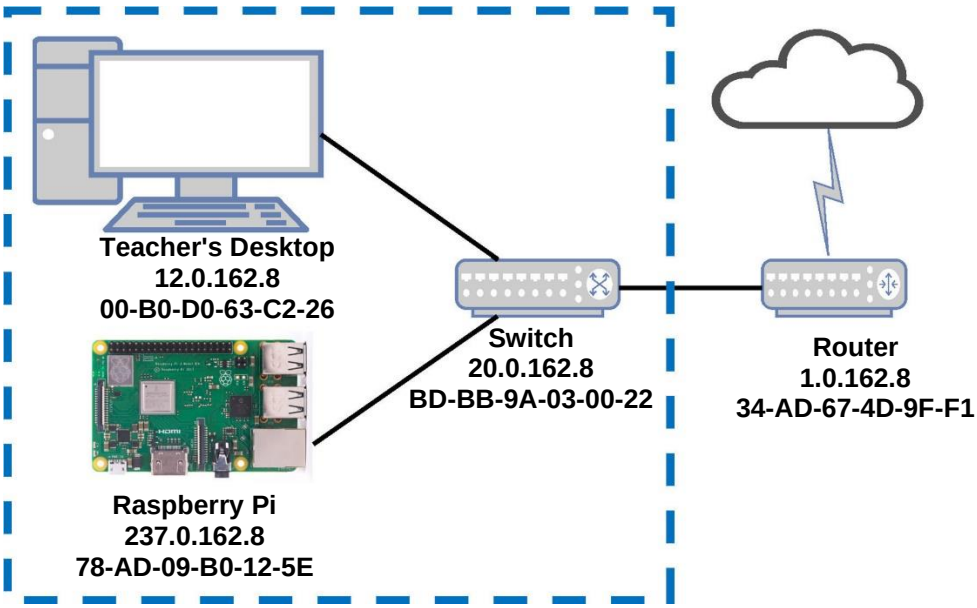
3.4 The school wants to show the current temperature and humidity on the home page of their remotely hosted website. The school's URL is www.someSchool.com, and the IP address of the website is 12.45.67.129.

3.4.1 Name the protocol that will map the website's URL to the website's IP address.

_____

(1)

3.4.2 The Raspberry Pi sends the current temperature and humidity to the website in a frame. List the FOUR addresses in the correct order that will be placed in the frame and packet header.



Address 1: _____

Address 2: _____

Address 3: _____

Address 4: _____

(4)

3.5 The remotely hosted website has a digital certificate to ensure encrypted data is sent over the Internet.

3.5.1 Explain how public and private keys are used in asymmetric encryption.

(4)

3.5.2 Describe THREE features of digital certificates that ensure a website is secure.

Feature 1:

Feature 2:

Feature 3:

(3)

3.5.3 Briefly explain how onion routing uses repeated asymmetric encryption to transfer Internet data.

(2)

28 marks

SECTION D SOCIAL IMPLICATIONS

QUESTION 4

Read the following adapted article entitled 'Wyze customers view strangers' camera feeds after glitch' by Ryan Daws | 20th February 2024.

Wyze, known for affordable home security cameras, faced a glitch on Friday, granting thousands access to others' camera images/videos. Wyze clients can normally view their home cameras in a web browser. The camera streaming service was disrupted on Friday, and when initially restored, 13 000 users received incorrect thumbnails/clips of their home cameras.

Around 1 500 users could view strangers' live camera feeds due to a server caching error during the mass camera reconnection. The server managed the relationship between the Camera Device ID and the User IDs. When the camera streaming service was restarted, the Camera Device IDs and User IDs were mixed up, causing cameras to be linked to incorrect user accounts.

This incident follows a similar breach in September 2022 affecting up to 2 300 users. Despite Wyze's efforts to prevent such occurrences, customer frustration grows, raising questions about security practices and past vulnerabilities. Investigations continue as concerns persist regarding unauthorized access to personal camera footage.

4.1 The ability to view a remote camera's live feed is made possible by a technology called the Internet of Things (IoT).

4.1.1 Define the *Internet of Things* (IoT).

_____

_____

_____

_____

(2)

4.1.2 Name the TCP/IP protocol that transfers high-speed video data.

_____

(1)

4.2 The video data is encrypted when it is sent to the user. The video data is decrypted when the users view their camera's video feed.

When users were temporarily connected to the incorrect cameras, would they be able to view another user's live stream video?

4.2.1 Select the correct answer:

Yes ☐ No ☐

(1)

4.2.2 Give ONE reason for your answer.

_____

_____

_____

_____

(1)

4.3 The Wyze website uses server-side scripting.

Define *server-side scripting*.

_____

_____

_____

_____

(2)

4.4 Explain ONE possible negative effect for a user whose private home camera's video stream was viewed by another unknown user.

_____

_____

_____

_____

_____

(2)

4.5 The article mentions a second similar data breach. Wyze needs to ensure its data is protected.

Name and explain TWO security measures to protect Wyze client's data from **any type** of data/video breaches.

	Security Measure	**How will this measure protect Wyze clients?**
1		
2		

(4)

13 marks

SECTION E DATA AND INFORMATION MANAGEMENT AND SOLUTION DEVELOPMENT

QUESTION 5

The Camera Device IDs and User IDs from Question 4 are stored in a database table shown in Appendix A in the Insert. Each user can have one or more cameras in their home. A user may choose which cameras can be viewed on the remote Wyze website. A user is charged R100 per month for each camera with remote access.

When Wyze installed the cameras at a user's home, they were automatically named **Cam1**, **Cam2**, **Cam3**, etc.

5.1 5.1.1 Define *duplicate data*.

_____

_____

_____

(1)

5.1.2 Name ONE field that has duplicated data values.

_____

(1)

5.2 5.2.1 Define *data redundancy*.

_____

_____

_____

(1)

5.2.2 Name ONE field that has redundant data values.

_____

(1)

5.3 The table will be normalised using the composite primary key of **UserID** and **DeviceID**. There is a transitive dependency between two other fields.

5.3.1 Define *transitive dependency*.

(2)

5.3.2 Name the two fields that are transitively dependant.

(2)

5.4 Normalise the table to third normal form (3NF). Write the solution as a set of relations and underline the primary keys.

(11)
[19]

QUESTION 6

The school is looking at a lightning alarm system that will sound a long alarm when there is a lightning strike within 15 km of the school. A short all-clear alarm will sound if no lightning strikes occur within 15 km for 30 minutes.

The IT teacher wants to design a **Lightning** class with fields to store the distance and the current time of a lightning strike. The **Lightning** class must also have a field to store the time of the first strike that sounded the alarm.

Create a class diagram for the **Lightning** class with the following **private** fields:

- **distance:** integer – stores the distance of a lightning strike to the school.
- **time:** Time – stores the time of the current lightning strike.
- **firstStrikeTime:** Time – the time of the first strike to sound the long alarm. This field will belong to the **Lightning** class and will record the time when the long lightning alarm is sounded. This field will be changed for the next lightning strike after the short all-clear has been sounded.

The **Lightning** class will have the following methods:

- a default constructor method with two parameters: **inDist** (integer) to assign a value to the **distance** field and **inTime** (Time) to assign a value to the **time** field.
- an overloaded constructor method for the first lightning strike. It will accept a parameter **inDist** (integer) to assign a value to the **distance** field.
- an accessor method for the **firstStrikeTime** field.
- a method called **timeDiff** to return the difference between the **firstStrikeTime** and **time** fields as an integer.
- a **toString()** method to return all the **Lightning** fields as a string object.

6.1 Complete the following **Lightning** class diagram.

Lightning
Fields:
Methods:

(11)

6.2 Write an algorithm for the second overloaded constructor method of the first lightning strike. It will accept a parameter **inDist** (integer) to assign a value to the **distance** field and assign the current time to the **firstStrikeTime** field.

(4)

6.3 Explain why the constructor method is overloaded.

(2)
[17]

QUESTION 7

A programmer has designed the following algorithm to determine when to sound the long lightning strike and short all-clear alarms.

Use the data provided in Appendix B on page ii of the Insert.

```
1       input distance
2       input time
3       if distance <= 15
        begin
4               longAlarm ← true
5               shortAlarm ← false
6               firstStrikeTime ←time
        end if
7       timeDiff ← 0
8       while distance <= 15 OR timeDiff <= 30
        begin
9               input distance
10              input time
11              timeDiff ← difference in minutes between time and firstStrikeTime
12              if distance <= 15 OR longAlarm = true
                begin
13                      if timeDiff <= 30
                        then
14                              firstStrikeTime ←time
                        end if
                end if
        end while
15      if distance > 15 AND timeDiff > 30
        then
16              longAlarm ←false
17              shortAlarm ← true
        end if
```

7.1 Complete the trace table in Appendix B on page ii of the Insert. (11)

7.2 Should the while loop be replaced with a do-while (repeat-until) loop in the algorithm?

7.2.1 Select the correct answer.

Yes ☐ No ☐

(1)

7.2.2 Explain your answer.

(2)
[14]

50 marks

SECTION F DATA REPRESENTATION, LOGIC GATES AND BOOLEAN ALGEBRA

QUESTION 8

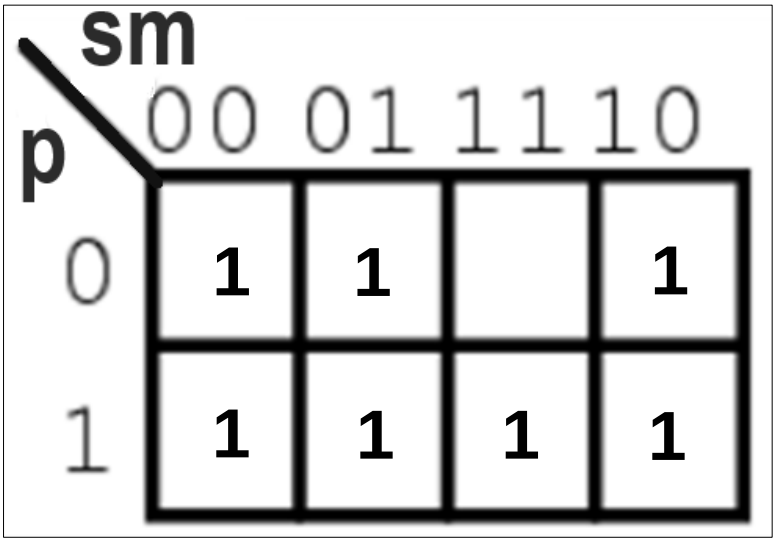
8.1 Using Boolean algebra, simplify the Boolean expression m' + s' to one term.

F(m,s) = m' + s'
=

(3)

8.2 8.2.1 Simplify the following Boolean expression placed on the **Karnaugh** map.

F(p,s,m) = p's'm' + ps'm' + p's'm + ps'm + psm + p'sm' + psm'



F(p,s,m) =

(6)

8.2.2 Simplify the same Boolean expression using Boolean algebra:

F(p,s,m) = p's'm' + ps'm' + p's'm + ps'm +psm + p'sm' + psm'

=

(8)

8.3 Draw a circuit diagram of the expression **(a + b)' + ac' + b'** using the most appropriate logic gates.

Your circuit diagram must demonstrate the correct use of OR, NOR, AND, NAND and NOT gates.

(7)

24 marks

Total: 150 marks

ADDITIONAL SPACE (ALL QUESTIONS)

REMEMBER TO CLEARLY INDICATE THE QUESTION NUMBER IN THE ADDITIONAL SPACE TO ENSURE ALL ANSWERS ARE MARKED.