Please paste the barcoded label here	TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2023

INFORMATION TECHNOLOGY: PAPER II

EXAMINATION NUMBER

Time: 3 hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 32 pages. 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 ALL the questions on the question paper and hand this in at the end of the examination. Remember to write your examination number in the space provided.**
4. Show all working where applicable.
5. A non-programmable calculator may be used.
6. It is in your own interest to write legibly and to present your work neatly.
7. One blank page (page 32) is included at the end of the paper. If you run out of space for a question, use this page. Clearly indicate the 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	10	10	25	10	30	15	20	30	**150**
Marked									
Moderated									
Re-Mark									

SECTION A SHORT QUESTIONS

QUESTION 1 DEFINITIONS

Give the most appropriate term for each of the following expressions:

1.1 A program which converts source code into machine code, line by line.

_____

(1)

1.2 The part of the machine cycle which translates the instruction into CPU commands.

_____

(1)

1.3 A form of network transmission where packets are transmitted to all nodes on the network rather than a specific device.

_____

(1)

1.4 A memory management technique where secondary storage can be used as if it were main memory.

_____

(1)

1.5 Reorganising the data stored on an HDD into contiguous blocks.

_____

(1)

1.6 The portion of a packet which contains the data being transmitted.

_____

(1)

1.7 An older communications technology which simultaneously transmits voice and data over public telephone networks using copper cable.

_____

(1)

1.8 Software which protects a computer against malicious programs.

_____

(1)

1.9 A secure data transmission protocol for viewing Internet pages with a web browser.

_____

(1)

1.10 Software which redirects traffic through a network of servers to avoid being traced and which uses layered encryption for protection.

_____

(1)

10 marks

SECTION B SYSTEM TECHNOLOGIES

QUESTION 2 THEORY

For each of the terms in Column A below, you should select the **most correct** definition in Column C, matching the letter to the question number. You should merely write down the appropriate letter in Column B. An example is shown as Question 2.0, using 'W' as the correct answer.

Column A	Column B	Column C
2.0	W	
2.1 SSD		A A motherboard path which connects the CPU and main memory
2.2 Register		B A computer interface used to connect storage devices
2.3 CMOS		C A portion of the CPU used to store the current instruction
2.4 IO Range		D A semiconductor chip which stores instructions to load the basic computer hardware on start-up
2.5 Virtual memory		E A software license which allows free use of software
2.6 Compiler		F A list of the available IRQs a device can use
2.7 BIOS		G A form of cloud storage
2.8 Freemium		H Converting and executing source code line by line
2.9 SATA		I A semiconductor chip which stores computer configuration data
2.10 FSB		J An interface which allows hot swappable devices to connect with the motherboard
		K Software used to convert source code into object code
		L A storage device which has no mechanical parts
		M A technology which allows segments of memory to be stored in pages on a hard drive
		N A buffer used to speed up a slow input-output device
		O A software license which allows free use of restricted features of software
		P The temporary storage of hard drive data in RAM to increase secondary storage access speed

[10]

SCENARIO

Consider the following scenario when answering the rest of the examination paper unless otherwise stated or the questions are of a general nature.

Fairly Fit is a fitness centre being established in a local shopping mall. They offer customers gym facilities such as a weights room, swimming pool and sauna, and a health food café.

QUESTION 3 APPLICATION

The business owners will need various computer hardware items for the fitness centre. To reduce start-up costs, they have purchased a second-hand server with the following specifications:

- Intel Xeon CPU 8 cores 3.3 Ghz
- 2 CPU slots (1 filled)
- 20 MB L3 cache
- DDR3 RAM
- 8 RAM slots
- 3 x 2 TB HDD
- Supported RAM chips: 2 GB, 4 GB, 8 GB, 16 GB and 32 GB
- 4 × USB 3 slots
- Intel onboard graphics card

3.1 Give an example of ONE device which will connect to a server via USB.

_____

(1)

3.2 The specification doesn't state how much RAM there is on the motherboard.

What is the maximum amount of RAM which can be **installed** using:

RAM chip capacity	**Total amount of RAM**
2 GB	
32 GB	

(2)

3.3 An operating system is critical to the operation of any computer.

3.3.1 What are the THREE basic functions of any operating system?

Function 1:	
Function 2:	
Function 3:	

(3)

3.3.2 The server does not include an operating system. Complete the following table to suggest an operating system suitable for the server in this scenario. You need to:

- name ONE operating system,
- give ONE reason to justify your choice, and
- name the license model used for the operating system.

Name of operating system	Justification for choice	License model used

(3)

3.4 Users often wish to improve the performance of computers.

3.4.1 The specifications state two CPU slots, although only one is currently used. If a second processor is added, would this be considered a co-processor? Justify your answer with ONE reason

YES ☐ NO ☐

Justification:

_____

_____

(2)

3.4.2 Multitasking and multithreading are two commonly used techniques to improve performance. Define each of these concepts and give ONE example of how each can improve performance.

Multitasking

Definition:	
Example:	

(2)

Multithreading

Definition:	
Example:	

(2)

3.4.3 The processor has 20 MB of Level 3 cache.

(a) What type of RAM is used in processor caches?

_____

(1)

(b) Will it be possible to increase the size of the L3 cache to improve the performance of the CPU further? Justify your answer with ONE reason.

YES ☐ NO ☐

Justification:

_____

_____

(2)

(c) Caches can either be 'shared' or 'unshared'. Shared means that each core of the processor makes use of the same cache memory. Explain why Level 1 cache is more likely to be unshared compared to Level 3, which is often shared.

_____

_____

_____

_____

(1)

3.4.4 The server has an onboard graphics card.

(a) TRUE or FALSE: An onboard graphics card makes use of system RAM. Support your answer with ONE reason.

TRUE ☐ FALSE ☐

Reason:	

(2)

(b) Regarding the current scenario, would you recommend that the owners use an additional graphics card in the server? Justify your answer with ONE reason.

YES ☐ NO ☐

Justification:

_____

_____

(2)

(c) Name TWO components that will be present on a dedicated graphics card that improves a computer's overall performance.

Component 1:	
Component 2:	

(2)
[25]

35 marks

SECTION C INTERNET AND COMMUNICATION TECHNOLOGIES

QUESTION 4 THEORY

For questions 4.1 to 4.5, you need to select **the most correct answer** from the options A–D. An answer grid is at the bottom of this page for your answers. You merely need to write down the appropriate letter for your answer.

4.1 DHCP …

A is a protocol used to setup transmission security.
B is a protocol used to allocate IP addresses to devices.
C is a protocol to allow data transfer on mobile networks.
D is a protocol used to link URLs and IP addresses. (1)

4.2 Thin clients …

A are only used on cabled networks.
B are used to reduce server processing requirements.
C are devices with minimal processing ability.
D are commonly used in most school networks. (1)

4.3 MAC addresses …

A uniquely identify network cards.
B uniquely identify nodes on a network.
C uniquely identify switch ports.
D None of the above. (1)

4.4 Ethernet …

A is a commonly used LAN protocol.
B uses ARP (Address Resolution Protocol) to identify devices.
C allows for different transmission speeds on the same network.
D All of the above. (1)

4.5 Video on demand …

A can only be offered on a cabled network.
B eliminates the constraint of static broadcast schedules.
C always uses the UDP protocol for transmission.
D is usually offered as a free service. (1)

Question	4.1	4.2	4.3	4.4	4.5
Answer					

4.6 Two techniques to compress data are lossy and lossless compression.

4.6.1 For each of the characteristics listed below, you must indicate whether each applies to lossy or lossless compression. You need to tick the appropriate box.

Letter	Characteristic	Lossy	Lossless
A	Removes as much data as possible from the original file		
B	Doesn't allow for significant storage savings		
C	Data quality, especially for video images, is compromised		

(3)

4.6.2 For TWO of the three characteristics above, explain why you chose lossy or lossless compression. Name the characteristic and then write your explanation.

Characteristic 1	Explanation
Circle the characteristic letter A / B / C	

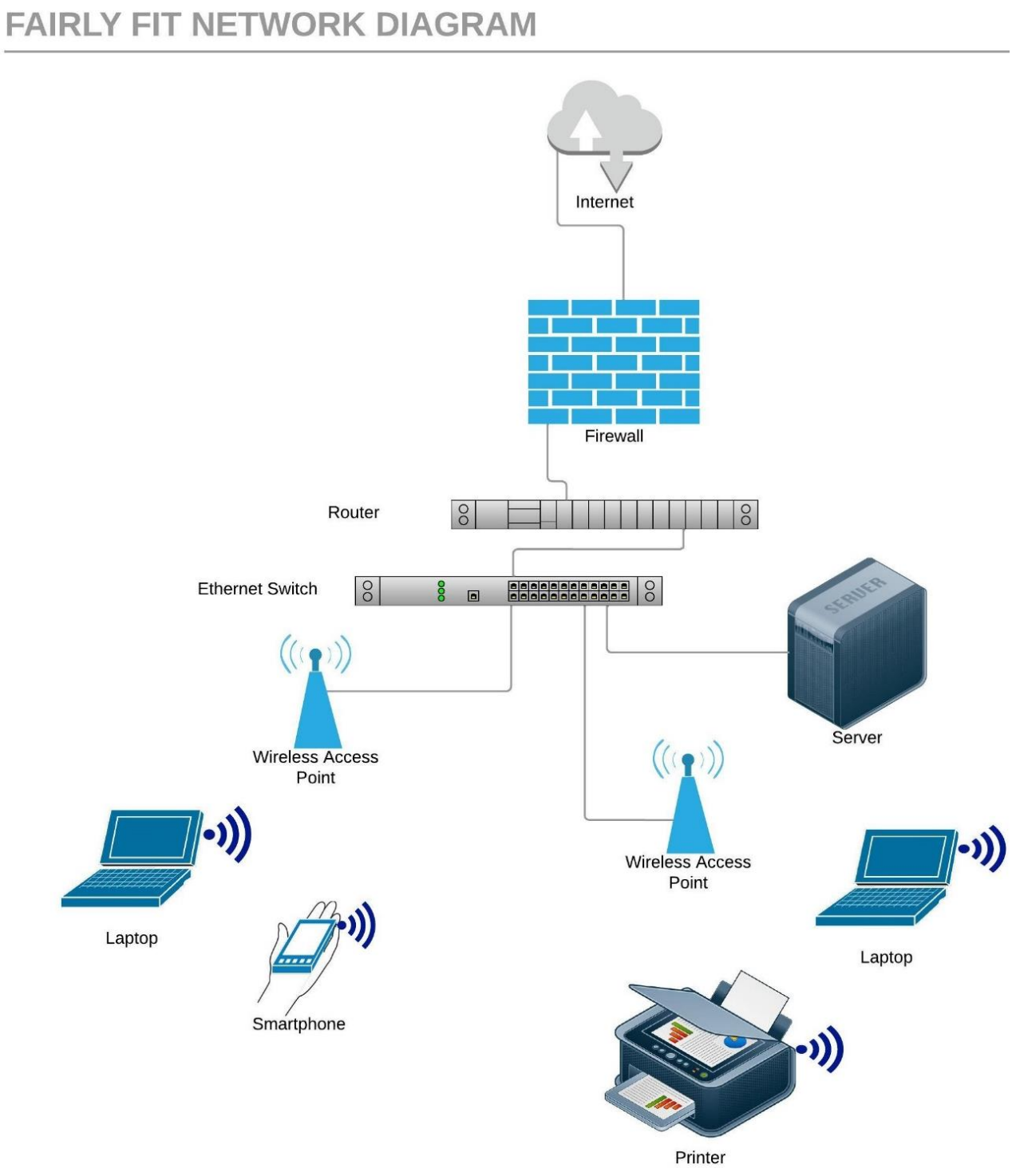
Characteristic 2	Explanation
Circle the characteristic letter A / B / C	

(2)
[10]

QUESTION 5 APPLICATION

Fairly Fit need some advice regarding the network which they are installing. The network will need to connect laptops and mobile devices used by the gym, the café, and customers. The business will also have a website allowing customers to purchase gym contracts, gym clothing and order food from the café.

5.1 **Fairly Fit** have been given the following network design:



The only cabled connections will be to the server and the wireless access points. All other devices will connect via a wireless connection. In the diagram, two wireless access points are shown – there will be significantly more than this in the installation.

5.1.1 What is the function of a wireless access point?

(2)

5.1.2 State ONE advantage and ONE disadvantage for laptops and mobile devices using **only** wireless connections. Your answers may not be the opposite of each other.

Advantage:	
Disadvantage:	

(2)

5.1.3 Which topology does the network design use? Justify your answer with ONE reason that highlights this network topology's characteristic.

Topology name:	
Reason:	

(3)

5.2 It is important that all the wireless traffic is encrypted.

5.2.1 What is meant by the term 'encrypted' when referring to network traffic?

(2)

5.2.2 The wireless access points used by **Fairly Fit** offer 256-bit encryption. 256 bit refers to the length of the key used to encrypt the data stream.

(a) How many different combinations would a potential hacker need to try to break an encrypted message? Write your answer as a power/ exponent.

_____

(1)

(b) The encryption technique used by the wireless access points is **symmetric** encryption. Name and describe ONE feature of symmetric encryption which is a weakness of the encryption technique.

Name: _____

Describe: _____

_____

_____

(2)

(c) There is an encryption technique which overcomes the weakness of symmetric encryption. What is this technique, and how does it improve the encryption process?

Technique:	
Improvement:	

(2)

(d) List ONE disadvantage of the technique you explained in (c) above.

_____

_____

(1)

5.3 The network diagram shows a device called a Firewall.

5.3.1 What is the purpose of a firewall in a network?

(2)

5.3.2 The owners of **Fairly Fit** have asked why it is necessary to have a firewall on their network. State and explain TWO reasons why their network should have a firewall, given that the network will be used by employees, gym users and café customers.

Reason 1:	
Reason 2:	

(4)

5.4 Customers have requested more interaction opportunities with the website, allowing food to be ordered from the café.

5.4.1 Explain why the website will make use of Web 2.0 principles.

(1)

5.4.2 List TWO types of information which customers could post to the website after ordering food from the café.

Type 1:	
Type 2:	

(2)

5.4.3 Customers could also use social media to communicate their experiences with **Fairly Fit**. Name TWO social media platforms which **Fairly Fit** could use for this purpose.

Platform 1:	
Platform 2:	

(2)

5.4.4 Add-on features on a website are often made possible by using scripting.

(a) Distinguish between server-side and client-side scripting.

Server-side:	
Client-side:	

(2)

(b) List TWO website features which make use of client-side scripting that will be useful to users when ordering food from the café

Feature 1:	
Feature 2:	

(2)
[30]

40 marks

SECTION D SOCIAL IMPLICATIONS

QUESTION 6

Read the following text about security concerns over the app 'TikTok'. This text has been paraphrased from the cited sources. You should then answer the questions that follow.

Universities in at least 10 US states have taken steps to ban the use of the popular app TikTok on campus Wi-Fi networks. The ban affects both staff and students.

Several US states and the federal government have also banned TikTok from government-owned devices due to concerns about the app's data collection and the Chinese company that owns it. Similar bans have been put in place in India and at the European Commission due to security concerns.

The app collects a large amount of user data, which could potentially offer sensitive information to the Chinese government. The head of the FBI has also expressed concerns about the app's data collection and its potential to spread Chinese state influence operations.

ByteDance, the company that owns TikTok, has not been transparent about how data flows between its US and China operations, raising concerns about its practices. Last month, a major US magazine reported that TikTok's parent company tracked journalists' IP addresses to identify which employees were sharing unauthorised information.

However, TikTok remains popular globally, with over 1 billion users, and the bans in the US at university level are unlikely to impact the app's popularity significantly. However, a greater ban (for example, country-wide) would substantially impact US users.

[Sources: <https://techcrunch.com/2023/02/23/european-commission-orders-staff-to-remove-tiktok-from-work-devices/>
<https://techcrunch.com/2023/01/19/tiktok-college-bans-texas-bytedance/>]
The contents of this text was simplified using ChatGPT.

Glossary

TikTok : TikTok is a popular social media app that allows users to create, watch, and share videos created on mobile devices or using webcams.

6.1 Cyber security is the term used to describe all methods individuals and companies use to reduce the risk of an attack that will result in data loss.

Name ONE hardware device or software application that reduces the risk of a cyber attack.

_____

_____

(1)

6.2 Give TWO reasons why you believe TikTok has become such a successful and popular social media platform.

Reason 1:	
Reason 2:	

(2)

6.3 List THREE types of information which TikTok might collect and possibly be made available to the Chinese government. You should briefly explain how each of these might be useful.

Information type	**Useful nature**

(6)

6.4 The article states that bans on campus networks are unlikely to make the app less popular. Give TWO ways a university student might still be able to use the app while on campus when TikTok is banned.

1:	
2:	

(2)

6.5 A student, who uses TikTok, has stated that they don't believe that their personal information is at risk as they merely use the app as a non-registered user (without creating an account). Do you believe this to be true? Justify your answer with ONE reason.

YES ☐ NO ☐

(2)

6.6 **Fairly Fit** is considering creating its own app for gym and café customers. Suggest to the owners TWO methods to ensure that their customer's data used by the app is secure.

Tip 1:	
Tip 2:	

(2)

15 marks

SECTION E DATA AND INFORMATION MANAGEMENT AND SOLUTION DEVELOPMENT

QUESTION 7

To manage their day-to-day business operations, **Fairly Fit** have many different IT solutions using both databases and OOP-designed applications.

7.1 Data stored or transmitted across a network can often be subject to threats. Consider a database which **Fairly Fit** use to store details of their gym and café customers.

7.1.1 Explain what each of the following threats to quality data means and give a possible example of how customer data could be affected in the **Fairly Fit** database.

Outdated data	
Definition	
Example	
Invalidated data	
Definition	
Example	

(4)

7.1.2 Customers using the **Fairly Fit** website need first to log in. A hacker is attempting to log into the website and steal customer information. All information about every customer is stored in a table called **tblCustomers**. The hacker has made up a **CustomerID** (harry0209) and typed in the following line into the **CustomerID** field on the webpage:

```
SELECT *
FROM tblCustomers
WHERE CustomerID = 'harry0209' OR 1=1;
```

(a) Entering a SQL statement into a web page field is a malicious SQL technique. What name is given to this technique?

_____

(1)

(b) Explain what this line of SQL code will achieve.

_____

_____

_____

(2)

(c) Why will this achieve what you have explained in (b) above?

_____

_____

_____

_____

(2)

(d) What can be done to ensure that a SQL statement such as that shown in part (b) above is not executed?

_____

_____

_____

_____

(1)

7.2 IP addresses are stored in a fixed number of bits. An IPv6 IP address consists of eight 16-bit fields, each separated by a colon (:). Each 16-bit field has four hexadecimal characters, each using 4 bits.

Here is an example of a valid IPv6 address:

2001:0db8:0000:0000:0000:ff00:0042:8329

Alternating 16-bit fields are shown in different colours for clarity.

7.2.1 How many bits will be required to store one IPv6 address?

_____

(1)

7.2.2 IPv6 addresses are long and difficult to work with, so several techniques can be used to shorten an IPv6 address without losing its uniqueness. One way of achieving this is by removing leading zeros, ensuring at least one character remains in each of the 16-bit fields.

Applying this technique to the IP address shown above, we would end up with the following address:

2001:db8:0:0:0:ff00:42:8329

Now consider the following IPv6 address:

2001:0db8:3c4d:0015:0000:0000:002f:000b

Once again, the alternating 16-bit fields have been shown in different colours for clarity.

(a) Write out this IPv6 address in shortened format using the technique described above. The first two fields are shown for you.

2001 : db8 : _____

(2)

(b) Assume that because we have a shorter IPv6 address, we can use fewer bits to store the address. Use the table/grid below to work out how many bits will be needed to store the shortened IPv6 address from (a) above. The first two blocks have been filled in for you.

Field	**Number of bits**
2001	16
db8	12
Total number of bits:	

(4)

(c) The shortening technique used above suppressed leading zeros. Why is it not possible to remove trailing zeros as well? Use the field ff00 to assist in answering this question if necessary.

(3)
[20]

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QUESTION 8

8.1 One of the programs used by **Fairly Fit** is used to store and work with details of various food items which are sold in the café. The program makes use of objects to hold relevant information and is made up of many different classes.

The Stock Class

This class will be used to instantiate **Stock** objects, one object for each stock item bought for sale in the café. Each **Stock** object will have the following fields:

description : string
stockQuantity : integer
costPrice : real
sellingPrice : real
healthyFood : boolean

These fields should only be accessible from the **Stock** Class.

Additionally, the class will need to have the following **class** fields:

markup : integer – this value is fixed at 60
totalStock : integer – this represents the total number of all food items in stock
totalCost : real – this represents the total cost price of all food items in stock
totalSales : real – this represents the total value of all food items sold

Except for the markup field, these fields should only be accessible from the **Stock** class.

Complete the following class diagram for the **Stock** class. Show the declaration of additional fields as well as the following methods:

Stock Class

- Parameterised constructor method accepting the following parameters: **d** (string), **sQ** (integer), **cP**(real), **sP** (real), **hF** (Boolean);
- Accessor methods for the **healthyFood** and **stockQuantity** fields;
- Mutator method for the **description** field, which will accept a parameter **dIn** (string)
- Accessor method for the **totalStock** field
- A **toString()** method to combine the various fields of a **Stock** object into a string.

Stock
Fields: - description : string - stockQuantity : integer - costPrice : real - sellingPrice : real - healthyFood : boolean
Methods:

(8)

8.2 An array of **Stock** objects called **sArr** exists which shows the stock of all food items at any one time. An example of data that is stored in the array is shown below:

sArr[0]	description	Lentil Salad
	stockQuantity	8
	costPrice	5.50
	sellingPrice	8.80
	healthyFood	Yes
sArr[1]	description	Power Oats
	stockQuantity	15
	costPrice	4.00
	sellingPrice	6.40
	healthyFood	Yes
sArr[2]	description	Protein Wrap
	stockQuantity	4
	costPrice	10.50
	sellingPrice	16.80
	healthyFood	Yes
sArr[3]	description	Prego Steak
	stockQuantity	15
	costPrice	12.80
	sellingPrice	20.48
	healthyFood	No

Fairly Fit has a policy that at all times, their stock of healthy food items must be greater than or equal to 80% of their total stock of food items. For example, if they have 50 items in stock, then at least 40 of these must be healthy food items.

Consider the following algorithm which has been designed to alert the café manager if the stock of healthy food items drops below 80% of all items in stock. This algorithm will be tested against the sample data in **sArr**.

```
method testHealthyFood() : String
begin
1       totalStock ← 30
2       size ← 4
3       count ← 0
4       alertLevel ← 0.00
5       alert ← "Level OK"
6       for k ← 0 to size – 1 inc by 1
        begin
7               if sArr[k].getHealthyFood() = true
                begin
8                       count = count + 1
                end if
        end for
9       alertLevel ← count / totalStock (real division)
10      if alertLevel < 0.80
            begin
11              alert ← "Level Low"
            end if
12      return alert
end method
```

8.2.1 (a) What method will be called to access the value of the variable totalStock?

_____

(1)

(b) You must complete the following trace table to show the algorithm's actions. You MUST include the line numbers as a reference to the line of code in the algorithm. There are more lines on the grid than are necessary for a correct answer.

Line	totalStock	size	count	alert	alertLevel	k	sArr[k].getHealthyFood() = 'true' ?	alertLevel < 0.80	Return

(11)

8.2.2 Line 8 of the algorithm is currently incorrect.

(a) Explain what is wrong with this line of code.

_____

_____

(2)

(b) Correct the line of code so that the correct result will be achieved.

_____

_____

(2)

8.3 **Fairly Fit** would like to incentivise customers who use the gym and eat healthy meals in the café to lose weight. They wish to apply the following conditions:

- A customer has eaten 10 healthy meals – let this equal M
- A customer has used the gym 5 times – let this equal G
- A customer is within 5 kg of their target weight – let this equal W

Fairly Fit will reward any customer who has eaten 10 healthy meals and used the gym 5 times, OR any customer who has not eaten 10 healthy meals but has used the gym 5 times and is within 5 kg of their target weight. This condition can be written as the following Boolean expression:

$$\mathbf{F(M,G,W) = (M.G) + (M'.G.W)}$$

Complete the following truth table to represent the condition
(M.G) + (M'.G.W).

M	G	W	M'	M.G	M'GW	M.G + M'GW	RESULT True/False
0	0	0					
0	0	1					
0	1	0					
0	1	1					
1	0	0					
1	0	1					
1	1	0					
1	1	1					

(6)
[30]

50 marks

Total: 150 marks

ADDITIONAL SPACE (ALL QUESTIONS)

REMEMBER TO CLEARLY INDICATE AT THE QUESTION THAT YOU USED THE ADDITIONAL SPACE TO ENSURE THAT ALL ANSWERS ARE MARKED.