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**TOTAL
MARKS**

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NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2021

INFORMATION TECHNOLOGY: PAPER II

EXAMINATION NUMBER

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Time: 3 hours

150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 34 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 on the question paper. Please make sure that you write your examination number in the blocks above.
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. Three blank pages (pages 32 to 34) 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	Total
Marks	8	10	32	10	25	15	50	150
Marked								
Moderated								

SECTION A SHORT QUESTIONS**QUESTION 1 DEFINITIONS**

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

- 1.1 A network device used to connect two LAN segments and reduce traffic.

_____ (1)

- 1.2 A network topology that is a combination of one or more topologies.

_____ (1)

- 1.3 A wireless technology standard that transmits data over short distances.

_____ (1)

- 1.4 A connection to the Internet that offers differing upload/download speeds.

_____ (1)

- 1.5 An Internet services technology that provides real-time location information.

_____ (1)

- 1.6 A compression technique where the original and restored files are the same size.

_____ (1)

- 1.7 A search technique that can be used to search for an existing image online.

_____ (1)

- 1.8 A technique to improve a website's hit rate on a search engine's results page.

_____ (1)

8 marks

SECTION B SYSTEM TECHNOLOGIES**QUESTION 2 THEORY**

For each of the questions below, you need to select **the most correct answer** from the options A–D. There is an answer grid at the bottom of each of the next two pages, each for five questions. You merely need to write down the appropriate letter for your answer.

2.1 Modular design ...

- A allows many components of a desktop computer to be replaced individually.
- B allows many components of a laptop to be replaced individually.
- C ensures that all components are designed in modules of the same size.
- D makes PCs operate more efficiently.

2.2 The address bus ...

- A is bidirectional.
- B works independently of the data bus.
- C is unidirectional.
- D defines the speed of the FSB.

2.3 SRAM (Static RAM) ...

- A is only used to store data from static variables.
- B has a slower access time than DRAM.
- C is cheaper than DRAM.
- D does not need to be refreshed.

2.4 Hyperthreading is a feature that ...

- A allocates tasks to different CPU cores.
- B simulates multiple CPU cores.
- C is only available on supercomputers.
- D None of the above.

2.5 A high-level language ...

- A is difficult to read and understand as it doesn't use English-like commands.
- B does not make use of logical operators.
- C is machine independent.
- D does not require translation.

Question	2.1	2.2	2.3	2.4	2.5
Answer					

2.6 Virtual memory ...

- A has no effect on the overall performance of a PC.
- B helps when system memory is running low.
- C cannot be configured with a solid-state drive.
- D is a feature only available for Windows®-based devices.

2.7 An external hard drive ...

- A can be used to back data up.
- B can be infected by viruses.
- C can act as a boot device.
- D All of the above.

2.8 The battery life of a laptop is not affected by ...

- A screen brightness.
- B loading and saving data to the hard drive.
- C typing speed.
- D large file downloads.

2.9 SATA is an interface suitable for connecting ...

- A a hard disk drive.
- B a high-definition graphics card.
- C a network card.
- D All of the above.

2.10 The system clock ...

- A can only run at one speed.
- B is used to keep all components synchronised.
- C controls the hard drive speed.
- D has no effect on the running of a computer.

Question	2.6	2.7	2.8	2.9	2.10
Answer					

[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.

AJ Garden Services offer homeowners in urban areas a small range of garden services: lawn maintenance, weeding, edging and pool maintenance. The business is operated from the home of the owner, AJ, and employs a small number of staff who are paid to undertake the work in customers' gardens.

In addition to the maintenance options offered, the company also offers a design service where they can produce a 3D garden design.

QUESTION 3 APPLICATION

The office has a single desktop computer that is used for all functions of the business. This desktop is several years old and needs to be replaced.

3.1 Any desktop computer will have a CPU.

3.1.1 Name one manufacturer of CPUs typically found in desktop computers.

(1)

3.1.2 CPUs have three main components: registers, an arithmetic logic unit (ALU) and a control unit (CU). **Briefly** explain the function of each of these.

Component	Function
Registers	
ALU	

CU	

(3)

- 3.1.3 The current desktop's CPU has registers that use 32 bits. Many modern processors have registers that use 64 bits. Explain to AJ how a CPU with 64 bits will improve the performance of the desktop computer.

(2)

- 3.2 Modern processors make use of caches. AJ needs to know how different caches on a new desktop will improve the performance of the machine.

- 3.2.1 Consider the following two processor/cache options where each CPU has two cores:

CPU 1		CPU 2	
Level 1 cache	512 KB per core	Level 1 cache	1024 KB per core
Level 2 cache	8 MB shared*	Level 2 cache	8 MB per core
Level 3 cache	16 MB shared*	Level 3 cache	16 MB shared*

* *shared* means shared between CPU cores

- (a) TRUE or FALSE – Level 1 cache usually operates at the same speed as the CPU itself.

(1)

- (b) Explain to AJ why processor caches are measured in a small unit of measurement (KB/MB) compared to RAM, which is measured in a larger unit (GB).

(2)

- (c) Consider the Level 2 caches shown in Question 3.2.1. Compare the two specifications and explain which you believe would provide the better performance.

(2)

3.2.2 The efficiency of a cache can be measured in terms of two concepts, known as the cache hit ratio and the cache miss ratio. A cache hit is the phrase used to describe when the cache is able to give the CPU the data it requested, whereas a cache miss is used to describe when the cache is unable to give the CPU the data it requested.

A high cache hit ratio, therefore, indicates that a large number of cache requests are satisfied by the cache.

The cache **hit ratio** can be calculated as follows:

$$\frac{\text{number of cache hits}}{(\text{number of cache hits}) + (\text{number of cache misses})}$$

The cache **miss ratio** can be calculated as : 1 – hit ratio

Assume that the caches of the two CPUs mentioned in Question 3.2.1 have the following statistics over a period of time:

	CPU 1	CPU 2
Cache hits	51	64
Cache misses	3	2

The miss ratio for CPU 1 can therefore be calculated as follows:

$$\begin{aligned} \text{Hit ratio:} \\ 51 / (51 + 3) \\ = 51 / 54 \\ = 0,944 \end{aligned}$$

$$\begin{aligned} \text{Miss ratio} &= 1 - \text{Hit ratio} \\ &= 1 - 0,9444 \\ &= 0,0556 \end{aligned}$$

Expressed as a percentage: 5,56%

- (a) Calculate the **miss ratio** for CPU 2. Express your answer as a percentage rounded off to two decimal places.

(2)

- (b) The two CPUs have different miss ratios. Which CPU will perform better using the miss ratio of CPU 1 and your calculated miss ratio of CPU 2?

(1)

- (c) Justify your answer by giving TWO reasons.

Reason 1: _____

(1)

Reason 2: _____

(1)

- 3.3 The work that AJ does to create 3D models of gardens for customers puts a great strain on the current desktop.

- 3.3.1 Give TWO reasons why creating 3D models would be more processor intensive than, for example, word processing.

Reason 1: _____

(1)

Reason 2: _____

(1)

3.3.2 Name **THREE components on the motherboard** that AJ should pay particular attention to when upgrading the desktop, that will improve the performance when creating 3D models.

Component 1: _____

(1)

Component 2: _____

(1)

Component 3: _____

(1)

3.4 AJ is not sure whether it would be a good idea to keep the current desktop computer and overclock the components, rather than buying a new computer.

3.4.1 What is meant by overclocking?

(2)

3.4.2 Explain the difference between:

(a) per component overclocking.

(1)

(b) whole system overclocking.

(1)

- 3.4.3 Complete the table below to demonstrate to AJ some of the effects of overclocking. You should place a tick in the 'YES' or 'NO' space to indicate whether each factor is linked to overclocking or not. An example is given for you.

Factor	YES	NO
Performance increases	✓	
Heat increases		
More RAM required		
Greater cooling required		
Less cache needed		
Hard drive access time increases		
Risk of component failure		
Greater power consumption		

(7)
[32]

42 marks

SECTION C INTERNET AND COMMUNICATION TECHNOLOGIES**QUESTION 4 THEORY**

For each of the questions below, you need to select **the most correct answer** from the options A–D. There is an answer grid at the bottom of each of the next two pages, each for five questions. You merely need to write down the appropriate letter for your answer.

4.1 DNS ...

- A allocates IP addresses to clients.
- B translates domain names to IP addresses.
- C allows multiple devices to share an IP address.
- D cannot be used on a network that isn't connected to the Internet.

4.2 A star topology ...

- A uses less cable than a ring network.
- B does not support fibre as a medium.
- C requires a central switch.
- D is difficult to add devices to.

4.3 Thin clients ...

- A have limited processing power of their own.
- B cannot connect to a wireless network.
- C have the same power requirements as a fat client.
- D All of the above.

4.4 Internet hotspots ...

- A are only found in public places.
- B always pose a security threat to users.
- C provide convenient access to the Internet.
- D only provide access to mobile devices.

4.5 The BitTorrent protocol ...

- A was designed to increase data transfer efficiency.
- B was designed to allow the illegal transfer of files.
- C can only be used to transfer video files.
- D cannot be used for files stored in cloud storage.

Question	4.1	4.2	4.3	4.4	4.5
Answer					

4.6 VOIP ...

- A transmits voice data in analogue form.
- B can be used on a LAN without an Internet connection.
- C needs specialised hardware, like headsets, to work.
- D cannot be used with mobile devices.

4.7 A VPN ...

- A is needed for hacking into networks.
- B allows for faster data transfer over the Internet.
- C allows for secure, remote access to networks.
- D does not offer encryption.

4.8 Fibre optic cables ...

- A support multiple high-speed data transfers.
- B can only transfer data in one direction at a time.
- C are very flexible.
- D are most suited to short network connections.

4.9 5G is a mobile technology ...

- A that is proven to transfer viruses to humans.
- B that provides very high-speed data transfers.
- C that is used to spy on the public.
- D All of the above.

4.10 Web 1.0 ...

- A was used to develop static websites.
- B allows for user interaction with websites.
- C did not support file downloads.
- D was a text-only interface for web users.

Question	4.6	4.7	4.8	4.9	4.10
Answer					

[10]

QUESTION 5 APPLICATION

AJ Garden Services have an Internet connection in their office that is used by both the business and by some of the staff members when they are in the office. The current desktop as well as some staff members' personal devices are connected to the Internet. The router, which connects to the incoming fibre link, provides for both wired and wireless connections. The fibre link to the Internet provides a symmetrical 4 MB/s access speed.

5.1 AJ has been monitoring some network traffic through the router. He knows that network traffic is broken up into packets and he is trying to understand some of the data he is viewing via the monitoring software.

5.1.1 What is contained in each of the following main components of a packet? You need to mention ONE item for each component.

Header: _____

(1)

Payload: _____

(1)

5.1.2 The network at **AJ Garden Services** is an Ethernet network.

(a) What type of cable is most commonly used in an Ethernet network?

(1)

(b) Most Ethernet networks will make use of a switch. List TWO functions of a switch on an Ethernet network.

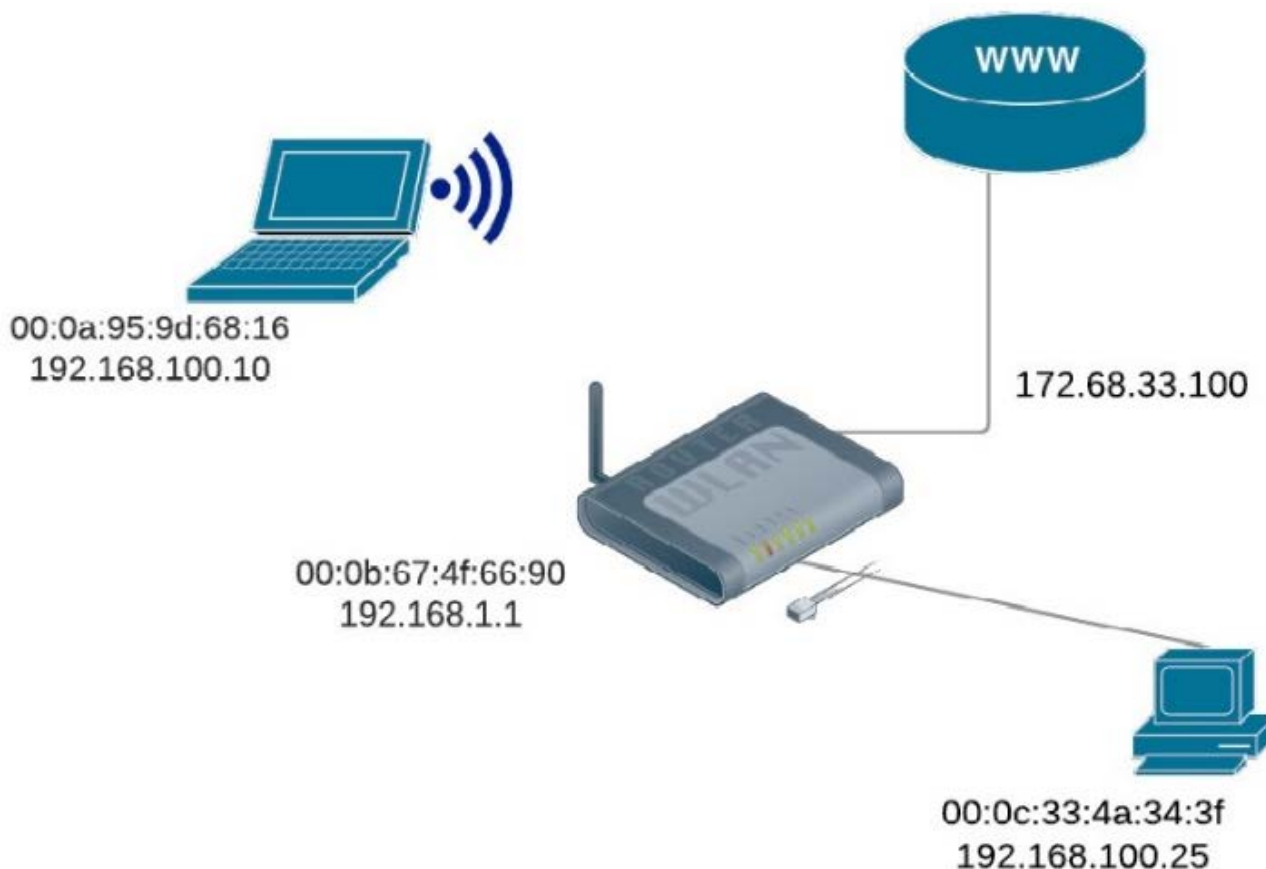
Function 1: _____

(1)

Function 2: _____

(1)

- (c) The diagram below shows the office desktop computer and an employee's laptop connected to the network in the office of **AJ Garden Services**. It also shows access to the Internet via the router, indicated by the device labelled WWW.



Data sent between the two devices will be in the form of Ethernet frames. Complete the following table for one frame of data transmitted **from the laptop to the desktop**.

Destination MAC	Source MAC	Destination IP	Source IP

(4)

- (d) Explain the need for Ethernet frames to contain both MAC and IP addresses.

(2)

- (e) The router has an external IP address 172.68.33.100. Who would have allocated this IP address to the router?

(1)

5.2 During lockdown, AJ decided to develop a new function for the company and is now offering online video webinars to help existing customers with their gardening needs.

5.2.1 Will the current Internet link be sufficient to run video calls with up to 50 customers at a time? Tick either the YES or the NO box below.

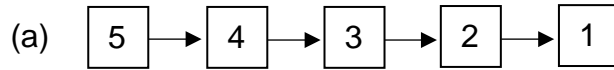
YES ☐ NO ☐

(1)

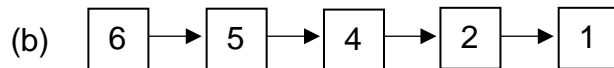
5.2.2 Justify your answer to Question 5.2.1 with ONE reason.

(1)

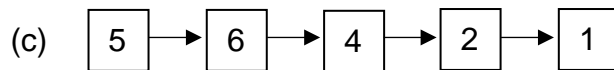
5.2.3 Examine the data transmissions represented below that are received by the network card on AJ's desktop computer. Indicate which protocol was used for each. Choose from **TCP** or **UDP** or **BOTH**. Each numbered box represents a packet.



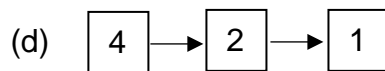
Protocol: _____



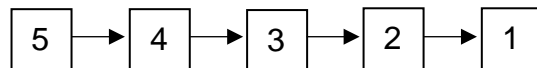
Protocol: _____



Protocol: _____



>repeat request<



Protocol: _____

(4)

5.3 AJ is setting up a website for his business to allow customers to book for the online webinars. The bookings will be processed through the website www.ajgardens.co.za.

5.3.1 To maintain security, which web protocol should be used on the section of the website dealing with bookings?

(1)

5.3.2 The booking website will be run from the new desktop computer that AJ is buying for the business. A website needs to be available to customers at all times. AJ wants to buy either a UPS or a redundant power supply with the new computer.

(a) Describe the function of these two devices with respect to how they provide power to a computer.

Device	Function
UPS	
Redundant power supply	

(4)

(b) Justify why both devices will be necessary to ensure that the website is available to customers at all times.

(2)

[25]

35 marks

SECTION D SOCIAL IMPLICATIONS**QUESTION 6**

Read the following extract from an article dealing with **digital heritage** and answer the questions that follow.

No one likes to think about it, but most of us know we should plan what happens to our possessions when we die. However, many of us don't extend this thinking to our digital assets and data.

The amount of digital data we generate is growing exponentially. In addition to social media data, devices such as smart phones, cameras and other Internet of Things (IoT) technologies are recording, measuring and storing data as we rely on them to make our lives easier.

There are many good reasons to know what happens to our data after we die. You might want to ensure private information remains private, or perhaps make it possible for those left behind to benefit from digital assets with value. Unfortunately, legislation has failed to keep pace with technological changes.

Digital media bought from iTunes, Amazon, Google Play and such services are probably the most common. We need to determine what happens to digital collections when we die.

Less common is what happens to the data we aren't likely to physically own. Personal data belongs to us – we can give permission to others (usually businesses) to use and store it, and businesses have a legal obligation to tell us if they are collecting it. It is also possible to ask such businesses to delete the data they hold. But a dead person, obviously, can't do this – he or she can't tell Google or Apple to delete the trail of GPS data which, in theory, could allow a third party to know intimate, private details about how they spent their time when they were alive.

[Adapted from: <<https://www.forbes.com/sites/bernardmarr/2017/02/01/what-really-happens-to-your-big-data-after-you-die>> (Accessed 02 January 2021)]

- 6.1 Give TWO examples of digital media that people buy online. Do not mention the names of companies that provide digital media such as those provided in the extract.

Example 1: _____

(1)

Example 2: _____

(1)

- 6.2 The article refers to the Internet of Things (IoT) technology. Without using the provided example of GPS data, give TWO examples of digital heritage data and the IoT devices that would have generated the data.

	Example of data generated	IoT device
1		
2		

(4)

- 6.3 "We need to determine what happens to digital collections when we die."

- 6.3.1 Do you believe those who inherit from you will **legally** be allowed to access and use your digital collections after you die?

YES

☐

NO

☐

(1)

- 6.3.2 Justify your answer to Question 6.3.1.

(2)

- 6.4 Detail TWO techniques that you can use to reduce the amount of data collected by a company, such as a third-party app provider, via your smartphone. Your answers should be different from each other.

Technique 1: _____

(1)

Technique 2: _____

(1)

- 6.5 The article mentions two types of data – digital collections and personal data (e.g., medical data).

Explain how medical data could be used in a negative way after a person dies.

(2)

- 6.6 The article doesn't mention items such as Bitcoins that could form part of the digital assets left when someone dies.

- 6.6.1 Will it be possible to access the Bitcoins that belonged to the person who died?

YES ☐ NO ☐

(1)

- 6.6.2 Justify your answer with ONE reason.

(1)

15 marks

SECTION E DATA AND INFORMATION MANAGEMENT AND SOLUTION DEVELOPMENT**QUESTION 7**

AJ Garden Services make use of several OOP designed programs in their business to keep track of their customers, orders and accounts.

- 7.1 When developing any application built along OOP principles, there are established processes involved using computational thinking.

Explain the importance of the following two processes. You need to mention TWO facts per process to show why each is important.

Principle	Importance
Decomposition	
Abstraction	

(4)

- 7.2 One of the programs used by **AJ Garden Services** deals with customers and the services offered by the company. The program makes use of objects to hold relevant information about the people involved with the business and is made up of a number of classes.

The Gardener Class

This class will be used to instantiate **Gardener** objects, one object for each gardener employed by **AJ Garden Services**. A **Gardener** object will have the following fields:

name : string
skills : string of up to 4 characters:
 l = lawn maintenance
 w = weeding
 e = edging
 p = pool maintenance

These fields should not be accessible from outside the **Gardener** Class.

The Customer Class

This class will be used to instantiate **Customer** objects for each customer who makes use of gardening services. A **Customer** object will have the following fields and types:

name : string
contactNumber : string
servicesUsed : string of up to 4 characters:
 l = lawn maintenance
 w = weeding
 e = edging
 p = pool maintenance
gardener : **Gardener**

These fields should be accessible from the **Customer Class** and any class that inherits from it.

The VideoCustomer Class

This class will be used to instantiate **VideoCustomer** objects for all customers who book to take part in a webinar in addition to the normal services provided by **AJ Garden Services**. This class inherits from the **Customer** class. In addition to the inherited fields, objects instantiated from this class will include the following fields:

date : Date
title : string

These fields should only be accessible from inside the **VideoCustomer Class**.

- 7.2.1 (a) Complete the class diagrams for the **Customer** and **VideoCustomer** classes. Indicate the relationship (if any) between the classes. Show the declaration of all the fields and methods of the following classes:

Customer Class

- Parameterised constructor method accepting the following parameters: **n** (string), **cN** (string), **sU** (string), **g** (**Gardener**);
- Accessor methods for the **name** and **gardener** fields;
- Mutator methods for the **servicesUsed** and **gardener** fields, which will accept parameters **sU** (string) and **g** (**Gardener**) respectively;
- A **toString()** method that will concatenate the various fields of a **Customer** object into one string object.

VideoCustomer Class

- Parameterised constructor method that accepts parameters **d** (Date object) and **t** (string) in addition to the parameters of the parent class;
- Accessor methods for the **date** and **title** fields;
- Mutator methods for the **date** and **title** fields, which will accept parameters **d** (Date) and **t** (string) respectively;
- A **toString()** method that will concatenate the fields of the child object with the fields of the parent object into a single string object.

Customer
Fields:
Methods:

VideoCustomer
Fields:
Methods:

(10)

- (b) Write Java/Delphi code for the constructor method of the **VideoCustomer** class.

(5)

7.2.2 In the class diagram in Question 7.2.1 (a), you were instructed to include certain methods in the class diagrams.

- (a) What is the purpose of:
an accessor method:

(1)

a constructor method:

(1)

- (b) Give an example of when the mutator method for the **servicesUsed()** field would need to be used.

(2)

7.2.3 Does the **VideoCustomer Class** make use of information hiding? Justify your answer with ONE reason.

YES ☐ NO ☐

(1)

(1)

7.2.4 Would any of the methods you included in the class diagrams in Question 7.2.1 (a) be classified as static methods? Justify your answer with ONE reason.

YES ☐ NO ☐

(1)

(1)

- 7.3 A number of the OOP programs that have been written for **AJ Garden Services** have decisions in them. One class has some code that looks at the array of skills of a gardener and compares them to the array of services that a customer contracts **AJ Garden Services** to provide. This will link to a promotion that AJ is going to run, offering a combination of services at a special price.

For the purposes of this question: L = lawn maintenance, W = weeding, E = edging, P = pool maintenance.

The combination the programmer is looking at currently is for a customer who wants to use the following services: lawn maintenance and edging or pool maintenance.

The programmer has written the condition as: L AND (E OR P), i.e. L.(E + P)

You are required to complete the truth table below to represent the condition shown above.

L	E	P	E OR P (E + P)	L AND (E OR P) L.(E + P)	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			

(7)

- 7.4 Consider the following algorithm that has been written to be coded into a method that will be used to add a skill for a particular gardener.

The method will assign values to the following variables.

skills: A string that shows the current skills the gardener has.

newSkill: A character representing the new skill that needs to be added to a gardener's list of skills.

Other variables are defined for specific use in the method.

A test will be performed to check to see if the value **newSkill** already exists in **skills**. If the skill exists, then a warning message will be displayed. If the skill does not exist, then it will be added to the list of skills that the gardener has, with a message to confirm this, as well as showing the new list of skills.

```
1 skills ← "lwp"
2 newSkill ← 'e'
3 flag ← false
4 size ← number of characters in skills

5 for k ← 0 to size – 1 inc by 1
6     if character at position k in skills = newSkill
7         flag ← true
8     end if
9 end for

10 if flag = false
11     skills ← newSkill
12     display "New Skill added"
13     display "Full skill list: " + skills
14 else
15     display "Skill already exists"
16 end else
17 end if
```

This algorithm has been coded, but it does not produce the correct results. You need to complete the following trace table to show what the algorithm is doing. You need to include the line numbers as reference to the line of code in the algorithm. There are more lines on the grid than are necessary for a correct answer.

[illegible]

(10)

7.5 JSON files are flexible and language independent allowing for easy manipulation of JSON objects. Consider the following JSON objects representing three gardeners employed by AJ Garden Services:

```
{
    "name" : "Simo",
    "skills" : "wep"
};

{
    "name" : "Wilbert",
    "skills" : "lwe"
};

{
    "name" : "Simone",
    "skills" : "ep"
};
```


ADDITIONAL SPACE (ALL questions)

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

[illegible]

[illegible]

[illegible]