PRELIMINARY EXAMINATION
SEPTEMBER 2022
GRADE 12

INFORMATION TECHNOLOGY: PAPER II
MEMORANDUM

NAME: Memo

TIME: 3 HOURS 150 MARKS

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SECTION A SHORT QUESTIONS

QUESTION 1 DEFINITIONS

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

1.1 A specialized operating system (OS) designed to perform a specific task for a device that is not a computer. (1)
Embedded operating system

1.2 A standard for connecting high-definition video devices. (1)
HDMI

1.3 The bus used to connect the CPU to the RAM. (1)
FSB

1.4 A n extension to HTTP that lets clients edit remote content on the web. (1)
WebDav

1.5 What is the purpose of using a product like Onion router / Tor? (1)
Anonymous browsing

1.6 A process in which different types of data are checked for accuracy and inconsistencies after data migration is done. (1)
Data verification

1.7 A way of storing the same data in different places on multiple hard disks or solid-state drives (SSDs) to protect data in the case of a drive failure. (1)
RAID

1.8 The interconnection via the internet of computing devices embedded in everyday objects, enabling them to send and receive data. (1)
Internet of Things

1.9 A Technique used to hide background details or any unnecessary implementation about the data so that users only see the required information. It is one of the most important and essential features of object-oriented programming. (1)
Abstraction

1.10 A document stipulating constraints and practices that a user must agree to for access to a corporate network, the internet or other resources. (1)
AUP

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QUESTION 2 MATCHING COLUMNS

2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10
C	H	E	A	K	B	G	Q	S	F

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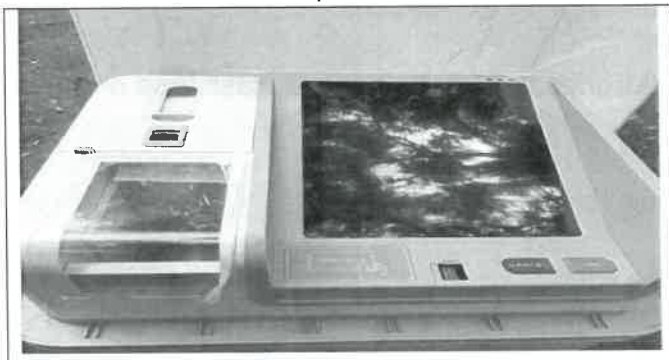
SECTION B SYSTEM TECHNOLOGIES

SCENARIO

QUESTION 3 APPLICATION

3.1 The government are considering two options at the moment. The devices will both merely be used to capture information. The information will be stored in and online database. The specifications for each device are listed below:



LG Voting Machine

Processor:	2.1 GHz Intel Quad Core i5
OS:	Windows 10
Memory:	8 GB RAM
Storage:	500 GB HD
Display:	13" LCD monitor touch screen
Network:	802.11ac 2.4/5 GHz
Ports:	2 x USB 3; 1 x USB C
Additional:	Biometric hand/fingerprint scanner

Nokia T20 Tablet

Processor:	1.8GHz Octa-core T610
OS:	Android 11
Memory:	4 GB RAM
Storage:	64 GB SSD
Display:	10.4" LED touch screen
Network:	802.11ac 2.4/5 GHz
Ports:	1 x USB C
Additional:	Front/Rear camera

3.1.1 In comparing these two devices, is it a hardware or a software problem that needs to be considered? (1)

Hardware

3.1.2 Neither of these devices are listed as having a co-processor. In your opinion, discuss ONE device and state whether or not you think it makes use of a co-processer by highlighting the functions of a co-processor. (3)

A coprocessor is a special set of circuit s in a microprocessor chip that is designed to manipulate numbers or perform some other specialized function more quickly than the basic microprocessor circuits could perform the same task. The device would process the information faster because it will spend less time on either graphics or mathematical calculations and therefore the device with the more cores will

3.1.3 Is this capacity of the hard drive of the Nokia Tablet sufficient for the purposes for what it would be used, give a reason for your answer (2)

Yes. Very little data will be stored locally.

3.1.4 The LG machine makes use of hyper-threading. Explain clearly what this is and what the result of this would be over a similar device that does not contain hyper-threading capabilities. (3)

a hardware innovation that allows more than one thread to run on each core. More threads means more work can be done in parallel. The device would be faster than one without the capability.

3.1.5 If we assume that BOTH devices are hyper-threading capable, which of these devices would perform better? Give a reason for you answer. (2)

Tablet. Has more cores, i.e. more threads.

3.1.6 Which of these devices would be capable of parallel processing? Define parallel processing and give a reason for you answer. (3)

Both. Parallel processing requires multiple processors and one had 4 and the other one 8.

3.2 Examine the secondary storage of both devices.

3.2.1 Name two disadvantages of the LG device's secondary storage. (2)

Relies on moving parts.
The disk surface can be damaged.
Heavy power consumption.
Slower read and write speed than RAM.
Slower to access than hard disk.
The regular head can crash and damage the surface of the disk.

3.2.2 Name two advantages of the Nokia device's secondary storage. (2)

Increased durability due to no moving parts to wear out or fail.
Significantly faster data transfer rates
More reliable long-term storage and no need to "exercise" drives.
Reduced power consumption.
Reduced heat.

3.2.3 Give one advantage of the Nokia device in the context of the scenario. (1)

Easier to move around to remote areas.
Interface is easier for users to use and/or understand

3.3 Many of the rural areas do not have stable electrical supply. Based on this fact, recommend and motivate one of the devices based on the specifications at hand for use in rural areas. Give two reasons for your selection. (3)

Nokia because it has a battery, can connect wirelessly, can be easily moved around / portable, is lighter and therefore easier to transport.

3.4 Which Operating System does each of these devices most likely use? Name them both and give the three main functions of an OS. (5)
LG – Windows 10; Nokia – Android 11; Manage the computer's resources, establish a user interface, and execute and provide services for applications software.

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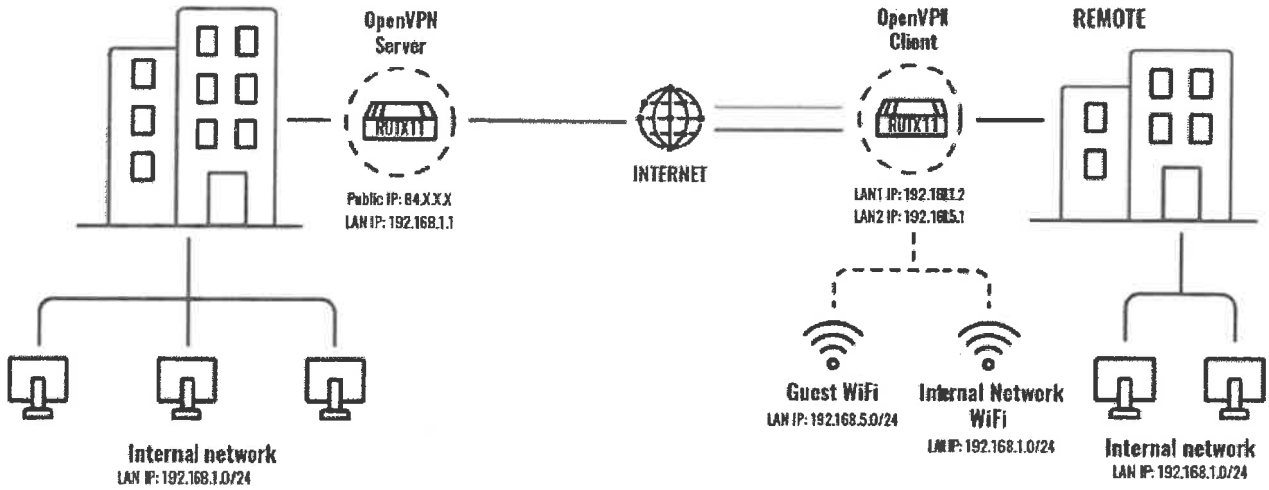
SECTION C INTERNET AND COMMUNICATION TECHNOLOGIES

QUESTION 4

Study the network diagram below depicting the connection between the main government servers and a remote voting location.



4.1 Are each of these devices that might be used for voting considered to be fat clients or smart clients. Motivate your answer and explain each term clearly. (4)

A fat client is a networked computer with many locally-stored programs or resources and little dependence on network resources so the LG is one.
A smart client is a rich client application that is downloaded from a Web server via HTTP which the Nokia can serve as.

4.2. The network on the left in the diagram is the main voting office building. For security purposes they do not make use of a wireless network in the building. They only make use of physical cabled network access points.

4.2.1 What kind of cable would be used in this main office network and list one advantage and one disadvantage of using the cable that you named. (3)

UTP
Benefits or advantages of UTP:
It is designed to counter EMI, RFI, and also crosstalk.
It is easy to handle.
These cables are used in most of the networking architecture.
It is flexible which further makes installation easier.
It is less expensive and less costly compare to other networking media types.
It is the most compatible cabling and can use with most other major networking systems and does not require grounding.
It is cheapest from the cable available for networking purposes.
Drawback or disadvantages of UTP:

It can be used up to a cable segment length of about 100 meters only.
UTP cable should follow specifications for a number of twists or braids permitted per meter of cable to reduce crosstalk.
Bandwidth is limited.
Unable to provide secure transmission of data.
It is highly prone to external interference like EMI and RFI.
Susceptible to noise.
The distance between the signal boosts is shorter with UTP cable than for coaxial and other fiber optic cables and shielded twisted pair cable, making it less able to carry the signal for the long-distance network.
It is more susceptible to interference compare to most of the other cable types.

4.2.2 What topology would you suggest be used here. (1)

Star; Mesh

4.2.3 The remote voting locations will need remote access to store their recorded results on the voting officials' local server. As you can see from the network diagram, OpenVPN is being used in the network. Explain clearly what that is, why they are using it and what the implications are for using that in this network configuration.~~(4)~~ (1)

an arrangement whereby a secure, apparently private network is achieved using encryption over a public network.

4.2.4 What purpose would each of the following devices serve in this network. Give a practical application related to the scenario for each in the Application column in the table below. (8)

	Function	Application
Gateway	The gateway connects networks of different kinds. Converts information, data or other communications from one protocol or format to another.	Allows connecting to the VPN and internet
Bandwidth	Bandwidth is often mistaken for internet speed when it's actually the volume of information that can be sent over a connection in a measured amount of time.	Determine how much can be downloaded at any moment, used to determine cost of lines in ISPs.
Firewall	A Firewall is a network security device that monitors and filters incoming and outgoing network traffic.	Prevents unauthorised access and protection against viruses.
UDP	User Datagram Protocol (UDP) is a communications protocol that is primarily used to establish low-	Voice over IP (VoIP), online games, and media streaming.

	latency and loss-tolerating connections between applications on the internet.	

4.3. There is a great deal that relies on the information being captured being error free. Give two sources of errors and give an example from the scenario for each. (4)

Human error: capturing the wrong details of the voter either not allowing them to vote or letting the wrong person vote
Arithmetic errors – rounding or counting wrong
Transmission errors – corrupting data during transmission due to cable problems
Programming errors – undetected logical errors leading to miscalculation of election results
Duplicates: same person votes more than once
Quality: getting information from the correct people, i.e. not secondhand
Accuracy: getting the correct information captured from the user
Any other valid reason

4.4. The electoral council has a website that interactively tries to deliver content based on the registered voter's political affiliation if they indicate which political party they are affiliated with. Is this an example of Web 2.0, Web 3.0 or Web 4.0. Describe two of these in your explanation. (3)

Web 2.0 is many people creating even more content for a growing audience. Users interact with websites
Web 3.0, is built on a foundation consisting of the core ideas of decentralization, openness, and more excellent user utility. User specific interaction and direct influence of interaction by the user
Web 4.0 services will be autonomous, proactive, content-exploring, self-learning, collaborative, and content-generating agents based on fully matured semantic and reasoning technologies as well as AI. Decision making taken out of the hands of the users.

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QUESTION 5

5.1 What are two data integrity risks that is a direct cause of load shedding in an election? (2)

Data could be lost – certain entries would not be captured
Data could be corrupted – during saving process could damage files which would lead to major data loss
Data could be changed while not connected or stored on the main server … inconsistencies and fraudulent voting

5.2. How can a Denial of Service attack affect an election? (1)

It can slow or render election-related public-facing websites inaccessible, which could hinder voters' ability to access voting information or voting results.
Prevent votes from being counted which could affect the outcome of an election.
Could cause corruption.

5.3 How do you envision the backing up of the data of the election working? Explain by first stating why a backup is necessary and then what is the best way in the context of the scenario. (3)

A backup is a copy of important data that is stored on an alternative location, so it can be recovered if deleted or it becomes corrupted.
Auditing elections to ensure that results were not changed ... can compare with backups.
Ensuring that votes are not lost

5.4 Give three ways in which Wi-Fi vulnerabilities be prevented at the mobile voting stations? (3)
Use of Default SSIDs and Passwords allowing attackers access to devices
Placing an Access Point Where Tampering Can Occur as some devices allow connecting if you can physically get to the device
Use of Vulnerable WEP Protocol
Fake WiFi Access Points – spoofing so information does not go to the correct place

5.5 Why are updates and upgrades important? (2)

Allows revisions which might include repairing security holes that have been discovered and fixing or removing computer bugs. Updates can add new features to your devices and remove outdated ones.

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SECTION D SOCIAL IMPLICATIONS

QUESTION 6

6.1 Read the following extract from a case study on **the possibility of making use of Electronic Voting**:

E-voting and media effects, an exploratory study

Anne-Marie Oostveen & Peter van den Besselaar

The introduction of electronic media in government and public services results into changing relations between citizens, politicians and government. In this project we address the question to which extent electronic media (e-voting) influence the articulation of political preferences and opinions by citizens, and how this effect is mediated by sociological and social psychological variables. We also want to investigate whether e-voting has an influence on the turnout and political representation. As cultural differences and differences in political systems may have a separate effect, we adopt an international comparative design.

This project is designed to realise an Internet based voting service that will provide users with a tool for expressing their opinion, however, it was quickly made clear that there has to be a registration process and followed by a monitored voting in order to prevent any irregularities.

[Adapted from: https://www.lse.ac.uk/media@lse/research/EMTEL/Conference/papers/Oostveen.pdf (Accessed 1 July 2022)]

6.1 South Africa cannot easily implement a system that would necessarily work in a European country. How will computers provide a solution to issues of global importance in the context of the proposed election concept? Refer to access, privacy and security specifically in your answer. (3)

Access to electricity is limited, difficult to vote. Easier access to the data of the voting if not secure. Information could be leaked. More difficult to secure the actual voting process.

6.2 What computer crime could easily be committed in the context of the voting scenario. State the specific computer crime and explain what it would entail. (2)

Any valid answer encompasing a valid crime like Hackers, Crackers, Theft of hardware, Identity theft.

6.3 How would you address the issue of voting in rural areas where there is very little to no data network coverage and no access to electricity, not even to mention electronic equipment. Would Biometrics be useful here in a mobile "command centre" of sorts? Explain your answer clearly. (3)

Biometrics can ensure that the right person votes, that people don't vote more than once, track who has voted.

6.4 Inaccurate information can have devastating consequences during a governmental election, especially with the prevalence of fake news.

6.4.1 Provide two criteria that can be used to evaluate an online data source. Explain each criterion clearly. (4)

Affiliation - ; Audience - ; Authority - ; Content - ; Currency - ; Objectivity -

6.4.2 How could e-mail be used as a "weapon" during an election campaign. (1)

Any way in which mass distribution of information can be sent out.

6.5 What impact can electronic voting have on Green Computing. Define the term and give a short description of how this could affect the environment. (2)

Electricity; Training; Network Coverage
Who will do the data processing

15 marks

SECTION E DATA AND INFORMATION MANAGEMENT AND SOLUTION DEVELOPMENT

Question 7

In the interest of national security, it has been decided that the software used to interface with the voting machines will be created from scratch by South African programmers.

7.1 The first software required is a program that will allow different users of the voting machines to have different rights. By making use of object orientated principles, this program will determine whether a user is a **Voter** object, a **Technician** object or a **SeniorTechnician** object.

The Voter Class

Voter objects will be instantiate using this class. Each **Voter** object will have the following fields:

Field name	Field data type	Field description
id	integer	This field contains the id of the voter
voteStatus	boolean	This field indicates whether the voter has voted yet.
technician	string	This field indicates the name and surname of the technician is assigned to this voter
These fields should not be accessible from outside the **Voter** Class.		

The Technician Class

Technician objects will be instantiate using this class. Each **Technician** object will have the following fields:

Field name	Field data type	Field description
fullName	string	the name and surname of the technician, separated by a space. Each technician will only have one name before the surname.
password	character[6]	Each technician is assigned a 6-letter password which is stored in the form of an array of characters. The first 2 characters and the last character of the password are numbers.

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

The SeniorTechnician Class

SeniorTechnician objects will be instantiate using this class. This class inherits from the **Technician** class. Each **SeniorTechnician** object will have the following field in addition to the inherited fields:

Field name	Field data type	Field description
masterCode	integer	This code will give the senior technician special privileges on the system.
This masterCode field should only be accessible from inside the **SeniorTechnician** Class.		
countST=0	integer	This public, static counter increases every time a **SeniorTechnician** object is instantiated.
This countST field should be accessible from outside the **SeniorTechnician** Class.		

7.1.1 Fill out the class diagrams for the **Voter**, **Technician** and **SeniorTechnician** classes. Also indicate the correct arrow to indicate inheritance between the **Technician** and **SeniorTechnician** classes. The following field and method declarations should be indicated:

Voter Class

- Parameterised constructor method accepting the following parameters: **i** (integer), **v** (boolean), **t** (string);
- An accessor method for the **voteStatus** field;

Technician Class

- Parameterised constructor method accepting the following parameters: **f** (string), **p** (character [ ]);
- A helper method called **convertPassword** that will convert the array of characters password into text. This method should not receive any parameters and return the password as a string.
- A toString() method that will concatenate the various fields of a **Technician** object into one string object.

SeniorTechnician Class

- Parameterised constructor method that accepts parameters **m** (integer) in addition to the parameters of the parent class. For each **SeniorTechnician** object instantiated the **countST** counter must increase by 1;
- A mutator method for the **masterCode** field, which will accept parameters **m** (int);
- A **toString()** method that will concatenate the fields of the child object with the fields of the parent object into a single string object.

Voter		
Fields:		
- id: integer		
- voteStatus: boolean		
- technician: string	1 mark if all correct	= 1 mark
Methods:		
+ Constructor(i:integer,v:boolean,t:string)	1 mark if constructor correct	
+ getVoteStatus():Boolean	1 mark if getter correct	= 2 marks

Technician		
Fields:		
# fullName: string	1 mark if field is correct	
# password: character[ ]	1 mark if field is correct	= 2 marks
Methods:		
+Constructor(f:string,p:character[ ])		
- convertPassword(): string		
+ toString(): string	2 marks if all correct	= 2 marks

Indicate the correct arrow by drawing an X over it:

= 1 mark

SeniorTechnician extends Technician		
Fields:		
-masterCode: integer		
+countST=0: integer	1 mark if underlined and =0	
	1 mark if rest is correct	= 2 marks
Methods:		
+ Constructor (f:string, p:character[ ],m:integer)		
+setMasterCode(m:integer)		
+toString(): string	2 marks if all correct	= 2 marks

(12)

7.2 List the names of the 3 access modifiers that were used in the class diagram (don't just give the symbol for the modifiers).

(3)

Private✓, protected ✓and public✓

7.3 Explain the difference between a class and an object.

(2)

A class is the blueprint of an object. ✓
An object is an instance of a class. ✓

7.4 What is the role of a constructor method and how is this achieved?

(2)

A constructor method is used to instantiate an object✓ by assigning values to the fields of the object. ✓

7.5 Name the two types of polymorphism and state which type will be used to create a default constructor in the **Voter** class. Motivate your answer.

(3)

Overriding and overloading✓ 1 mark if both correct
In this example we see method overriding ✓ as the signature of the methods will differ (they will have a different set of parameters) ✓

7.6 Write Java/Delphi code for a **default constructor method** for the Voter class. This method must not receive any parameters and must initialise the fields with the following default values:

id: 1234567891011
voteStatus: false
technician: Jon Doe

(3)

```
public Voter()✓
{
        Id=1234567891011;
        voteStatus=false;
        technician= "Jon Doe"; ✓
}✓
```

1 mark for correct constructor signature
1 mark if all allocations correct
1 mark for opening and closing brackets

7.7 Fill in the missing code below for the **convertPassword** helper method in the **Technician** class.

```
7.7.1 _____ _____ convertPassword()
{
  String 7.7.2 _____ ="";
  for (7.7.3 _____ _____ x++)
  {
    convertedPassword+=7.7.4 _____;
  }
```

return 7.7.5 _____;
}

(5)

7.7.1 private String ✓
7.7.2 convertedPassword✓
7.7.3 int x=0; x<6 OR int x=0;x<=5; ✓
7.7.4 password[x] ✓
7.7.5 convertedPassword ✓

Question 8

8.1 You have been asked to use boolean logic to help them determine which users voting stations should be serviced. New machines which need to be set up are the top priority. Second hand machines older than 5 years also need to be service.
For the purposes of this question: S = a second hand machine, O = a machine older than 5 years, N = a new machine that needs to be set up.

Based on the paragraphs above, the condition for servicing a machine is:
(S.O) OR N, i. e. (S.O)+N

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

S	O	N	S.O	N	(S.O)+N	Result True/False
0	**0**	**0**	0	0	0	False
0	**0**	**1**	0	1	1	True
0	**1**	**0**	0	0	0	False
0	**1**	**1**	0	1	1	True
1	**0**	**0**	0	0	0	False
1	**0**	**1**	0	1	1	True
1	**1**	**0**	1	0	1	True
1	**1**	**1**	1	1	1	True

S.O column correct = 2 marks
N column correct = 2 marks
(S.O)+N column correct = 2 marks
Result column correct = 2 marks

(8)

8.2 The password of technicians includes a checksum, which is a method for validating a number. In this case, each 6-character password of a technician consists of 3 numbers and 3 letters. The numbers can be found at characters 1,2 and 6. The checksum works as follows:

The value of the number in position 2, deducted from the value of the number in position 1 should equal the value of the number in position 6. See below the example of a valid password according to this checksum:
31joh2
When we apply the checksum to this password, we find the following: 3-1=2. As this sum is correct, the checksum passes, and we know that the password is valid.
The partial algorithm below has been coded to check whether passwords (that have been converted to string using the **convertPassword** method) are valid using this checksum. If valid, a true is returned. If the checksum formula does not work, a false is returned. Complete the algorithm.

```
password← "63dee3"
char1←characterAt(password,0)
char2← characterAt(password,1)
char6← characterAt(password,5)
num1←char1 converted to integer
num2←char2 converted to integer
num3←char6 converted to integer

if num1-num2=num3✓          1 mark for if and calculation correct
    return true
    else
        return false✓        1 mark for return true, else and return false
    end else                 correct
end if      ✓✓               1 mark for if and else ended + 1 mark for all
                             indentation correct
```

(4)

8.3 You were asked to code an algorithm that would determine whether a technician can be promoted to a senior technician. The criteria for a promotion are as follows:

- The technician needs to have at least 2 clients.
- There may not be more than 5 senior technicians currently.

The algorithm below checks whether "Matt Watt" can be promoted by checking an array listing the technicians used by three voters as is indicated below:
techArray[ ]

techArray[0]	techArray[1]	techArray[2]
Matt Watt	Joe Barr	Matt Watt

The current amount of senior technicians is 4.

1	**techN← "Matt Watt"**
2	**techASize←3**

3	clientAmount←0
4	stAmount←4
5	for x←1 to techArraySize-1 inc by 1
6	if techArray[x]=techN
7	clientAmount←clientAmount+1
8	end if
9	end for
10	if clientAmount>2 AND stAmount<5
11	return techname+ " can be promoted."
12	else
13	return techname+ " cannot be promoted."
14	end else
15	end if

Unfortunately, the algorithm produces unexpected output. Complete the following trace table to determine where the error in the algorithm lies. You have been provided with the first 3 line numbers.

line	techName	techASize	clientAmount	stAmount	x	techArray[x] = techName?	amountOfClients >2 AND amountOfST<5?	Output
1	Matt Watt							
2		3						
3			0					
4				4				
5					1			
6						false		
7			1					
5					2			
6						false		
10							false	

13								Matt Watt cannot be promoted
	Given							

(7)

8.4 Give the line number of the algorithm where the error can be found.

(1)

5

[20]