PECANWOOD COLLEGE
Prepared for Life

PRELIMINARY EXAMINATION
SEPTEMBER 2022
GRADE 12

INFORMATION TECHNOLOGY: PAPER II

NAME: _____

TIME: 3 HOURS

150 MARKS

EXAMINERS: K Cronjé (Section A – D)
J Joubert (Section E)

MODERATORS: S de Lange

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of **28** pages.
2. Read the questions carefully and make sure that you answer all parts of each question.
3. Answer on the question paper. Please make sure that you write your name on the line above.
4. Answer ALL questions – there are no options in this paper.
5. Show all working where applicable.
6. A non-programmable calculator may be used.
7. It is in your own interest to write legibly and to present your work neatly.
8. Two blank pages (pages ___ to ___) 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	10	10	27	27	11	15	30	20	**150**
Marked									
Moderated									

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)

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

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

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

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

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

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)

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

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)

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)

[10]

QUESTION 2 MATCHING COLUMNS

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	Availability of personal information.		A LBS
2.2	A self-replicating program able to propagate itself across a network, typically having a detrimental effect.		B Mesh Topology
2.3	A device that provides battery backup when the electrical power fails or drops to an unacceptable voltage level.		C Data
2.4	Services that are based on the location of a mobile user as determined by the device's geographical location.		D Star Topology
2.5	The part of the World Wide Web that is not discoverable by means of standard search engines, including password-protected or dynamic pages and encrypted networks.		E UPS F Bridge
2.6	A type of networking where all nodes cooperate to distribute data amongst each other.		G Assembler
2.7	A program that takes basic computer instructions and converts them into a pattern of bits that the computer's processor can use to perform its basic operations.		H Worm I Router
2.8	A specification for a software program that connects a computer's firmware to its operating system.		J Inverter K Deep web
2.9	A software model whereby basic services are provided free of charge while more advanced features must be paid for.		L Dark web
2.10	A network device mainly operating at the data link layer of the OSI model with filtering and forwarding capabilities and sees the two networks as a single entity.		M Anti-Virus N BIOS
			O POPI
			P Compiler
			Q UEFI
			R Freeware
			S Freemium

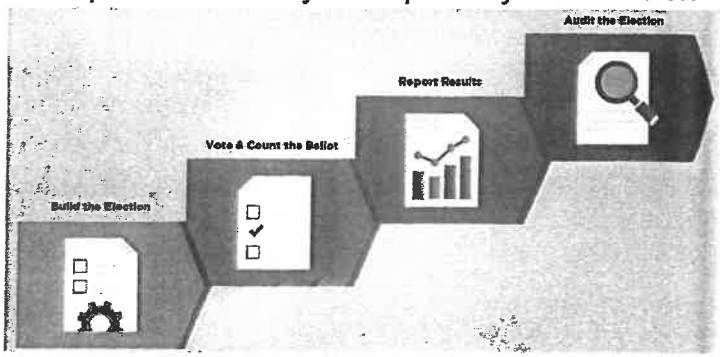
[10]

SECTION B SYSTEM TECHNOLOGIES

SCENARIO

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

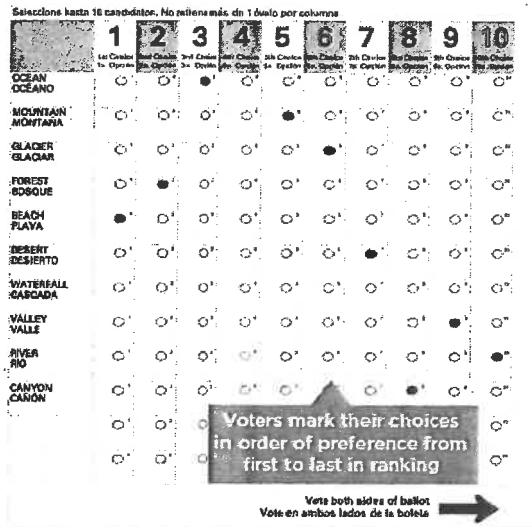
The Government of South Africa has decided that they want to upgrade the current voting system to an electronic vote counting system and have been approached by the company called Dominion, that provides a product that they could possibly make use of.

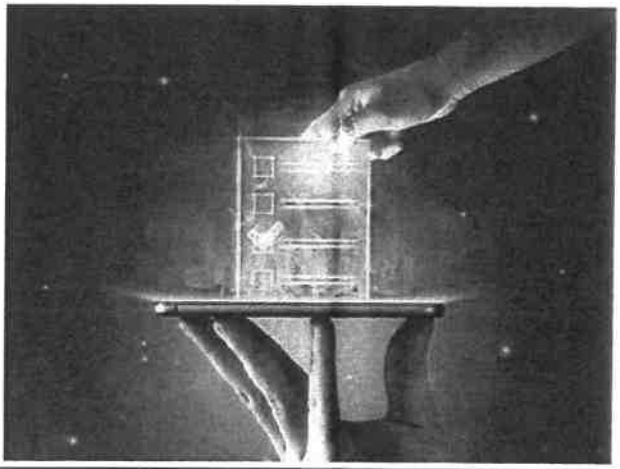


The system can still rely on physical ballots or can be completely electronic, based on the needs of the country. Much discussion is taking place in order to determine what exactly would be the best way forward for the country. Dominion guarantees security and validity, but safeguards have to be put into place in order to ensure a free and fair election.

Dominion's Democracy Suite System includes the most comprehensive and transparent Ranked Choice Voting functionality in the market today!

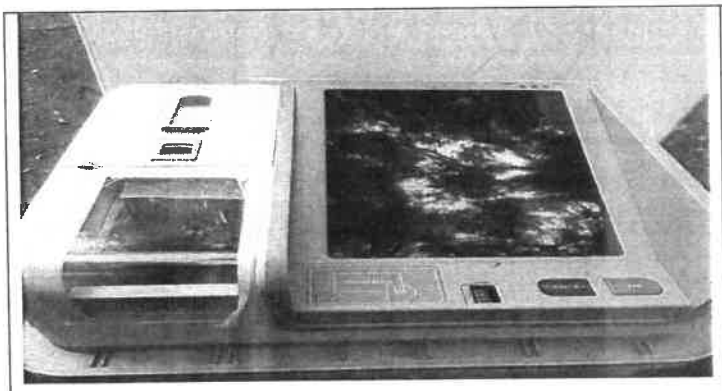
Whether voting in-person, by absentee, or in a vote centre, Dominion's Ranked Choice Voting ballots are easy to use and tabulate seamlessly across all our machines to provide you with FAST and IMMEDIATE results at the end of election day.





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
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:	1.8 GHz Octa-core T610
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? Motivate your answer. (2)

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 a function of a co-processor. (2)

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)

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)

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)

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

3.2 Examine the secondary storage of both devices.

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

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

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

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)

3.4 Which Operating System does each of these devices use? (2)

Give the three main functions of an OS. (3)

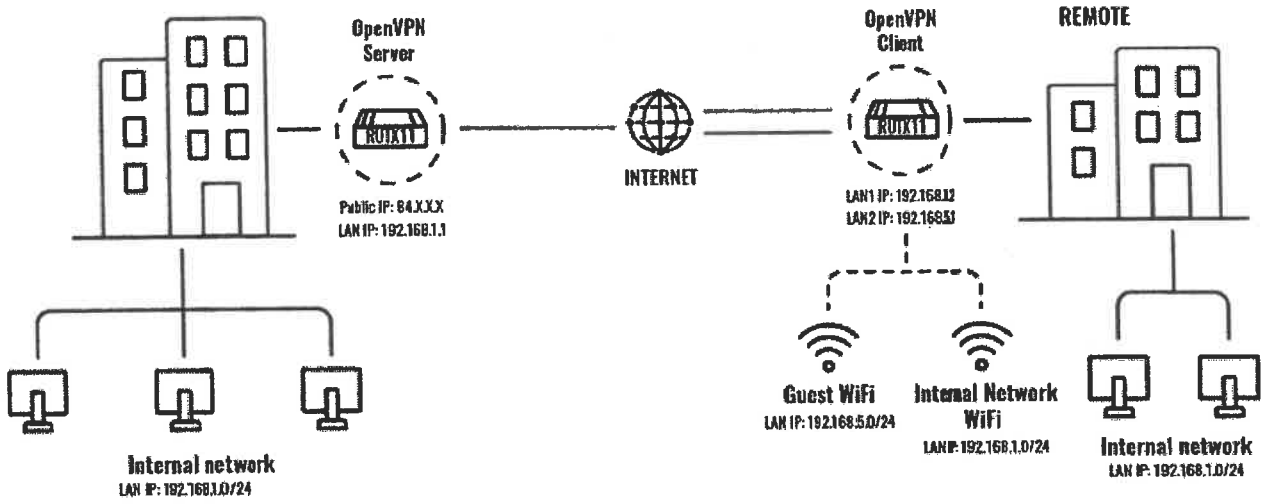
[27]

27 marks

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)

4.2. The network on the left in the diagram (on page 10) 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 recommend.? (3)

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

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 (on page 10), OpenVPN is being used in the network.

(a) Explain clearly what that is. (1)

(b) Why they are using it? (1)

(c) What the implications are for using that in this network configuration? (2)

4.2.4 What purpose would each of the following devices serve in this network (on page 10)? Give a practical application related to the scenario for each in the Application column in the table below. (8)

	Function	Application
Gateway		
Bandwidth		
Firewall		
UDP		

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)

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 functions of your choice in your explanation. (3)

QUESTION 5

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

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

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 describe the best way in the context of the scenario. (3)

5.4 Give three ways in which Wi-Fi vulnerabilities be prevented at the mobile voting stations? (3)

5.5 Why are updates and upgrades important? (2)

[11]

38 marks

SECTION D SOCIAL IMPLICATIONS

QUESTION 6

6.1 Read the following extract from a case study on **the possibility ofmaking 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 anddifferences 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 thatwill provide users with a tool for expressing their opinion, however, it was quickly made clearthat 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)

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)

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)

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)

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

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)

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** (integer);
- 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:
Methods:

Technician
Fields:
Methods:

Indicate the correct arrow by drawing a circle around it:

SeniorTechnician extends Technician
Fields:
Methods:

(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)

7.3 Explain the difference between a **class** and an **object**. (2)

7.4 What is the role of a **constructor method** and how is this achieved? (2)

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)

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)

7.7 Fill in the missing code below for the **convertPassword** helper method in the Technician class. (5)

```
7.7.1 _____ _____ convertPassword()
{
    String 7.7.2 _____ ="";
    for (7.7.3 _____ _____ x++)
    {
        convertedPassword+=7.7.4 _____;
    }
    return 7.7.5 _____;
}
```

[30]

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 this information, 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	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

(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
```

(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 lines.

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

(7)

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

_____

(1)

[20]

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.