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TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
MAY 2021

INFORMATION TECHNOLOGY: PAPER 1

EXAMINATION NUMBER

Time: 3 hours 180 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 each question.
3. Answer ALL questions – there are no options in this paper.
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 MARKERS' USE ONLY

Question	1	2	3	4	5	6	7	**Total**
Marks	10	10	33	55	19	22	31	**180**
Obtained								
Moderated								

SECTION A SHORT QUESTIONS

QUESTION 1 DEFINITIONS

Supply a concise definition for each of the following computing terms. It is insufficient to merely expand an acronym.

1.1 Polymorphism

(2)

1.2 Biometrics

(2)

1.3 RSI

(2)

1.4 Clock multiplier

(2)

1.5 Hot-swappable

(2)

[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. Write your answer in Column B.

Example: 2.0 W

Column A	Column B	Column C
2.0 Computer term	W	A a protocol which doesn't worry if packets are lost in data transmission
2.1 Parameter		B a network node equipped for interfacing with another network which uses different communication protocols
2.2 CMOS		C an interface for transferring high definition video and audio
2.3 SEO		D the conversion of scanned images of text into editable text
2.4 HDMI		E data which is passed into a method or sub-program
2.5 Cloud computing		F a way to ensure that your website attracts the most hits
2.6 Constant		G a virtual network
2.7 Gateway		H a programming concept which groups methods and fields of an object together
2.8 OCR		I a networking technology which makes use of servers and storage linked to the internet
2.9 Encapsulation		J non-volatile memory which has pre-loaded information
2.10 UDP		K a data type whose value never changes
		L a fault-tolerant transmission protocol
		M a programming value which does not change

[10]

20 marks

SECTION B SYSTEM TECHNOLOGIES

Consider the following scenario when answering **questions 3 and 4**. **Questions in other sections may also refer to the scenario but this will be indicated in the question**.

The Clan is a group of young computer gamers who meet regularly to play the latest games. They aim to have the best PCs optimised for playing games.

QUESTION 3

Bob, a new member of **The Clan**, has been reading about ways to improve the performance of his laptop, which is a little older than the others', for gaming purposes. His laptop currently has an on-board graphics card and it is still covered by a warranty. From two online articles, he has made the following list:

- Update your drivers
- Overclock your GPU
- Upgrade your graphics card
- Defragment your HDD
- Regularly clean your laptop
- Close background applications
- Disable automatic updates

Bob has asked for your assistance regarding these suggestions.

3.1 Updating drivers.

3.1.1 What is a driver?

_____

(1)

3.1.2 Explain to Bob why it is important to update drivers and how this will improve the laptop's performance.

_____

_____

_____

_____

(2)

3.2 Bob has previously experimented with overclocking the CPU on his laptop.

3.2.1 What is overclocking?

(2)

3.2.2 Explain to Bob why the article he read focusses more on the GPU being overclocked, rather than the CPU.

(2)

3.3 Upgrading the graphics card on a laptop is not always possible.

3.3.1 Give TWO reasons why Bob won't be able to upgrade his graphics card.

(2)

3.3.2 Other than overclocking the GPU or replacing the graphics card, give ONE other way in which Bob might be able to improve the performance of his graphics card without purchasing any new hardware.

(1)

3.4 Defragmenting a HDD (mechanical) is important for all laptop and PC users.

3.4.1 Why do HDDs need to be defragmented?

_____

_____

(1)

3.4.2 Give TWO factors where the performance of Bob's laptop will improve while playing games as a result of having defragmented the HDD.

Factor 1: _____

_____

(1)

Factor 2: _____

_____

(1)

3.5 Bob is particularly confused by the tip which suggests that he should regularly clean his laptop. He doesn't know how this might help improve its performance, particularly with reference to cooling.

Suggest ONE reason why a dirty laptop might slow down the performance of a laptop.

_____

_____

(1)

3.6 Bob has been reading more about the second-last tip, i.e. "close background applications". His reading has suggested that applications running in the background will "consume unnecessary CPU cycles and RAM".

3.6.1 What is meant by a "background application"?

_____

_____

(1)

3.6.2 Give an example of a background application.

_____

_____

(1)

3.6.3 Explain to Bob what is meant by a "CPU cycle".

(2)

3.7 The last item on the list relates to automatic updates.

3.7.1 Name TWO items which often receive automatic updates.

Item 1: _____

Item 2: _____

(2)

3.7.2 Give ONE reason why computer users are normally advised to have automatic updates turned ON.

Reason: _____

(1)

3.7.3 Why would turning automatic updates OFF allow for improved gaming performance on Bob's laptop?

(2)

3.8 After listening to your explanations, Bob believes it is probably a better idea to purchase a new, affordable laptop or desktop PC for gaming. He will use this laptop/desktop for his studies. Bob has access to an unlimited Google Account for data storage. He has made a list of possible specifications for CPU, RAM and HDD for a new machine.

Component	**Option 1**	**Option 2**	**Option 3**
CPU	i5 4-core 2.6 Ghz	i7 4-core 3.8 Ghz	i7 6-core 4.3 Ghz
RAM	12 GB	128 GB	16 GB
HDD	1 TB	2 TB	4 TB

3.8.1 Write down and justify which option for each component you would recommend. Your justification must relate clearly to the PC he is going to buy, and should not be something like "Because it is the fastest" or "This is the biggest".

(a) CPU

Option: _____

Justification: _____

_____

_____

_____

(2)

(b) RAM

Option: _____

Justification: _____

_____

_____

_____

(2)

(c) HDD

Option: _____

Justification: _____

_____

_____

_____

(2)

3.8.2 All CPUs in desktop PCs and laptops need to be cooled. Explain to Bob why they need to be cooled and what might happen if they are not sufficiently cooled. Recommend TWO techniques that can be used for CPU cooling on either a laptop or a desktop PC.

Reason for cooling	
Consequence of not cooling	
Technique 1	
Technique 2	

(4)

33 marks

SECTION C INTERNET AND COMMUNICATION TECHNOLOGIES

QUESTION 4

The Clan would now like to expand their gaming offering and start playing games over a LAN. In order to do this, they will have to install a network at the venue where they meet.

4.1 Members of **The Clan** have decided to install a network with an all-in-one router, which includes a switch, and LAN cables to each node.

4.1.1 What is the name given to the topology of the network they have installed?

_____

(1)

4.1.2 (a) What is a switch? _____

_____

_____

(1)

(b) Explain how a switch reduces network traffic: _____

_____

_____

_____

_____

(2)

4.2 Three of the members of **The Clan** have laptops which don't have a LAN port.

4.2.1 What is a LAN port?

_____

_____

(1)

4.2.2 Suggest ONE way these three laptops will be able to connect to the network to be able to play games.

_____

_____

(1)

4.2.3 Will the all-in-one router need to be changed to allow these three laptops to connect via the connection method you mentioned in Question 4.2.2? Justify your answer with ONE reason.

_____

_____

_____

_____

(2)

4.3 Bob has been reading about network speed and wants to know a little more about how this can affect playing games, both on the local network and over the Internet.

4.3.1 What unit of measurement is most commonly used to measure the speed of a LAN?

_____

_____

(1)

4.3.2 List TWO common causes of slow network performance in the type of LAN network which **The Clan** have set up.

Cause 1: _____

_____

Cause 2: _____

_____

(2)

4.3.3 Bob wants to know how poor network speeds might affect their gaming ability. Explain to Bob how ONE of the causes you mentioned in Question 4.3.2 above might affect their gaming.

Cause/affect: _____

_____

_____

_____

(2)

4.4 When members connect their laptops or desktop PCs to the network, each one is allocated an IP address.

4.4.1 What is an IP address?

(1)

4.4.2 Explain to Bob why IP addresses must be unique within a LAN.

(2)

4.4.3 Explain why a network card needs both an IP address and a MAC address.

(2)

The Clan have decided that they would like to extend their gaming experience by playing games online with other gaming enthusiasts over the Internet. They have installed a server on the network to store gaming-related programs and data. They have access to an Internet connection.

4.5 The Internet connection they have is asymmetrical.

4.5.1 What is meant by an asymmetrical connection?

(1)

4.5.2 Will an asymmetrical connection be suitable to gaming? Justify your answer with ONE reason.

Yes/No: _____

(1)

Reason: _____

_____

_____

_____

(2)

4.6 Bob and the other members of **The Clan** are aware that having an online server for gaming might lead them to be vulnerable to an attack from rival gamers.

For each of the solutions listed in the table below, you are required to explain to **The Clan** whether each would enhance the security of their network from an outside attack by explaining the function of each on their network.

Solution	**Prevent attacks? Y/N**	**Explanation**
Installing a UPS		
Installing anti-virus software		
Using RAID		
Installing a firewall		

(12)

4.7 **The Clan** have decided to set up a website which will allow them to promote their gaming group and encourage new members. They will have a number of different services running on their server, including a space where the public can log in, purchase **The Clan** T-shirts and caps, as well as registering to become members of **The Clan**. They realise that their webserver needs to be secure and Bob has asked for some information about SSL.

4.7.1 What software implements SSL?

(1)

4.7.2 SSL uses TWO keys. What are these keys called and why are two needed?

(3)

4.7.3 What do **The Clan** need in order to guarantee secure connections to their webserver which users can trust?

(1)

4.7.4 What organisation will supply this to **The Clan**?

(1)

4.7.5 Bob has been doing more reading about keys. Their website is using a 256 bit key pair. He wants to know why some other websites use a 512 bit key pair. Explain the benefit of having a larger key.

(2)

4.7.6 How can any users of **The Clan's** website know that their data transmissions are secure?

_____

_____

(1)

4.7.7 Give an example of a website that might not use SSL and explain why it would not be necessary in that instance.

Example: _____

Explanation: _____

_____

_____

(2)

4.8 **The Clan** need to further boost their presence online to get more members and sell more goods. They are looking at a number of social media options to assist. For each of the options listed below, you need to explain what benefit each could have for **The Clan**.

Social Media	**Benefit**
Twitter	
Facebook	
Blog	

(3 × 2 = 6)

4.9 A lot of the questions you have answered in this section have been based on what Bob and other members of **The Clan** have read online. Online content can often be inaccurate, which doesn't help those who are doing research.

You need to give Bob FOUR points to help him evaluate any website and be able to know whether the content is credible or not.

Point 1: _____

_____

_____

(1)

Point 2: _____

_____

_____

(1)

Point 3: _____

_____

_____

(1)

Point 4: _____

_____

_____

(1)

55 marks

SECTION D SOCIAL IMPLICATIONS

QUESTION 5

Read the following extract from an article on mobile phone security. This will be necessary to answer the questions that follow:

Are your phone camera and microphone spying on you?

In an interview, former FBI director James Comey stated that he covered his laptop's webcam with tape. If he does, we all should!

Who could be accessing your camera and microphone?

When a user grants an app like WhatsApp, Facebook, Snapchat, Instagram, Twitter or LinkedIn access to their camera and microphone, the app could do the following:

- Access both the front and the back camera.
- Record you at any time the app is in the foreground.
- Take pictures and videos without telling you.
- Upload the pictures and videos without telling you.
- Immediately upload the pictures/videos it takes.
- Run real-time face recognition to detect facial features or expressions.
- Livestream the camera on to the internet.
- Detect if the user is on their phone alone, or watching together with a second person.
- Upload random frames of the video stream to your web service and run a proper face recognition software which can find existing photos of you on the internet and create a 3D model based on your face.

Edward Snowden revealed an NSA program called "Optic Nerves". The operation was a bulk surveillance program under which they captured webcam images every five minutes from Yahoo users' video chats and then stored them for future use. It is estimated that between 3% and 11% of the images captured contained "undesirable nudity".

Government security agencies like the NSA can also have access to your devices through built-in backdoors. This means that these security agencies can tune in to your phone calls, read your messages, capture pictures of you, stream videos of you, read your emails, and steal your files … at any moment they please.

[Adapted from: <https://www.theguardian.com/commentisfree/2018/apr/06/phone-camera-microphone-spying> Accessed 20 May 2019]

5.1 When installing an application such as those listed in the article, users will be asked if they want to give the application access to their microphone and camera.

5.1.1 Do you believe that the average user thinks carefully about granting this access? Justify your answer.

Answer: _____

(1)

Justification: _____

_____

_____

(1)

5.1.2 If Facebook recorded an image of a person using Facebook by making use of the webcam, give TWO ways that Facebook could use this image.

Use 1: _____

_____

_____

_____

(1)

Use 2: _____

_____

_____

_____

(1)

5.1.3 Facebook Lite (an app designed for poor data connections and low-end phones, targeting developing countries) suffered a data breach when a Facebook employee revealed that usernames and passwords were stored as plain text.

(a) What document defines the digital behaviour of an employee?

_____

_____

(1)

(b) Do you believe that Facebook should take action against the employee for revealing the breach? Justify your answer.

(2)

5.1.4 What is meant by a "backdoor", referred to in the last paragraph?

(2)

5.1.5 Give TWO examples where making use of access to a phone's microphone or camera could be to the **advantage** of the phone owner.

Example 1:

(1)

Example 2:

(1)

5.1.6 Give TWO practical methods by which a user could detect unsanctioned use of their phone, i.e. their audio or video data is being intercepted or removed from their phones.

Method 1: _____

_____

_____

_____

(1)

Method 2: _____

_____

_____

_____

(1)

5.2 Later in the article (not shown here) the author goes on to explain that it is not only governments who might have access to people's mobile phones, but hackers can do the same. With reference to the gaming scenario, define the terms "hacker" and "cracker" and describe typical behaviour of each.

5.2.1 Hacker: _____

_____

Behaviour: _____

_____

_____

(2)

Cracker: _____

_____

Behaviour: _____

_____

_____

(2)

5.2.2 Give ONE way in which a hacker might be able to gain access to a person's mobile phone to either eavesdrop on their conversations, or view files on their phones.

_____

_____

_____

_____

(2)

19 marks

SECTION E DATA AND INFORMATION MANAGEMENT AND SOLUTION DEVELOPMENT

QUESTION 6

Assume South Africa holds elections every 10 years, and it is compulsory to vote in the elections if you are 18 years of age or older in the year in which the election takes place, and you are a citizen of the country. Also assume that citizens are fined if they do not vote. Elections took place in 2019. The government holds a database of all people living in the country with the following information:

Field	Description
ID	Unique ID number for each person
Surname	The surname of the person
First Name	The first name of the person
Province Code	A one- or two-character abbreviation of the province where the person lives
Province Name	The full name of the province where the person lives
Citizen	Is the person a citizen of the country?
Previous vote	Did the person vote in the previous election?
Fine	Any unpaid fine as a result of not voting in previous elections

The first SIX digits of the ID field are the date of birth of each person in the format yymmdd. Voters may have been born in either the 20th or 21st Centuries.
Sample data for this table is shown below. (Please note that some data may have been captured incorrectly.)

tblVoters

ID	Surname	First Name	Province Code	Province Name	Citizen	Previous vote	Fine
6805014578963	Nelson	Lance	G	Gauteng	Yes	Yes	0.00
0308147821453	Cain	Sylvester	L	Limpopo	Yes	No	100.00
0102034512032	Robbins	Eve	K	KwaZulu-Natal	Yes	Yes	0.00
7810253652145	Joyce	Ruby	NC	Northern Cape	No	Yes	0.00
0102034512032	McClain	Sonja	EC	Eastern Cape	Yes	Yes	0.00
9612013265214	Dudley	Hop	WC	Western Cape	No	No	0.00
0312013265214	Dale	Minerva	K	KwaZulu-Natal	Yes	No	100.00
4532033262312	Joyce	Ruby	G	Gauteng	Yes	Yes	0.00

6.1 The field ID is initially chosen as the primary key in this table.

6.1.1 Why does a database table need a primary key?

(2)

6.1.2 Explain why a person's name (first name or surname) is not a good primary key in a database.

(2)

6.1.3 Surname and first name have now been suggested as a possible primary key, along with just the ID field.

(a) What name is given to all possible keys of a table?

(1)

(b) What is the name for a key which consists of more than one field?

(1)

6.2 The final key for the table has been chosen as **Province Code** and **ID**.

6.2.1 Why do we need two fields for the key when ID field is unique?

(2)

6.2.2 For any of the anomalies; update, insert and delete, explain why TWO of these will be problematic in THIS database.

Anomaly 1: _____

_____

_____

(1)

Anomaly 2: _____

_____

_____

(1)

6.2.3 Why is it necessary to remove transitive dependencies when normalising?

_____

_____

_____

_____

(2)

A reminder:

- Elections are held every 10 years.
- It is compulsory to vote in the elections if you are 18 years of age or older in the year in which the election takes place, and you are a citizen of the country.
- Citizens are fined if they do not vote.
- Elections took place in 2019.

6.3 The integrity of the data in this table is questionable. Study the data in the table carefully.

6.3.1 Identify and explain THREE errors when looking at the data in the table in conjunction with the above voting rules.

Error 1: _____

_____

_____

_____

(2)

Error 2: _____

(2)

Error 3: _____

(2)

6.3.2 Explain how a programmer could have ensured that the data was not captured incorrectly.

(2)

6.3.3 Name and explain ONE technique the database administrator could use to try and find out how and when the errors occurred.

(2)
[22]

QUESTION 7

In order to assist with monitoring the elections, you have been asked to write some Java/Delphi code according to OOP principles.

Information about the current election's voting will be stored in a text file and you are going to develop an object definition class which will allow for **Voter** objects to be instantiated, and later stored in an array of **Voter** objects, named **voterArr**.

Each **Voter** object will have the following properties:

voterName – string	//first name and surname combined
voterID – string	//the same ID format as used in the database in Question 6
hasVoted – Boolean	//this field indicates whether or not the person voted – true or false

The data file ONLY contains data relating to those people who are citizens.

7.1 Complete the blank class diagram below to represent the **Voter** class. You should use the fields shown above. The **Voter** class will need the following:

- Accessor methods for all three fields;
- A mutator method for the **hasVoted** field. The mutator method should accept a Boolean parameter called "hv";
- A parameterised constructor method which will accept THREE parameters, "vn", "vid", "hv" which correlate to the fields defined above;
- A **toString**() method which will display all the fields of a **Voter** object.

Class Name:
Fields
Methods

(10)

7.2 There is suspicion of election fraud in the current election. You have been supplied with a text file with some data regarding the voting which took place. A sample of the data in the text file, with fields for **voterName**, **voterID** and **hasVoted**, is shown below.

```
Lance Nelson#6805014578963#No
Cain Sylvester#0308147821453#No
Eve Robbins#0102034512032#Yes
Sonja McClain#0102034512032#No
Minerva Dale#0312013265214#No
Ruby Joyce#4506094512302#Yes
Bill Watkins#6602183265214#Yes
David Briggs#0408293625124#Yes
Jimmy Baldwin#0405305462321#No
Mary Howard#0104193254125#Yes
```

You are required to write an algorithm which will examine each line of data in the text file and report as follows:

- If the voter was eligible to vote and did not vote, i.e. this person should be fined;
- If the voter was not eligible to vote and did vote, i.e. this person voted fraudulently.

Sample output from the algorithm might be as follows:

>name< was eligible to vote and did not vote – fine this person! or
>name< was not eligible to vote and did vote – FRAUD!

Some points to remember:

- Voters may vote in an election in the year they turn 18, in other words they may vote even if they haven't turned 18 at the time of the election, provided they do turn 18 in that year;
- The data file contains details of voters who were born in both the 20th and 21st centuries.

open file for reading loop to read file begin
end loop

(12)

7.3 The process of vote counting is under way, and the results are starting to arrive at the Election Head Quarters (HQ). Each area sends data to the HQ in the form of an array of **VoteResult** objects. Each **VoteResult** object has TWO fields, a party name and the number of votes that party received. As each **VoteResult** object is instantiated, it will be placed in an array of objects, defined by the class **PartyArr**. This class has two private fields named **pArr** to store the array of vote result object and **counter** to record the number of **VoteResult** objects.

An example of the array might look like this:

Array element	pArr [0]	pArr [1]	pArr [2]	pArr [3]	pArr [4]	pArr [5]
Party name Number of votes	Mater 82898	Zoom 202707	Still 12137	Hedel 147555	Glad 141631	Highlands 219775

There is, however, suspicion of irregular or illegal voting having taken place. An investigation has revealed that this has happened with more than one party, and the election officials have ruled that each guilty party must have the number of votes reduced by 1000. They have created a method, called **adjustVotes()** which will be part of the **PartyArr** class. The method will reduce the number of votes in a **VoteResult** object given the name of the party. The algorithm for this method is shown in Appendix A on page 31.

7.3.1 Will the **adjustVotes()** method be a typed method or a void method? Justify your answer with ONE reason.

Typed/Void: _____

(1)

Reason: _____

_____

_____

(1)

7.3.2 How will the method receive the value for the party name (allocated to **party** in line 1 of the algorithm) which needs to be tested against each element in the array?

_____

_____

_____

_____

(2)

7.3.3 (a) Where in the **PartyArr** class would the field **counter** have received its value of 6?

(1)

(b) What is the benefit of counter being declared as private?

(2)

7.3.4 The purpose of the **PartyArr** class is to store and adjust votes (if necessary) of a party. Why would this class still need a **toString()** method?

(2)
[31]

53 marks

Total: 180 marks

APPENDIX A

PartyArr Class

Array element	**pArr [0]**	**pArr [1]**	**pArr [2]**	**pArr [3]**	**pArr [4]**	**pArr [5]**
Party name Number of votes	Mater 82898	Zoom 202707	Still 12137	Hedel 147555	Glad 141631	Highlands 219775
Counter 6						

Algorithm for the AdjustVotes method

1	party ← name of party
2	for loop ← 0 to <= counter-1
	begin
3	if pArr [loop].getPartyName = party
	begin
4	temp ← pArr [loop].getNumVotes – 1000
5	pArr [loop].setNumVotes(temp)
	end if
	end loop

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

