INFORMATION TECHNOLOGY: PAPER I

EXAMINATION NUMBER

Time: 3 hours   180 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1.   This question paper consists of 28 pages and an Appendix of 1 page (i). 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 on the question paper. Please make sure that you write your examination number in the blocks 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.   There are two blank pages at the end of this paper. In case you run out of space when answering a question, use these pages. Clearly indicate the number of the question you are working on.

SECTION A   SHORT QUESTIONS

QUESTION 1   DEFINITIONS

Supply a concise definition for each of the following computing terms.

1.1   Freeware

_____

_____   (2)

1.2   Cloud computing

_____

_____   (2)

1.3   Archiving

_____

_____   (2)

1.4   Multitasking

_____

_____   (2)

1.5   Method overloading

_____

_____   (2)
[10]

QUESTION 2   MATCHING COLUMNS

For each of the terms in Column A below, select the **most correct** definition in Column B, matching the letter to the question number. Merely write down the appropriate letter next to the question number.

Column A		Column B	
2.1	embedded operating system	A.	Reducing the number of files on your hard disk.
2.2	network backbone	B.	A piece of software that uses data about your physical position to control features of an application.
2.3	location-based service	C.	A data item created in a program.
2.4	encryption	D.	An application for instant messaging.
2.5	object	E.	A string that translates back to an IP address to allow access to a website.
2.6	STP	F.	A specialised operating system built into a larger system.
2.7	file compression	G.	Single Transfer Protocol.
2.8	bridge	H.	An item in programming that contains fields and methods.
2.9	POP3	I.	A device that only boosts the signal of a network.
2.10	domain name	J.	A part of a network that connects all other parts of the same network together.
		K.	A form of bounded media that is less susceptible to interference.
		L.	An email protocol that downloads messages to the mail client when the user connects to the mail server.
		M.	A technique to reduce the size of a file.
		N.	A web protocol.
		O.	The process of encoding data.
		P.	A device that creates a single network from multiple network segments and can reduce network traffic.
		Q.	The process of password-protecting a file.

2.1 _____   2.2 _____

2.3 _____   2.4 _____

2.5 _____   2.6 _____

2.7 _____   2.8 _____

2.9 _____   2.10 _____

[10]

20 marks

SECTION B　　　　SYSTEM TECHNOLOGIES

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

GoodReads is a library in a South African village. The library aims to encourage children who live in the village to read more books. The librarian has decided that the library needs to introduce computer-based systems. A committee is giving technical advice.

QUESTION 3

An old, unused PC was donated to **GoodReads**. The PC is intended to be used for keeping a database of the books in the library, issuing and returning of books, stocktaking, writing letters, calculating budgets, communicating via email and meeting the librarian's day-to-day computer needs. It has the following specifications:

- Intel® Core™ 2 Duo CPU 2.4 GHz (Socket 775 LGA)
- 2 GB DDR RAM
- 1.2 GB HDD (mechanical hard disk)
- 400 W power supply
- 15 inch colour monitor
- Microsoft® Windows® XP Home Edition

The only computer store in the village has advised that the computer should be upgraded with the following:
- Intel® Core™ i3 (dual core) 3.40 GHz (Socket 1151 LGA)
- 4 GB DDR3 RAM
- 1 TB SSD (solid-state drive)
- 21 inch LED colour monitor

3.1　　How many cores does the original processor have?

(1)

3.2　　A member of the committee has suggested that not all these upgrades might be possible considering the specifications of the original computer.

　　　　3.2.1　A member of the committee believes that 4 GB of RAM will not be enough because the operating system and user data could easily need more than 4 GB of storage. Another person has mentioned virtual memory.

　　　　　　　　(a)　　What is virtual memory?

(2)

(b)   Explain how virtual memory will address the concern raised by the committee member.

(3)

3.2.2   The proposed new drive is a solid-state drive (SSD).

(a)   When compared to a mechanical hard drive (HDD), how is data stored on an SSD?

(1)

(b)   Another committee member suggests a hybrid drive should rather be used. What does a hybrid drive consist of?

(2)

3.2.3   By **comparing** the original specifications with the proposed upgrade, and making use of your knowledge of hardware components, state TWO upgrades that might **not** be possible. Substantiate your answer with an explanation.

Upgrade 1: _____

Reason: _____

Upgrade 2: _____

Reason: _____

(4)

3.2.4   Which part of the computer needs to be changed to make most of the upgrades possible? Justify your answer.

(2)

3.3   A committee member has suggested that a laptop might be a better option for the librarian than a desktop.

Give one advantage and one disadvantage of a laptop and a desktop in this scenario. Your answers may not be opposites of each other, e.g. your advantage for a laptop may not be the opposite of your disadvantage for a desktop.

	Laptop	**Desktop**
Advantage		
Disadvantage		

(4)

3.4   The librarian would like to introduce e-books once the library computer system is fully operational.

3.4.1   What is an e-book reader?

(2)

3.4.2   List TWO reasons why an e-book is more user-friendly than a print book.

Reason 1:

Reason 2:

(2)

3.5   Each book in the library needs to have a barcode that will be used to uniquely identify the book and assist with the issuing and returning of books.

      3.5.1   What hardware device will be needed to read the barcode?

                           (1)

      3.5.2   The librarian has two options when using barcodes: use the standard barcode, which is on most books to identify the book, or have barcodes printed especially for the library, one for each book.

            Considering the scenario:

            (a)   Justify using the standard barcodes on books.

                           (2)

            (b)   Justify having specific barcodes printed for the library.

                           (2)

3.6   Virtualisation and cloud computing are current trends in computing.

Explain to the librarian how Software as a Service (SaaS) could be used in the current scenario by naming any TWO applications used by the library. Explain how your chosen application could be implemented using SaaS.

Name of Application 1:

Explanation:

Name of Application 2:

Explanation:

                           (4)

32 marks

SECTION C   INTERNET AND COMMUNICATION TECHNOLOGIES

QUESTION 4

The librarian wanted to expand the technology for members of the public to use in the library. In order to do this, a series of computers were purchased and installed in a peer-to-peer network.

The librarian also wants Internet connectivity in the library for online research and to be in contact with other libraries.

4.1   What is a peer-to-peer network?

(2)

4.2   Suggest and justify a network topology to be used in the library's peer-to-peer network.

Topology:

Reason:

(2)

4.3   There is no landline connectivity available in the village.

4.3.1   Name ONE possible unbounded means to establish Internet connectivity in the library.

(1)

4.3.2   What additional piece of hardware will be needed to allow any Internet connection to be used on the network?

(1)

4.4   Internet access has been established and it is proving very popular and library users want to bring their own mobile devices to the library to access the Internet. A Wi-Fi hotspot needs to be set up for these devices.

    4.4.1   What is a Wi-Fi hotspot?

_____

_____

_____ (1)

    4.4.2   The librarian is investigating ways to charge library users for Internet access on their personal devices. There are two options: charge for the amount of time a user is logged on to the hotspot, or charge for the amount of data used by a user.

Compare the two proposed methods of charging by giving TWO factors about each method that should be considered when making a decision.

Method/Factors	Charge for time used	Charge for data used
Factor 1		
Factor 2		

(4)

4.5 **GoodReads**, the village library, decided to create a library website to publicise the library and to make facilities available to people outside the village.

    4.5.1 There are a number of different web protocols used on websites. Give an example of what a user will be **doing** on the website that would require the following protocols.

- HTTP   _____

- HTTPS   _____

- FTP   _____

- WebDAV _____   (4)

    4.5.2 The librarian thinks the website should make use of Web 2.0 concepts.

      (a) What is meant by Web 2.0?

      _____   (1)

      (b) Select TWO features commonly found on social media sites like Facebook or Instagram and explain how these could be used on the library website.

      Feature 1: _____

      Explanation: _____

      _____

      _____

      Feature 2: _____

      Explanation: _____

      _____

      _____   (4)

    4.5.3 Library users would like to be able to write reviews of books they have read and publish them on the website. The librarian is unsure whether a blog or a wiki would be more suitable for this.

      (a) What is a wiki?

      _____

      _____   (2)

(b)   Which TWO features of a wiki would make it suitable in this context?

Feature 1: _____

_____

Feature 2: _____

_____   (2)

(c)   What is a blog?

_____

_____

_____

_____   (2)

(d)   Which TWO features of a blog would make it suitable in this context? Do not repeat any of the features mentioned in (b) above.

Feature 1: _____

_____

Feature 2: _____

_____   (2)

(e)   Would you recommend using a wiki or a blog? Justify your answer.

_____

_____

_____

_____   (2)

4.6   Several books have been stolen from the library. In order to help prevent any further thefts, **GoodReads** wants to start using RFID (radio frequency identification) tags on the books.

4.6.1   What is an RFID tag?

_____

_____

_____

_____   (2)

4.6.2   Explain how RFID tags will help reduce theft in the library.

_____

_____

_____

_____   (2)

4.6.3   Where would you suggest the RFID tags are placed on books?

_____

_____   (1)

4.7   The librarian has been reading about peer-to-peer file sharing and that it can often lead to illegal activities.

4.7.1   Explain the concept of peer-to-peer file sharing.

_____

_____

_____

_____   (2)

4.7.2   **Compare** peer-to-peer file sharing and peer-to-peer networking showing the similarities and differences between the two. You need to use ONE factor in your comparison. Your answers may not be opposites of each other.

Method/Factor	Peer-to-peer file sharing	Peer-to-peer networking
Factor		

(2)

4.7.3   Under what circumstances is peer-to-peer file sharing legal?

_____   (1)

4.8   When viewing a number of overseas websites, the librarian notices that there is often a warning about the use of cookies.

    4.8.1   What is a cookie?

                      (2)

    4.8.2   What is the purpose of a cookie on a website such as *amazon.com*?

                      (2)

    4.8.3   Explain why websites give a warning about their use of cookies.

                      (1)

    4.8.4   Explain TWO ways in which the website for the village library might make use of cookies.

                      (2)

4.9   **GoodReads** wants to make audio recordings of books available via their website so that blind people can also benefit from the books in the library.

    4.9.1   (a)   What file type would you recommend using for the audio files created by the recording process?

                      (1)

(b)　　Should the audio file compression be lossy or lossless? Justify your answer.

lossy / lossless (Circle ONE)

Justification: _____

_____

_____

_____　　(2)

4.9.2　The librarian has asked for advice as to whether the audio files should be streamed or downloaded from the website.

Compare the two options (streaming vs downloading) by mentioning TWO factors about each technology. The factors you give may not merely be opposites of each other.

Method/Factors	Streaming	Downloads
Factor 1		
Factor 2		

(4)

4.9.3　Is it legal to make audio recordings of books and upload these recordings to the library website? Justify your answer.

_____

_____

_____

_____　　(2)

56 marks

SECTION D   SOCIAL IMPLICATIONS

QUESTION 5

Read the following extract from an article on cybersecurity and answer the questions that follow.

Becoming cyber-smart

2016 was a significant year for cybersecurity. We saw the Russian "Fancy Bears" hacking team leaking athletes' medical data, the Tesco Bank hack, and the Bank of Bangladesh heist – where US$101 million was stolen in a cyber attack. And all this before we get to the alleged Russian hacking of the US election campaign ...

The hackers and cyber criminals are improving their game. Amongst the most concerning developments is the continuing increase in ransomware, and the release of the Mirai malware onto the Dark Web in October 2016. Mirai can turn "Internet of Things" (IoT) devices such as webcams, CCTV systems and home broadband routers into a large, malicious network called a "Botnet", which can be used to undertake large-scale distributed denial-of-service (DDoS) attacks against websites.

Businesses – as well as the general public – will need to be smarter and adapt to these threats if they don't want to fall victim to an increasingly sophisticated and well-coordinated network of cyber gangs.

[Adapted from: <http://www.huffingtonpost.co.uk/vince-warrington/2017-the-year-we-all-need_b_14101814.html> Accessed 25 January 2018]

5.1   What is meant by a DDoS attack in the above article? Explain how such an attack would affect a website. Do not merely expand the acronym.

_____

_____

_____

_____   (3)

5.2   The extract refers to "ransomware", a form of cyber attack.

     5.2.1 Describe how a ransomware attack could cause loss of data.

     _____

     _____

     _____

     _____

     _____

     _____   (3)

5.2.2   Name TWO techniques that everyday computer users can use to ensure they do not fall victim to a ransomware attack.

Technique 1: _____

_____

Technique 2: _____

_____   (2)

5.3   Later in the article (not shown here), the author suggests that there is a lack of cybersecurity staff worldwide. This obviously presents several challenges to IT companies and leaves a gap in a vital aspect of their IT security.

One option to help reduce this risk is to train current software developers, operations teams and tech support staff to learn about cybersecurity. Give TWO possible benefits of this approach for the individual organisation or individual employees.

Benefit 1: _____

_____

_____

Benefit 2: _____

_____

_____   (2)

5.4   There are a number of simple techniques to help prevent certain forms of cyber attacks. One of these is to have secure passwords.

List TWO characteristics of a secure password.

Characteristic 1: _____

_____

Characteristic 2: _____

_____   (2)

5.5   Information overload is a worrying trend in the 21st century.

5.5.1   Define information overload with reference to human beings.

_____

_____   (1)

5.5.2 Assume you are the chief/leader of the village. Give ONE example of the effect that information overload might have on your day-to-day work activities.

_____

_____

_____

_____ (2)

15 marks

SECTION E   DATA AND INFORMATION MANAGEMENT AND SOLUTION DEVELOPMENT

QUESTION 6

GoodReads has a database that stores details of all the books in the library. The following data is stored in the database:

Field	Description
BookID	Unique ID for each book in the library
Title	The title of the book
Genre	The genre of the book
Author	The author of the book; first name and surname
BirthCountry	The country where the author was born
TimesBorrowed	A count of how many times the book has been borrowed
MemberID	The unique ID of the person who currently has the book if it is not in the library
DaysOverdue	The number of days the book is overdue, i.e. the number of days past the return date
Fine	The value of the fine the member must pay if the book is overdue

Sample data for table tblBooks is shown below:

tblBooks

BookID	Title	Genre	Author	BirthCountry	TimesBorrowed	MemberID	DaysOverdue	Fine
1	The Hobbit	Fantasy	JRR Tolkien	South Africa	59	4	0	
2	The Da Vinci Code	Conspiracy Fiction	Dan Brown	United States	48	3	20	
3	Pride and Prejudice	Classic	Jane Austen	United Kingdom	18	6	4	
4	Jamie's 15 Minute Meals	Cooking	Jamie Oliver	United Kingdom	60	2	2	
5	The BFG	Children	Roald Dahl	United Kingdom	59	1	0	
6	Animal Farm	Satire	George Orwell	India	36	3	0	
7	The Shining	Horror	Stephen King	Australia	44	7	1	
8	Noddy in Toyland	Children	Enid Blyton	United Kingdom	78	1	3	

6.1   **BookID** and **MemberID** have been suggested as the primary key.

6.1.1   What is a primary key made up of more than one field called?

(1)

6.1.2 Describe an insert anomaly that could result from this choice of primary key.

_____

_____

_____

_____ (2)

6.1.3 Name TWO other types of anomalies.

_____

_____ (2)

6.2 Assume **BookID** and **MemberID** are chosen as the primary key. It is good practice to normalise a database. This process identifies two types of data dependencies: partial and transitive.

6.2.1 Define a partial dependency.

_____

_____

_____

_____ (2)

6.2.2 Define a transitive dependency.

_____

_____

_____

_____ (2)

6.3   The field **Fine** has been left blank on purpose. A fine is calculated as follows: for each day a book is overdue (past the return date), the person who has borrowed the book will be charged an amount of 50 cents.

Example: the book *The Da Vinci Code* (BookID 2) is 20 days overdue. Therefore, the fine payable is R10,00.

6.3.1   What type of SQL query will need to be written to populate the **Fine** field? Choose from insert/select/update/delete.

_____   (1)

6.3.2   Complete the following SQL statement to calculate the overdue fine to be paid. The output field generated by your query should be headed "FinePayable". Exclude books that are NOT overdue.

SELECT _____ AS _____

FROM _____

_____

WHERE _____

_____

_____   (5)

6.3.3   Explain why defining a field that contains the number of days a book is overdue is not a good way to keep track of overdue books.

_____

_____

_____

_____   (2)

6.3.4   (a)   Suggest a different field to track the number of days a book is overdue.

_____

_____   (1)

(b)   Describe how this field would be used to determine the number of days the book is overdue.

_____

_____

_____   (2)

6.4   Data in a database must be protected and managed properly. If data is lost or changed incorrectly, we need to be able to know why and rectify the problem.

      6.4.1 (a)   What is an audit trail?

                    (1)

          (b)   How will an audit trail assist when data is changed incorrectly?

                    (2)

      6.4.2   How do we restrict who can make changes to data in a database?

                    (1)

      6.4.3 (a)   What are parallel data sets?

                    (1)

          (b)   How will parallel data sets assist when data is changed incorrectly?

                    (2)

[27]

QUESTION 7

The library is now going to use an object-oriented programming (OOP) solution rather than a database. **Book** objects will be instantiated and stored in an array of **Book** objects named **bookArr**. Each object will have the following properties that should not be accessible from outside the **Book** class:

bookID – integer
title – string
genre – string
timesBorrowed – integer

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

- Accessor methods for the **genre** and **timesBorrowed** fields.
- A mutator method for the **title** field. The mutator method should accept a string parameter "t".
- A parameterised constructor method that will accept four parameters, "b", "t", "g", "tb", which correlate to the fields defined above.
- A **toString**() method that will display all the fields of a **Book** object.

Class name:
Fields:
Methods:

(10)

7.2   The librarian would like to know which genre is the most popular. This will be worked out based on the number of times a book is borrowed. Your assistance has been requested to help write an algorithm to answer her question.

       7.2.1   What is an algorithm?

                                                                    (2)

       7.2.2   Explain why an algorithm can be used to code programs in any programming language.

                                                                     (2)

7.2.3 The algorithm to work out the most popular genre will form part of the **BookArray** class. The **BookArray** class is used to instantiate an array of **Book** objects, and to undertake other tasks. The array named **bookArr** is a field of the class and is declared together with an integer field called **size** to record the number of elements in array.

Book [ ] bookArr

size ← 0

A partial algorithm for a typed method called **popularGenre()** is shown below. You are required to complete the algorithm in the space provided. The **bookArr** array begins at index 0.

```
method popularGenre() : String
popular ← 0
position ← 0

//complete the algorithm here


























return  "The most popular genre is:" +
```

(6)

7.3   Another part of the OOP solution has an array that is used to store integer values. There appears to be some duplicate integers in this array, which should not be the case. A programmer has written an algorithm to remove these duplicate values and has coded it, but it is not working correctly. The algorithm he used to code his program has been given to you in **Appendix A**. The line numbers are for reference only. Assume the array has the following values:

intArr[0]	intArr[1]	intArr[2]	intArr[3]	intArr[4]	intArr[5]	intArr[6]
1	2	2	4	6	9	11

To help find the problem, the programmer decided to use a trace table. You need to complete this trace table up to and including the step where size becomes 6 (when the outer loop controlled by variable **i** has executed **once**).

Step Number	size	i	k	p	intArr							intArr[i] = intArr[2]?
					[0]	[1]	[2]	[3]	[4]	[5]	[6]	
					1	2	2	4	6	9	11	
1	7											
2		0										
3			1									
4												F
3			2									
4												F
3			3									
4												F
3			4									
4												F
3			5									
4												F
3			6									
4												F
2		1										
3												
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(10)

[30]

57 marks

Total: 180 marks

Extra page

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