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**INFORMATION TECHNOLOGY PAPER I
MATRIC
PRELIMINARY EXAMINATIONS 2018**

Marks: 180
Time: 3 hours
Reading Time: 10 minutes

Examiner: IT Cluster
Moderator: IT Cluster

NAME : _____

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 32 pages (including the extra pages and front cover). 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 in the space provided. TWO blank pages have been included at the end of the paper. Number each question clearly on these pages, should you use the space.
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.

	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q7	Total
Possible Marks	10	10	50	42	16	42	10	180
Actual Marks								

Question 1**Terminology****10 Marks**

Define the following terms. Do NOT expand the acronym. You may use an example to support your answer once you have provided a definition. Please note that examples on their own will not be given any credit. Please do not use brand names.

1.1 Protocol (2)

1.2. Polymorphism (2)

1.3 Inheritance (2)

1.4 Encapsulation (2)

1.5 SaaS (Software as a Service) (2)

Question 2**Matching Columns****10 Marks**

Column A		Column B	Column C	
2.0	Computer Term	V	A.	An Internet protocol for sending e-mails over the Internet.
2.1	Interrupt		B.	The attempt to obtain sensitive information such as usernames, passwords, and credit card details (and money), often for malicious reasons, by disguising as a trustworthy entity in an email
2.2	Copyleft		C.	A unique identifier assigned to a network interface controller for communications in a network segment.
2.3	MAC Address		D.	The maximum capacity of a network connection.
2.4	Botnet		E.	A signal from a device attached to a computer or from a program within the computer that requires the operating system to stop and process the request.
2.5	Hyper threading		F.	Tricking or deceiving computer systems or other computer users. This is typically done by hiding one's identity or faking the identity of another user on the Internet.
2.6	Phishing		G.	A hacking technique that places malicious code in SQL statements, via web page input.
2.7	POP3		H.	A unique string of numbers separated by full stops that identifies each computer using the Internet Protocol to communicate over a network.
2.8	jpg		I.	A number of Internet computers that have been set up to forward transmissions to other computers on the Internet without the knowledge of their owners.
2.9	SQL injection		J.	An Internet protocol for email retrieval.
2.10	Bandwidth		K.	The practice of offering people the right to freely distribute copies and modified versions of a work with the stipulation that the same rights be preserved in derivative works.
			L.	An image format used on the Web that provides lossless compression.
			M.	An image file, commonly used for photographs and has lossy compression.
			N.	A technology that allows a single microprocessor to act like two separate processors to the operating system.

Scenario

Consider the scenario below when answering the rest of the examination paper:

The Gauteng eye clinic is a specialised day clinic that provides facilities for surgical procedures that do not require over-night treatment. The facilities offered at the hospital include:

- **Theatre:**
The eye hospital has six operating theatres with state of the art ophthalmic (eye) equipment.
- **Ward:**
The hospital ward has 20 beds and 6 recliner units.
- **Coffee Shop:**
Friends and family members can enjoy something to eat or drink.

The clinic is reliant on their IT infrastructure and has been in operation for 5 years. The owners of the clinic have asked you to advise them on certain upgrade options. Jason is the IT administrator at the eye clinic.

Question 3**System Technologies****50 Marks**

Jason has received a quote for a new server. The specifications are given in the table below.

Processor	Intel® Xeon® processor E3-1225 v5/ 3.3GHz • 8 MB L3 Cache • 4 Cores • 3.30 GHz Clock Speed • Max Turbo speed 3.7GHz
Memory	8GB DDR4 RAM installed (Maximum RAM 64GB DDR4)
Slots	1 PCIe x16 3.0 1 PCIe x4 3.0 1 PCI
Ports	8 x USB3, Gigabit ethernet
Storage	1 TB SATA HDD 6 SATA ports Supports RAID Level RAID 0, RAID 1, RAID 5, RAID 10
DVD	Slimline DVD drive
OS	Microsoft® Windows Server® 2012 OR Red Hat® Enterprise Linux® OR Microsoft Windows Server with Hyper-V® VMware vSphere ESXi®
Networking	Data link protocol ethernet, Fast ethernet, Gigabit Ethernet
Graphics	On board graphics

3.1 The CPU has a clock speed of 3.30GHz and a Max Turbo speed of 3.7GHz.

Intel® Turbo Boost Technology 2.0¹ accelerates processor and graphics performance for peak loads, automatically allowing processor cores to run faster than the rated operating frequency if they're operating below power, current, and temperature specification limits.

3.1.1 Define the term clock speed.

(1)

- 3.1.2 Explain how overclocking can increase the speed of all components on the mother board. (2)

- 3.1.3 Explain one benefit of the turbo boost technology compared to over overclocking. (2)

- 3.2 The processor has 8MB of L3 cache.

- 3.2.1 What is the purpose of cache memory? (2)

- 3.2.2 Where would L3 cache be located? (1)

- 3.3 The maximum amount of RAM that can be installed in this computer is specified as being 64 GB.

- 3.3.1 Briefly explain the purpose of RAM. (1)

- 3.3.2 RAM can be either static (SRAM) or dynamic (DRAM). Use the table below to help categorise them. Do NOT write statements that are the opposite of each other. (4)

	Feature	Where used
SRAM		
DRAM		

- 3.3.3 How many bits would you expect the address bus to be considering that RAM can be a maximum of 64 GB? (1)

- 3.4 In one of the reviews on the server Jason found the following comment:

**Pros :**

Affordable; Easy access for upgrades and maintenance; Excellent management capabilities

**Cons :**

No hot-swap capabilities as standard; No embedded OS deployment tools;

- 3.4.1 Explain the term “hot-swap capabilities”. (2)

- 3.4.2 Would this be a critical factor for the server at the day clinic? Support your answer. (2)

- 3.5 The server supports 2 types of storage, namely HDD and DVD. Compare the two types of storage in terms of capacity and technology (4)

	Technology	Storage capacity
HDD		
DVD		

- 3.6 The server supports RAID Level RAID 0, RAID 1, RAID 5, RAID 10

- 3.6.1 Describe two features of **RAID 1**. (2)

Feature 1:

Feature 2:

3.6.2 Describe two features of **RAID 5**. (2)

Feature 1:

Feature 2:

3.6.3 Would you recommend **RAID 1** or **RAID 5** for the clinic? (1)

3.6.4 What configuration changes would be required to the server to support the option you specified in 3.6.3? (1)

3.7 The server is not supplied with an operating system. The operating systems supported by the server are:

VMWare

Ubuntu

Windows Server 2016

The server currently running at the clinic is using Windows Server 2012.

3.7.1 Describe TWO functions that are required by a SERVER operating system. (2)

Function 1:

Function 2:

3.7.2 VMWare supports virtualisation

3.7.2.1 Define virtualisation

(2)

3.7.2.2 Describe how server virtualisation could be of benefit to the clinic.

(2)

3.8 The clinic need to safeguard the data on their computers. You need to detail a backup policy for them to make sure they can recover from processing errors and a disaster situation.

(3)

Include the following three factors:

- Medium for backup
- Location of backups
- Frequency of backups

Medium:

Location:

Frequency:

3.9 The clinic have contracted a developer to create a mobile app that the patients can use to pre-register.

3.9.1 The developer will use a high-level language to develop the software application.

3.9.1.1 Describe two advantages for a programmer when using a high-level programming language. (2)

Advantage 1:

Advantage 2:

3.9.1.2 Give an example of a high-level programming language. (1)

3.9.2 State two challenges faced by programmers when they develop software applications for smart phone / mobile devices. (2)

Challenge 1:

Challenge 2:

3.9.3 Name ONE operating system developed specifically for smart phones. (1)

3.10 Cloud technology has been widely adopted by healthcare organisations to provide quality service to patients. Jason would like you to help him better understand the potential of cloud computing.

- 3.10.1 Name three characteristics that distinguish cloud computing from traditional hosting. (3)

Characteristic 1:

Characteristic 2:

Characteristic 3:

- 3.10.2 What would the advantage of cloud computing be to a doctors at the health care organisation? (2)

- 3.11 Describe two potential risks of using cloud computing. (2)

Risk 1:

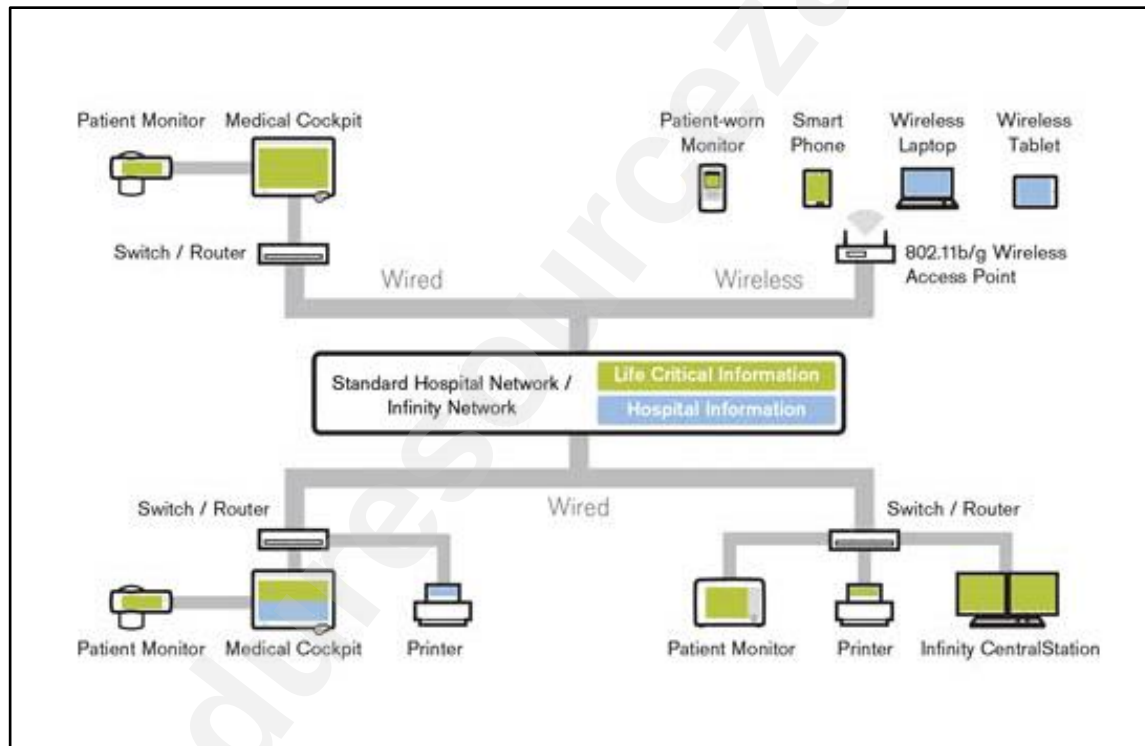
Risk 2:

Question 4**Networks****42 Marks**

The network at the clinic is a hybrid wired and wireless solution. They have strict requirements as detailed below:

- Seamless fast roaming & continuous communication
- Secure network for sensitive medical data
- Separate guest network
- Access Points and wireless controllers High Availability
- Modern 802.11n standard to support higher throughput allowing a faster data exchange between the server and the staff computers and stations.

They have received proposals from a number of service providers and are in favour of the solution shown below.



[Source: https://www.draeger.com/en-us_us/Hospital/Products/Patient-Monitoring/Network-Solutions/Infinity-OneNet]

4.1 Explain the following network terms.

4.1.1 Network topology (2)

4.1.2 Give an example of a network topology in the diagram above. (1)

4.1.3 What type of cable will be used to set up the backbone? (1)

4.2 It is critical that the patient information being transmitted over the wireless network is secure. The clinic will not support the use of WEP (Wired Equivalent Privacy) or WPA. They have specified that the WLAN must support WPA-2 (Wi-Fi Protected encryption) only.

4.2.1 List two shortcomings of WEP as a wireless protocol. (2)

Shortcoming 1:

Shortcoming 2:

- 4.2.2 Describe two features of WPA-2 protocol that make it more secure than WEP. (2)

Feature 1:

Feature 2:

- 4.3 For each of the statements below, match the appropriate device/term from the following list:

gateway, router, firewall, proxy server

- 4.3.1 A device that regulates traffic between two networks with different protocols. (1)

-
- 4.3.2 A server that acts as an intermediary for requests from clients seeking resources from other servers. (1)

-
- 4.3.3 A network security system that monitors and controls incoming and outgoing network traffic based on predetermined security rules (1)

-
- 4.3.4 A device that connects a local area network (LAN) to another local area network that uses the same protocol. (1)
-

- 4.4 The clinic have been advised that they should consider implementing a wireless mesh network to replace the WLAN.

4.4.1 What is a Wireless Mesh Network (WMN)? (2)

4.4.2 Name two advantages of a WMN over a WLAN. (2)

Advantage 1:

Advantage 2:

- 4.5 The clinic would like to have a separate guest network. Explain how a VLAN could be used to achieve this. (2)

- 4.6 The clinic could use a video server to provide entertainment for the patients. It has been suggested that it would be useful to use BitTorrent to source video materials.

4.6.1 What is BitTorrent? (2)

4.6.2 Name ONE advantage and ONE disadvantage to using BitTorrent (2)

Advantage:

Disadvantage:

- 4.7 The doctors like to use video conferencing to consult with specialists in other parts of the country for educational purposes.

4.7.1 Name THREE protocols used for video conferencing. (3)

Protocol 1:

Protocol 2:

Protocol 3:

- 4.7.2 Discuss ONE way in which the doctors could make use of social media services to connect and stay up to date with other medical practitioners and research. You will need to include an example of a social media service in your description. (2)

- 4.8 The clinic have requested that SSL should be implemented as an encryption protocol.

- 4.8.1 Define encryption. (2)

- 4.8.2 How will the clinics website address (<http://GTEyes.co.za>) change once SSL has been implemented? Write down the new address. (1)

- 4.8.3 The **Public Key** Infrastructure (**PKI**) allows users of the Internet to securely and privately exchange data and money securely. (4)

Choose from the words below to complete the paragraph about the PKI.

Certification Authority, digital signature, digital certificate, public key, private key

A _____ issues and verifies a _____
that includes the _____ that is used to encrypt a
message that the receiver will unlock with their _____.

- 4.9 A number of clients have commented that when they search for the clinic's website it does not appear on the first page of the search engine. Describe how they could use SEO to improve their ranking in the search engine. (2)

- 4.10 Websites often use scripting to add features to the site.

- 4.10.1 Distinguish between server-side and client-side scripting. Do NOT use the words client or server in your answer. (4)

- 4.10.2 Give an example of client side scripting that would be useful in this scenario. (2)

Question 5**Social Implications****16 Marks**

- 5.1 Healthcare is one of the industries that is benefitting from BIG DATA. (4)

The medical profession is overwhelmed by the volume of data it stores. Medical offices and hospitals submit data to central organisations like the World Health Organisation (WHO) about medical conditions, diagnoses and immunizations of its patients, but without big data, this data are meaningless. Using analytics, raw patient and medical data can be used to guide regulations and provide better helath care.

Describe how BIG DATA can benefit the healthcare industry in terms of:

- Benefit to the doctors (2)
- Benefit to the patients (2)

Benefit to doctors:

Benefit to patients:

- 5.2 Telemedicine, defined as the remote diagnosis and treatment of patients, has obvious benefits for a country like South Africa. Discuss the ONE benefit and ONE challenge of using telemedicine in South Africa. (4)

Benefit:

Challenge:

- 5.3 You have been asked to run an educational session for the staff to create awareness of the risks of social engineering. Describe TWO popular social engineering techniques that the clinic staff may be exposed to. (4)

Social technique 1:

Social technique 2:

- 5.4 It is the responsibility of the clinic to protect the patient's data. Describe TWO measures the clinic should put in place to protect the data from a ransomware attack. (4)

Measure 1:

Measure 2:

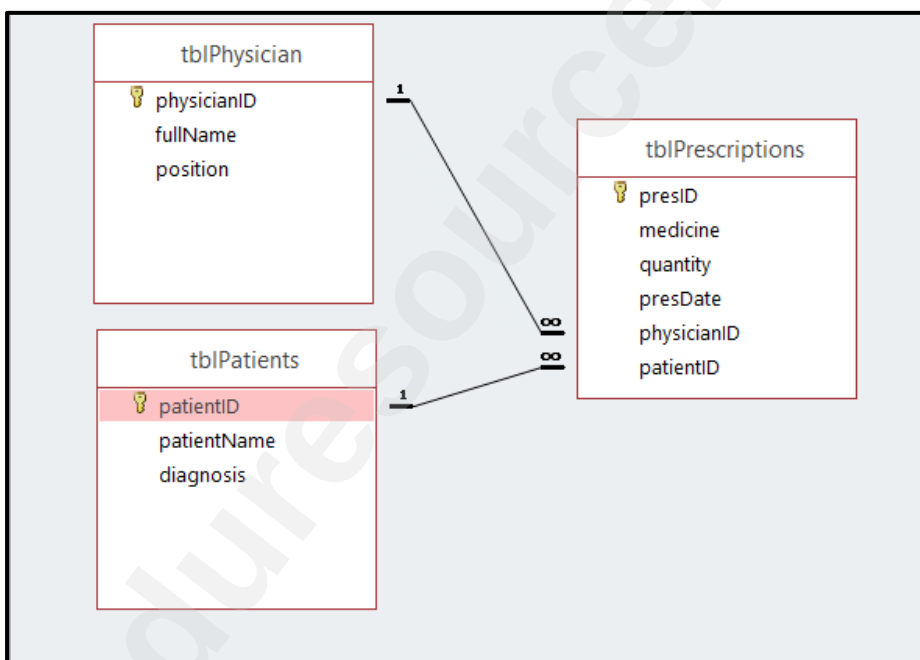
SECTION C**Software development****52 Marks****QUESTION 6****[42]**

- 6.1 The hospital has its data is stored in a very large relational database. Describe two advantages to using a database. (2)

Advantage 1:

Advantage 2:

6.2



- 6.2.1 Name the type of relationship between the **tblPhysician** and **tblPrescriptions** tables. (1)

- 6.2.2 The **physicianID** field appears in both the **tblPhysicians** table and the **tblPrescriptions** table.

What is the purpose of the **physicianID** field in the **tblPrescriptions** table? (2)

- 6.3 Explain the purpose of using **GROUP BY**, **DESC** and **LIMIT 5** in the following SQL statement. (3)

```
SELECT diagnosis, count(*) AS Number
FROM tblPatients
GROUP BY diagnosis
ORDER BY count(*) DESC
LIMIT 5;
```

GROUP BY:

DESC:

LIMIT 5:

- 6.4 The theatre schedules are drawn up daily in spreadsheet. The clinic would like to incorporate this information into the database.

Consider the following details:

- When a patient is booked for a procedure they receive a unique **Booking ID**.
- Each patient has a unique **Patient ID** and their details are saved to an existing table **tblPatients** when they register, which has the following fields.

tblPatients(PatientID, PatientSurname, PatientFirstName, CellNo)

Examine an extract of the booking register in the table below.

Booking ID	Procedure Date	Procedure Start	Procedure Code	Procedure Desc	Patient ID	Doctor	Doctor Contact number
B1	18/06/2018	08:00	CAT	Cataract surgery	P1	Dr John Dorian	0828503234
B2	18/06/2018	09:00	COR	Cornea Surgery	P2	Dr John Dorian	0828503234
B3	18/06/2018	08:00	ELS	Eyelid surgery	P3	Dr Elliot Reid	0749987760
B4	18/06/2018	09:00	CAT	Cataract surgery	P4	Dr Molly Clark	0116675590
B5	18/06/2018	13:00	COR	Cornea Surgery	P5	Dr John Dorian	0828503234
B6	20/06/2018	08:00	ELS	Eyelid surgery	P6	Dr Elliot Reid	0749987760
B7	20/06/2018	09:00	CAT	Cataract surgery	P7	Dr Molly Clark	0116675590

- 6.4.1 The data needs to be normalised.

- 6.4.1.1 Explain the purpose of normalisation. (2)

- 6.4.1.2 The normalisation process will remove data anomalies. (2)

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Name and identify one type of anomaly that could occur in the above table.

- 6.4.2 Suggest a 3NF relational structure for the database. Write your answer in the standard relational format: (10)

tablename (field1, field2, ...)

You need to underline all primary and foreign keys by underlining the primary key with TWO lines and foreign keys with ONE line.

[illegible]

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6.5 A new program will need to be developed to make use of the new tables in the database and to programmatically create the booking register for a patient. This will require the creation of a **Booking** class. (9)

The basic requirements of this class will be:

- A constructor method to initialise the fields.
- Accessor methods for each of the fields.
- Mutator methods for each of the fields
- A toString() method to neatly display the fields
- A method to calculate the cost of the procedure. This method will need to be used by another class.

Booking objects will each have three fields namely: the booking id, the procedure code, the patient name.

You are required to draw a class diagram for the Booking class according to the specification shown above. Use the space provided in the grid below for your answer. You should make appropriate selections for your field types. Include appropriate details for each method header.

Booking
Fields:
Methods:

QUESTION 7**[10]**

- 7.1 Jason has been teaching himself to code. In one of his practice tasks he needed to create a program to convert a binary number to a decimal number. (8)

He used the following algorithm to code his program, but he is not getting the correct output. Help him to debug his logic by the use of a trace table:

Use the binary value 10_2 to test the algorithm. The user will enter 10 as a String.

```
1 input binary
2 len ← length of binary

3 decimal ← 0

4 loop i from 0 to len
5   digit ← character at position i in binary
6   decimal ← decimal + (2i * digit)
7 end loop

8 output "The decimal number is " + output
```

Use the trace table template below. The first line has been completed for you.

Line No	binary	len	decimal	i	i<len?	digit	output
1	10						

7.2 Identify the error and write the correction as an algorithm.

(2)

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EXTRA SPACE – WRITE DOWN EACH QUESTION NUMBER

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