Instructions to the Student

➢ Treat this Practice Exam like a real exam – print it out, put a "do not disturb" sign on your door, turn off your phone, and give yourself a block of 3 hours to work through the exam.

➢ Space has been provided in this document to write answers. In the actual exam, you will be asked to write your answers in an examination booklet.

➢ Solutions to Practice Exams will NOT be made available to students.

➢ Check your answers by comparing and discussing your answers with other students, for example, on the Course Mailing List, and/or (for SQL Queries) by actually building the required database and running your queries against this.
SECTION A

Practical Application

Question 1 – Structured Query Language

Formulate SQL queries to answer the following information requests. Use the tables tblClinic, tblDoctor, tblPatient, and tblTreatment provided below.

You are asked to provide a general solution to each request. If the database contents change, each of your queries should continue to answer the information requested correctly.

Your queries should produce the result shown following each information request. If you think that the result provided is incorrect, or it is not possible to formulate an SQL query to answer the information request, you must document this opinion. If necessary, state any assumptions that may help to clarify your understanding of the information requests.

**tblClinic**

<table>
<thead>
<tr>
<th>ClinicId</th>
<th>ClinicName</th>
<th>Address</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>C001</td>
<td>HeartWest Clinic</td>
<td>111 Derrimut Road, Melbourne</td>
<td>03 96395555</td>
</tr>
<tr>
<td>C002</td>
<td>Surgery Point Clinic</td>
<td>121 Williamstown Road, Melbourne</td>
<td>03 96394422</td>
</tr>
<tr>
<td>C003</td>
<td>Westgate Medical Centre</td>
<td>150 Alma Avenue, Melbourne</td>
<td>03 98785151</td>
</tr>
<tr>
<td>C004</td>
<td>Collins St Medical Centre</td>
<td>352 Collins Street, Melbourne</td>
<td>03 86651253</td>
</tr>
<tr>
<td>C005</td>
<td>AAA Doctors</td>
<td>512 Swanston Street, Melbourne</td>
<td>03 86696963</td>
</tr>
</tbody>
</table>

**tblDoctor**

<table>
<thead>
<tr>
<th>DoctorId</th>
<th>Name</th>
<th>Phone</th>
<th>Specialization</th>
<th>ClinicId</th>
</tr>
</thead>
<tbody>
<tr>
<td>D001</td>
<td>John Sanders</td>
<td>03 93936060</td>
<td>Cardiologist</td>
<td>C005</td>
</tr>
<tr>
<td>D002</td>
<td>Tim Mckenzie</td>
<td>03 93936061</td>
<td>Podiatrist</td>
<td>C005</td>
</tr>
<tr>
<td>D003</td>
<td>Heidi Mckenzie</td>
<td>03 93936062</td>
<td>Osteopath</td>
<td>C004</td>
</tr>
<tr>
<td>D004</td>
<td>Anthony Young</td>
<td>03 86652525</td>
<td>Cardiologist</td>
<td>C003</td>
</tr>
<tr>
<td>D005</td>
<td>Michael Klim</td>
<td>03 97978525</td>
<td>Radiologist</td>
<td>C002</td>
</tr>
<tr>
<td>D006</td>
<td>Warren Smith</td>
<td>03 92923052</td>
<td>Neurologist</td>
<td>C003</td>
</tr>
</tbody>
</table>

**tblPatient**

<table>
<thead>
<tr>
<th>PatientId</th>
<th>Name</th>
<th>Age</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>P001</td>
<td>Ramesh Naga</td>
<td>23</td>
<td>52 Browns Avenue, Coburg</td>
</tr>
<tr>
<td>P002</td>
<td>Mike Patel</td>
<td>25</td>
<td>36 Clarinda Street, Fairfield</td>
</tr>
<tr>
<td>P003</td>
<td>Kris Chohan</td>
<td>22</td>
<td>1 William Street, South Melbourne</td>
</tr>
<tr>
<td>P004</td>
<td>Brad Hoghe</td>
<td>27</td>
<td>23 Collins Street, Melbourne</td>
</tr>
<tr>
<td>P005</td>
<td>David Lim</td>
<td>24</td>
<td>31 Railway Parade, Altona</td>
</tr>
<tr>
<td>P006</td>
<td>Wilson Philips</td>
<td>25</td>
<td>26 Railway Parade, Westona</td>
</tr>
</tbody>
</table>
a) Obtain details of patients who have not received any treatment. (2 marks)

Result using sample data:

<table>
<thead>
<tr>
<th>PatientId</th>
<th>Name</th>
<th>Age</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>P003</td>
<td>Kris Chohan</td>
<td>22</td>
<td>1 William Street, South Melbourne</td>
</tr>
<tr>
<td>P005</td>
<td>David Lim</td>
<td>24</td>
<td>31 Railway Parade, Altona</td>
</tr>
</tbody>
</table>

ANSWER:

b) Obtain the number of doctors working at each clinic. (2 marks)

Result using sample data:

<table>
<thead>
<tr>
<th>ClinicName</th>
<th>Number Of Doctors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westgate Medical Centre</td>
<td>2</td>
</tr>
<tr>
<td>AAA Doctors</td>
<td>2</td>
</tr>
<tr>
<td>Surgery Point Clinic</td>
<td>1</td>
</tr>
<tr>
<td>Collins St Medical Centre</td>
<td>1</td>
</tr>
</tbody>
</table>

ANSWER:
c) Obtain details of patients who live in Fairfield and received treatment at the clinic “AAA Doctors”.  

Result using sample data:

<table>
<thead>
<tr>
<th>PatientId</th>
<th>Name</th>
<th>Age</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>P002</td>
<td>Mike Patel</td>
<td>25</td>
<td>36 Clarinda Street, Fairfield</td>
</tr>
</tbody>
</table>

**ANSWER:**


d) Obtain details of patients who have been treated by doctor “Tim Mckenzie”.

Formulate 3 queries to answer this request (each query is worth 2 marks):

i) One that does not use a sub-query

**ANSWER:**

ii) One that uses the IN operator with a sub-query

**ANSWER:**

iii) One that uses the EXISTS operator with a sub-query

**ANSWER:**
Result using sample data:

<table>
<thead>
<tr>
<th>PatientId</th>
<th>Name</th>
<th>Age</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>P001</td>
<td>Ramesh Naga</td>
<td>23</td>
<td>52 Browns Avenue, Coburg</td>
</tr>
<tr>
<td>P002</td>
<td>Mike Patel</td>
<td>25</td>
<td>36 Clarinda Street, Fairfield</td>
</tr>
</tbody>
</table>

e) List details of patients who have had a treatment in the last 30 days. Order the result by ascending PatientID. You should assume that \( \text{Date}() \) gives the current date and the expression \( \text{Date}() - 30 \) gives the date 30 days earlier. (3 marks)

Result using sample data:

<table>
<thead>
<tr>
<th>PatientId</th>
<th>Name</th>
<th>Age</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>P001</td>
<td>Ramesh Naga</td>
<td>23</td>
<td>52 Browns Avenue, Coburg</td>
</tr>
<tr>
<td>P002</td>
<td>Mike Patel</td>
<td>25</td>
<td>36 Clarinda Street, Fairfield</td>
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<td>P004</td>
<td>Brad Hoghe</td>
<td>27</td>
<td>23 Collins Street, Melbourne</td>
</tr>
<tr>
<td>P006</td>
<td>Wilson Philips</td>
<td>25</td>
<td>26 Railway Parade, Westona</td>
</tr>
</tbody>
</table>

**ANSWER:**

**Question 2 - Relational algebra** (4 Marks)

Using the tables in Question 1, write expressions in Relational Algebra to answer each of the following information requests.

a) Obtain names of doctors who are cardiologists.

**ANSWER:**
b) Obtain all details of doctors who work at the clinic “AAA Doctors”.

**ANSWER:**

| blank cell |

---

c) Obtain the age of each patient who has received an X-Ray treatment.

**ANSWER:**

| blank cell |

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d) Obtain the phone number of each clinic that has treated a patient who is 23 years old.

**ANSWER:**

| blank cell |
SECTION B
Conceptual Modelling, Database Design & Normalisation

Question 3 (10 Marks)

Draw an Entity Relationship Diagram to represent the entities, attributes and relationships mentioned in the following case study. Make sure you include appropriate identifiers for each entity (the inclusion of foreign keys is not necessary). Make assumptions where necessary and state them clearly in the solution you provide.

Digital Video Rentals

*Digital Video Rentals (DVR)* is a DVD rental store that specialises in renting a wide range of DVDs, from old classic movies to the latest releases. It also rents out XBox and Playstation games on DVD. DVR needs a database to log its customers and hirings.

When a new customer joins DVR, an employee records the customer’s name, contact telephone, and postal address. The system should automatically assign a new membership number to the customer. Also, the customer is asked to choose a secret password, and this is also recorded. Once entered on the system, the customer is given a membership card showing their name and membership number. The customer is then ready to hire out items.

A customer may make any number of hirings over time. Each time the customer hires some items, an employee records the date and time that the hiring is taking place. The system automatically assigns a reference number to uniquely identify each hiring, but this number is not given out to the customer.

Each hiring may involve one or more items. Obviously, you can’t have a hiring with zero items being hired. For each item being hired, it is necessary to record whether or not it has been returned. It is also necessary to record when each item is due back.

Finally, DVR keeps a complete list of all items in the store. As mentioned, there are two types of items, Video DVDs and Game DVDs. Each item has a unique catalog number, title, cost to hire, and hire duration. (For example, some DVDs cost $6 to hire over night, while other older DVDs only cost $3 to hire for one week.) It is also necessary to record the Genre and Year for all those items that are video DVDs. For Game DVDs, it is necessary to record whether they are for XBox or for Playstation II.
Question 4  

(5 Marks)

Convert the ER model shown below into a relational database design.
List the relational tables in a manner that is similar to the example provided below:

*Example:*

Customer (CustomerID, FamilyName, GivenName, Phone)
Order (OrderID, OrderDate, CustomerID)
FOREIGN KEY (CustomerID) REFERENCES Customer

**ER Model**

```
ER Model

Employee

Project

Casual

Salaried

Contractor

Z

Z

Z

Hourly Rate

Annual salary Stock Options

Contract No Billing Rate

FOREIGN KEY (CustomerID) REFERENCES Customer
```
Question 5  

(5 Marks)

Background Information

The following table identifies players and matches played by those players. You may assume that the combination of Player Id and Match No uniquely identifies each tuple in the relation.

<table>
<thead>
<tr>
<th>Player Id</th>
<th>Player Name</th>
<th>Match No</th>
<th>Match Location</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>P001</td>
<td>John Smith</td>
<td>M001</td>
<td>Vodafone Arena</td>
<td>Lost</td>
</tr>
<tr>
<td>P001</td>
<td>John Smith</td>
<td>M002</td>
<td>Rod Laver Arena</td>
<td>Lost</td>
</tr>
<tr>
<td>P002</td>
<td>Tim McKenzie</td>
<td>M001</td>
<td>Vodafone Arena</td>
<td>Won</td>
</tr>
<tr>
<td>P003</td>
<td>Lucy Vulic</td>
<td>M003</td>
<td>MCG</td>
<td>Lost</td>
</tr>
<tr>
<td>P004</td>
<td>David Christof</td>
<td>M002</td>
<td>Rod Laver Arena</td>
<td>Won</td>
</tr>
</tbody>
</table>

a) Describe an **Update Anomaly** that may occur for the above relation.  

**ANSWER:**

b) Describe an **Insert Anomaly** that may occur for the above relation.  

**ANSWER:**

c) Describe a **Delete Anomaly** that may occur for the above relation.  

**ANSWER:**
d) Explain why this relation does not satisfy *Boyce-Codd Normal Form (BCNF)*?

**ANSWER:**

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e) Convert this table into a set of relations that do satisfy *BCNF*.

**ANSWER:**
SECTION 3

20 MARKS

Theory Questions

Please feel free to provide example(s) if this helps to explain your answers.

Question 6 (2 marks)
Distinguish between HAS-A relationships and IS-A relationships.

**ANSWER:**

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Question 7 (2 marks)
Briefly explain what is meant by a *Functional Dependency*.

**ANSWER:**

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Question 8 (2 marks)
Briefly explain what is meant by a *Multi-valued Dependency*.

**ANSWER:**
Question 9
Briefly explain what the term **cardinality** means and give an example.

**ANSWER:**

Question 10
Distinguish between **Primary Keys** and **Foreign Keys**.

**ANSWER:**

Question 11
To address the issue of data independence, the **ANSI/SPARC 3-Level Architecture** was proposed. Briefly describe the three levels.

**ANSWER:**

Question 12
Discuss the differences between the **candidate keys** and the **primary key** of a relation.

**ANSWER:**
Question 13  
(2 marks)  
Give three reasons why it is desirable to separate each user’s view of a database from the way it is physically represented.  

**ANSWER:**

Question 14  
(2 marks)  
Briefly describe three of the characteristics (properties) that a *table* must satisfy to qualify as a *relation*.  

**ANSWER:**

Question 15  
(1 marks)  
Briefly explain what is meant by a *recursive relationship*?  

**ANSWER:**
Question 16  
What is the difference between a \textit{recursive relationship} and a \textit{unary relationship}?

\textbf{ANSWER:}

Question 17  
What is the difference between an \textit{association relation} and an \textit{intersection relation}?

\textbf{ANSWER:}

\begin{center}
End of exam paper
\end{center}