Imperial College Business School

MSc Business Analytics Examinations 2019/2020

For internal Students of Imperial College London.
This paper also forms part of the examination for the Associateship.

FUNDAMENTALS OF DATABASE TECHNOLOGIES (BUSI97270)

Thursday 12th December 2019; 10:00 – 12:00

CLOSED BOOK

Instructions

Answer **ALL** questions from both Part A and Part B.

Write **ALL** of your answers in the answer booklet provided.

Assume you are using the Postgres dialect of SQL.

College approved calculators may be used.

The supplied Postgres information sheet may be used.

The marking weightings are indicated next to each question and sub-question.

Part A: Theory **(Total: 20 marks)**

Question A1

State the definition of a transitive functional dependency.

(2 marks)

Question A2

State the definition of first normal form (1NF).

(2 marks)

Question A3

Briefly describe the difference between second normal form (2NF) and third normal form (3NF).

(2 marks)

Question A4 **[Total: 6 marks]**

Consider the following description of a table describing animals in a zoo.

animals

Attribute name	Description	Datatype
animal_id	Animal's ID	text
animalName	Animal's name	real
keeper_Name	Animal's handler's name	varchar(20)
last_fed	Time last fed	float
IsEndangered	Whether the animal is endangered or not	real

a) What problems exist concerning the attribute names?

(1 mark)

b) What problems exist concerning the attribute datatypes?

(3 marks)

c) What problems might occur if we delete all the animals belonging to one keeper? How would we fix these?

(2 marks)

Question A5

Give a **concise** summary of the relational paradigm, defining attributes, columns, keys, rows, relations, relationships, records, and tables. It is not necessary to mention history, benefits, or applications.

(4 marks)

Question A6

Do not draw out tables when providing examples for this question.

a) Explain why one piece of information should be stored in just one place (not copied in multiple places) in an SQL database, giving an example of what can go wrong if this principle is violated.

b) Explain why information that does not "belong" to an entity should not be stored in that entity's table, giving an example of what can go wrong if this principle is violated.

(4 marks)

End of Part A

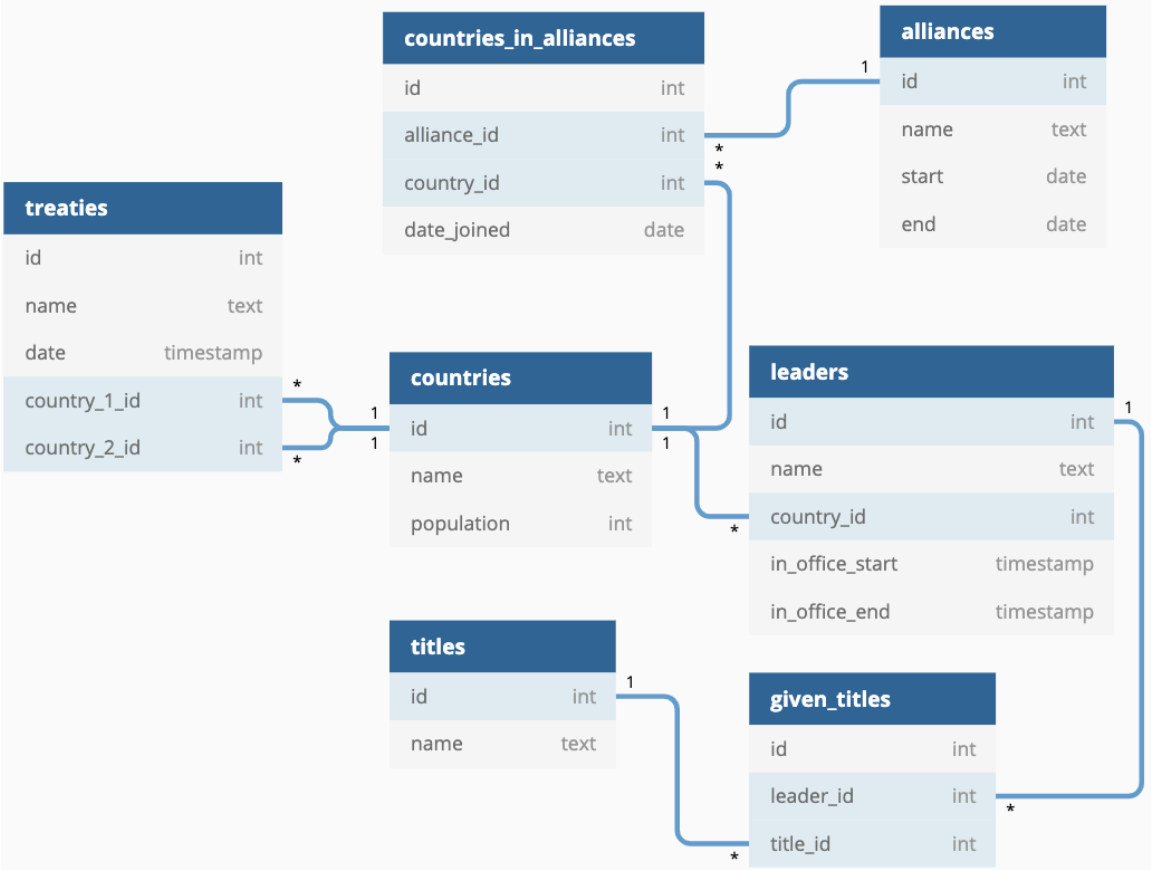
Questions continue on next page

Part B: Queries **(Total: 30 marks)**

Consider the following entity-relationship (ER) diagram.

Legend

1	Up to one entity at this end of the relationship
*	Unlimited entities at this end of the relationship
highlighted	Foreign key for another table



This ER diagram shows political relationships between **countries**. The **leaders** table describes countries' leaders (heads of state), showing the start and end of their time in office. End times are not filled in until leaders leave office. The **titles** table holds titles, such as Prime Minister or Queen. The **treaties** table shows treaties between countries. The **alliances** table shows the alliances which exist between countries, along with their start and end dates (only currently existing alliances are shown in this table).

Question B1

Are there any many-to-many relationships in this ER diagram? Justify your conclusion.

(2 marks)

Question B2

Does this ER diagram provide support for treaties which link more than two countries? Justify your answer.

(1 mark)

Question B3

Write a query to show the names of all leaders and the dates/times when they took office.

(1 mark)

Question B4

Write a query to show the entire leaders table, along with the number of titles each leader has.

(2 marks)

Question B5

Write a query to show the id and name of each country, along with the date of the oldest alliance entered into by this country.

(2 marks)

Question B6

Write a query to show the name of each country along with the name of the oldest alliance it entered, and the date on which this happened.
Hint: use the query from the previous question as a subquery.

(3 marks)

Question B7

With regards to the query you wrote for the previous question, explain what happens if a country is in two alliances which are tied for the oldest.

(2 marks)

Question B8

Write a query to show the name of each alliance, along with the total population of countries in that alliance.

(3 marks)

Questions continue on next page

Question B9

Write a query to show all the leaders currently in office.

(3 marks)

Question B10

Write a query to show the name of each country along with the number of treaties it participates in (either as country_1 or as country_2).

(4 marks)

Question B11

Does the leader currently in office, who has been in office the longest, also have the most titles? Write a single query to answer this question.

(4 marks)

Question B12

Write a query to show all the treaties in the database in chronological order, with three extra columns showing a) the name of that treaty's first country; b) the name of that treaty's second country; c) the cumulative treaty count.

(3 marks)

End of Exam