THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

This exam paper must not be removed from the venue

Venue _____

Seat Number _____

Student Number |__|__|__|__|__|__|__|__|

Family Name _____

First Name _____

School of Information Technology and Electrical Engineering

EXAMINATION

Semester One Final Examinations, 2016

INFS1200 Introduction to Information Systems

This paper is for St Lucia Campus students.

Examination Duration: 120 minutes

Reading Time: 10 minutes

Exam Conditions:

This is a Central Examination

This is a Closed Book Examination - specified materials permitted

During reading time - write only on the rough paper provided

This examination paper will be released to the Library

Materials Permitted In The Exam Venue:

(No electronic aids are permitted e.g. laptops, phones)

An unmarked Bilingual dictionary is permitted

Calculators - No calculators permitted

Materials To Be Supplied To Students:

Instructions To Students:

Additional exam materials (eg. answer booklets, rough paper) will be provided upon request.

Answer all questions in the space provided

For Examiner Use Only

Question	Mark

Total _____

PART I – FUNDAMENTALS (10 Marks)

Question 1. Use the example below to explain the following concepts (4 Marks)

SHOP [sno, sname, address]

PRODUCT [pno, pname, price]

PURCHASE [sno, pno, qty]

a) Super Key

b) Minimal Key

c) Foreign Key

d) Non-prime Attribute

Question 2. The schema and instances for a relational database are given below.

An online Puzzle-Solving system has been developed that contains a database of challenging puzzles. Both students and teachers can register in this system and obtain a login and working space. Once a solver opens a puzzle, it appears in their space in a so-called "unsolved" list. Solvers can have unlimited attempts to solve the puzzle and submit their solution. When and if the right solution is submitted, the Puzzle is transferred to the "solved" list for that solver. Dates of both first opening the puzzle and of solving the puzzle are recorded in this system.

There are three levels of Puzzle "Difficulty", namely Simple, Advanced and Hard. The "Solutions" attribute in the PUZZLE relation cannot be retrieved by any solver, and are only used by the system to check solutions submitted by solvers. STUDENT and TEACHER are sub-classes of SOLVER. "Type" attribute in the SOLVER relation has two values, "Student" and "Teacher". "Year" in the STUDENT relation represents the year of study for the student e.g. first year, second year, honors, etc. "PName" is a unique Puzzle Name. A NULL value for the "DateSolved" attribute indicates that the given puzzle has not yet been solved by the given solver.

PUZZLE [PName, Difficulty, Solution]

SOLVERS [RegNo, Password, Name, RegistrationDate, Type]

STUDENT [RegNo, Year]

SOLVED [RegNo, PName, DateOpen, DateSolved]

TEACHER [RegNo, Position]

The sample instances below are indicative of the domain (data type) for the various attributes.

PUZZLE

PName	Difficulty	Solution
Bits	Simple	101
Astro	Advanced	Teapot
Travel	Hard	9 days

SOLVERS

RegNo	Password	Name	RegistrationDate	Type
112	XXVT	Steve	1/9/2007	STUDENT
227	9987	Lisa	1/9/2008	TEACHER

SOLVED

RegNo	PName	DateOpen	DateSolved
112	Bits	1/10/2007	5/10/2007
227	Bits	1/4/2009	3/4/2009
112	Astro	1/2/2008	16/5/2008

Using the above database, give an example of a tuple insert (or update or delete) that would cause the following integrity constraint violations: (2 Marks)

a) Key constraint violation in PUZZLE

b) Entity integrity constraint violation in SOLVERS

c) Referential integrity constraint violation in SOLVED

d) Domain constraint violation in PUZZLE

Question 3.
Briefly explain the role of the following in database systems (4 Marks)

a) Views

b) Indexes

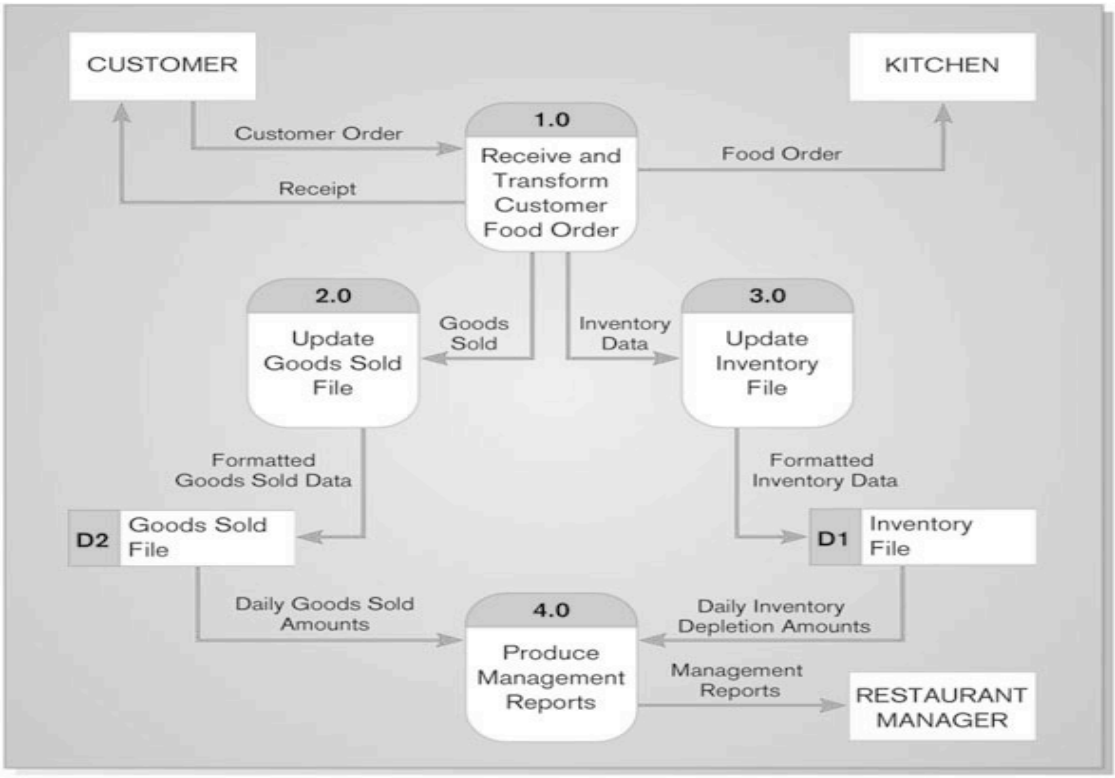
c) Integrity Constraints

d) System Catalogue (or Data Dictionary)

PART II – DATABASE DESIGN (20 Marks)

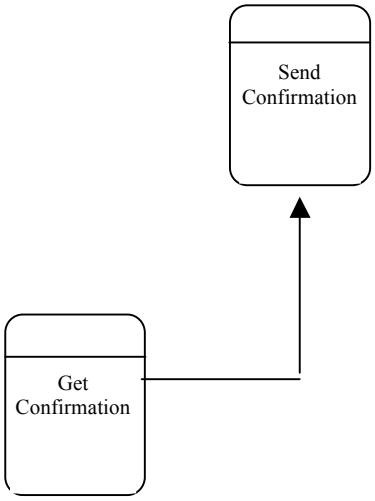
Question 4.

a) Draw a *balanced* context level data flow diagram (DFD) for the level 0 DFD below. (3 Marks)

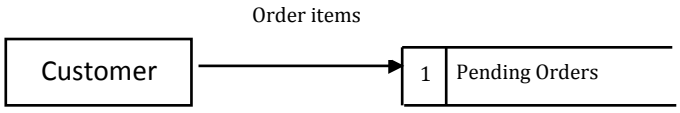


b) Is there an error in the following DFD fragments?
If yes, briefly explain the error. (2 Marks)

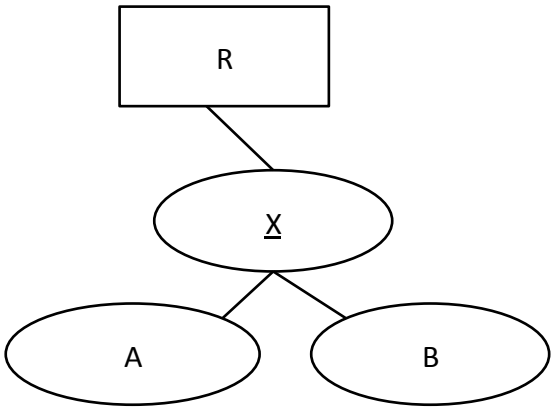
i) (Y/N) _____



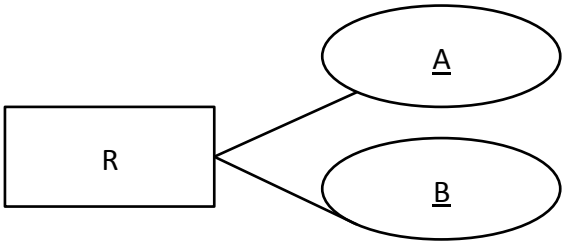
ii) (Y/N) _____



Question 5.
a) Map the following ERs into relational schemas. (1 Mark)

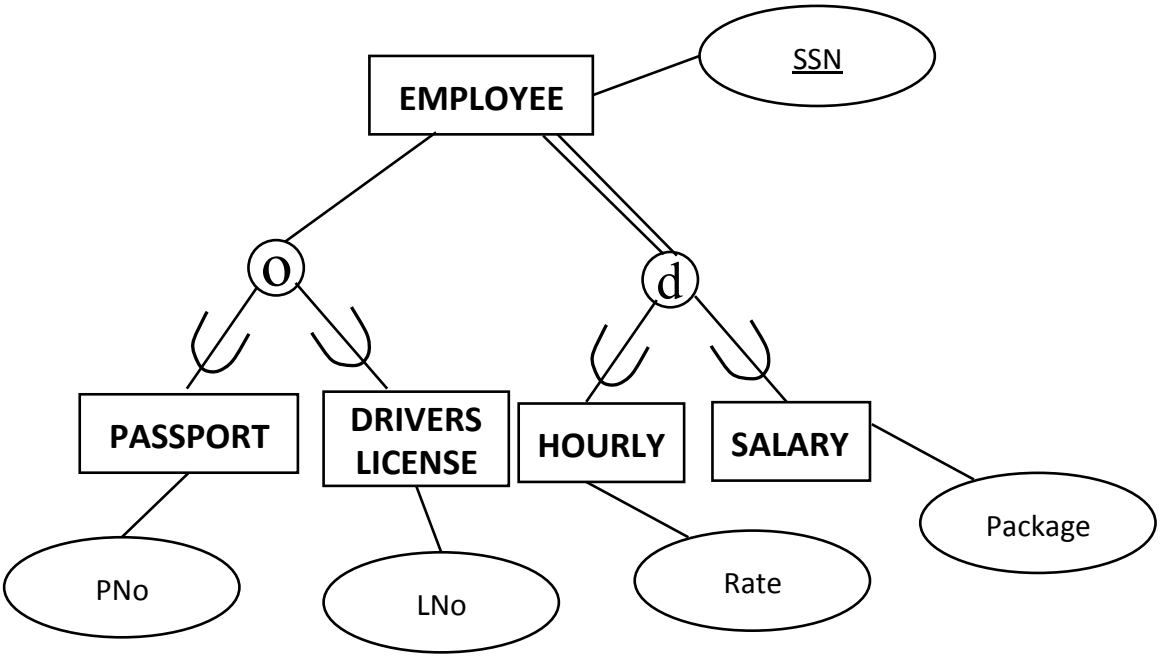


R ( )



R ( )

b) Tick the option below that represents an ideal mapping for the given ER. (1 Mark)



☐ HOURLY (SSN, Rate)
SALARY (SSN, Package)
EMPLOYEE (SSN, T1, PNo, T2, LNo)

☐ EMPLOYEE (SSN, Rate, Package, T1, PNo, T2, LNo)

☐ EMPLOYEETYPE (SSN, Rate, Package)
EMPLOYEEID (SSN, PNo, LNo)

T1 and T2 represent attributes that contain a binary value (Y/N) of whether a tuple belongs to a subclass or not

c) Reverse Engineer the following Schema to make an ER. (4 Marks)

BANK [Code, Name, HOAddr]
BRANCH [BankCode, BranchNo, Addr]
ACCOUNT [ACNo, Type, Balance, BankCode, BranchNo]
LOAN [LoanNo, Type, Amount, BankCode, BranchNo]
CUSTOMER [SSN, Name, Address]
CUSTPHONE [SSN, Phone]
ACCOUNT-HOLDER [ACNo, SSN]
LOAN-HOLDER [LoanNo, SSN]

Foreign Keys:
BRANCH.BankCode → BANK.Code
ACCOUNT.{BankCode, BranchNo} → BRANCH.{BankCode, BranchNo}
LOAN.{BankCode, BranchNo} → BRANCH.{BankCode, BranchNo}
ACCOUNT-HOLDER.ACNo → ACCOUNT.ACNo
ACCOUNT-HOLDER.SSN → CUSTOMER.SSN
LOAN-HOLDER.LoanNo → LOAN.LoanNo
LOAN-HOLDER.SSN → CUSTOMER.SSN
CUSTPHONE.SSN → CUSTOMER.SSN

Question 6. Construct an ER for the following UoD. (4 Marks)
The modern Olympic Games is the leading international sporting event featuring summer and winter sports competitions in which thousands of athletes across the planet participate in a variety of competitions. Consider OLYMPICS as an example of a database used to manage and store information about past Olympic Games. The database stores information about the various athletes that have competed at the games and the results they achieved. The database also holds information on the various events that take place.

An athlete is identified by a unique athleteID and their name, age, sex and representative country are also stored. Each event is given a unique eventID and is described by its name and sport (e.g. *Men's 100m Freestyle* is an event and the sport is *Swimming*). The database also stores a list of each Olympic games, which incudes its year, the type (*summer* or *winter*) and the host country. For example *Summer2000*, *Australia*. There can only be one type of Olympic games in a given year. Results are stored by recording an individual athlete's result in a particular event in a specific Olympic games.

Question 7.

a) Give one reason why you would not further normalize a 3NF relation into a BCNF relation. (1 Mark)

b) Determine all (minimal) keys for the following relation. (1 Mark)

i) R [A B C D]

F = {A → BC, C → D}

ii) R [A B C D]

F = {C → D, BC → A}

c) Given the following:

MOVIES [movieID, Title, Synopsis, Language, releaseDate, roleType, castID, Biography, DOB, castName, awardID, awardName, Organisation, Year]

FD1: movieID → {Title, Synopsis, Language, releaseDate}
FD2: {movieID, castID} → roleType
FD3: castID → {Biography, DOB, castName}
FD4: awardID → {awardName, Organisation}
FD5: {movieID, castID, awardID} → Year

i) Determine the candidate key(s) for the given relation (0.5 Mark)

ii) Determine the highest normal form of the given relation (0.5 Mark)

iii) Decompose the given relation to achieve BCNF. You only have to show the final BCNF relations here (2 Marks)

PART III – SQL (10 Marks)

Question 8. Which of the following two queries are equivalent? (2 Marks)

a) Equivalent (yes/no) _____

If no, briefly explain why:

SELECT a FROM R1 WHERE a NOT IN (SELECT a FROM R2)	SELECT R1.a FROM R1, R2 WHERE R1.a <> R2.a

b) Equivalent (yes/no) _____

If no, briefly explain why:

SELECT a FROM R1 WHERE a IN (SELECT a FROM R2)	SELECT R1.a FROM R1, R2 WHERE R1.a = R2.a

Question 9. The following schema and respective domain information is given:

Person (secret-identifier, month-of-birth, eye-color, head-circumference, fav-pizza-topping, fav-magical-character)

month-of-birth is 01-12
head-circumference is in cm
fav-magical-character examples are Gollum, Dobby, Tinker Bell etc.

Movie (secret-identifier, movie-name, genre, watched-in-year, theatre-or-dvd, why-I-like-it)

Legal values for genre: action, comedy, drama, sci-fi, animation, horror
watched-in-year is entered as yyyy
Legal values for theatre-or-dvd (indicates whether you watched it in theatre or on dvd): theatre, dvd
why-I-like-it is free text

App (secret-identifier, app, since, hours-per-week, rating)

Example values for app: facebook, twitter, shazam, etc
rating is 1-5 with 1 being most favorite, and 5 being least
since is a date field to be entered as yyyy-mm-dd

Formulate the following questions in SQL. (2 Marks each)

a) List details of people with blue eyes, who use the app *facebook* for more than 20 hours a week.

b) What is/are the most favorite pizza topping(s). (Hint: Most favorite means people like it more than any other topping).

c) Find the details of all persons who have never used an app with rating of 5.

d) Display secret-identifier of persons who have watched at least ALL the movies that person with secret-identifier *bart* has watched.

END OF EXAMINATION