La Trobe University
Summer Examination Period 2022-23

Subject code:	CSE2DBF/CSE4DBF	
Reading time:	15	minutes
Writing time:	300	minutes
Number of pages:	20	(Including cover sheet)

Academic Integrity (read this before starting the exam):

Academic integrity means putting values into practice by being honest in the academic work you do at university, being fair to others, taking responsibility for learning, and following the conventions of scholarship. It is the University's responsibility to award credit for honestly conducted work, and it is your responsibility to ensure that you demonstrate academic integrity.

This is an individual exam. You must undertake this exam by yourself and without any assistance from any other person or any website or other resources which are not specifically permitted. You are not permitted to share any aspect of your exam participation or answers with other students or provide assistance to them in any way.

Instructions to students:

1.   This paper consists of 9 questions (5 multiple-choice questions and 4 descriptive questions). They are worth 180 marks.

2.   Students need to answer all questions.

Question 1 (ER/EER Diagram – Single Answer Multiple Choice Question) – 10 marks

Write down the correct option (a, b, c, or d) in the provided answer sheet. There is only ONE correct answer. 5 marks will be awarded for the second-best answer.
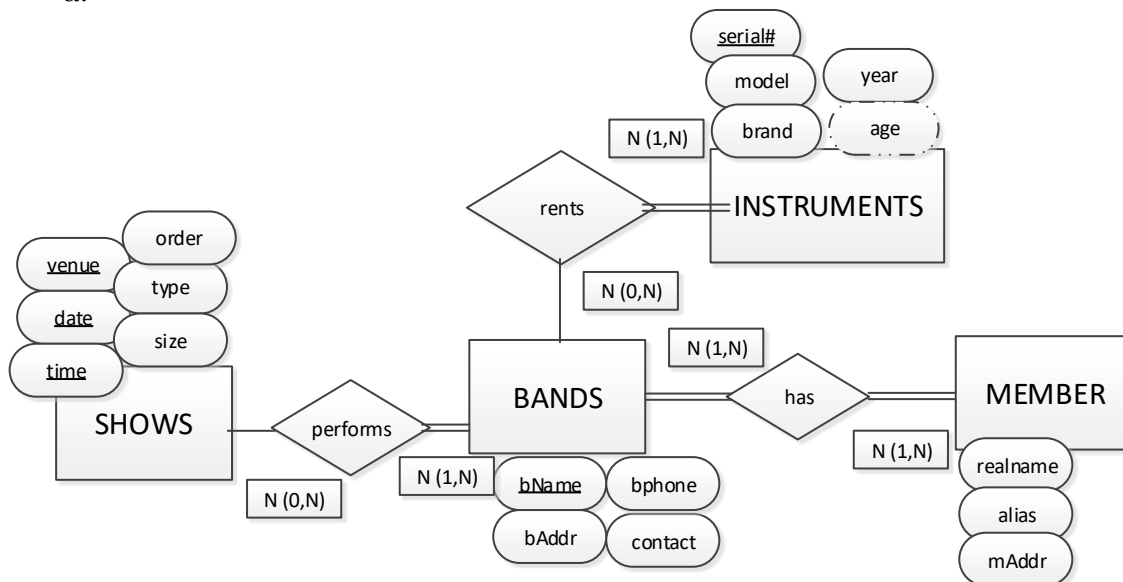
"Funky Bizz" is a rental business that rents musical instruments to bands. The Funky Bizz Operations Database will keep track of instruments that the business owns. For each instrument, Funky Bizz will keep track of a unique instrument serial number as well as the instrument model and brand, the year when the instrument was made, and the age (measured in years) of the instrument.

The customers of Funky Bizz are bands. For each band, Funky Bizz will keep track of the unique band name as well as the band's address, contact person's name, and a phone number. Funky Bizz also wants to store the real name, alias name, and address of the band's members. However, if the information of the band is no longer required for whatever reason, the information of the members must be removed for privacy purposes.
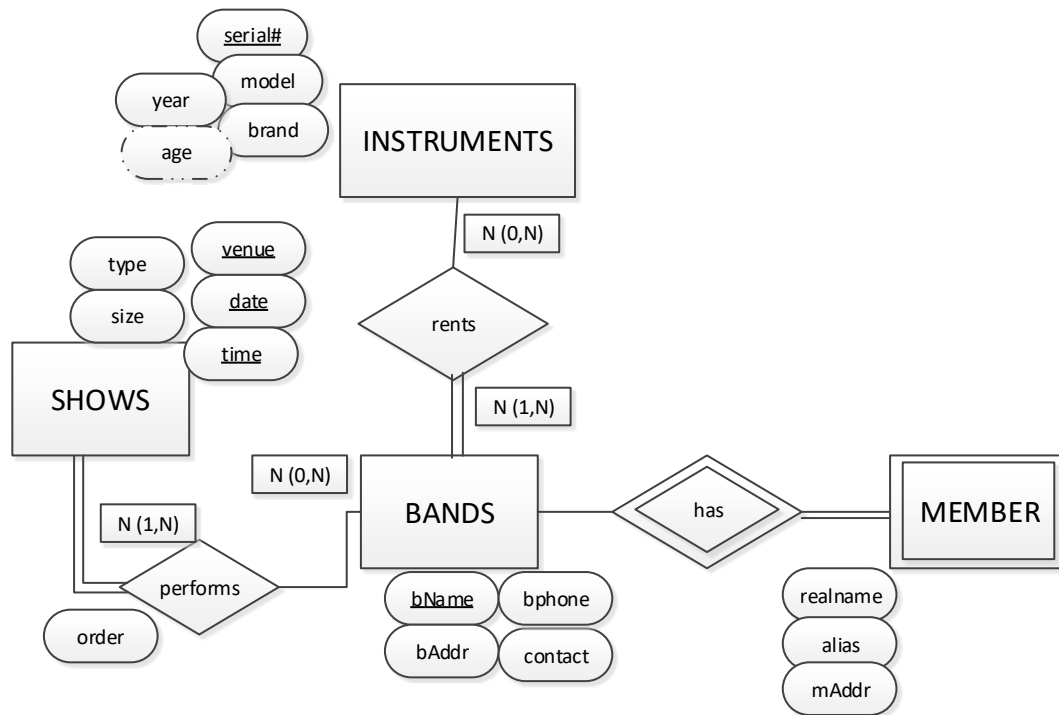
Funky Bizz will record information about shows that its customer bands perform in. For each show, it will keep track of a unique show identifier composed of the show venue name and date. For each show, it will also keep track of show type and show size (in terms of the number of audience). A band may perform in many shows but does not have to perform in any. Each show must have at least one band performing, but many have many bands performing. For each band, Funky Bizz keeps track the order of their appearance in a show. This is to track the popularity of the band.

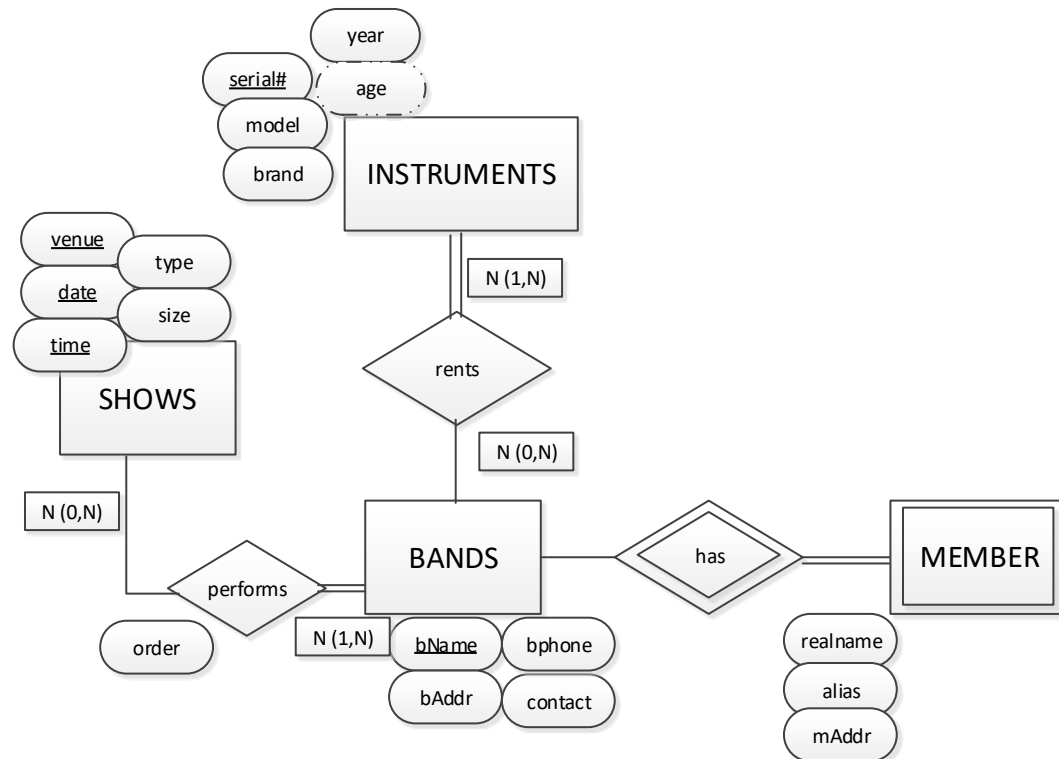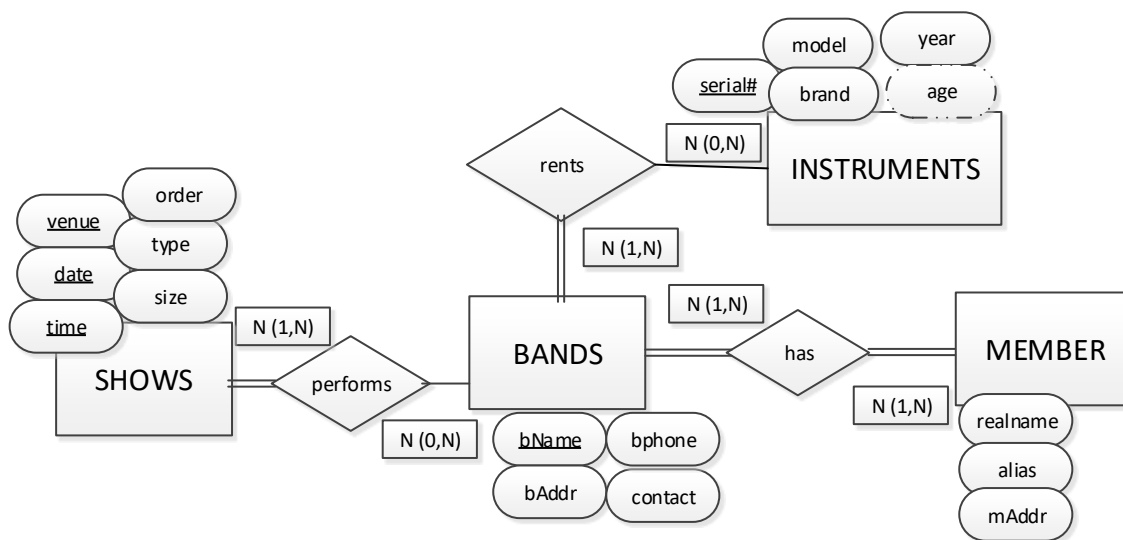Which EER Diagram below *most correctly* models the problem described above?

a.

b.

c.

d.

An ER diagram with the following entities and relationships:

- **INSTRUMENTS** entity with attributes: serial# (underlined), model, brand, year, age (derived/dashed)
- **rents** relationship between INSTRUMENTS and BANDS, with N (0,N) on the INSTRUMENTS side and N (1,N) on the BANDS side
- **SHOWS** entity with attributes: venue (underlined), date (underlined), time (underlined), order, type, size
- **performs** relationship between SHOWS and BANDS, with N (1,N) on the SHOWS side and N (0,N) on the BANDS side
- **BANDS** entity with attributes: bName (underlined), bphone, bAddr, contact
- **has** relationship between BANDS and MEMBER, with N (1,N) on the BANDS side and N (1,N) on the MEMBER side
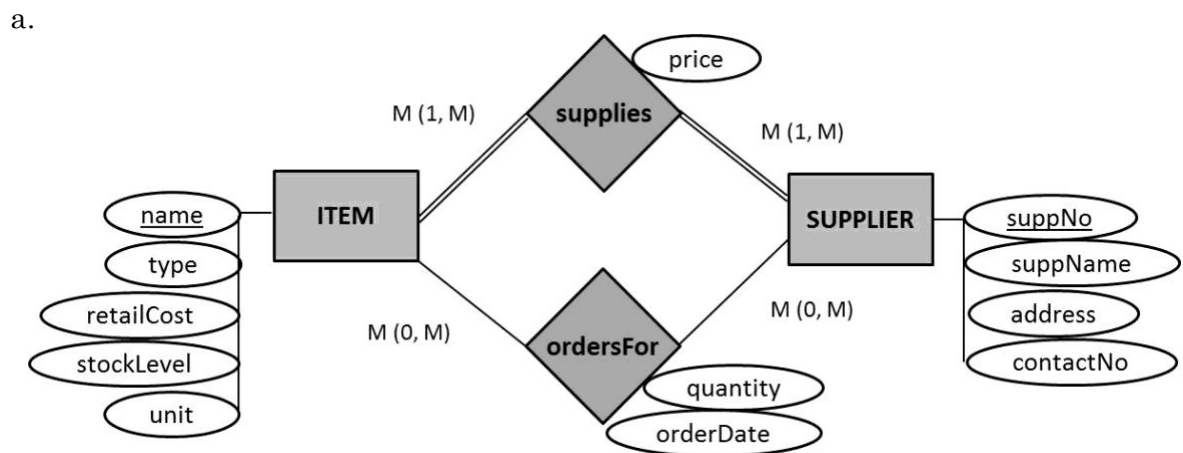- **MEMBER** entity with attributes: realname, alias, mAddr

[10 marks]

Question 2 (ER/EER Diagram - Single Answer Multiple Choice Question) – 10 marks
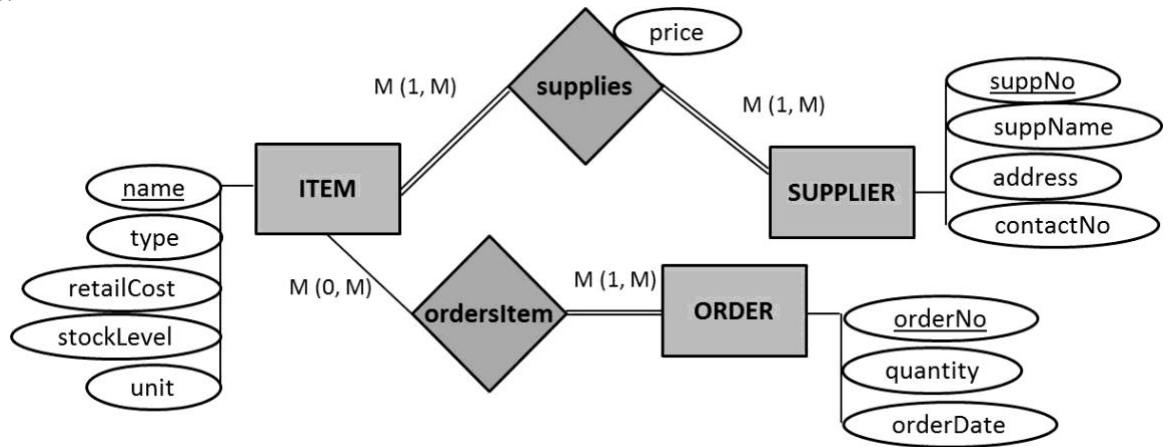
Write down the correct option (a, b, c, or d) in the provided answer sheet. There is only ONE correct answer. 5 marks will be awarded for the second-best answer.

The manager of a restaurant wants to keep track of stock level of items so that an order is placed with the supplier in case there is shortage of items. The supplier's detail consists of name, address, contact number, the item/s that they supply and the price. Note that the same item can be supplied by different suppliers, and an order may include one or more items from the same supplier. For taxation purpose, unique order numbers must be kept.
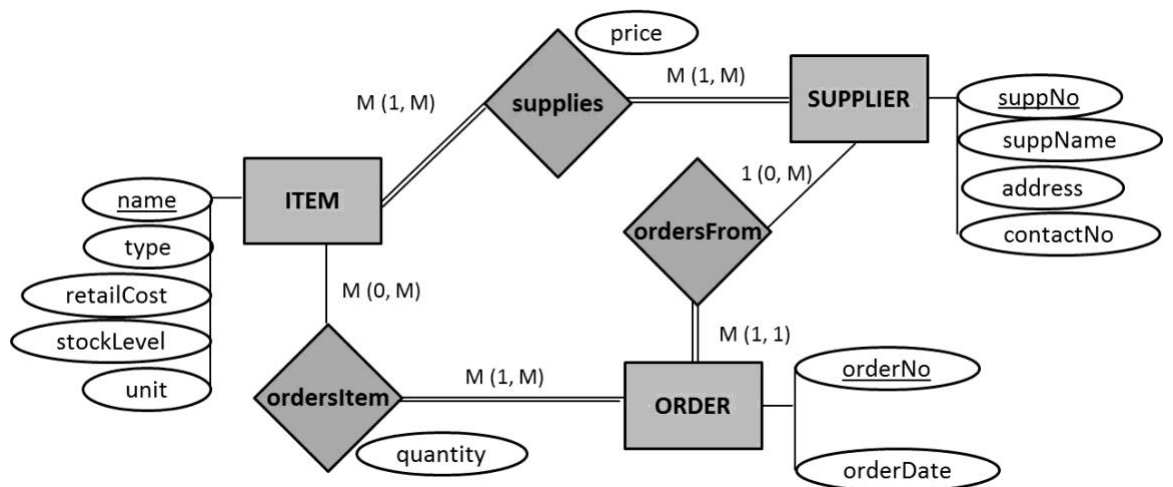
Which EER Diagram below _most correctly_ models the problem described above?
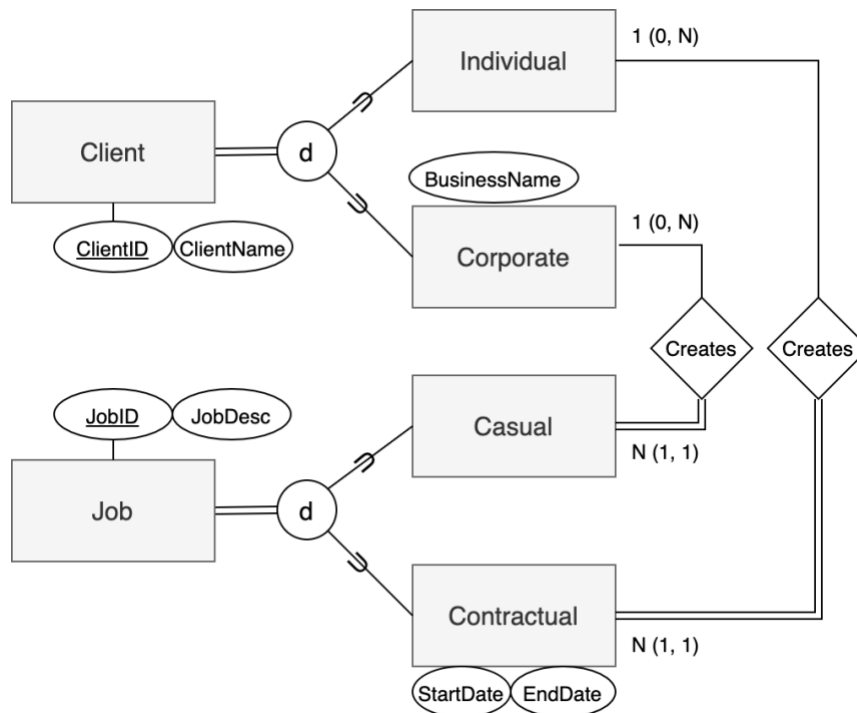
a.

b.

c.

d.
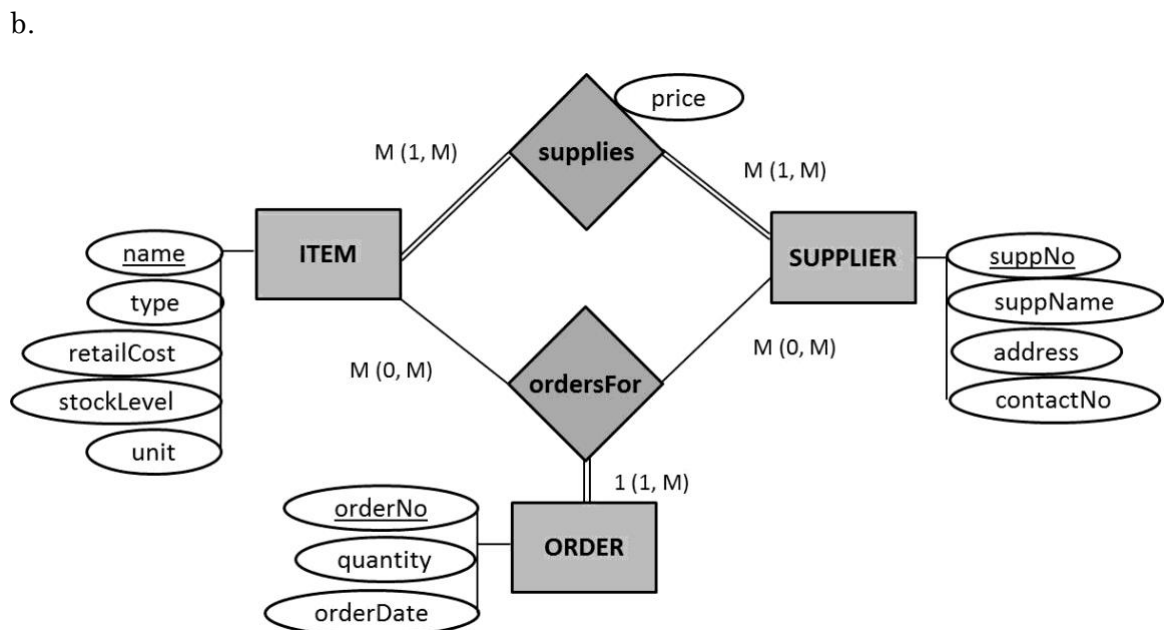
[10 marks]

Question 3 (ER/EER Diagram - Single Answer Multiple Choice Question) – 10 marks

Write down the correct option (a, b, c, or d) in the provided answer sheet. There is only ONE correct answer. 5 marks will be awarded for the second-best answer.

Servicematch is a business who provide a platform where clients can access services, needed on a regular basis, easily. For example, if a client wants their lawn mowed, they can post a job on *Servicematch* website and get quotes from local businesses. From the perspective of the company, the clients are classified as corporate and individual clients. Corporate clients are those who require services for professional purposes and individual clients are those who require services on personal or household purposes. When a registered client requires assistance from *Servicematch*, they can create a job request. Jobs can also be of two categories. Casual jobs are created by individual clients and are one-time events. On the other hand, contractual jobs are created by corporate clients and have specific contract start and end date.

Which EER Diagram below *most correctly* models the problem described above?

a.

b.

c.

d.

[10 marks]

Question 4 (Relational Algebra - Single Answer Multiple Choice Question) – 10 marks

Write down the correct option (a, b, c, or d) in the provided answer sheet. There is only ONE correct answer. 5 marks will be awarded for the second-best answer.
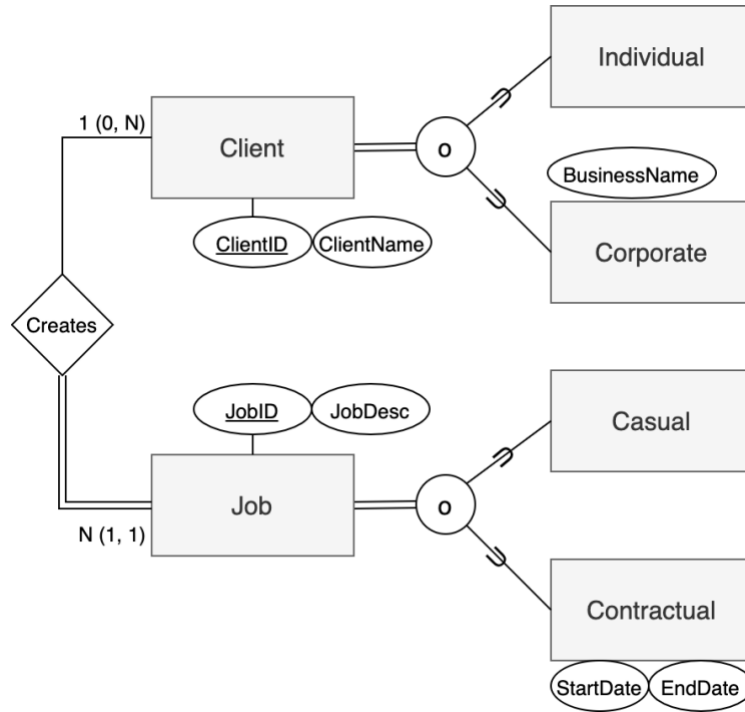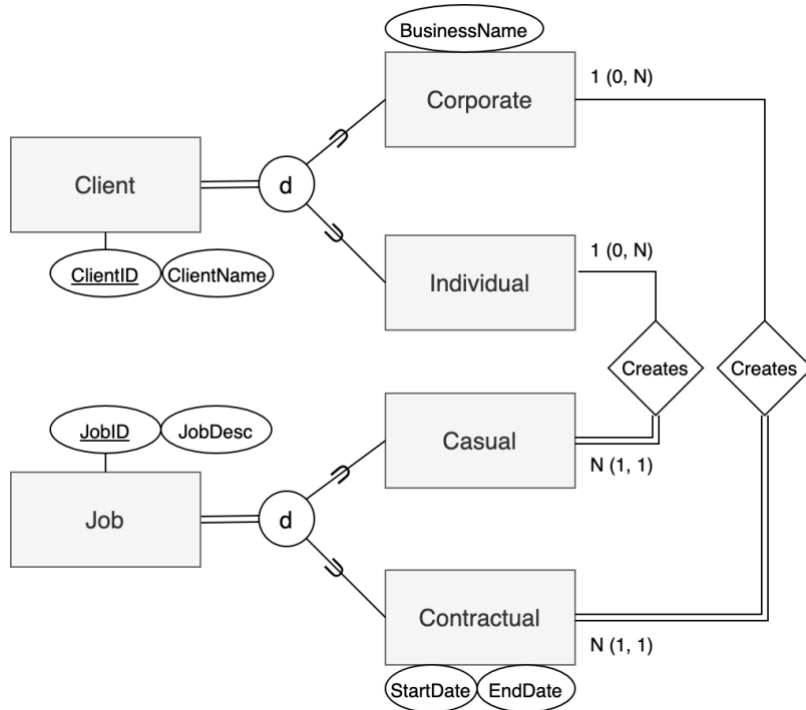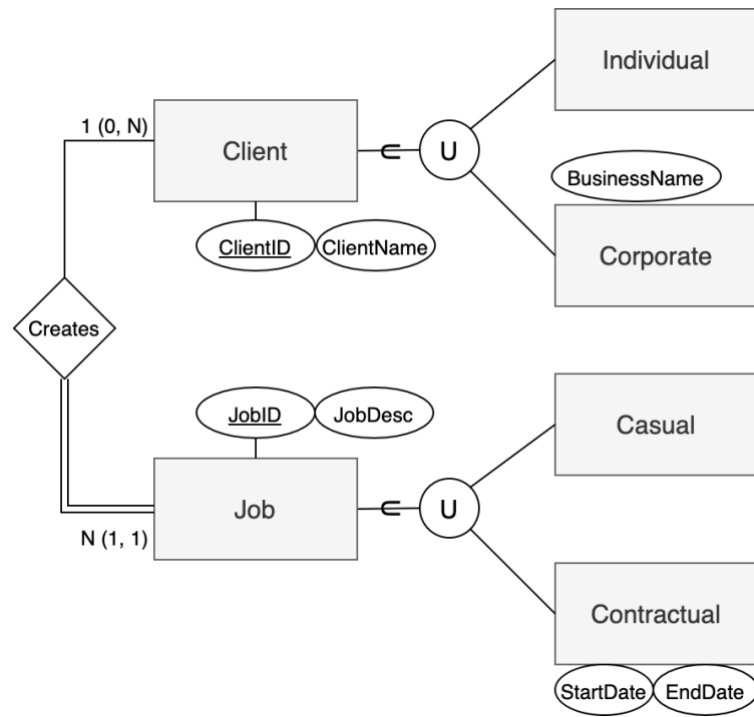
Consider the following two tables R and S with their instances:

R

A	B	C	D
a	x	y	9
a	z	w	5
b	x	k	4
b	m	j	3
b	n	h	4
c	x	y	1
d	m	y	3
f	g	h	5

S

E	F	G
x	a	5
z	f	3
g	j	7
x	h	8
t	b	9
x	m	8
z	d	2

Which one of the following four options lists the table instances of RESULT in the following relational algebra query?

$$Temp_1 \leftarrow \pi_{A, C, E, F} (R \bowtie_{R.B=S.E} S)$$
$$Temp_2 \leftarrow \pi_{A, C, E, F} (R \bowtie_{R.B=S.E} S)$$
$$Result \leftarrow \pi_{E, F} (Temp_1 - Temp_2)$$

(a)

E	F
x	a
x	a
x	a
z	f
g	j
x	h
x	h

(c)

E	F
x	h
t	b
x	m
x	m
x	m
z	d

(b)

E	F
t	b

(d)

E	F
t	b
g	j

Question 5 (Relational Algebra - Single Answer Multiple Choice Question) – 10 marks

Write down the correct option (a, b, c, or d) in the provided answer sheet. There is only ONE correct answer. 5 marks will be awarded for the second-best answer.

Consider the tables below, where the primary keys are underlined, and foreign keys are printed in italic.

BUILDING

BuildingID	BNoofFloor	BManagerID
B1	5	M12
B2	6	M23
B3	4	M23
B4	4	M34
B5	3	M34

APARTMENT

BuildingID	AptNo	ANoOfBedrooms
B1	41	1
B1	21	1
B2	11	2
B2	31	2
B3	11	2
B4	11	2

INSPECTOR

InsID	InsName
I11	Jane
I22	Niko
I33	Mick
I44	Rudy

INSPECTING

InsID	BuildingID	DateLast	DateNext
I11	B1	15-MAY-2015	14-MAY-2016
I11	B2	17-FEB-2016	17-MAY-2016
I22	B2	17-FEB-2016	17-MAY-2016
I22	B3	11-JAN-2016	11-JAN-2017
I33	B3	12-JAN-2016	12-JAN-2017
I33	B4	11-JAN-2016	11-JAN-2017

MANAGER

ManagerID	MFName	MLName	MBDate	MSalary	MBonus
M12	Boris	Grant	30-JUN-1980	60000	
M23	Austin	Lee	30-OCT-1975	50000	5000
M34	George	Sherman	11-JAN-1976	52000	2000

Which one of the following relational algebra expressions answers the following query?

"*Display the apartment numbers and the manager name of the building where the apartments are located. Only list the apartments that are located in buildings with 4 level or more.*"

(a)

$\pi_{\text{AptNo, MFName, MLName,}}$ **(APARTMENT)** $\bowtie_{\text{BuildingID = BuildingID}}$ $(\sigma_{\text{BNoOfFloor >= 4}})$ **(BUILDING)** $\bowtie_{\text{BManagerID = ManagerID}}$ **(MANAGER)**

(b)

π AptNo, MFName, MLName, (APARTMENT) $\bowtie$ BuildingID = BuildingID (σ BNoOfFloor >=

4) (BUILDING) $\bowtie$ BuildingID = InsID (INSPECTOR) $\bowtie$ BManagerID = ManagerID (MANAGER)

(c)

π AptNo, MFName, MLName, (APARTMENT) $\bowtie$ BuildingID = BuildingID (σ BNoOfFloor >=

4) (BUILDING) $\bowtie$ (MANAGER)

(d)

π AptNo, MFName, MLName, (APARTMENT) $\bowtie$ BuildingID = BuildingID (BUILDING)

$\bowtie$ BManagerID = ManagerID (MANAGER)

Question 6 (Transformation of EER into Relational tables – 25 marks)

The following EER diagram models the database for a catering business.
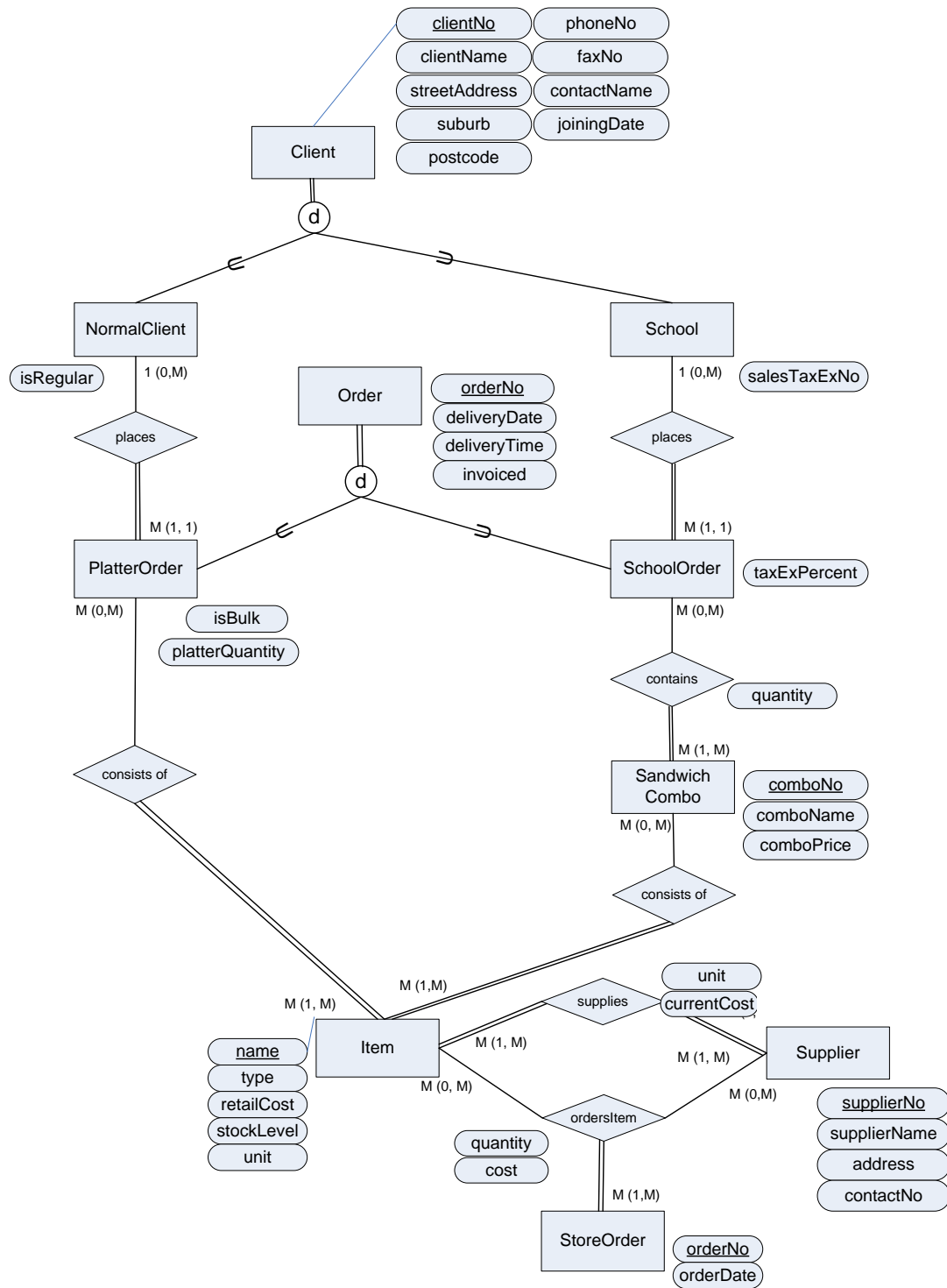
You need to perform the following tasks:

a) Perform the transformation of the EER model into the **relational tables**. For CLIENT specialization, you need to apply option 8A (multiple tables for superclass and sub classes) and for ORDER specialization, you need to apply option 8B (multiple tables for sub classes).

[20 marks]

b) Technically, can you apply transformation rules options 8C and 8D for both specialization relationships of this EER model? What are the implications of applying these two options to your database?

[5 marks]

Question 7 (Normalisation) – 35 marks

a) Consider the following RECRUITEMENT relation with sample data. The primary keys are underlined.

Recruiter-ID	Recruiter-Name	Status-ID	Status	City	State	State-Population	City-Population	NoOf-Recruits
R1	Cate	IF	Internal Full Time	Portland	ME	1,350,000	70,000	11
R1	Cate	IF	Internal Full Time	Grand Rapids	MI	9,900,000	190,000	20
R2	Abra	IP	Internal Part Time	Rockford	IL	12,900,000	340,000	17
R3	Jana	CN	Contractor	Spokane	WA	6,800,000	210,000	8
R3	Jana	CN	Contractor	Portland	OR	3,900,000	600,000	30
R3	Jana	CN	Contractor	Eugene	OR	3,900,000	360,000	20
R4	Maria	IF	Internal Full Time	Rockford	IL	12,900,000	340,000	14
R4	Maria	IF	Internal Full Time	Grand Rapids	MN	5,400,000	11,000	9
R5	Dan	CN	Contractor	Grand Rapids	MI	9,900,000	190,000	33

University ABC uses a single relation RECRUITEMENT to store its recruitment data. For each recruiter in University ABC, the table lists the number of recruited students from a particular city. It also lists the population of the cities and state from where University ABC recruits students. There can be more than one city with the same name, but within one state each city has a different name. Currently this table also lists the status of the recruiter and the population of the State and City. The primary key of this relation is the composite key RecruiterID, City and State.

i) List down the full functional dependencies (on the primary key), partial dependencies (if any), and transitive dependencies (if any) in the RECRUITEMENT table.

ii) Normalize RECRUITEMENT table to 3NF. Show each normalization step clearly.

[5 + 15 marks]

b) Consider the following Book relation:

BOOK (Book_title, Author_name, Book_type, List_price, Author_affiliation, Publisher)

Suppose the following dependencies exist:

       Book_title → Publisher, Book_type
       Book_type → List_price
       Author_name → Author_affiliation

Normalize the above BOOK table into 3NF. Show each normalization step clearly. You are not required to assume any additional dependencies.

[15 marks]

Question 8 (SQL) – 35 marks

The following show the tables and sample data of **Bundoora Clinic**. The *PATIENT, DOCTOR,* and *NATUROPATH* tables store the list of patients, doctors, and naturopaths respectively. *PATIENT_DOCTOR* table stores the information of the relationship between patients and doctors. *VISIT* table stores information of patient's visit to the clinic including the medication prescribed to the patient during that visit. *CONDITION* table lists possible condition that patients can have. Finally *PATIENT_CONDITION* table identifies what conditions that each patient has.

PATIENT

PatientID	PatientName	Age	NaturoNo
P1	Jake Long	25	NP1
P2	Drew Green	35	NP2
P3	Amy Chan	10	
P4	Lisa Moon	60	NP1
P5	Henry Tran	55	NP3

NATUROPATH

NaturoNo	NaturoName	NaturoContact
NP1	Glenn Murphy	98562562
NP2	Helena Bond	98659620
NP3	Daniel Rowe	95369485
NP4	Adam Auburn	94793459
NP5	Hasan Sulistyo	95568840

DOCTOR

DoctorNo	DoctorName	Specialty	DoctorContact
D1	Ramon Dunn		98698544
D2	Jill Ilic	Oncologist	98695214
D3	Dean Hanson	Cardiologist	90248965
D4	Kunal Reddy	Pediatrician	88963562
D5	Hans Bolte	Perinatologist	98012563

PATIENT_DOCTOR

PatientNo	DoctorNo
P1	D1
P1	D2
P2	D3
P2	D4
P3	D3

VISIT

VisitNo	VisitDate	AmountPaid	Medication	PatientID
V1	15-Apr-2022	95	Chinese Herbs	P4
V2	16-Apr-2022	75	Anti-Depressant	P1
V3	30-Apr-2022	120	Supplements	P2
V4	13-May-2022	125		P2
V5	15-May-2022	265	Antihistamine	P4

CONDITION

ConditionCode	ConditionName
C1	Allergy
C2	Artificial Implants
C3	Hospitalized
C4	Under Medical Care

PATIENT_CONDITION

PatientID	ConditionCode	Notes
P1	C1	Antihistamine
P2	C1	Chinese Herbs
P3	C3	5 Years Ago
P4	C4	Since Birth

Write SQL statements to answer the following queries:

a) Display the details of all naturopaths in the database along with his/her patient(s) (if any). Patient Name and age should be displayed. The display should be ordered by naturopath name in ascending order and then the patients should be ordered from the older patients to the younger ones.

[5 marks]

b) Display the detail of the doctors who have the highest number of patients in the database.

[7 marks]

c) Display the name and age of patients who have an allergy.

[7 marks]

d) Display the name of each patient in the database along with the total amount of money they have paid for doctor visits.

[8 marks]

e) Display the names and contact numbers of doctors and naturopaths who have at least one patient in the database.

[8 marks]

Question 9 (PL/SQL) – 35 marks

The following show the tables and sample data of **La Trobe Airline**. The *PLANE* and *PILOT* tables store the list of planes owned by the airline and the pilots working there respectively. *PASSENGER* table stores the information of the passenger flying with the airline. *FLIGHT* table stores information of the flights. This table includes information about the pilot and plane used. *CITY* table identifies the city where the airline flies to along with the airport information. *PASSENGERFLIGHTS* stores the relationship between passenger and flights. These are the **ONLY** tables in the airline database.

NOTE: Primary Key (PK) is underlined, Foreign Key (FK) is printed in italic, PK that is also FK is underlined and printed in italic.

PLANE

SerialNo	Capacity	NextServiceDate
ABC100	150	04/08/2022
ABC200	150	05/09/2023
ABC300	100	01/09/2023
ABC400	200	03/08/2022
ABC500	300	01/08/2022

PASSENGER

Name	Address	PhoneNo
Jamie Roberts	Bundoora	95695687
Lily Chan	Kew	95821456
Duke Gold	Mill Park	96582563
Harry Nguyen	Williamstown	93569282
Sonya Taylor	Camberwell	95869582

CITY

CityCode	CityName	State	AirportDesc
MEL	Melbourne	VIC	Large
ADL	Adelaide	SA	Medium
CBR	Canberra	ACT	Medium
SYD	Sydney	NSW	Large
PER	Perth	WA	Medium

PILOT

PilotID	PilotName
P1	Yuka Yamashita
P1	Matt Green
P2	Bernie Winston
P2	Kay Malson
P3	Cliff Marsden

FLIGHT

FlightNo	Date	DepTime	ArrTime	Origin	Dest	PilotNo	SerialNo
LAT123	01/08/2022	09:00	10:15	MEL	SYD	P1	ABC100
LAT345	01/08/2022	10:30	11:30	ADL	PER	P2	ABC200
LAT456	01/08/2022	11:00	12:15	MEL	SYD	P4	ABC300
LAT567	01/08/2022	11:30	12:20	MEL	ADL	P5	ABC400

PASSENGERFLIGHTS

Name	FlightNo
Jamie Roberts	LAT123
Lily Chan	LAT123
Duke Gold	LAT456
Harry Nguyen	LAT567

a) Write a *stored procedure* that receives a given date as input and prints the details of the aircraft/plane scheduled for flights on that date and separately prints those, which are not scheduled for a flight.

[20 marks]

b) A *trigger* on the **FLIGHT** table that prevents a plane from being assigned for a flight whose service is due within the next 3 months from the flight date.

[15 marks]