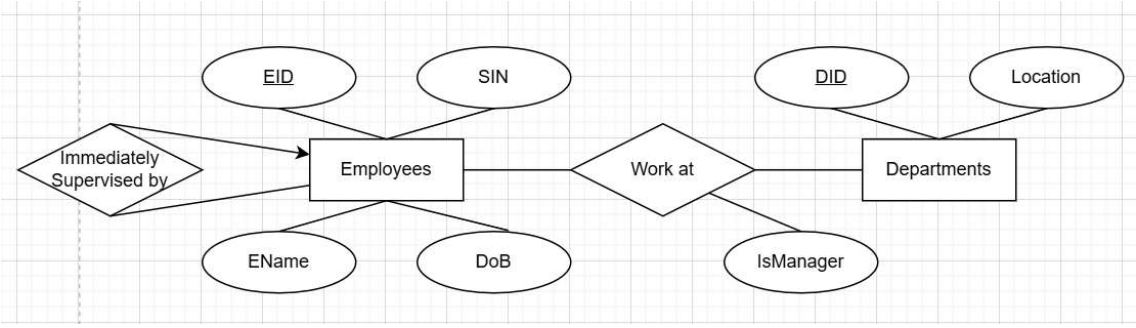
Question 1

a) E/R Diagram



b) Employees(EID, EName, SIN, DoB, SupervisorEID)

EID	EName	SIN	DoB	SupervisorEID
0001	Amita Dixit	249 525 960	1983-05-12	NULL
0002	Ashwin Dixit	248 525 961	1986-08-07	0001
0003	Ashwin Dixit	247 525 962	1989-05-01	0001

Departments(DID, Location)

DID	Location
01	Floor 1
02	Floor 1
03	Floor 2

WorkAt(EID,DID,IsManager)

EID	DID	IsManager
0001	01	TRUE
0002	01	FALSE
0002	02	FALSE

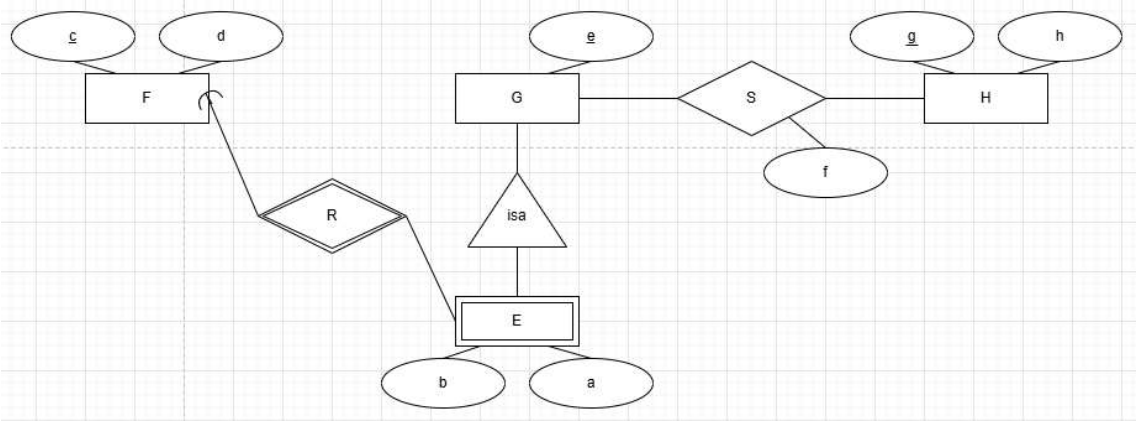
c) For the **Employees** relation, EID (employee ID) is the primary key and SIN (Social Insurance Number) is an alternate key. Though SIN is also unique, it is preferable to use EID as the primary key as it is specifically issued by the company itself when they onboard a new employee. In the case of SIN, while most employees have them, some may be in the process of acquiring them and as such, the field can be temporarily null.

For the **Departments** relation, DID (department ID) is the primary key. Similarly to EID, DID is specifically issued by the company itself whenever a new department is established.

For the **WorkAt** relation, given that it is a many-many relationship (a department can have many employees and an employee can potentially work in many departments), the primary key is composed of both EID (employee ID) and DID (department ID).

Question 2

a)



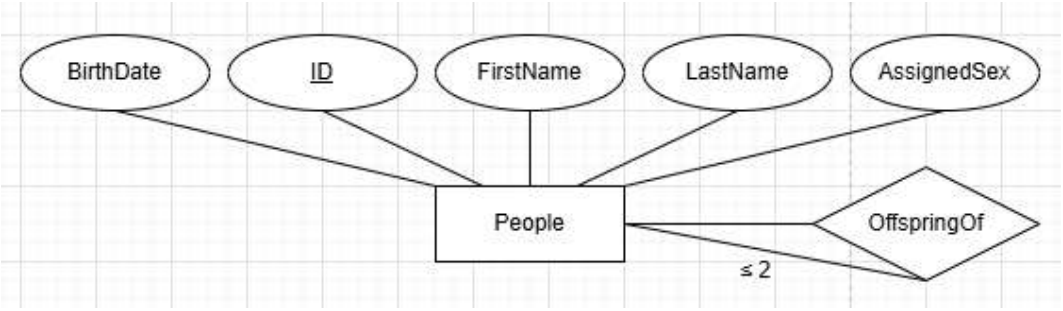
Relations
F(c, d)
G(e)
H(g,h)
S(e,g,f)
E(e,b,a,c)

b) F(c, d)
G(e)
H(g,h)
S(e,g,f)
E(e,b,a,c,d)

c) Relation
R(a,b,c,d,e,f,g,h)

Question 3

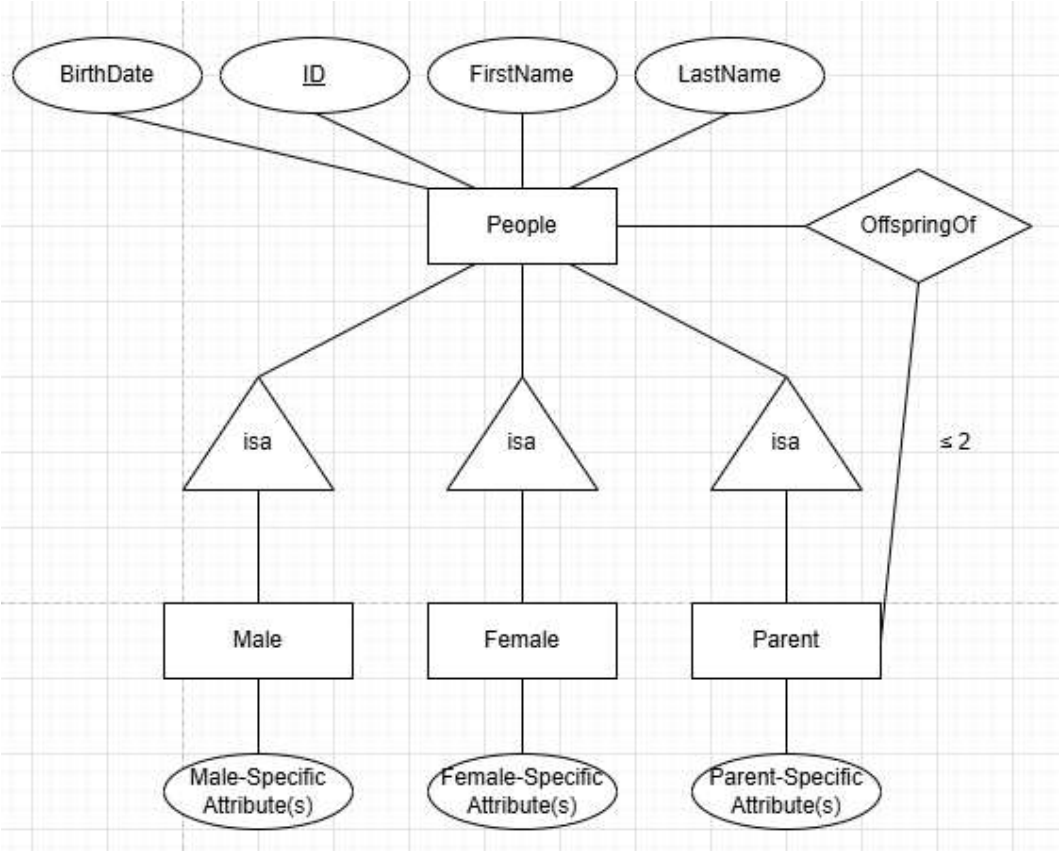
a) E/R Diagram



b) People(ID, FirstName, LastName, BirthDate, AssignedSex, MID, FID)
(N.B. MID and FID are Mother's ID and Father's ID respectively.)

ID	FirstName	LastName	BirthDate	Assigned Sex	MID	FID
0001	Amita	Dixit	1983-05-12	F	0004	0003
0002	Ashwin	Dixit	1986-08-07	M	0004	0003
0003	Dilip	Dixit	1941-11-17	M	0005	0006
0004	Madhuri	Navangul	1956-01-14	F	0007	0008

Question 4



People(ID, FirstName, LastName, BirthDate, AssignedSex, MID, FID)
(N.B. MID and FID are Mother's ID and Father's ID respectively.)

ID	FirstName	LastName	BirthDate
0001	Amita	Dixit	1983-05-12
0002	Ashwin	Dixit	1986-08-07
0003	Dilip	Dixit	1941-11-17
0004	Madhuri	Navangul	1956-01-14

Males(ID, Male-Specific Attribute)

ID	Male-Specific Attribute
0002	abc
0003	def

Females(ID, Female-Specific Attribute)

ID	Female-Specific Attribute

0001	ghi
0004	jkl

Parents(ID, Parent-Specific Attribute)

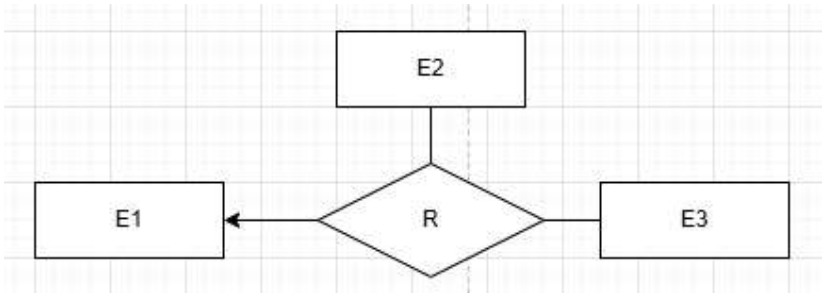
ID	Parent-Specific Attribute
0003	mno
0004	pqr

OffspringOf(ID,PID)
(N.B. PID is Parent ID.)

ID	PID
0001	0004
0002	0004
0003	0005
0003	0006
0004	0007
0004	0008
0001	0003
0002	0003

Question 5

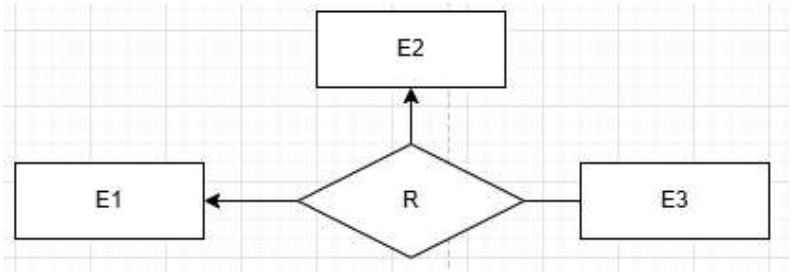
a)



Given that tuples in E2 and E3 must be associated with at most one tuple in E1 but can be associated with as many tuples as possible amongst each other, the range of values in R are from 0 to e2*e3.

0 ≤ |R| ≤ e2*e3

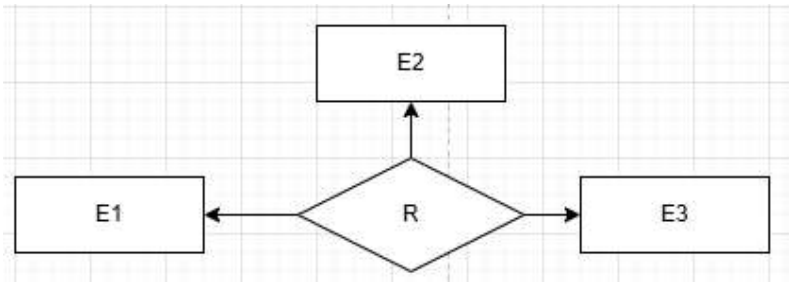
b)



Given that tuples in E3 can be associated with at most one tuple in each E1 and E2, the range of values in R are from 0 to e3.

0 ≤ |R| ≤ e3

c)



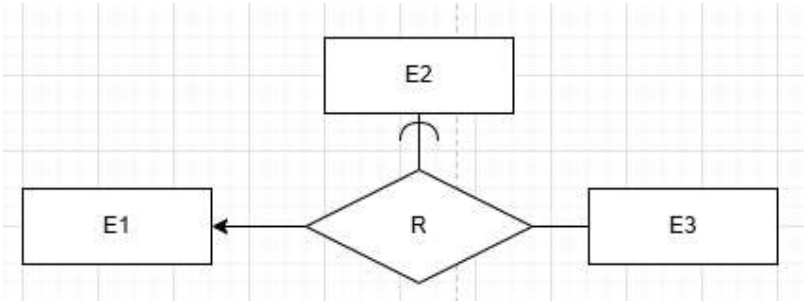
Given that:

Tuples in E1 must be associated with at most one tuple in E2 and E3.
Tuples in E2 must be associated with at most one tuple in E1 and E3.
Tuples in E3 must be associated with at most one tuple in E1 and E2.

The range of values in R are from 0 to the maximum number of tuples in either E1, E2 or E3.

0 ≤ |R| ≤ max(e1,e2,e3)

d)



Given that tuples in E3 must be associated with exactly one tuple in E2 and can be associated with at most one tuple in E1, the exact value of |R| is e3.

|R| = e3