☑ Instructions

Uppsala University

Department of Information Technology

Database Design I (1DL301)

2023-10-20

Instructions: Read through the complete exam and note below any unclear directives before you start solving the questions. Answer **all** questions.

The paper has two types of questions:

- If a **question is marked with ♥** you must **select ALL correct choices**. If you do not select all correct choices or you include any incorrect choice, your answer will be marked as incorrect.
- For all **other questions** you must **select only one choice** even if there are several correct choices. Your answer will be marked as correct if you select any of the correct choices. If you select an incorrect choice or select more than one choice, your answer will be marked as incorrect.

Please also answer questions: ♣ Q1, Q2 and Q3 which can be useful to us.

Grading. For each correct answer, you gain 1 point. A wrong answer does not generate negative points. To achieve a grade of 3, you must gain at least 14 points in the whole exam. To achieve a grade of 4, you must gain at least 17 points in the whole exam. To achieve a grade of 5, you must collect at least 21 points in the whole exam.

If you find any unclear directives, please note the question number below and explain what you think is unclear.

1 ♣ Question G1: When

General questions (useful for us)

When have you attended the course?

Select one alternative (no points awarded for this question):

○ 2023

○ 2022

○ 2021

○ Before 2021

Totalpoäng: 0

2 ♣ Question G2: How many

General questions (useful for us)

How many lectures have you attended?

Select one alternative (no points awarded for this question):

○ None or very few

○ Around 25%

○ Around 50%

○ Around 75%

○ Almost all

Totalpoäng: 0

3 ♣ Question G3: Study program

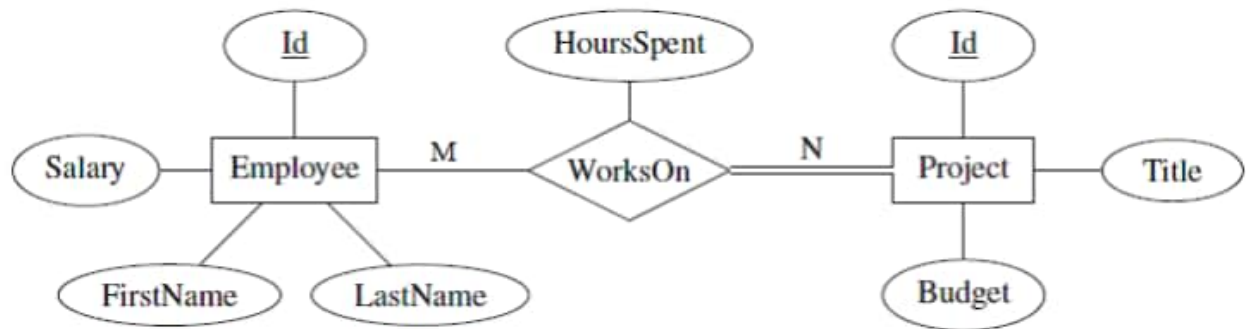**General questions (useful for us)**

What is your study program?
Select one alternative (no points awarded for this question):

- ○ F

- ○ STS

- ○ CS

- ○ X

- ○ IT

- ○ None of the previous answers

Totalpoäng: 0

4 ♥ Interpreting ER model

For the depicted ER model, select **all** statements that must hold!

♥ **Select one or more alternatives:**

☐ An employee can work on several projects.

☐ There can be employees who work on no projects.

☐ The ID for an employee must match the ID for some project.

☐ There can be projects on which no employees work.

☐ Every employee has a unique combination of first and last name.

Totalpoäng: 1

5 ♥ ER to relational

We want to convert the ER-model below to the relational model. Select all valid solutions.
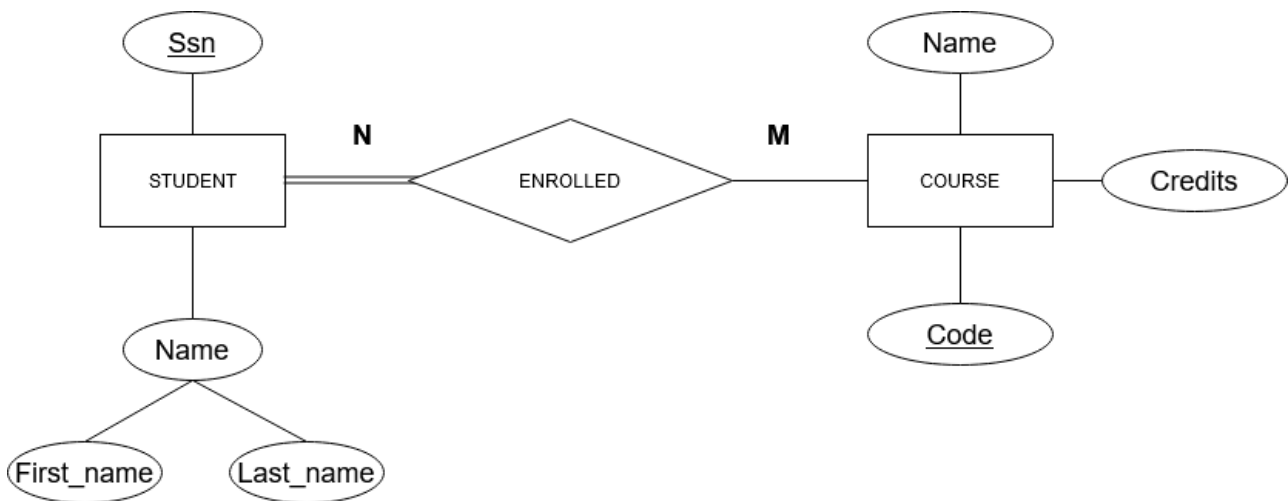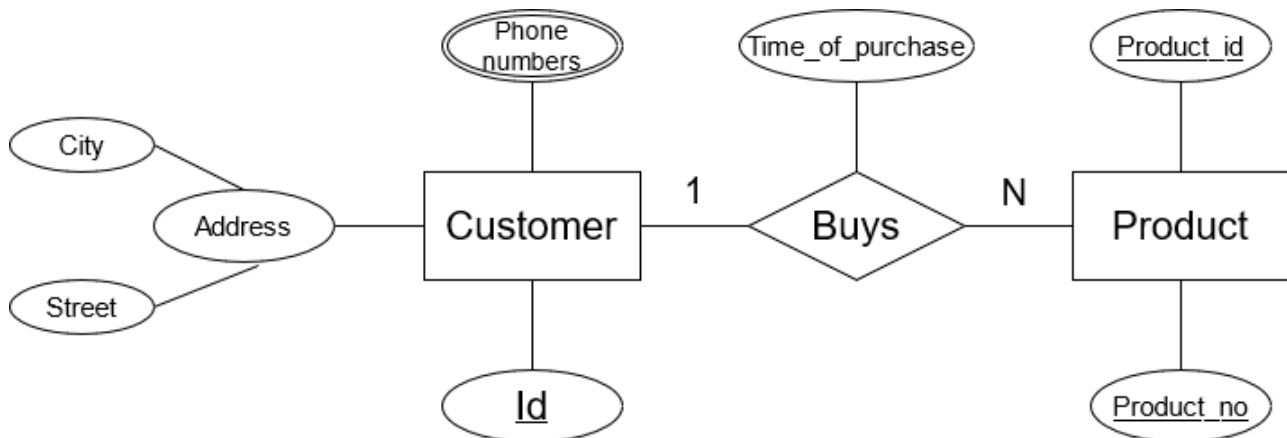

♥ Select one or more alternatives:

- ☐ STUDENT(Ssn, First_name, Last_name), COURSE(Code, Name, Credits), ENROLLED(Ssn, Code) with Ssn $\xrightarrow{FK}$ STUDENT(Ssn) and Code $\xrightarrow{FK}$ COURSE(Code)

- ☐ STUDENT(Ssn, First_name, Last_name, Code), with Code $\xrightarrow{FK}$ COURSE(Code), COURSE(Code, Name, Credits),

- ☐ None of the other options.

- ☐ STUDENT(Ssn, First_name, Last_name), COURSE(Code, Name, Credits), ENROLLED(Ssn, Name) with Ssn $\xrightarrow{FK}$ STUDENT(Ssn)

- ☐ STUDENT(Ssn, Name, First_name, Last_name), COURSE(Code, Name, Credits, Ssn), with Ssn $\xrightarrow{FK}$ STUDENT(Ssn)

Totalpoäng: 1

6 Mapping ER to relational model

Which of the following options is a correct mapping of the ER diagram to the relational model?

Select one alternative:

○ CUSTOMER(Id, {Phone numbers}, Address, City, Street),
BUYS(Id, Product_id, Time_of_purchase), with Id $^{FK}\rightarrow$ CUSTOMER(Id) and
Product_id $^{FK}\rightarrow$ PRODUCT(Product_id),
PRODUCT(Product_id, Product_no)

○ CUSTOMER(Id, {Phone numbers}, Address(City, Street)),
PRODUCT(Product_id, Product_no, Customer_id, Time_of_purchase), with
Cutomer_id $^{FK}\rightarrow$ CUSTOMER(Id)

○ CUSTOMER(Id, City, Street),
PHONES(Phone_number, Id), with Id $^{FK}\rightarrow$ CUSTOMER(Id),
PRODUCT(Product_id, Product_no, Time_of_purchase, Buyer_id), with
Buyer_id $^{FK}\rightarrow$ CUSTOMER(Id)

○ CUSTOMER(Id, City, Street, Product_id, Product_no), with
{Product_id, Product_no} $^{FK}\rightarrow$ PRODUCT({Product_id, Product_no})
PHONES(Phone_number, Id), with Id $^{FK}\rightarrow$ CUSTOMER(Id),
PRODUCT(Product_id, Product_no, Time_of_purchase)

Totalpoäng: 1

7 EER to Relational

We want to convert the following diagram to the relational model. Choose the MOST appropriate answer from the following.
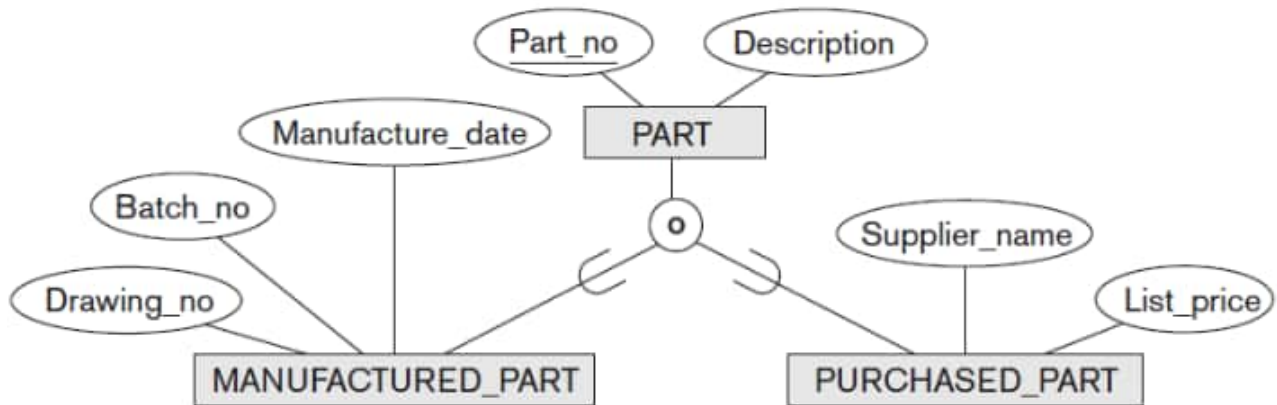
Select one alternative:

○ MANUFACTURED_PART(Part_no, Manufacture_date, Batch_no, Drawing_no, Description),
PURCHASED_PART(Part_no, Supplier_name, List_price, Description)

○ PART(Part_no, Description),
MANUFACTURED_PART(Manufacture_date, Batch_no, Drawing_no),
PURCHASED_PART(Supplier_name, List_price)

○ PART(Part_no, Description, Manufacture_date, Batch_no, Drawing_no, Supplier_name,
List_price, Manufactured_part_flag, Purchased_part_flag)

Totalpoäng: 1

Consider the following populated database, with the two tables CAR and OWNER where VIN is the primary key for CAR and OwnerID is the primary key for OWNER. Also, CAR.OwnerID is a foreign key to OWNER.OwnerID.

CAR				
VIN	Year	Manufacturer	Color	OwnerID
1234	2001	Toyota	Red	1
4201	2017	Tesla	Silver	2
5678	2005	Ford	Black	3
9999	1999	Saab	Blue	1
1111	2010	Volvo	Green	NULL
2345	2015	Volvo	Gray	3

OWNER		
OwnerID	Name	Age
1	Mandy	19
2	George	45
3	Styrbjörn	39
4	Ingrid	80

8 SQL

Which of the following SQL-statements will return a list of manufacturers, without repetitions, who have made cars before 2000 or after 2005 in the database?

○ SELECT Manufacturer
FROM CAR
WHERE Year < 2000 OR Year > 2005;

○ (SELECT Manufacturer FROM CAR WHERE Year < 2000)
UNION ALL
(SELECT Manufacturer FROM CAR WHERE Year > 2005);

○ SELECT DISTINCT Manufacturer
WHERE Year < 2000 OR Year > 2005;

○ (SELECT Manufacturer FROM CAR WHERE Year < 2000)
UNION
(SELECT Manufacturer FROM CAR WHERE Year > 2005);

Totalpoäng: 1

9 SQL

Which of the following SQL-statements will return the manufacturing year and colors of the cars made in the earliest year in our database? Note that there may be several cars that are equally old (i.e. made in the same year).

○ SELECT MIN(Year, Color)
FROM CAR, OWNER
WHERE CAR.OwnerID = OWNER.OwnerID;

○ SELECT MIN(Year), Color
FROM CAR;

○ SELECT Year, Color
FROM CAR
WHERE Year IN (SELECT MIN(Year) FROM CAR);

○ SELECT CAR.Year, CAR.Color
FROM CAR JOIN Year ON Year = MIN(CAR.Year);

Totalpoäng: 1

10 SQL

Which of the following SQL statements will return all information available in the CAR table about cars that are not green?

○ SELECT *
FROM CAR
WHERE Color <> 'Green';

○ SELECT ALL
FROM CAR
WHERE Color NOT 'Green';

○ SELECT *
WHERE Color <> 'Green'
FROM CAR;

○ SELECT *
FROM CAR
WHERE Color NOT 'Green';

Totalpoäng: 1

¹¹ SQL

Which of the following SQL statements will return the average age of owners older than 20?

○ SELECT Age
FROM OWNER
WHERE Age IN AVG(Age);

○ SELECT AVG(Age)
FROM OWNER
WHERE Age > 20;

○ SELECT Average_age
FROM OWNER
WHERE (Age > 20) AS Average_age;

○ SELECT AVG(Age)
FROM OWNER
GROUP BY Age > 20;

Totalpoäng: 1

¹² SQL

Which SQL statement returns the name of the manufacturer that has produced the most cars in the database along with the number of cars made by that manufacturer?

○ SELECT T.Manufacturer, MAX(Num)
FROM
(SELECT CAR.Manufacturer, COUNT(CAR.Manufacturer) AS Num
FROM CAR
GROUP BY CAR.Manufacturer) AS T;

○ SELECT Manufacturer, COUNT(Manufacturer)
FROM CAR
WHERE MAX(COUNT(Manufacturer));

○ (SELECT Manufacturer FROM CAR)
UNION
(SELECT COUNT(Manufacturer) FROM CAR WHERE COUNT(Manufacturer) IN
MAX(COUNT(Manufacturer)))

○ None of the options are correct.

○ SELECT Manufacturer, Num
FROM CAR
WHERE COUNT(Manufacturer) IN MAX(SELECT COUNT(Manufacturer) GROUP BY
Manufacturer) AS Num;

Totalpoäng: 1

Consider the following database

T1				T2		
C1	**C2**	**C3**		**C1**	**C2**	**C3**
a	x	1		a	z	4
a	y	5		a	x	3
b	z	2		b	z	2
c	z	2		b	x	1
d	u	3		c	u	2

13 SQL B1

What is the result of the following SQL query?

SELECT count(*)
FROM T1 **INNER JOIN** T2 ON (T1.C1 = T2.C1);

Select one alternative

○ None of them is correct.

○ 7

○ 2

○ An empty table

○ The statement is incorrect

○ 1

Totalpoäng: 1

¹⁴ SQL B1

What is the result of the following SQL query?

SELECT count (T1.C1)
FROM T1
WHERE T1.C2 **IN**
    (SELECT T2.C2 **FROM** T2
     WHERE T2.C2="u"**);**

Select one alternative

- ◯ 7

- ◯ An empty table

- ◯ None of them is correct.

- ◯ 1

- ◯ The statement is incorrect

- ◯ 2

Totalpoäng: 1

15 SQL B1

Consider the following SQL statement and SQL results:
SELECT DISTINCT T1.C1
FROM T1, T2
WHERE T1.C2=T2.C2;

a		a		x		a
a		b		y		b
b		c		z		c
b				u		d
c						

A   **B**   **C**   **D**

Select one alternative:

○ Result C is correct

○ Result D is correct

○ Result A is correct

○ Result B is correct

Totalpoäng: 1

16 SQL B1

Consider the following SQL statement and SQL results:

SELECT T1.C2, SUM(T1.C3*T2.C3)
FROM T1, T2
WHERE T1.C2 = T2.C2
GROUP BY T1.C2
HAVING SUM(T1.C3*T2.C3)>5;

z	24

y	35

x	7
y	35
z	10

u	6
z	24

A   **B**   **C**   **D**

Select one alternative:

○ Result B is correct

○ Result C is correct

○ Result D is correct

○ Result A is correct

Totalpoäng: 1

17 SQL B1

Consider the following SQL statement and SQL result.

SELECT T1.C1
FROM T1 **INNER JOIN** T2 ON (T1.C1 = T2.C1)
WHERE (T1.C3>2);

a		a		x		a
a		a		y		a
b						NULL
b						NULL

A   **B**   **C**   **D**

Select one alternative:

○ Result A is correct

○ Result B is correct

○ Result C is correct

○ Result D is correct

Totalpoäng: 1

18   SQL B1

What is the result of the following SQL query?

SELECT count(*)
FROM T1, T2;

Select one alternative:

- ○ 4

- ○ 10

- ○ 5

- ○ 25

Totalpoäng: 1

19   ♥ Functional Dependencies

The following table shows the current state of a relation, where C_1 is the **primary key** and C_2 is a **candidate key** of the relation. Which of the following options are correct? (Select **all** correct choices)

C_1	C_2	C_3	C_4	C_5
1	101	George	Anna	100
2	301	George	Chris	100
3	311	George	Iliada	100
4	401	John	Nek	2
5	891	John	Maria	1
6	999	Marina	Anna	3

♥ **Select one or more alternatives:**

☐ The functional dependency $C_2 \rightarrow C_1$ certainly holds.

☐ We cannot be certain whether the functional dependency $C_2 \rightarrow C_3$ holds.

☐ The functional dependency $C_3 \rightarrow C_5$ could hold.

☐ The functional dependency $C_2 \rightarrow C_4$ certainly holds.

☐ The functional dependency $C_1 \rightarrow C_3$ holds.

☐ The functional dependency $\{C_3, C_4\} \rightarrow C_5$ could hold but we can not be sure for it.

Totalpoäng: 1

20 Normal Forms Q1

Consider a relation R(A, B, C, D), where {A, B} constitute the primary key
and the following full functional dependency holds:

- $C \rightarrow D$

Which of the following holds?

○ R is in the third normal form.

○ R is in the second normal form.

○ R is certainly in the second normal form but not in the first normal form.

○ R is certainly in the third normal form but not in the first normal form.

Totalpoäng: 1

21 Normal Forms Q2 (DBI 2022)

Consider a relation R1(A, B, C, D), where {A, B} constitute the primary key
and the following full functional dependencies hold:

- $B \rightarrow D$
- $C \rightarrow D$

and R2(G, E, F) where G is the primary key.

Select one alternative:

○ We are sure that R2 is in second normal form.

○ R1 is in third normal form

○ R1 is in second normal form

○ None of the other is correct

Totalpoäng: 1

²² Normal Forms Q3 (DBI 2022)

Consider the relation R(A, B, C, D, E, F, G) and the following full functional dependencies:

- {A, B} → C, D, E, F, G
- {C, D} → E, F
- B → G

Which of the following set of relations can be in the third normal form?

Select one alternative:

○ R1(A, B, C, D) R2(C, D, E, F) R3(B, G)

○ R1(A, B, C, D, G) R2(C, D, E, F)

○ R1(A, B, C, D) R2(E, F) R3(G)

○ R1(A, B, G) R2(C, D, E, F)

Totalpoäng: 1

23 ♥ Serializability

For the following sets of transactions T_1, T_2, and T_3, which of the schedules are (conflict) serializable?:

♥ Select one or more alternatives:

T1	T2	T3
read_item(A);		
A := A * 5;		
write_item(A);		
	read_item(A);	
read_item(B);		
B := B − 10;		
write_item(B);		
	A := A + 10	
		read_item(C);
		C := C / 10;
		write_item(C)
	write_item(A);	
		read_item(A)
		A := A / 5;
		write_item(A)

☐

T1	T2	T3
read_item(A);		
		read_item(C);
A := A * 5;		
		C := C / 10;
write_item(A);		
	read_item(A);	
	A := A + 10	
	write_item(A);	
read_item(A);		
A := A − 10;		
		write_item(C)
		read_item(A)
		A := A / 5;
write_item(A);		
		write_item(A)

☐

T1	T2	T3
read_item(A);		
A := A * 5;		
write_item(A);		
read_item(B);		
B := B − 10;		
write_item(B);		
	read_item(A);	
	A := A + 10	
	write_item(A);	
		read_item(C);
		C := C / 10;
		write_item(C)
		read_item(A)
		A := A / 5;
		write_item(A)

☐

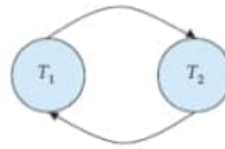| T1	T2	T3
	read_item(A);	
	A := A + 10	
		read_item(C);
		C := C / 5;
		write_item(C)
		read_item(A)
read_item(A);		
A := A * 3;		
write_item(A);		
read_item(B);		
B := B − 5;		
write_item(B);		
	write_item(A);	
		A := A / 3;
		write_item(A)

☐

Totalpoäng: 1

24 Transactions- Precedence graphs
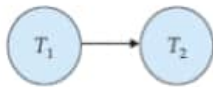
Precedence Graph A1

Precedence Graph B1

Consider these two Precedence graphs, where T1 and T2 represent transactions. Which of the following is true?

Select one alternative:

○ Precedence graph B1 corresponds to a Schedule that may suffer from the lost update problem.

○ None of the other answers is correct!

○ Precedence graph A1 corresponds to a Schedule that may suffer from the lost update problem.

○ Both Precedence graphs, A1 and B1, corespond to schedules that are serializable.

Totalpoäng: 1

Consider the database below. Where, the primary keys are underlined and the foreign key (FK) relationships are:

- PROJECT.Dnum is FK ref. DEPARTMENT.Dnumber;

- PROJECT.Plocation is FK ref. DEPT_LOCATIONS.Dlocation;

- DEPT_LOCATIONS.Dnumber is FK ref. DEPARTMENT.Dnumber;

- DEPARTMENT.Mgr_ssn is FK ref. EMPLOYEE.Ssn;

- EMPLOYEE.Super_ssn is FK ref. EMPLOYEE.Ssn;

- EMPLOYEE.Dno is FK ref. DEPARTMENT.Dnumber.

Suppose each of the following update operations is applied directly to this database:

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

DEPT_LOCATIONS

Dnumber	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

25 ♥ Constraint violations

Choose the correct statements regarding the integrity constraints (i.e. key constraints, entity and referential integrity constraint) of the following operation when applied to the database on the left.

INSERT INTO DEPARTMENT VALUES (Outreach, 5, '333225555', '2021-01-13');

♥ **Select one or more alternatives:**

- [ ] No constraint violations.

- [ ] It violates the key constraint.

- [ ] It violates referential integrity.

- [ ] It violates entity integrity.

Totalpoäng: 1

26 ♥ Constraint violations

Choose the correct statements regarding the integrity constraints (i.e. key constraints, entity and referential integrity constraint) of the following operation when applied to the database on the left:

UPDATE EMPLOYEE

SET Fname = 'John', Minit = 'B', Lname = 'Smith', Dno = '3', Super_ssn = '333445555'

WHERE Ssn = '987654321';

♥ **Select one or more alternatives:**

- [ ] It violates the key constraint.

- [ ] No constraint violations.

- [ ] It violates referential integrity.

- [ ] It violates entity integrity

Totalpoäng: 1

27 ♥ Constraint violations

Choose the correct statements regarding the integrity constraints (i.e. key constraints, entity and referential integrity constraint) of the following operation when applied on the database shown to the left.

DELETE FROM EMPLOYEE WHERE Lname = 'Borg'

♥ **Select one or more alternatives:**

☐ It violates entity integrity constraint.

☐ No constraint violations.

☐ It violates referential integrity constraint.

☐ It violates the key constraint.

Totalpoäng: 1