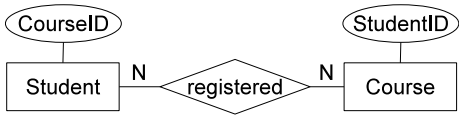
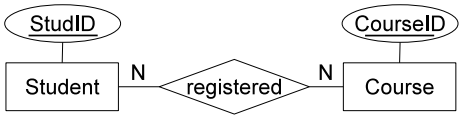
Uppsala University
Department of Information Technology
Database Design I (1DL300/1) – 2016-03-18

Instructions: Read through the complete exam and note any unclear directives before you start solving the questions. For each question there can be one or more correct answers, but you can choose only one. If you choose a correct answer, you gain 3 points. A wrong answer does not generate negative points – but the teacher reserves the right to penalize answers that are outrageously wrong. The questions are divided into three sections with 10 questions each. To achieve a grade of 3, you must gain at least 18 points in each section. To achieve a grade of 4, you must gain at least 65 points in the whole exam. To achieve a grade of 5, you must collect at least 75 points in the whole exam. You are allowed to use dictionaries to and from English and a calculator, but no other material. Answers must be given exclusively on the answer sheet, at the end: answers given on the other sheets will be ignored. To mark an answer fill in the box *completely* (that is, not just crossing it) using a pen.

1 Database design

Question 1 Which of the following ER diagrams is correct?

A


■


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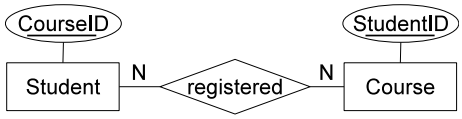
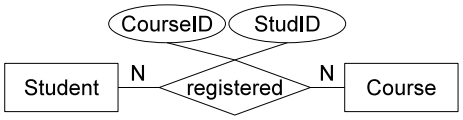
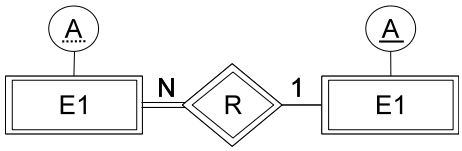
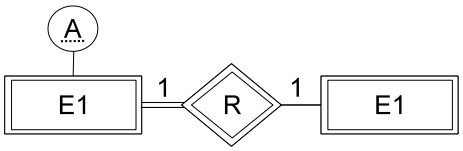
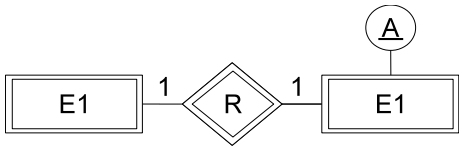


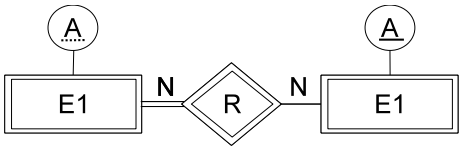
D


Question 2 Which of the following ER diagrams is correct?

■


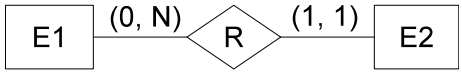
B


C


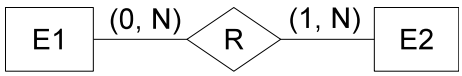
D


Question 3 Which of the following portions of ER diagrams with min-max notation corresponds to the diagram:


?

A


B


C


■

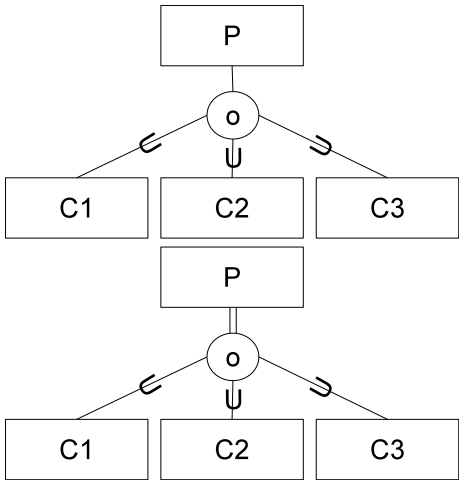

E

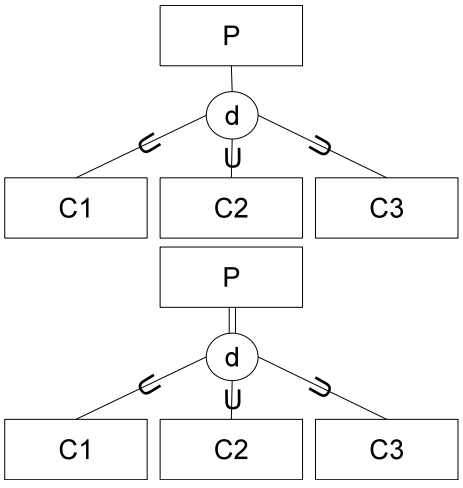

F


G


H


Question 4 Entity type P can be (but is not necessarily) of type C1, C2, C3. It can be of more than one type at the same time. Which of the following ER diagrams corresponds to these specifications? (only a portion of the diagram has been visualized)

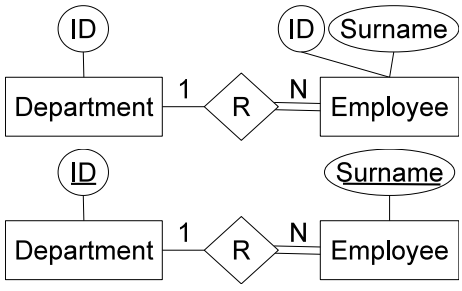
■ 

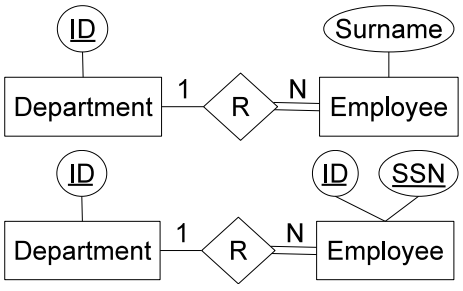
B 

C

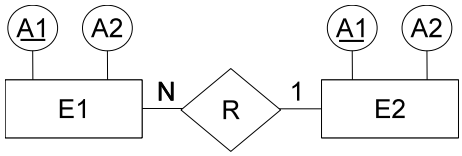
D

Question 5 Choose the best among the following ER diagrams.

A 

B 

Question 6 Which relational schema corresponds to the following ER diagram?



A $E1(\underline{A1}, A2)$, $E2(\underline{A1}, A2)$, $R(\underline{E1, E2})$ (with $R.E1$ FK ref. $E1.A1$ and $R.E2$ FK ref. $E2.A1$)

B $E1(\underline{A1}, A2)$, $E2(\underline{A1}, A2, E1)$ (with $E2.E1$ FK ref. $E1.A1$)

C None of the other answers

D $E1(\underline{E2, A1}, A2)$, $E2(\underline{A1}, A2)$ (with $E1.E2$ FK ref. $E2.A1$)

E $E1(\underline{A1}, A2)$, $E2(\underline{E1, A1}, A2)$ (with $E2.E1$ FK ref. $E1.A1$)

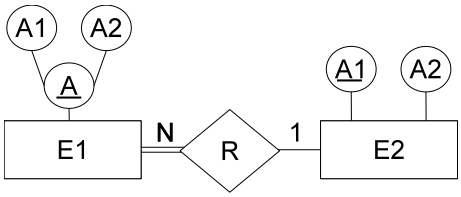
F $E1(\underline{A1, A2})$, $E2(\underline{A1}, A2)$

G $E1(\underline{A1}, A2)$, $E2(\underline{A1}, A2)$, $R(E1, \underline{E2})$ (with $R.E1$ FK ref. $E1.A1$ and $R.E2$ FK ref. $E2.A1$)

■ $E1(\underline{A1}, A2, E2)$, $E2(\underline{A1}, A2)$ (with $E1.E2$ FK ref. $E2.A1$)

I $E1(\underline{A1}, A2)$, $E2(\underline{A1}, A2)$

Question 7 Which relational schema corresponds to the following ER diagram?



- [A] $E1(A, \underline{A1, A2})$, $E2(\underline{A1}, A2, A\_A1, A\_A2)$ (with $E2.A\_A1$ FK ref. $E1.A1$ and $E2.A\_A2$ FK ref. $E1.A2$)
- [B] $E1(\underline{A, A1, A2})$, $E2(\underline{A1}, A2)$, $R(\underline{E1, E2})$ (with $R.E1$ FK ref. $E1.A$ and $R.E2$ FK ref. $E2.A1$)
- [C] $E1(\underline{A, A1, A2})$, $E2(\underline{A1}, A2, A, A\_A1, A\_A2)$ (with $E2.A$ FK ref. $E1.A$, $E2.A1$ FK ref. $E1.A1$ and $E2.A2$ FK ref. $E1.A2$)
- [D] $E1(\underline{A\_A1, A\_A2})$, $E2(\underline{A1}, A2, A\_A1, A\_A2)$ (with $E2.A\_A1$ FK ref. $E1.A\_A1$ and $E2.A\_A2$ FK ref. $E1.A\_A2$)
- [■] $E1(\underline{A\_A1, A\_A2}, E2)$, $E2(\underline{A1}, A2)$ (with $E1.E2$ FK ref. $E2.A1$ NOT NULL
- [F] None of the other answers
- [G] $E1(A, \underline{A\_A1, A\_A2})$, $E2(\underline{A1}, A2, A\_A1, A\_A2)$ (with $E2.A$ FK ref. $E1.A$, $E2.A\_A1$ FK ref. $E1.A\_A1$ and $E2.A\_A2$ FK ref. $E1.A\_A2$)

Question 8 Consider a relation in 1NF $R(A, B, C, D, E)$ with the following dependencies:

- $A, B \to C$
- $B \to D, E$
- $E \to D$

Which of the following is true?

- [A] None of the other answers
- [B] R is in 2NF but not in 3NF
- [■] R is in 1NF but not in 2NF
- [D] R is in 3NF but not in 2NF
- [E] R is in 3NF but not in BCNF
- [F] R is in BCNF
- [G] R is in BCNF but not in 3NF

Question 9 Consider a relation in 1NF $R(A, B, C, D, E)$ with the following dependencies:

- $A, B \to C, D, E$
- $C \to A, B, D, E$

Which of the following normalized databases contains all the information contained in the original table, with all relations in BCNF?

- [A] $R_1(A, B, E)$, $R_2(C, E)$, $R_3(E, D)$
- [B] $R_1(A, B, C, E)$, $R_2(E, D)$
- [C] None of the other answers
- [D] $R_1(A, B, C, D, E)$, $R_2(C, A, B, D, E)$, $R_3(E, D)$
- [■] $R(A, B, C, D, E)$
- [F] $R_1(A, B, D)$, $R_2(C, D)$, $R_3(E, D)$

Question 10 Consider the relation corresponding to the following SQL statement:
CREATE TABLE R (A int PRIMARY KEY, B int, C int, D int NOT NULL)
and assume that there is a functional dependency $C \to D$. Which of the following is true?

- [A] R is in 1NF but not in 2NF
- [B] None of the other answers
- [C] R is in 3NF but not in BCNF
- [D] R is in BCNF but not in 3NF
- [E] R is in BCNF
- [F] R is in 3NF but not in 2NF
- [■] R is in 2NF but not in 3NF

2 SQL

Consider the following database:

A

A	B
A	B
A	C
B	B
B	C

B

A	B
A	C
A	B
B	B
C	C

C

A	B
A	B
NULL	C
C	*NULL*
D	E

Question 11 What is the result of the following SQL query? (showing only the content)
SELECT A.A, count(B.B)
FROM A Join B on A.A=B.A
WHERE A.B=B.B

[A]

A	2
B	1

[■] The SQL is incorrect

[C]

A	1
B	2

[D] An empty table

[E]

A	2
B	2

[F]

A	4
B	1
C	1

[G]

A	1
B	1

[H] None of the other answers

Question 12 What is the result of the following SQL query? (showing only the content)
SELECT A.A, C.B
FROM A full outer join C on A.B=C.A

[■] None of the other answers

[B]

A	B

[C] The SQL is incorrect

[D]

B	*NULL*
A	*NULL*
NULL	B
NULL	C
NULL	E

[E]

A	B
A	B

[F]

B	*NULL*
B	E
A	B
A	C

[G] An empty table

[H]

A	*NULL*
B	*NULL*

Question 13 What is the result of the following SQL query? (showing only the content)
SELECT A FROM A
UNION
SELECT B FROM B

[A]

A	C
A	B
B	B
B	C

[B] The SQL is incorrect

[C]

A
C
B

[D]

A	B	C

[E] None of the other answers

[F] An empty table

[G]

A
A
B
B
B
C
B
C

[H]

A	C	A	B	B	B	B	C

Question 14 What is the result of the following SQL query? (showing only the content)
SELECT COUNT(DISTINCT B)
FROM C
WHERE A IS NOT NULL
GROUP BY A

[A] The SQL is incorrect

[B] 3

[C]

1
1
1

[D]

1
0
1

[E] 4

[F] None of the other answers

[G] An empty table

[H] 2

Question 15 What is the result of the following SQL query? (showing only the content)
SELECT B FROM A
WHERE B NOT IN
(SELECT A FROM B)

[A] The SQL is incorrect

[B]

A
B

[C]

A

[D] An empty table

[E]

A
A
B
B

[F] B

[G]

A
A
B

[H] None of the other answers

Question 16 What is the result of the following SQL query? (showing only the content)
SELECT * FROM C
WHERE A =ALL
(SELECT B FROM C)

[A] None of the other answers

[B]

A	B
D	E

[C] The SQL is incorrect

[D]

A	B
C	*NULL*
D	E

[E]

A	B
NULL	C
C	*NULL*
D	E

[G]

A	B
NULL	C
D	E

■ An empty table

Consider the following database:
Student(<u>SID</u>, Name, Surname, Age)
Registration(<u>StudentID, CourseID</u>)
Course(<u>CID</u>, Name, Cost)

Question 17 Which of the following queries extracts the number of courses to which student S0001 is registered?

[A] SELECT Count('S0001')
FROM Registration JOIN Course ON CourseID = CID
GROUP BY CourseID

[B] All answers are correct

[C] SELECT Count('S0001')
FROM Registration JOIN Course ON CourseID = CID

[D] SELECT Count(StudentID)
FROM Registration JOIN Course ON CourseID = CID
WHERE StudentID = 'S0001'

[E] None of the other answers

[F] SELECT Count(Distinct StudentID)
FROM Registration JOIN Course ON CourseID = CID
WHERE StudentID = 'S0001'

■ SELECT Count(CourseID)
FROM Registration JOIN Course ON CourseID = CID
WHERE StudentID = 'S0001'

Question 18 Which of the following queries extracts the students registered to at least three courses whose cost is unknown?

A SELECT StudentID
FROM Registration JOIN Course ON CourseID = CID
WHERE Cost <>ALL
AND NUM_COURSES >=3

B SELECT StudentID, Count(CourseID) AS NUM_COURSES
FROM Registration JOIN Course ON CourseID = CID
WHERE Cost IS NULL
AND NUM_COURSES >=3 GROUP BY StudentID

C SELECT StudentID, Count(CourseID) AS NUM_COURSES
FROM Registration LEFT JOIN Course ON CourseID = CID
WHERE Cost = 0
AND NUM_COURSES >=3 GROUP BY CourseID

■ SELECT StudentID
FROM Registration JOIN Course ON CourseID = CID
WHERE Cost IS NULL
GROUP BY StudentID
HAVING Count(*)>=3

E All answers are correct

F None of the other answers

G SELECT StudentID, Count(CourseID) AS NUM_COURSES
FROM Registration RIGHT JOIN Course ON CourseID = CID
WHERE Cost = 0
AND NUM_COURSES >=3 GROUP BY CourseID

Question 19 Consider the following incomplete SQL query:
SELECT SID
FROM Student
WHERE _____ (
SELECT CourseID
FROM Registration JOIN Course ON CourseID = CID
WHERE Name = 'Database Design IV' AND StudentID=SID)
Which of the following texts should be added so that the query extracts the students who did not attend courses whose name is 'Database Design IV'?

■ NOT EXISTS

B SID NOT IN

C None of the other answers

D All answers are correct

E SID EXISTS

F SID NOT EXISTS

G EXISTS

H SID =ANY

Question 20 Consider the following incomplete SQL instruction:
CREATE VIEW AVERAGE_COST(StudentID, Cost) AS
SELECT StudentID, AVG(_____ Cost)
FROM Course JOIN Registration ON CID=CourseID
GROUP BY _____
Which of the following texts should be added so that the view computes for each student the average cost of his/her courses? (notice that there are two texts to insert)

- [A] 1: *nothing*, 2: CourseID
- [■] 1: *nothing*, 2: StudentID
- [C] 1: DISTINCT, 2: Cost
- [D] All answers are correct
- [E] 1: DISTINCT, 2: CourseID
- [F] None of the other answers
- [G] 1: *nothing*, 2: AVG(Cost)
- [H] 1: DISTINCT, 2: StudentID
- [I] 1: *nothing*, 2: Cost

3 Theory

Question 21 In the relational model, if a set of attributes K is a candidate key of a relation R and $X \in K$, then:

- [A] K is also a primary key of R
- [B] $K \setminus \{X\}$ is also a candidate key ($\setminus$ indicates set difference)
- [C] X cannot be the primary key of R
- [D] $K \cap \{X\}$ is also a candidate key
- [■] None of the other answers

Question 22 In the relational model, if a set of attributes K is a superkey of a relation schema R then (with $t[K]$ we notate the projection of t on the attributes in K) :

- [A] R contains at least two different tuples t_1 and t_2 with $t_1[K] = t_2[K]$
- [B] K is a primary key of R
- [C] R contains at least two different tuples t_1 and t_2 with $t_1[K] \neq t_2[K]$
- [D] K is a candidate key of R
- [■] None of the other answers
- [F] R contains exactly two different tuples t_1 and t_2 with $t_1[K] = t_2[K]$

Question 23 Consider a relation $R(A_1, \ldots, A_n)$, with:

- $X \subseteq \{A_1, ..., A_n\}$
- $Y \subseteq \{A_1, ..., A_n\}$
- $Z \subseteq \{A_1, ..., A_n\}$
- $W \subseteq \{A_1, ..., A_n\}$
- $X \to Y$
- $WY \to Z$

[A] $Y \to Z$
[B] $X \to WZ$
[C] None of the other answers
[■] $WY \to X$
[E] $X \to WY$
[■] $ZW \to Z$

Question 24 Consider a relation $R(A, B, C, D)$ in 1NF, where A and B are the only candidate keys. Then:

[A] None of the other answers
[B] R is at least in BCNF
[C] R can be in 1NF but not in 2NF
[D] R is at least in 3NF
[■] R is at least in 2NF

Question 25 If A1 is the primary key of table T, and we execute the following SQL queries:
Q1: SELECT COUNT(*) FROM T
Q2: SELECT COUNT(distinct A1) FROM T
Q3: SELECT COUNT(A1) from T

[A] None of the other answers
[■] The results of Q1, Q2 and Q3 are the same
[C] The result of Q2 is always lower than the results of both Q1 and Q3
[D] The result of Q2 is always lower than the result of Q3
[E] The results of Q1 and C are the same
[F] The results of Q1 and Q2 are the same

Question 26 If a table T has 10 rows, the SQL instruction `delete from T`:

[A] Deletes the 10 rows, but does not remove the table from the database schema
[B] May change data contained in other tables
[C] The SQL is incorrect
[D] None of the other answers
[E] Removes the table from the database schema (and as a consequence also the 10 rows)
[■] May delete less than 10 rows because of referential integrity constraints

Question 27 Consider a relation $R(\underline{A}, B, C, D)$ containing 10^7 records. A is the primary key, and B contains 10^5 distinct values. The following SQL prepared statement is executed very frequently:
SELECT B FROM R WHERE A=?
Considering this statement, which indexes would you create?

- [A] One index on A and one on B
- [B] One index on A
- [■] One index on B
- [D] One single index on A and B

Question 28 Which of the following is true if a transaction is executed at isolation level SERIALIZABLE?

- [A] A join that returns a non-empty table, when re-executed inside the transaction may return an empty result
- [B] SELECT B FROM T WHERE A=1 may return different results if executed multiple times inside the transaction (A is the primary key)
- [C] Nested queries may not be allowed, if another transaction has disabled them
- [■] SELECT COUNT(*) FROM T may return different results if executed multiple times inside the transaction
- [■] None of the other answers is true

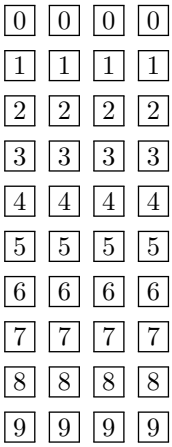
Question 29 User Bob creates a table called X. Then, the following sequence of statements is executed, in this order (the name of the user executing the statement is indicated at the beginning of each statement):
Bob: GRANT select ON X TO Jim WITH GRANT OPTION
Bob: GRANT select, update ON X TO Ann WITH GRANT OPTION
Jim: GRANT select ON X TO Tim
Ann: GRANT select ON X TO Tim
Bob: REVOKE select ON X FROM Tim
Which privileges does Tim have according to the SQL specification?

- [A] select with grant option
- [■] select without grant option
- [C] select, update, both with grant option
- [D] none
- [E] select with grant option, update without grant option
- [F] select, update, both without grant option

Question 30 With physical data independence we mean:

- [A] That we can create indexes on different attributes of the same relation at the same time
- [B] That the way in which the data is saved in storage devices does not depend on the physical laws used by the specific device, e.g., magnetism (for disks and tapes), optics (for CDs and DVDs), and electrostatics (for main memories)
- [C] That data can be stored on storage devices that are independent of the client used to access the database management system, e.g., hard disk or SSD
- [D] None of the other answers
- [■] The physical organization of the data may change without affecting their logical representation, e.g., relation names and attributes remain the same
- [F] The ability to create views

Answer sheet:



← please write your exam code in the box below (full code), and also encode it on the left (only the number). For example, if your code is AB0037 you should fill in 0 in the first column, 0 in the second, 3 in the third and 7 in the fourth.

Full exam code:

.....

Question 1: A ■ C D

Question 2: ■ B C D

Question 3: A B C ■ E F G H

Question 4: ■ B C D

Question 5: A B C ■

Question 6: A B C D E F G ■ I

Question 7: A B C D ■ F G

Question 8: A B ■ D E F G

Question 9: A B C D ■ F

Question 10: A B C D E F ■

Question 11: A ■ C D E F G H

Question 12: ■ B C D E F G H

Question 13: A B ■ D E F G H

Question 14: A B C ■ E F G H

Question 15: A B C ■ E F G H

Question 16: A B C D E ■ G

Question 17: A B C D E F ■

Question 18: A B C ■ E F G

Question 19: ■ B C D E F G H

Question 20: A ■ C D E F G H I

Question 21: A B C D ■

Question 22: A B C D ■ F

Question 23: A B C ■ E ■

Corrected

Question 24: [A] [B] [C] [D] [■]

Question 25: [A] [■] [C] [D] [E] [F]

Question 26: [A] [B] [C] [D] [E] [■]

Question 27: [A] [B] [■] [D]

Question 28: [A] [B] [C] [■] [■]

Question 29: [A] [■] [C] [D] [E] [F]

Question 30: [A] [B] [C] [D] [■] [F]