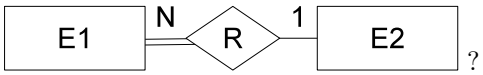
Uppsala University
Department of Information Technology
Database Design I (1DL300/1) – 2016-10-21

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, 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 with min-max notation corresponds to the diagram: 

?

A 

B 

C 

D 

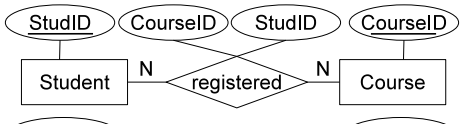
■ 

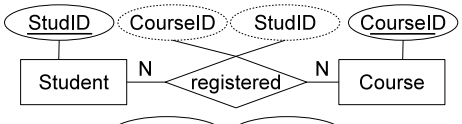
F 

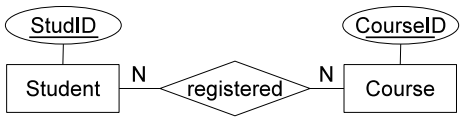
G 

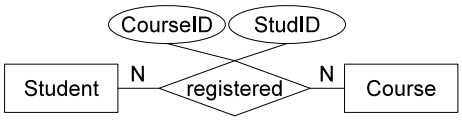
H 

Question 2 Choose the best among the following ER diagrams.

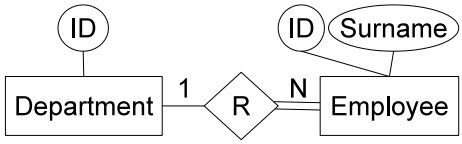
A 

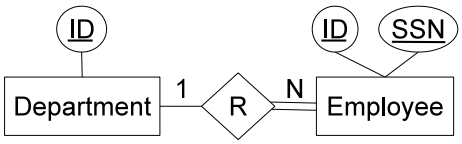
B 

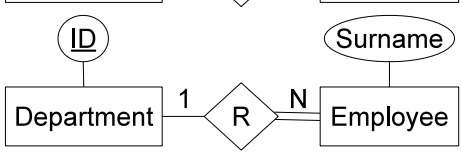
■ 

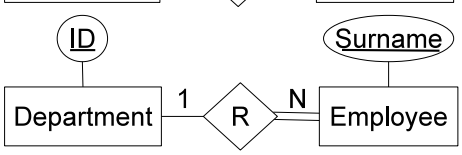
D 

Question 3 Choose the best among the following ER diagrams.

A 

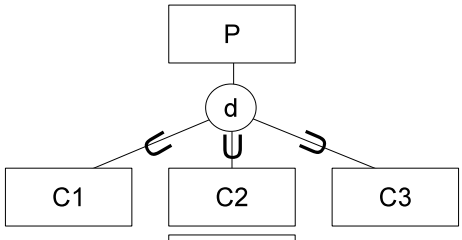
■ 

C 

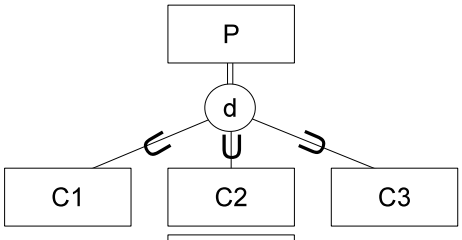
D 

Question 4 Entity type P can be of type C1, C2 or C3, and of no other type. 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)

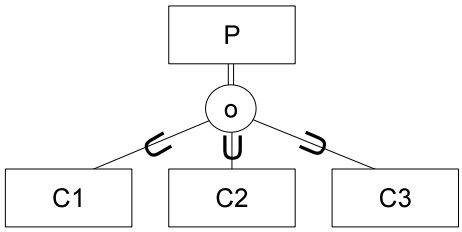
A



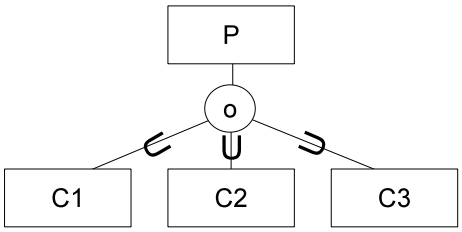
B



■

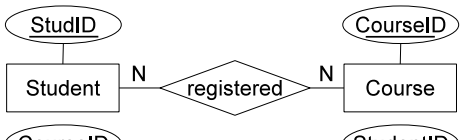


D

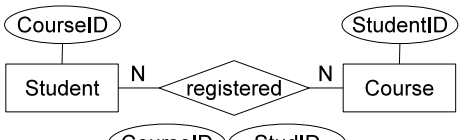


Question 5 Which of the following ER diagrams is correct?

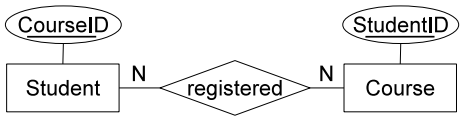
■



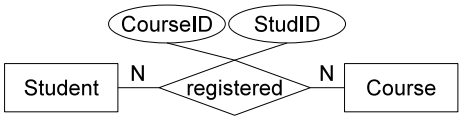
B



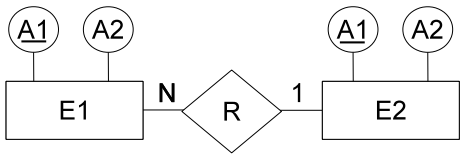
C



D



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



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

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

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

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

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

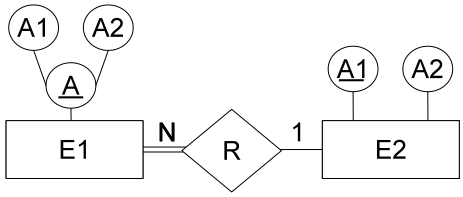
F None of the other answers

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

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

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

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



A $E1(A, \underline{A\_A1, A\_A2})$, $E2(\underline{A1}, A2, A\_A1, A\_A2)$ (with $E2.A$ FK ref. $E1.A$, $E2.A\_A1$ FK ref. $E1.A\_A1$ and $E2.A\_A2$ FK ref. $E1.A\_A2$)

B $E1(\underline{A, A1, A2})$, $E2(\underline{A1}, A2, A, A\_A1, A\_A2)$ (with $E2.A$ FK ref. $E1.A$, $E2.A1$ FK ref. $E1.A1$ and $E2.A2$ FK ref. $E1.A2$)

C $E1(\underline{A\_A1, A\_A2})$, $E2(\underline{A1}, A2, A\_A1, A\_A2)$ (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

E None of the other answers

F $E1(A, \underline{A1, A2})$, $E2(\underline{A1}, A2, A\_A1, A\_A2)$ (with $E2.A\_A1$ FK ref. $E1.A1$ and $E2.A\_A2$ FK ref. $E1.A2$)

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

Question 8 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 $R_1(A, B, C, D, E)$, $R_2(C, A, B, D, E)$, $R_3(E, D)$

C None of the other answers

■ $R(A, B, C, D, E)$

E $R_1(A, B, D)$, $R_2(C, D)$, $R_3(E, D)$

F $R_1(A, B, C, E)$, $R_2(E, D)$

Question 9 Consider the relation corresponding to the following SQL statement:
CREATE TABLE R (A int PRIMARY KEY, B int, C int, D int NOT NULL, UNIQUE(B,C))
and assume that there is a functional dependency $C \to D$. Which of the following is true?

A R is in 3NF but not in 2NF

B R is in BCNF but not in 3NF

C None of the other answers

■ R is in 2NF but not in 3NF

E R is in 3NF but not in BCNF

F R is in BCNF

G R is in 1NF but not in 2NF

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?

■ R is in 2NF but not in 3NF

B R is in BCNF

C R is in 3NF but not in 2NF

D R is in 3NF but not in BCNF

E None of the other answers

F R is in BCNF but not in 3NF

G R is in 1NF but not in 2NF

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 B FROM A
WHERE B NOT IN
(SELECT A FROM B)

A

A
B

B

A

C

A
A
B
B

D

A
A
B

E

B

F None of the other answers G The SQL is incorrect ■ An empty table

Question 12 What is the result of the following SQL query? (showing only the content)
SELECT A FROM A
WHERE B NOT IN
(SELECT A FROM B
WHERE A>A.A)

A

A
A
B
B

B

A
A
B

C An empty table

D

A
B

■

B

F The SQL is incorrect G None of the other answers H

A

Question 13 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

A

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

B

A	B

C

A	B
A	B

D An empty table

■ None of the other answers

F

B	*NULL*
B	E
A	B
A	C

G The SQL is incorrect

H

A	*NULL*
B	*NULL*

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 An empty table C 3 D 4

E None of the other answers ■ 1 / 0 / 1 G 1 / 1 / 1 H 2

Question 15 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 | 1 | B | 2 |

B None of the other answers C An empty table

D | A | 1 | B | 1 |

E | A | 4 | B | 1 | C | 1 |

F | A | 2 | B | 2 |

G | A | 2 | B | 1 |

■ The SQL is incorrect

Question 16 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.B
GROUP BY A.A

A An empty table B | A | 1 | B | 2 |

C | A | 4 | B | 1 | C | 1 |

■ None of the other answers E | A | 2 | B | 1 |

F The SQL is incorrect

G | A | 2 | B | 2 |

H | A | 1 | B | 1 |

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

Question 17 Consider the following incomplete SQL query:
SELECT SID
FROM Student
WHERE ------ (
SELECT StudentID
FROM Registration JOIN Course ON CourseID = CID
WHERE Name = 'Database Design IV')
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'?

A NOT EXISTS
B EXISTS
C SID EXISTS
D None of the other answers
E SID NOT EXISTS
F All answers are correct
G SID =ANY
H IN
■ SID <>ALL

Question 18 Which of the following queries extracts the number of students registered to at least one course whose name contains 'design'?

A All answers are correct

B SELECT Count(StudentID)
FROM Registration, Course
WHERE CourseID = CID
WHERE Name = '%design%'
GROUP BY StudentID

C None of the other answers

■ SELECT Count(DISTINCT StudentID)
FROM Registration JOIN Course ON CourseID = CID
WHERE Name LIKE '%design%'

E SELECT Count(StudentID)
FROM Registration JOIN Course ON CourseID = CID
WHERE Name LIKE '%design%'

F SELECT Count(StudentID)
FROM Registration, Course
WHERE Name LIKE '%design%'

Question 19 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

B All answers are correct

C 1: *nothing*, 2: Cost

D 1: DISTINCT, 2: CourseID

E None of the other answers

F 1: DISTINCT, 2: StudentID

G 1: DISTINCT, 2: Cost

■ 1: *nothing*, 2: StudentID

I 1: *nothing*, 2: AVG(Cost)

Question 20 Consider the following incomplete SQL instruction:
CREATE VIEW AVERAGE_AGE(CourseID, Age) AS
SELECT CourseID, AVG(_____ Age)
FROM Student JOIN Registration ON SID=StudentID
GROUP BY _____
Which of the following texts should be added so that the view computes for each course the average age of the students registered to it? (notice that there are two texts to insert)

A 1: *nothing*, 2: SID

B None of the other answers

C 1: *nothing*, 2: AVG(Age)

D 1: DISTINCT, 2: CourseID

E 1: DISTINCT, 2: Age

■ 1: *nothing*, 2: CourseID

G 1: DISTINCT, 2: SID

H All answers are correct

I 1: *nothing*, 2: Age

3 Theory

Question 21 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) :

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

Question 22 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] None of the other answers
- [B] $WY \to X$
- [C] $Y \to Z$
- [D] $X \to WZ$
- [E] $X \to WY$
- [■] $ZW \to Z$

Question 23 If a table T has 10 rows, the SQL instruction `delete from T`:

- [A] None of the other answers
- [B] May delete more than 10 rows from T
- [C] Deletes the 10 rows, but does not remove the table from the database schema
- [D] 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
- [F] The SQL is incorrect

Question 24 Consider a relation $R(A_1, \ldots, A_n)$, with:

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

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

Question 25 In the relational model, if an attribute K is a candidate key of a relation R and X is an attribute of R different from K then:

- [■] $\{K, X\}$ is always a super key (even if X is not a candidate key)
- [B] K is also a primary key of R
- [C] X cannot be a candidate key
- [D] X cannot be the primary key of R
- [E] None of the other answers
- [F] $\{K, X\}$ is also a candidate key

Question 26 A view:

- [A] Cannot be used inside a nested query
- [B] Needs to be kept manually synchronized with the base tables
- [■] Is recomputed every time it is accessed
- [D] Cannot be used inside a UNION query
- [E] A view you are saying? Well, let me think... no, I do not think it is a relevant concept for a database course, I am sure I have never heard of views in the relational model - of course, it is a valid word in English, like, I have a personal view on something, but a database is something, uh, specific, well defined, there is no space for personal views
- [F] None of the other answers
- [G] Cannot be used inside a query with a GROUP BY

Question 27 In the relational model, if a set of attributes K is a candidate key of a relation R and X is an attribute of R not in K, then:

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

Question 28 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 single index on A and B
- [■] One index on B
- [D] One index on A

Question 29 Which of the following are ACID properties?

- [A] Independence, Dependability, Aggregation
- [■] Isolation, Durability, Atomicity
- [C] None of the other answers is true
- [D] Independence, Dependability, Atomicity
- [E] Isolation, Dependability, Atomicity
- [F] Isolation, Dependability, Aggregation
- [G] Independence, Durability, Atomicity

[H] Independence, Durability, Aggregation

[I] Isolation, Durability, Aggregation

Question 30 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, and we assume that the system follows the SQL standard):
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
Jim: REVOKE select ON X FROM Tim
Which privileges does Tim have?

[A] select with grant option, update without grant option

[■] select without grant option

[C] select with grant option

[D] none

[E] select, update, both with grant option

[F] select, update, both without grant option

Answer sheet:

0 0 0 0
1 1 1 1
2 2 2 2
3 3 3 3
4 4 4 4
5 5 5 5
6 6 6 6
7 7 7 7
8 8 8 8
9 9 9 9

⟵ 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 B C D ■ F G H

Question 2: A B ■ D

Question 3: A ■ C D

Question 4: A B ■ D

Question 5: ■ B C D

Question 6: A B C D E F ■ H I

Question 7: A B C ■ E F G

Question 8: A B C ■ E F

Question 9: A B C ■ E F G

Question 10: ■ B C D E F G

Question 11: A B C D E F G ■

Question 12: A B C D ■ F G H

Question 13: A B C D ■ F G H

Question 14: A B C D E ■ G H

Question 15: A B C D E F G ■

Question 16: A B C ■ E F G H

Question 17: A B C D E F G H ■

Question 18: A B C ■ E F

Question 19: A B C D E F G ■ I

Question 20: A B C D E ■ G H I

Question 21: ■ B C D E F

Question 22: A B C D E ■

Question 23: A B C D ■ F

Corrected

Question 24: ■ B C D E F

Question 25: ■ B C D E F

Question 26: A B ■ D E F G

Question 27: A B C ■ E F

Question 28: A B ■ D

Question 29: A ■ C D E F G H I

Question 30: A ■ C D E F