UPPSALA UNIVERSITET

Department of Information Technology

INSTRUCTIONS

Please check that you have the correct exam!

This sheet should always be turned in, even if you haven't solved any of the exam questions.

Each solution should be written on a new paper.

Write your exam code on each new paper.

Please use only *one side* of the papers and *do not* use a pencil with red colour.

Sort the solutions in question order, with question 1 first, before you turn them in.

FRONT SHEET FOR EXAMS	**DATE:**

Course name (incl. group)

Your exam code

Semester and year when you were first registered for the course[1]	Programme (or similar)

Time for turning in the exam:	Table number

Nr.	Solved questions (mark with X)	Points earned	Comment from the teacher:
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
∑			
Exam grade			

☐ Exam with bonus points: Grade is not shown[2].

Grade limits:
VG≥   G≥

5≥   4≥   3≥

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[1] Please note: If you are NOT registered for the course your exam will NOT be graded.
[2] The final result (points including bonus points and grade) will appear at the student portal when the result has been added to Uppdok.

Uppsala University
Department of Information Technology
Database Design I (1DL300/1) – 2016-08-17

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 with min-max notation corresponds to the diagram:

?
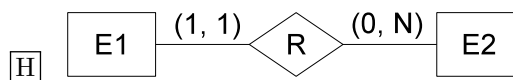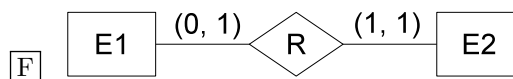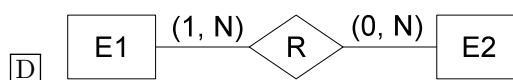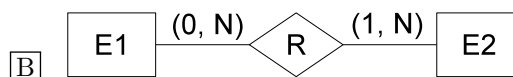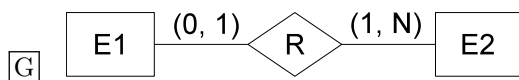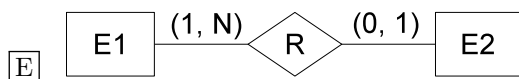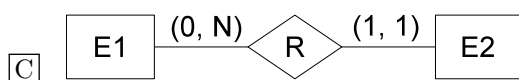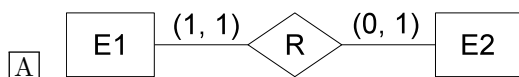
Question 2 Entity type P can be of subtype C1, C2 or C3, but also other subtypes. However, an entity in P cannot be of more than one of these subtypes at the same time. Which of the following ER diagrams corresponds to these specifications? (only a portion of the diagram has been visualized)
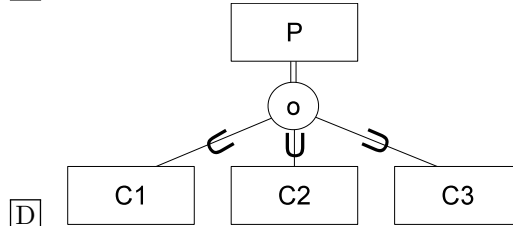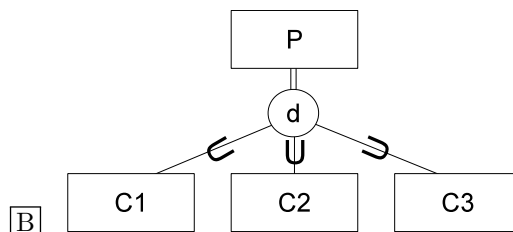
Question 3 Choose the best among the following ER diagrams.
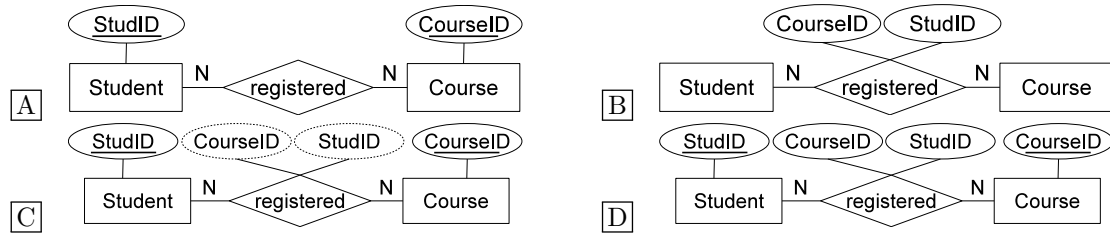
Question 4 Choose the best among the following ER diagrams.
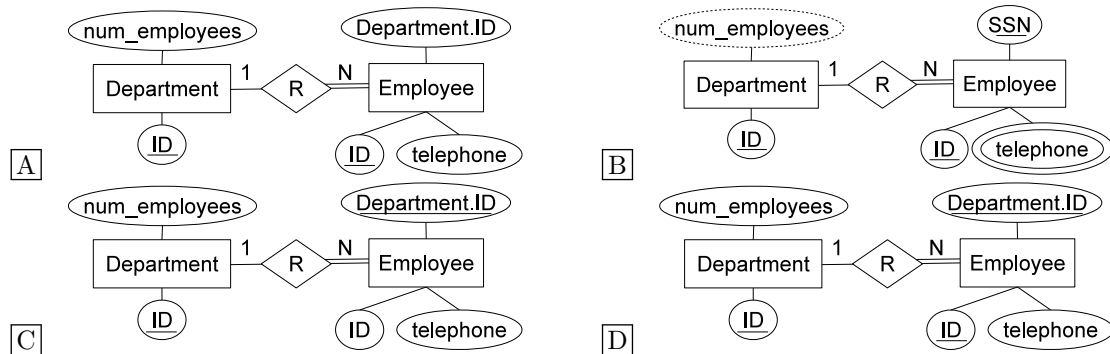
Question 5 Choose the best among the following ER diagrams.
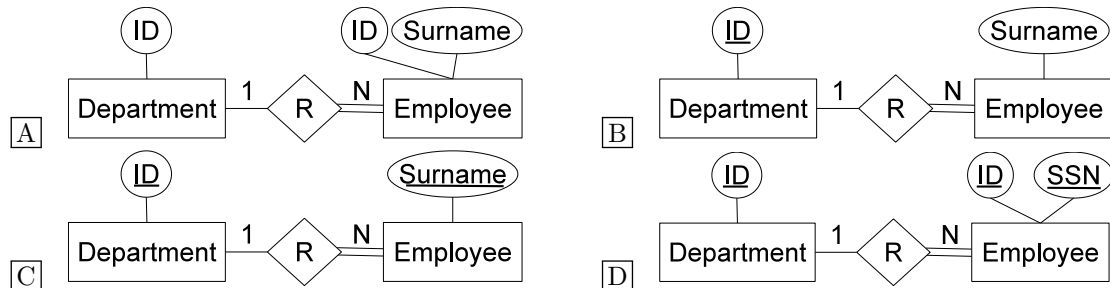
Question 6 Which relational schema corresponds to the following ER diagram?
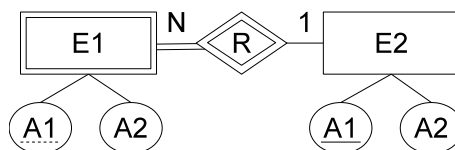
[A] $E1(\underline{A1}, A2)$, $E2(\underline{A1}, A2, E1)$ (with $E2.E1$ FK ref. $E1.A1$)
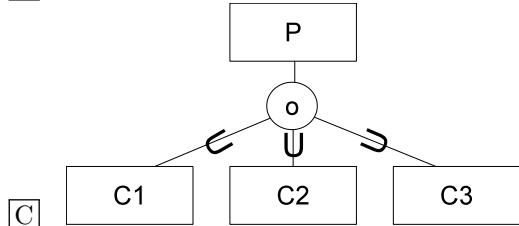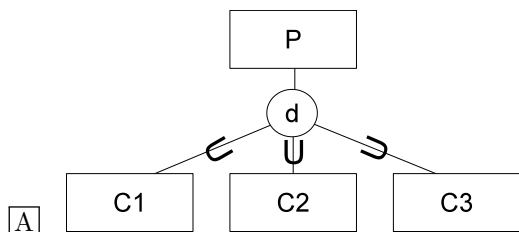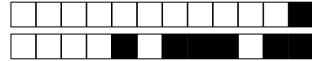
[B] $E1(\underline{A1}, A2)$, $E2(\underline{E1}, \underline{A1}, A2)$ (with $E2.E1$ FK ref. $E1.A1$)

[C] None of the other answers

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

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

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

[G] $E1(\underline{A1}, A2)$, $E2(\underline{A1}, A2)$

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

Question 7   Which relational schema corresponds to the following ER diagram? (additional contraints may apply, not shown in the answers)
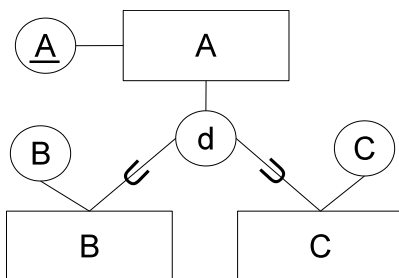
[A] $B(\underline{A}, B)$, $C(\underline{A}, C)$

[B] $A(\underline{A}, B, C, \mathrm{Is}B, \mathrm{Is}C)$

[C] $B(\underline{A}, B)$, $C(\underline{A}, C)$

[D] $A(\underline{A}, Type, B, C)$

[E] $A(\underline{A}, B, C, Type)$

[F] $A(\underline{A})$, $B(\underline{B})$, $C(\underline{C})$ (with $B.B$ FK ref. $C.C$)

[G] $A(\underline{A})$, $B(\underline{A}, B)$, $C(\underline{A}, C)$ (with $B.A$ FK ref. $A.A$ and $C.A$ FK ref. $A.A$)

[H] None of the other answers

[I] $A(\underline{A}, IsB, B, IsC, C)$

[J] $A(\underline{A})$, $B(\underline{A}, \underline{B})$, $C(\underline{A}, \underline{C})$ (with $B.A$ FK ref. $A.A$ and $C.A$ FK ref. $A.A$)

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

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

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

Which of the following is the result of the normalization of this relation to BCNF?

[A] None of the other answers

[B] $R(A, B, C, D, E)$

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

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

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

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

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

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

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

- $E \to D$

Which of the following is the result of the normalization of this relation to BCNF?

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

B $R(A, B, C, D, E)$

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

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

E   None of the other answers

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

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   None of the other answers

B R is in BCNF but not in 3NF

C R is in 2NF but not in 3NF

D R is in 1NF but not in 2NF

E R is in 3NF but not in 2NF

F R is in BCNF

G R is in 3NF but not in BCNF

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.B
GROUP BY A.A

A   None of the other answers

B
A	2
B	1

C
A	1
B	1

D   An empty table

E   The SQL is incorrect

F
A	1
B	2

G
A	2
B	2

H
A	4
B	1
C	1

Question 12   What is the result of the following SQL query? (showing only the content)
SELECT A.A, C.B
FROM A right outer join C on A.B=C.A WHERE A.A is not null

A
B	NULL
B	E
A	B
A	C

B   The SQL is incorrect

C
A	B

D
B	NULL
A	NULL
NULL	B
NULL	C
NULL	E

E   An empty table

F   None of the other answers

G
A	NULL
B	NULL

H
A	B
A	B

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

A
A
A

B   An empty table

C   None of the other answers

D   all work and no play makes Jack a dull boy

E
A	C	A	B	B	B	B	C

F
C
C

G
A	B	C

H
A
A
B
B
B
C
B
C

I
A	C
A	B
B	B
B	C

J
A

K   The SQL is incorrect

L
C
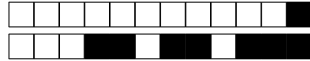
Question 14   What is the result of the following SQL query? (showing only the content)
SELECT COUNT(DISTINCT B)
FROM B
GROUP BY DISTINCT A

A   2   B   4   C
1
1
1
          D   An empty table   E   3

F
1
0
1
          G   None of the other answers   H   The SQL is incorrect

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
A
B
          B   B   C   An empty table   D   A

E   The SQL is incorrect   F
A
A
B
          G   None of the other answers

H
A
A
B
B

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   The SQL is incorrect   B
A	B
D	E
          C   None of the other answers

D
A	B
NULL	C
D	E
          E
A	B
NULL	C
C	NULL
D	E
          F   An empty table

G
A	B
C	NULL
D	E

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

Question 17 Which of the following queries extracts the students registered to at least three courses whose cost is unknown?

A 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

B All answers are correct

C None of the other answers

D 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

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

F 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

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

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

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

B All answers are correct

C None of the other answers

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

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

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

Question 19 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 SID EXISTS

B SID =ANY

C EXISTS

D SID NOT EXISTS

E SID <>ALL

F None of the other answers

G All answers are correct

H IN

I NOT EXISTS

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: StudentID

B 1: *nothing*, 2: Cost

C 1: DISTINCT, 2: CourseID

D All answers are correct

E None of the other answers

F 1: DISTINCT, 2: Cost

G 1: *nothing*, 2: CourseID

H 1: DISTINCT, 2: StudentID

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

3 Theory

Question 21 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:

A None of the other answers

B X cannot be a candidate key

C $\{K, X\}$ is always a super key (even if X is not a candidate key)

D K is also a primary key of R

E $\{K, X\}$ is also a candidate key

F X cannot be the primary key of R

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 K is a primary key of R

B R contains at least two different tuples t_1 and t_2 with $t_1[K] = t_2[K]$

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

E 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 None of the other answers

B $Y \to Z$

C $WY \to X$

D $X \to WY$

E $ZW \to ZY$

F $X \to WZ$

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

A R is at least in BCNF

B R can be in 1NF but not in 2NF

C R is at least in 2NF

D R is at least in 3NF

E None of the other answers

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

B The result of Q2 is always lower than the result of Q3

C The results of Q1 and Q3 can be different

D The result of Q2 is always lower than the results of both Q1 and Q3

E The results of Q1, Q2 and Q3 are always the same

F The results of Q1 and Q2 can be different

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

A The SQL is incorrect

B Deletes the 10 rows, but does not remove the table from the database schema

C May change data contained in other tables

D Removes the table from the database schema (and as a consequence also the 10 rows)

E May delete less than 10 rows because of referential integrity constraints

F None of the other answers

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

C One single index on A and B

D One index on B

Question 28 Which of the following are ACID properties?

A None of the other answers is true

B Isolation, Dependability, Atomicity

C Isolation, Durability, Aggregation

D Isolation, Durability, Atomicity

E Isolation, Dependability, Aggregation

F Independence, Durability, Aggregation

G Independence, Durability, Atomicity

H Independence, Dependability, Aggregation

I Independence, Dependability, Atomicity

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 update ON X TO Tim
Jim: REVOKE select ON X FROM Tim
Bob: REVOKE ALL ON X FROM Ann CASCADE

Which privileges does Tim have?

A select without grant option

B select with grant option, update without grant option

C select, update, both with grant option

D select with grant option

E select, update, both without grant option

F none

Question 30   A view:

A Cannot be used inside a query with a GROUP BY

B Needs to be kept manually synchronized with the base tables

C Cannot be used inside a UNION query

D None of the other answers

E Cannot be used inside a nested query

F Is recomputed every time it is accessed

G 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

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

QUESTION 1: A B C D E F G H

QUESTION 2: A B C D

QUESTION 3: A B C D

QUESTION 4: A B C D

QUESTION 5: A B C D

QUESTION 6: A B C D E F G H

QUESTION 7: A B C D E F G H I J

QUESTION 8: A B C D E F

QUESTION 9: A B C D E F

QUESTION 10: A B C D E F G

QUESTION 11: A B C D E F G H

QUESTION 12: A B C D E F G H

QUESTION 13: A B C D E F G H I J K L

QUESTION 14: A B C D E F G H

QUESTION 15: A B C D E F G H

QUESTION 16: A B C D E F G

QUESTION 17: A B C D E F G

QUESTION 18: A B C D E F

QUESTION 19: A B C D E F G H I

QUESTION 20: A B C D E F G H I

QUESTION 21: A B C D E F

QUESTION 22: A B C D E F

QUESTION 23: A B C D E F

QUESTION 24: A B C D E

QUESTION 25: A B C D E F

QUESTION 26: A B C D E F

QUESTION 27: A B C D

QUESTION 28: A B C D E F G H I

QUESTION 29: A B C D E F

QUESTION 30: A B C D E F G