02170 Test Exam Week 13 in 2023: F22 MCQ

This multiple choice constitutes Part 2 of the written examination. Part 1 should be accessed separately.
Both parts have questions concerning the same database. The two parts can be solved in any order, but the database is only described on page 2 in the Part 1 document. So you may need to read that page in order to answer the multiple choice questions.

The multiple choice is based on a "One best answer" concept:

There is always only one correct answer – an answer that is more correct than the others.
Students are only able to select one answer per question.
Every incorrect answer gives 0 points (incorrect answers do not result in subtraction of points).

This question group has no title yet

Conceptual Design

The conceptual design for the *Takeaway* database was specified by an Entity-Relationship (E-R) diagram before the relational design (with the relation schemas shown on page 2 in Part 1 of this exam) was made.

We are now going to consider a part of this Entity-Relationship diagram. In order to answer the question below, you may need to study the text and the tables from page 2 in Part 1 of this exam. For convenience, relevant pieces of that text and relation instances are repeated here:

The shop sells food items belonging to various food categories. A food category has a unique id *catId* and a name *catName*. The *FoodCategory* table describes the possible food categories. Each food item has a unique id *itemId*, a *description*, and a *unitPrice* (i.e. the price for one food item), and it belongs to one of the possible food categories specified by a *catId*. The *FoodItem* table describes the food items sold by the shop.

FoodCategory(catId, catName)

catId	catName
bev	Beverages
fish	Fish dishes
meat	Meat dishes
start	Starters

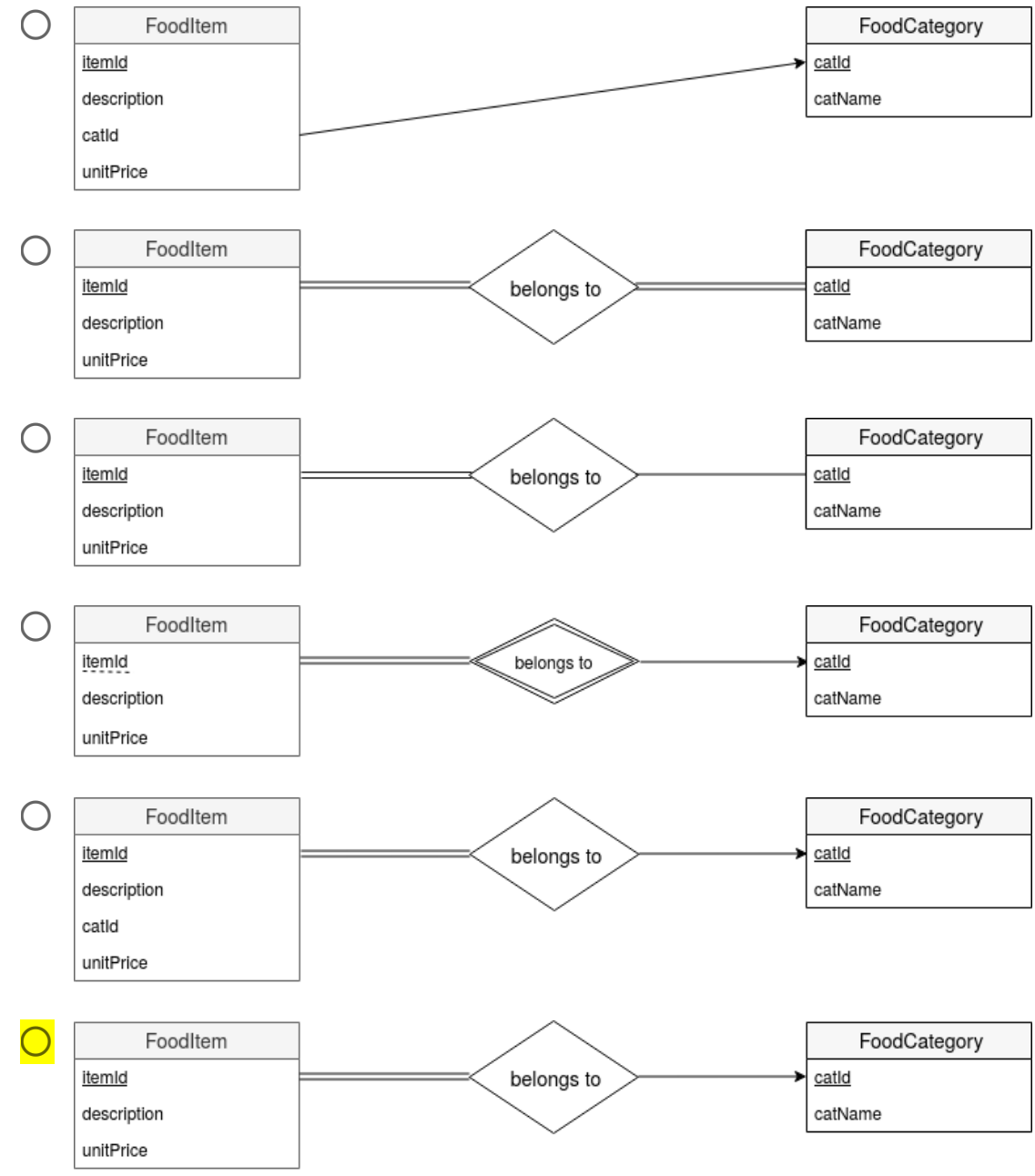
FoodItem(itemId, description, catId, unitPrice)

itemId	description	catId	unitPrice
bburg	Big Burger	meat	100
nburg	Normal Burger	meat	75
sroll	Spring Rolls	start	45
sushi	Sushi Menu	fish	65

Question 1.1

Which of the following (sub-)diagrams is a correct E-R diagram specifying *FoodItem* and *FoodCategory* entity sets and the relationship set *belongs to* between them?

Choose one answer



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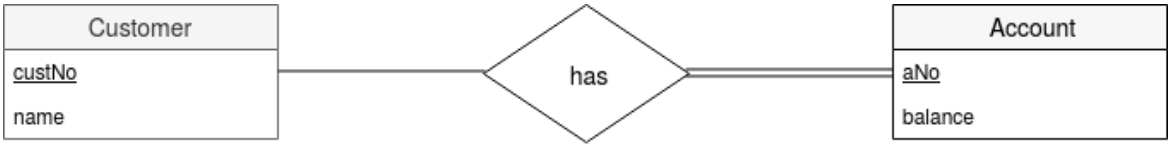
Entity-Relationship Diagrams and their Conversion to Relation Schemas

In the *Takeaway* database each registered customer has a unique customer number *custNo* and a *name*. The database engineer is going to develop an extension to the database such that it is possible for customers to get an account on which they can insert money that can be used for payment of orders. The Entity-Relationship Diagram below is a conceptual model describing entity sets *Customer* and *Account* and a relationship set *has* between them:



Questions 2.1-2.4

The questions below are concerned with the implications of the depicted cardinality of the *has* relation and the participation of *Customer* and *Account* in *has.*

Select the correct answers

	yes	no
Can a customer have no accounts?	◯	○
Can a customer have several accounts?	◯	○
Can several different customers have the same account?	◯	○
Can an account exist without having customer?	○	◯

Question 2.5

Convert the Entity-Relationship diagram shown above into relation schemas using the method described in the textbook and slides adopted in this course. What will the result be (here shown without foreign key constraints)?

Choose one answer

- Customer(<u>custNo</u>, name), Account(<u>aNo</u>, balance), has(<u>custNo</u>, <u>aNo</u>)
- Customer(<u>custNo</u>, name, aNo), Account(<u>aNo</u>, balance)
- Customer(<u>custNo</u>, name), Account(<u>aNo</u>, balance, custNo)

This question group has no title yet

Integrity Constraints

Questions 3.1-3.3

Consider the following relation schema used in the *Takeaway* database:

OrderLine(orderNo, lineNo, itemId, quantity, unitPrice)

The following questions concern which relation/table instances are legal for this logical design.

Select the correct answers

	yes	no
Is it possible that two rows having the same *orderNo*, but different *itemId,* can have the same *lineNo*?	○	○
Is it possible that two rows having the same *orderNo*, but different *lineNo,* can have the same *itemId* ?	○	○
Is it possible that two rows having the same *itemId*, but different *orderNo*, can have the same *lineNo*?	○	○

Questions 3.4-3.6

Consider the following relation schemas:

- RA(A, B, E) **foreign key** (B) **references** RB(B), **foreign key** (E) **references** RE(E)
- RB(B, C) **foreign key** (C) **references** RC(C)
- RC(C, D)
- RE(E, F)

Assume that these have been implemented in SQL and all three foreign key constraints have been given the referential action **on delete cascade.**
Which tables would *potentially* be changed when a row is deleted in the *RC* table*? (Potentially* means that it will happen for some table instances, but not for others.)

Select the correct answers

	Yes	No
Is *RA* potentially changed?	◯	○
Is *RB* potentially changed?	◯	○
Is *RE* potentially changed?	○	◯

This question group has no title yet

Normalization

Question 4.1

Consider a relation with schema *R(A, B, C)* for which the following functional dependencies are assumed:

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

Which of the following attribute sets are candidate keys of *R*?

Choose one answer

- ○ There is one candidate key: {A}
- ○ There are two candidate keys: {A} as well as {B}
- ○ There is one candidate key: {A,B}

Questions 4.2-4.4

For the relation schema *R* considered in question 4.1, decide for each of the following relation instances (tables) whether it satisfies the stated functional dependencies.

Select the correct answers

	yes	no
A B C a1 b1 c1 a2 b2 c1	◯	○
A B C a1 b1 c1 a2 b1 c2	○	◯
A B C a1 b1 c1 a1 b2 c2	○	◯

Question 4.5

What is the highest normal form of the relation R considered in question 4.1?

Choose one answer

- 1NF
- 2NF
- 3NF
- BCNF

Question 4.6

Consider a relation with schema *S(A, B, C, D)* for which the following functional dependencies are assumed:

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

Choose a primary key and perform normalization of *S* to at least 3 NF (using the method described in the textbook adopted in this course). What is the result of that (ignoring foreign key constraints)?

Choose one answer

- S(A, B, C, D)
- S1(A, B, D), S2(B, D, C)
- S1(A, B), S2(A, D), S3(B, D, C)

This question group has no title yet

Indexing and Hashing

When answering the questions on this page, you should use the terminology and theory of the text book and slides adopted in this course.

Question 5.1

Suppose that hashing (a hash file organization) is used for the relation *FoodOrder(orderNo, custNo).*
The search key is *custNo* and the hash function is *h(custNo) = custNo % 4*.
(% is the remainder-by-division operator.)
In which number bucket should the tuple with values (4, 7) be inserted?

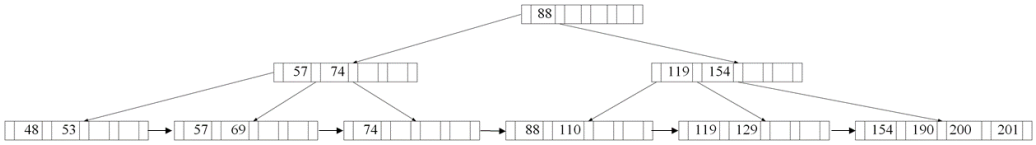
Choose one answer

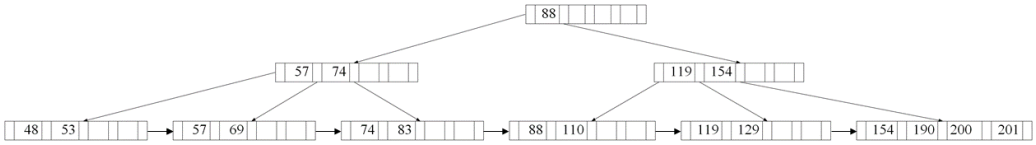
- 0
- 3
- 4
- 7

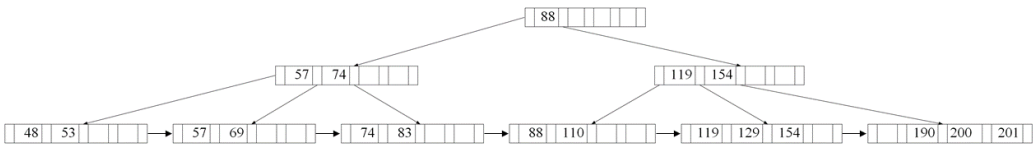
Question 5.2

Which of the following trees is a legal B+ tree? (Pointers from the leaf nodes to a data file are not shown.)

Choose one answer






88
57
74
119
154
48
53
57
69
74
83
88
110
119
129
154
190
200
201

This question group has no title yet

Formal Relational Query Languages

The following questions consider the relation schemas *FoodOrder(orderNo, custNo)* and *OrderLine(orderNo, lineNo, itemId, quantity, unitPrice)* of the *Takeaway* database described in Part 1 of this exam. Here are examples of relation instances of *FoodOrder* and *OrderLine*, respectively:

orderNo	custNo
1	1
2	1
3	7
4	7

orderNo	lineNo	itemId	quantity	unitPrice
1	1	sroll	2	45
1	2	nburg	5	75
2	1	sushi	1	65
2	2	nburg	2	75
3	1	nburg	3	75

Question 6.1

Relational Algebra: Which of the following is a correct Relational Algebra expression finding the number of Normal Burgers ("nburg") for each customer number (*custNo*) appearing in the *FoodOrder* table?

Choose one answer

- $\Pi_{\text{custNo, count(quantity)}}(\sigma_{\text{itemId="nburg"}}(\text{FoodOrder} \bowtie \text{OrderLine}))$
- $\Pi_{\text{custNo, sum(quantity)}}(\sigma_{\text{itemId="nburg"}}(\text{FoodOrder} \bowtie \text{OrderLine}))$
- $_{\text{custNo}}\mathcal{G}_{\text{count(quantity)}}(\sigma_{\text{itemId="nburg"}}(\text{FoodOrder} \bowtie \text{OrderLine}))$
- $_{\text{custNo}}\mathcal{G}_{\text{sum(quantity)}}(\sigma_{\text{itemId="nburg"}}(\text{FoodOrder} \bowtie \text{OrderLine}))$
- $_{\text{custNo}}\mathcal{G}_{\text{custNo, sum(quantity)}}(\sigma_{\text{itemId="nburg"}}(\text{FoodOrder} \bowtie \text{OrderLine}))$

Question 6.2

Domain Calculus: Which of the following is a correct Domain Calculus expression finding the customer numbers (*custNo*) of those customers who have ordered a Normal Burger ("nburg"), but not a Sushi Menu ("sushi") in the same order?

Choose one answer

- $\{< c > \mid \exists\, o\, (< o, c > \in FoodOrder)\ \wedge$
  $\exists o, l, f, q, p (< o, l, f, q, p > \in OrderLine\ \wedge f = \texttt{"nburg"})\ \wedge$
  $\forall o, l, f, q, p (< o, l, f, q, p > \in OrderLine\ \implies f \neq \texttt{"sushi"})\ \}$

- $\{< c > \mid \exists o, c (< o, c > \in FoodOrder\ \wedge$
  $\exists l, f, q, p (< o, l, f, q, p > \in OrderLine\ \wedge f = \texttt{"nburg"})\ \wedge$
  $\forall l, f, q, p (< o, l, f, q, p > \in OrderLine\ \implies f \neq \texttt{"sushi"})\ )\}$

- $\{< c > \mid \exists\, o\, (< o, c > \in FoodOrder\ \wedge$
  $\exists l, f, q, p (< o, l, f, q, p > \in OrderLine\ \wedge f = \texttt{"nburg"})\ \wedge$
  $\forall l, f, q, p (< o, l, f, q, p > \in OrderLine\ \implies f \neq \texttt{"sushi"})\ )\}$

- $\{< c > \mid \exists\, o\, (< o, c > \in FoodOrder\ \wedge$
  $\exists l, f, q, p (< o, l, f, q, p > \in OrderLine\ \wedge f = \texttt{"nburg"} \wedge f \neq \texttt{"sushi"})\ )\}$