

**Midterm Exam
Fall 2000**

Max. Points: 100

(Please read the instructions carefully)

Instructions:

- Total time for the exam is 75 minutes. No extra time will be awarded so budget your time accordingly.
- The exam is closed books and closed notes.
- The exam is divided into 2 sections.
 - 10 multiple choice questions – a correct answer will get you 5 points, an incorrect answer will cost you 2 point and answers left blank will get you 0 points.
 - 4 other questions totaling 50 points
- If you find ambiguities in a question or in the schema, write down the interpretation you are taking, and then answer the question based on your interpretation.
- This exam contains 12 pages of which pages 11 and 12 are blank. You can use them as scratch paper.

NAME:

ALIAS:

Part	Points	Score
I	50	
II	50	
Total	100	

Question 1: Which of the following statements are true

1. Each superkey is a superset of some candidate key.
2. Each primary key is also a candidate key, but there may be candidate keys that are not primary keys.

- a) only 1 is true
- b) only 2 is true
- c) both 1 and 2 are true
- d) neither 1 nor 2 are true

Answer

C

Question 2. Below is an ODL specification:

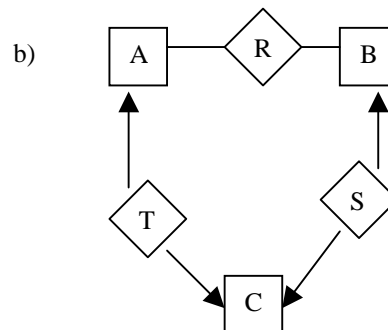
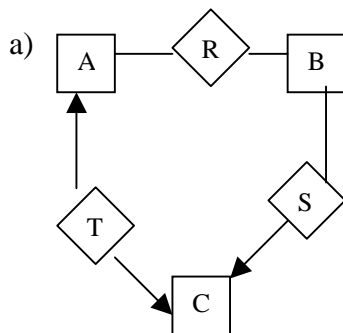
Interface A
 {relationship SetR
 inverse B ::R;
 relationship C T
 inverse C::T;
 };

interface B
 {relationship Set<A>R
 inverse A ::R;
 relationship C S
 inverse C::S;
 };

interface C
 {relationship SetS
 inverse B ::S;
 relationship A T
 inverse A::T;
 };

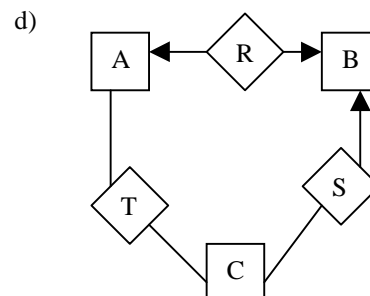
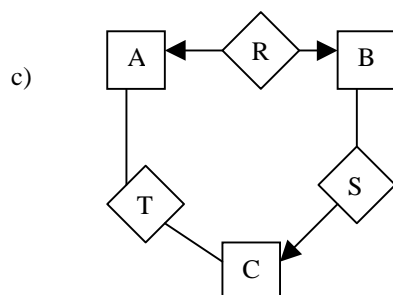
For simplicity all attributes are omitted.

Which one of the E –R diagrams below , best captures the intent of the ODL specification above?

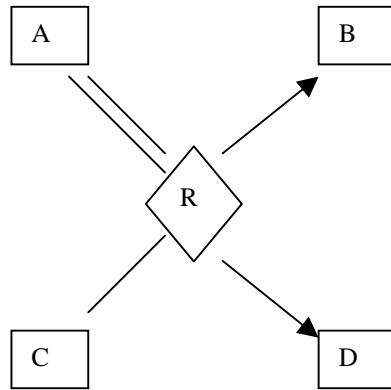


Answer

A



Question 3: Consider the following E-R diagram



Suppose the key of entity set A is attribute A, the key of B is B, the key of C is C, the key of D is D. If we translate relationship set R into a relation R (A,B, C,D), what are the keys of R?

- a) {A}
- b) {B,C} AND {C,D}
- c) {A,C}
- d) none of the above

Answer :

D

The following two questions refer to the relational scheme R (A, B, C, D, E, F, G, H) and the following functional dependencies over R:

$A \rightarrow BCD$

$AD \rightarrow E$

$EFG \rightarrow H$

$F \rightarrow GH$

Question 4: Based on the functional dependencies, there is one key for R.

What is it ?

AF

Question 5: One of the four functional dependencies can be removed without altering the key.

Which one ?

EFG -> H

The following two questions refer to the instances of relations R(A,B,C,D,E) and S (P, Q,R,S) shown below :

A	B	C	D	E
7	4	1	2	3
1	5	3	1	1
1	6	3	2	4
5	5	1	2	3

P	Q	R	S
7	2	1	4
5	2	1	2
1	2	3	7

Question 6: Which of the following FDs hold over the instance of relation R given above?

- I) $ABC \rightarrow E$
- II) $CD \rightarrow EB$
- III) $B \rightarrow D$

a) I & III

b) II & III

c) I & II

d) I only

Answer :

D

Question 7: Which of the following Inclusion Dependencies hold over the instances of relation R and S given above?

- I) $PQ \subseteq AD$
- II) $RS \subseteq CD$
- III) $PQR \subseteq ADC$

a) I & III

b) II & III

c) I & II

d) I only

Answer :

A

Question 8: Consider a relation scheme $R(P, M, L, Q, N)$ with the FD's :

$$M \rightarrow Q, PM \rightarrow L, QN \rightarrow P$$

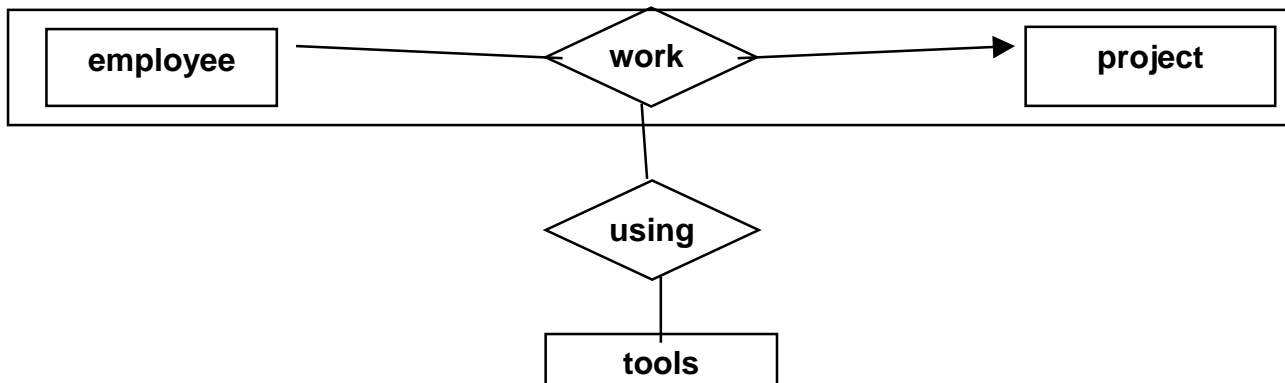
What are the keys of R ,

- a) $\{P, M, N\}$ & $\{M, Q, N\}$
- b) $\{P, M, Q, N\}$
- c) $\{M, N\}$
- d) $\{P, M\}$ & $\{Q, N\}$

Answers

C

Question 9: Consider the following ER diagram



For simplicity, we have not listed the attributes associated with the entity sets. Let us assume that the keys corresponding to the three entity sets employee, projects, and tools are *ssn*, *proj#*, and *toolid* respectively. Furthermore, the work relationship has an attribute *start-date*. If we map the above ER diagram into the relational model, what will be the relation scheme for the relationship set **using**

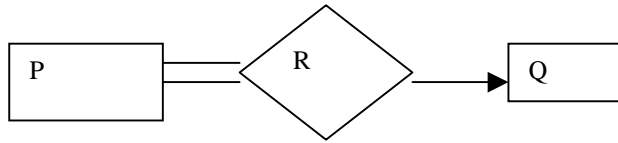
- a) **using**(*ssn*, *toolid*)
- b) **using**(*toolid*, *start-date*)
- c) **using**(*ssn*, *toolid*, *proj#*)
- d) none of the above

Answer

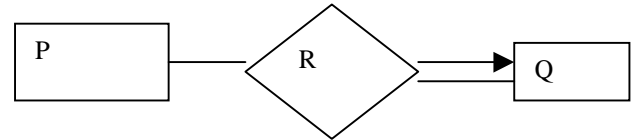
A

Question 10: Consider the following two ER diagrams -- ER1 and ER2

ER1



ER2



The statement that the number of entities in entity set P must be greater than or equal to the number of entities in entity set Q holds for:

- a) ER1 but not ER2
- b) ER2 but not ER1
- c) Both ER1 and ER2
- d) Neither ER1 nor ER2

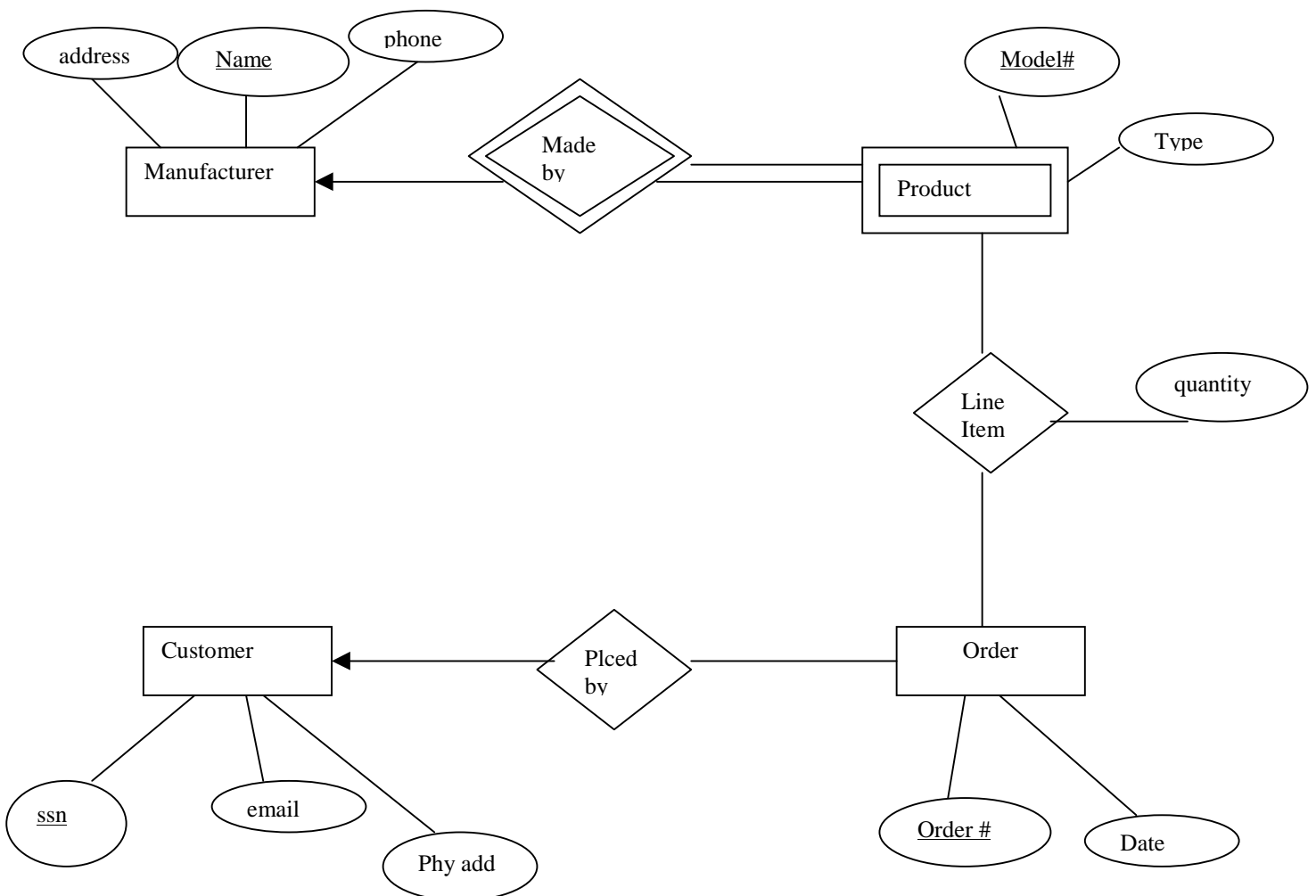
Answer

B

The next four questions are based on the following information

1. Manufacturers have a name, which we may assume is unique, an address, and a phone number.
2. Products have a model number and a type (e.g., television set). Each product is made by one manufacturer, and different manufacturers may have different products with the same model number. However, you may assume that no manufacturer would have two products with the same model number.
3. Customers are identified by their unique social security number. They have email addresses, and physical addresses. Several customers may live at the same (physical) address, but we assume that no two customers have the same email address.
4. An order has a unique order number, and a date. An order is placed by one customer. For each order, there are one or more products ordered, and there is a quantity for each product on the order.

Question 11: (15 points) In the space below, draw an E/R diagram that represents the above information. Do not forget to underline the keys as usual.



Question 12: (15 points) Design the ODL Description of the above information. Give the classes (Interfaces), attributes and relationships for each class, and information about the inverse of relationships.

```
interface Manufacturer {  
  attribute string name;  
  attribute string address;  
  attribute string phone;
```

```
  relationship Set < Product> makes  
  inverse <Product> :: made_by;
```

```
  key(name); }
```

```
interface Product {  
  attribute string model_no;  
  attribute enum ptype {“some relavent types”} p_type;
```

```
  relationship <Manufacturer> made_by  
  inverse <Manufacturer> :: makes;
```

```
  relationship Set <Line_items> : prod_line  
  inverse <Line_items> :: line_prod;
```

```
  key (model_no); }
```

```
interface Order {  
  attribute string order_no;  
  attribute string date;
```

```
  relationship Set <Line_item> : ord_line  
  inverse <Line_item> ::line_ord;
```

```
  relationship <Customer> :placed_by  
  inverse <Customer> :: places;
```

```
  key(order_no); }
```

```
interface Customer{  
  attribute string ssn;  
  attribute string email;  
  attribute string phy_add;
```

```
  relationship Set <Order> : places  
  inverse <Order> :: placed_by;
```

```
key(ssn); }
```

```
interface Line_items{  
attribute integer quantity;  
  
relationship <Product> line_prod  
inverse <Product>:: prod_line;  
  
relationship <Order> line_ord  
inverse <Order> :: ord_line;  
  
}
```

Question 13: (15 points) Convert the E/R diagram in Question 11 to the relational model. Remember to specify not just the relational scheme but also integrity constraints including keys as well as inclusion dependencies.

Manufacturer (address, name, phone)
Product (p_name, model_no, type)
Customer (ssn, email, address)
Order (order_no, date)
Line_item (p_name, model_no, order_no)
Placed_by (ssn, order_no)
Product [p_name] \subseteq Manufacturer [name]
Placed_by [ssn] \subseteq Customer [ssn]
Line_item [name, model_no] \subseteq Product [name, model_no]

Question 14: (5 points) Suppose we had a relation Customer(ssNo, email, addr) as part of our relational database schema. What functional dependencies would you expect to hold?

Ssn \rightarrow ssn, email, physical_address
Email \rightarrow ssn, email, physical_address

What are the keys for this relation?

ssn and email