Case Study 1:

Imagine a database for a library management system. The initial database design has a single table called Books with the following attributes:

BookID, Title, Author, Genre, ISBN, PublicationYear, Edition, NumberOfCopies, Publisher, AuthorAddress, AuthorPhone, AuthorEmail, EditionNotes

Multiple Choice Questions:

1. Which of the following is the primary key for the Books table, based on the current design?

a) Title
b) Author
c) BookID
d) ISBN

Answer: c) BookID

2. Why is the Books table not in 1NF (First Normal Form)?

a) It has multiple candidate keys.
b) It has repeating groups (like author information).
c) It has null values.
d) It does not have a primary key.

Answer: b) It has repeating groups (like author information).

3. **What is the goal of normalization in database design?**

a) To increase the size of the database.
b) To reduce redundancy and improve data consistency.
c) To simplify queries.
d) To make the database more complex.

Answer: b) To reduce redundancy and improve data consistency.

4. Which normal form would be achieved by separating author information into a separate Authors table?

a) 1NF
b) 2NF
c) 3NF
d) BCNF

Answer: a) 1NF

5. **What is a partial dependency in the context of 2NF?**

a) A non-key attribute depends on part of the primary key.
b) A key attribute depends on a non-key attribute.
c) A non-key attribute depends on the entire primary key.
d) A key attribute depends on another key attribute.

Answer: a) A non-key attribute depends on part of the primary key.

6. If the Books table has a composite primary key (BookID, Edition), and the Edition attribute is not fully dependent on the primary key, what normal form is it not in?

a) 1NF
b) 2NF

c) 3NF
d) BCNF
Answer: b) 2NF

7. **What is a transitive dependency in the context of 3NF?**

a) An attribute depends directly on the primary key.
b) An attribute depends indirectly on the primary key via another non-key attribute.
c) An attribute depends on a non-key attribute.
d) An attribute depends on a foreign key.
Answer: b) An attribute depends indirectly on the primary key via another non-key attribute.

8. **Which normal form ensures that every non-prime attribute is dependent on a candidate key?**

a) 1NF
b) 2NF
c) 3NF
d) BCNF
Answer: c) 3NF

9. **What is a BCNF violation?**

a) A non-key attribute depends on a non-candidate key.
b) A non-key attribute depends on a candidate key.
c) A key attribute depends on a non-key attribute.
d) A prime attribute depends on a non-prime attribute.
Answer: a) A non-key attribute depends on a non-candidate key.

Case Study 2:

Table: Customer Orders

OrderID	CustomerID	CustomerName	ProductID	ProductName	Quantity	Price	OrderDate
1	101	Alice	P001	Laptop	2	500	2025-05-01
2	102	Bob	P002	Mobile	1	300	2025-05-02
3	101	Alice	P003	Mouse	3	25	2025-05-02
4	103	Charlie	P001	Laptop	1	500	2025-05-03

1. Which of the following statements is true regarding the above table?
A) The table is in 1NF but not in 2NF because there is partial dependency.
B) The table is in 2NF but not in 3NF because there is a transitive dependency.
C) The table is in 3NF but not in BCNF.
D) The table is in BCNF.
Answer:
A) The table is in 1NF but not in 2NF because there is partial dependency.
Explanation: The table has partial dependency because CustomerName depends only on CustomerID, which is a non-prime attribute. The table should be decomposed to eliminate partial dependencies to achieve 2NF.

2. After decomposing the table to satisfy 2NF, which of the following would be the correct schema for the normalized tables?

A)
Customer (CustomerID, CustomerName)
Order (OrderID, CustomerID, OrderDate)
OrderDetails (OrderID, ProductID, Quantity, Price)

B)
CustomerOrders (OrderID, CustomerID, ProductID, Quantity, Price, CustomerName, OrderDate)

C)
Customer (CustomerID, CustomerName)
Product (ProductID, ProductName)
Order (OrderID, CustomerID, ProductID, Quantity, Price, OrderDate)

D)
Order (OrderID, ProductID, Quantity, Price)
Customer (CustomerID, CustomerName)
OrderDetails (OrderID, ProductID, CustomerName, Quantity)

Answer:
A)
Customer (CustomerID, CustomerName)
Order (OrderID, CustomerID, OrderDate)
OrderDetails (OrderID, ProductID, Quantity, Price)

Explanation: In this schema, Customer and Order tables are normalized to 2NF by removing partial dependencies. The OrderDetails table separates product-related data from the order.

Case Study 3:

Table: Student Enrollment

StudentID	StudentName	CourseID	CourseName	InstructorID	InstructorName	Credits
1001	John	C101	Math	I001	Dr. Smith	3
1002	Alice	C102	Physics	I002	Dr. Lee	4
1003	Bob	C101	Math	I001	Dr. Smith	3
1004	Charlie	C103	Chemistry	I003	Dr. White	3

3. Which normal form is the Student Enrollment table in?
A) The table is in 1NF but not in 2NF.
B) The table is in 2NF but not in 3NF.
C) The table is in 3NF but not in BCNF.
D) The table is in BCNF.

Answer:
B) The table is in 2NF but not in 3NF.

Explanation: The table is in 1NF because it has atomic values. However, there are transitive dependencies like InstructorName depends on InstructorID, and CourseName depends on CourseID. The table should be decomposed into two tables: one for Courses and one for Instructors.

4. After normalizing the table to 3NF, which of the following would be the correct schema?

A)
Student (StudentID, StudentName)
Course (CourseID, CourseName, Credits)
Instructor (InstructorID, InstructorName)
Enrollment (StudentID, CourseID, InstructorID)

B)
Student (StudentID, StudentName, CourseID, CourseName, InstructorID, InstructorName, Credits)

C)
Student (StudentID, StudentName, CourseID, Credits)
Instructor (InstructorID, InstructorName)
Course (CourseID, CourseName)

D)
Student (StudentID, StudentName, CourseID, InstructorID)
Course (CourseID, CourseName, Credits)
Instructor (InstructorID, InstructorName)

Answer:
A)
Student (StudentID, StudentName)
Course (CourseID, CourseName, Credits)
Instructor (InstructorID, InstructorName)
Enrollment (StudentID, CourseID, InstructorID)

Explanation: In this schema, we have removed transitive dependencies and split the table into four tables, ensuring all non-prime attributes are fully functionally dependent on the key.

Case Study 4:

Table: Employee Project Assignment

Employee ID	EmployeeName	ProjectID	ProjectName	ManagerID	ManagerName	HoursWorked
E001	Sarah	P001	Database	M001	Mr. James	20
E002	Mark	P002	WebApp	M002	Ms. Emily	30
E003	Tom	P003	CloudService	M003	Mr. Robert	25
E004	Lisa	P001	Database	M001	Mr. James	15

5. Which of the following is a problem with the Employee Project Assignment table as shown above?
A) It contains partial dependencies and should be normalized to 2NF.
B) It contains transitive dependencies and should be normalized to 3NF.
C) It is already in 3NF.
D) It does not contain any dependencies, so it is in BCNF.
Answer:
B) It contains transitive dependencies and should be normalized to 3NF.
Explanation: ManagerName depends on ManagerID, which is a transitive dependency in the table. This violates 3NF, and the table should be decomposed.

6. After decomposing the table into 3NF, which of the following would be the correct schema?
A)
Employee (EmployeeID, EmployeeName)
Project (ProjectID, ProjectName)
Manager (ManagerID, ManagerName)
Assignment (EmployeeID, ProjectID, HoursWorked)
B)
Employee (EmployeeID, EmployeeName, ProjectID, ProjectName, ManagerID, ManagerName, HoursWorked)
C)
Employee (EmployeeID, EmployeeName, ProjectID, HoursWorked)
Project (ProjectID, ProjectName, ManagerID)
Manager (ManagerID, ManagerName)
D)
Employee (EmployeeID, EmployeeName, ProjectID, HoursWorked)
Manager (ManagerID, ManagerName)
Project (ProjectID, ProjectName)

Answer:
A)
Employee (EmployeeID, EmployeeName)
Project (ProjectID, ProjectName)
Manager (ManagerID, ManagerName)
Assignment (EmployeeID, ProjectID, HoursWorked)
Explanation: This schema normalizes the table into 3NF by separating employee, project, and manager information and creating an Assignment table for the relationship between employees and projects.