

## Solutions

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**2.1** MemberID and Hours form the repeating group. The 1NF rows are (E1, Fair, M1, 2) and (E1, Fair, M2, 3). Primary key: (EventID, MemberID). A separate EVENT table and an EVENT\_MEMBER table with the same two attendance records is also valid.

**2.2** Partial dependency: ProductName depends on ProductID alone, part of the composite key.

PRODUCT(ProductID, ProductName).

ORDER\_LINE(OrderID, ProductID, Quantity).

ProductID in ORDER\_LINE is a foreign key to PRODUCT. Its two underlined fields form one composite key.

**2.3** Transitive dependency: EmployeeID → DepartmentID → DepartmentName.

EMPLOYEE(EmployeeID, Name, DepartmentID).

DEPARTMENT(DepartmentID, DepartmentName).

EMPLOYEE.DepartmentID is a foreign key to DEPARTMENT.DepartmentID.

**2.4** 3NF. The table is 1NF because it has atomic values and no repeating groups. Mark depends on the full pair, and there is no partial or transitive dependency. Repeating StudentID or TestID separately is allowed: only the pair must be unique.

**3.1** The table is 1NF and its key is a single field, so there is no partial-key dependency. ISBN → PublisherID → PublisherName is transitive, so it is not 3NF.

BOOK(ISBN, Title, PublisherID).

PUBLISHER(PublisherID, PublisherName).

BOOK.PublisherID is a foreign key to PUBLISHER.PublisherID.

### 3.2

DELIVERY(DeliveryID, Date, DriverID).

DRIVER(DriverID, DriverName).

ITEM(ItemID, ItemName).

DELIVERY\_ITEM(DeliveryID, ItemID, Quantity).

DELIVERY.DriverID refers to DRIVER.DriverID. DELIVERY\_ITEM.DeliveryID and ItemID refer to the corresponding keys in DELIVERY and ITEM.

After expanding the repeating group, ItemName depends on ItemID alone rather than the full delivery-item key: a partial dependency. DriverName depends on DriverID, which depends on DeliveryID: a transitive dependency. Quantity remains with the full pair.

### 3.3

| 3NF vet database |                                     |                           |
|------------------|-------------------------------------|---------------------------|
| Table            | Primary key                         | Other fields              |
| OWNER            | <u>OwnerID</u>                      | OwnerName, Telephone      |
| PET              | <u>PetID</u>                        | PetName, Species, OwnerID |
| VISIT            | <u>VisitID</u>                      | VisitDate, PetID          |
| TREATMENT        | <u>TreatmentID</u>                  | TreatmentName, Cost       |
| VISIT_TREATMENT  | <u>VisitID</u> , <u>TreatmentID</u> | None                      |

One mark for each correctly keyed table.

Foreign keys:

- PET.OwnerID refers to OWNER.OwnerID.
- VISIT.PetID refers to PET.PetID.
- In VISIT\_TREATMENT, VisitID refers to VISIT.VisitID.
- In VISIT\_TREATMENT, TreatmentID refers to TREATMENT.TreatmentID.

VisitID can repeat for different treatments and TreatmentID can repeat for different visits; the pair identifies one treatment in one visit. Names are not used as keys because uniqueness is not guaranteed.