9.

O1(orderno, shipaddr, orderdate, custno, custbal, custdiscount)

O2(itemno, itemdesc)

O3(orderno, itemno, lineno, qtyordered, qtyoutstanding)

O4(plantno, itemno, qtyonhand, reorderpoint)

10.

O1.1(orderno, shipaddr, orderdate, custno)

O1.2(custno, custbal, custdiscount)

11. Steps of BCNF

Step 1: There are no extraneous columns to remove

Step 2: There are no transitively derived FDs. If the following FDs were in the dependency diagram, they should be removed.

orderno 🡪 custbal

orderno 🡪 custdiscount

Step 3: Arrange the remaining FDs into groups by determinant

custno 🡪 custbal, custdiscount

orderno 🡪 orderdate, shipaddr, custno

itemno 🡪 itemdesc

orderno, itemno 🡪 qtyord, qtyoutstanding, lineno

orderno, lineno 🡪 qtyord, qtyoutstanding, itemno

itemno, plantno 🡪 qtyonhand, reorderpoint

Step 4: For each FD group, make a table with the determinant as the primary key.

Order (OrderNo, ShipAddr, OrderDate, CustNo)

FOREIGN KEY (CustNo) REFERENCES Customer

Customer (CustNo, CustBal, CustDiscount)

Item(ItemNo, ItemDesc)

OrderLine1 (OrderNo, ItemNo, LineNo, QtyOrdered, QtyOutstanding)

FOREIGN KEY (OrderNo) REFERENCES Order

FOREIGN KEY (ItemNo) REFERENCES Item

OrderLine2 (OrderNo, LineNo, ItemNo, QtyOrdered, QtyOutstanding)

FOREIGN KEY (OrderNo) REFERENCES Order

FOREIGN KEY (ItemNo) REFERENCES Item

PlantStocking (PlantNo, ItemNo, QtyOnHand, ReorderPoint)

FOREIGN KEY (ItemNo) REFERENCES Item

Step 5: Merge tables with the same columns. The tables orderline1 and orderline2 should be merged into one table. Either (orderno, itemno) or (orderno, lineno) can be chosen as the primary key.

12. The order table is not in BCNF because shipaddr is a determinant but not a candidate key it should be split into two tables as shown below.

order(orderno, shipaddr, orderdate)

shipping(shipaddr, custno)

13. Shipping addresses table should be added. The foreign key in the order table should reference shipaddress.

shipaddress(custno, shipaddr)

FOREIGN KEY (CustNo) REFERENCES Customer

After conversion

Home(HomeId, AgentId, PerNo, Street, City, State, Zip, NoBedRms, NoBath, SqFt, Price, …)

FOREIGN KEY(AgentId) REFERENCES Agent

FOREIGN KEY(PerNo) REFERENCES Owner

Agent(AgentId, OfficeId, Name, Phone)

FOREIGN KEY(OfficeId) REFERENCES Office

Person(PerNo, Name, Phone)

Owner(PerNo, SpouseName, Profess, SpouseProfess)

FOREIGN KEY(PerNo) REFERENCES Person ON DELETE CASCADE

Buyer(PerNo, Address, BdRms, BathRms, MinPrice, MaxPrice, AgentId)

FOREIGN KEY(AgentId) REFERENCES Agent

FOREIGN KEY(PerNo) REFERENCES Person ON DELETE CASCADE

Office(OfficeId, MgrName, Phone, Address)

MakesOffer(PerNo, HomeId, ExpDate, Price, CounterOffer)

FOREIGN KEY(HomeId) REFERENCES Home

FOREIGN KEY(PerNo) REFERENCES Buyer