21.

a) Best key: **a, c**

b) No. Becuase **d** and **b** depend on a part of the best key (primary key).

c) R(b, o, a, q, c, d) → R1(<u>c, a</u>, q, d) and R2(<u>c</u>, b, o)
    Now, we are descomposing R1 and R2 to satisfy the third normal form:
        R1 → R1.1(<u>a</u>, d) and R1.2(<u>c,a</u>, q)
        R2 → R2.1(<u>c</u>, b) and R2.2(<u>b</u>, o)

d) No, because **o** depends on **b** that at the same time depends on **c**. For the same reason **q** depends on **a** and **c**, but **d** only depends on **a**.

22.

R = RESERVATION: F = FLIGHTS
p = passengerName   f = flightID
SSN = SSN   t = time
f = flightID   d = departureAirport
d = departureAirport   a = arrivalAirport
a = arrivalAirport   dC = departureCity
t = time   aC = arrivalCity
date = date
c = cost

Examinating all the requirements we can assume those functional dependencies:

R= RESERVATION: F = FLIGHTS
SSN → P   d → dC
{SSN, f, date} → c   a → aC
{f, date} → t, a, d   flightID → {t, d, a, dC, aC}
{t, date, d} → f, a   {time, d} → {flightID, a, dC, aC}

a) Candidates Key:
    R-Cand1 = {SSN, f, date}
    F-Cand1 = {flightID}
        note: {time, d} also describes uniquely a row but it is not minimal.
    R-PK = {SSN, f, date}
    F-PK={flightID}

b)
R= RESERVATION: F = FLIGHTS
SSN → P   d → dC
{SSN, f, date} → c   a → aC
{f, date} → t, a, d   flightID → {t, d, a, dC, aC}
{t, date, d} → f, a   {time, d} → {flightID, a, dC, aC}

c)
R and F satify first NF, but they don't satisfy 2nd and 3rd .

d)
R={SSN, p, f, d, a, t, date, c}
  R.1={SSN, p}
  R.2={SSN, f, d, a, t, date, c}
    R2.1={SSN, f, date, c}
    R2.2={f, date, t, a, d}

F={f, t, d, a, dC, aC)
  F1={f, t, d, a}
  F2={a, aC}
  F3={d, dC}

23.

Due to the fact all relations have to have a Primary Key, let's suppose three cases:

A → B : A is the determinant and at the same time it's the Primary Key (which is one of the possible Candidates Keys). So it satisfies BCNF.

B → A: B is the determinant and at the same time it's the Primary Key (which is one of the possible Candidates Keys). So it satisfies BCNF.

AB → AB: Now AB is the determinant and at the same time it's the Primary Key (which is one of the possible Candidates Keys). So it satisfies BCNF.