3A

a) {a,c,e} {b,c,e} {d,c,e}
Note (not part of answer): Set notation ({,}) is not required as long as it is clear which attributes are in each key.

b) {b,c,d} {a,b,c,d} {a,b,d,e}

c) Example:

a	b	c	d	e
0	0	0	0	0
0	0	0	1	1

Note: b and c must be the same in both rows, and d differ to violate the functional dependency. Column a is essentially irrelevant and e must be different to respect the keys. Having additional rows is OK as long as the keys are respected.

Another correct solution where values are "as unique as possible":

a	b	c	d	e
0	1	2	3	4
5	1	2	6	7

d)

a → b
b c → d
d e → a

Additional derived dependencies (just a few examples, there are a lot of derived dependencies):

a c → d, b c e → a

R(a,b,c,d,e)
Decomposing on a → b, $\{a\}^+ = \{a, b\}$
R1(a,b) - BCNF
R2(a,c,d,e)
Decomposing on d e → a, $\{d, e\}^+ = \{d,e,a,(b)\}$
R21(d, e, a) - BCNF
R22(d, e, c) - BCNF

Final schema with keys:

R1(<u>a</u>, b)
R21(<u>d</u>, <u>e</u>, a)
R22(<u>d</u>, <u>e</u>, <u>c</u>)

Alternative solution where we split R2 on $\{a,c\}^+ = \{a,c,d,(b)\}$ a c → d (implied dependency):
R1(<u>a</u>, b)
R21(<u>a</u>, <u>c</u>, d)
R22(<u>a</u>, <u>c</u>, <u>e</u>)

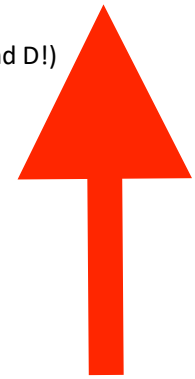
3B

We can note that the two sets A, B, E and C, D are not interconnected at all and can essentially be separate relations.

C, D can be email and name or any other pair of attributes where the first determines the second but not the other way around. Importantly, it should not have any connection to A, B and E. Maybe C=Ice cream flavor, D=Price (assumes each flavor has the same price everywhere)

A, B, E
We have E -> A and A -> B. This could be something like
A=model, B=manufacturer, E=licensePlate for cars or any other hierarchy where E is the most specific then A then B.
E=Person, A=Address, B=HouseArea (does not work with email and name as C and D!)

E=Planet, A=Solar system, B=Galaxy



3C

MVDs:

flightNo, departure ->> airport
flightNo, departure ->> passenger, movie
Note: The two above are equivalent and express “the airports a flight lands at are independent from the passengers and the movies they can watch”

passenger ->> movie
passenger ->> airport, flightNo, departure
Note: These two are also equivalent and express “The movies a passenger can watch are independent from the flights they are booked on and airports those flights land at”

R(flight, departure, airport, passenger, movie)
decomposing on flightNo, departure ->> airport
 R1(flightNo, departure, airport)
 R2(flightNo, departure, passenger, movie)
 decomposing on passenger ->> movie
  R21(passenger, movie)
  R22(passenger, flightNo, departure)

Final relations with keys (only trivial FDs):

R1(<u>flightNo</u>, <u>departure</u>, <u>airport</u>)

R21(<u>passenger</u>, <u>movie</u>)

R22(<u>passenger</u>, <u>flightNo</u>, <u>departure</u>)

Logically, the first ones lists where flights land, the second what movies passengers have and the third what passengers are on what flights.