Question 1: Part A

X	X$^+$	Key?
A	A	
B	B,C	
C	C	
D	A,D	
AB	A,B,C	
AC	A,C	
A,D	A,D	
BC	B,C	
BD	A,B,C,D	Yes, Minimal Key
CD	A,C,D	
ABC	A,C,D	
ABD	A,B,C,D	Super Key
ACD	A,C,D	
BCD	A,B,C,D	Super Key

Question 1: Part B

R is not in BCNF because both FD's are violations.

It is in 3NF because A,C does not belong to a key.

Question 1: Part C

$F^+ = \{B \rightarrow C, D \rightarrow A\}$

ABCD

B→C

ABD   BC

D→A
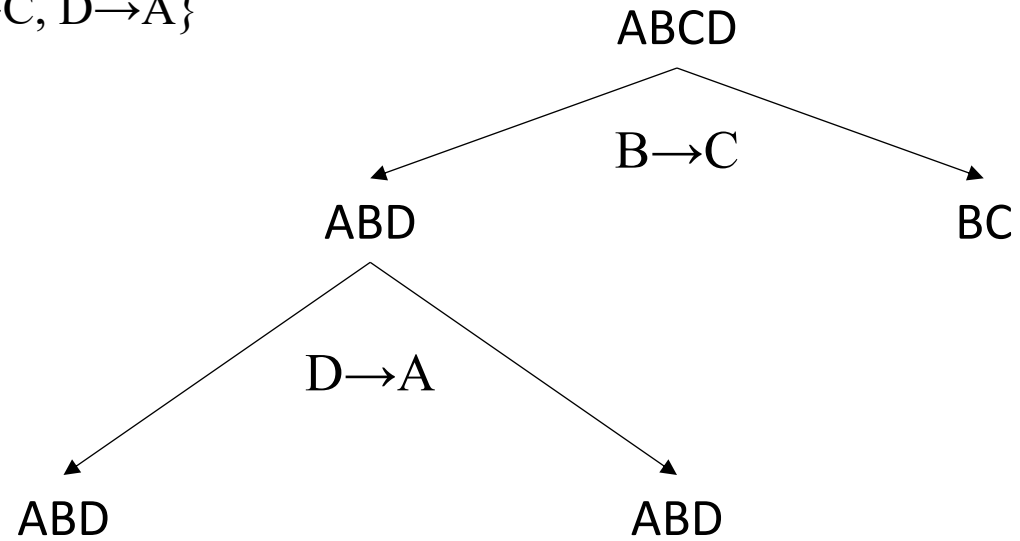
ABD   ABD

Question 2: Part A

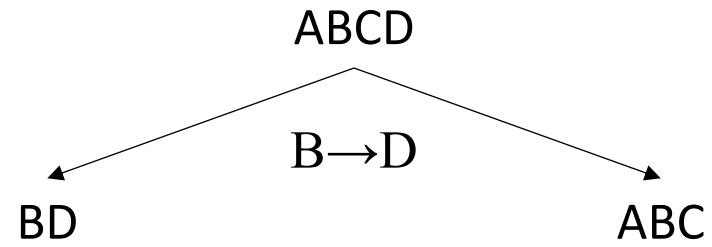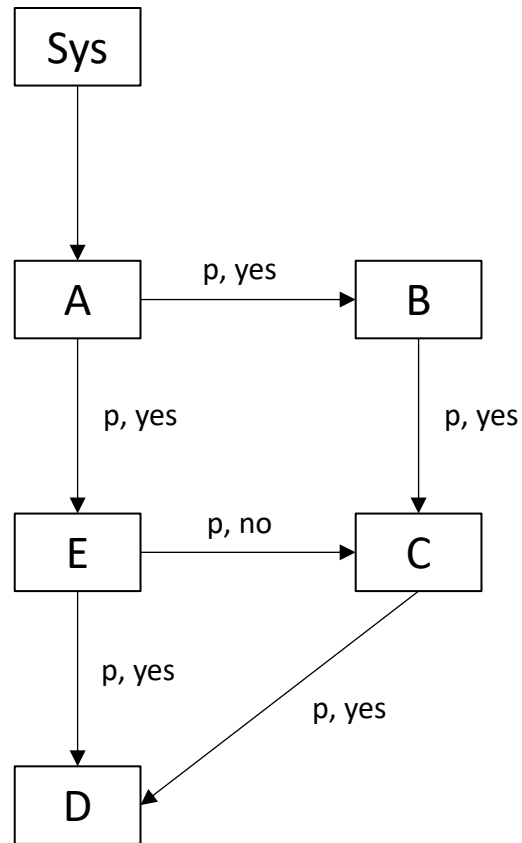| X	X$^+$	Key?
A	A	
B	B,D	
C	C	
D	D	
AB	A,B,C,D	Yes, Minimal Key
AC	A,C	
A,D	A,D	
BC	B,C,D	
BD	B,D	
CD	C,D	
ABC	A,B,C,D	Super Key
ABD	A,B,C,D	Super Key
ACD	A,C,D	
BCD	B,C,D	

Question 2: Part B

R is not in BCNF because at least 1 FD violates BCNF.

R is not 3NF because D is not part of any key.

Question 2: Part C

$F^+ = \{AB \rightarrow C, B \rightarrow D\}$

ABCD

$B \rightarrow D$

BD   ABC

Question 3: Part A – After Step 6

Question 3: Part B – After Step 7