Q1

(1) C^+={C} , J $\notin C^+$so C→ J $\notin F^+$

(2) F'={ A→B, A→C, E→A, E→D, BD→E, CE→D, CE→H, H→G, EI→J }

BD→E, $B^+ = \{B\}$, Hence, BD→E cannot be replaced by B→ E

$D^+ = \{D\}$, Hence, BD→E cannot be replaced by D→ E

so BD→E cannot be replaced

CE→D, $C^+ = \{C\}$, Hence, CE→D cannot be replaced by C→D

$E^+ = \{A, B, C, D\}$, Hence, CE→D can be replaced by E→D

CE→H, $C^+ = \{C\}$, Hence, CE→H cannot be replaced by C→H

$E^+ = \{A, , B, C, D\}$, Hence, CE→H can be replaced by E→H

EI→J, $E^+ = \{A, B, C, D\}$, Hence, EI→J cannot be replaced by E→J

$I^+ = \{I\}$, Hence, CE→H cannot be replaced by I→J

so F''={ A→B, A→C, E→A, E→D, BD→E, CE→H, H→G, EI→J }

$A^+|_{F''-\{A\to B\}}$={A,C}, so A→B is not redundant

$A^+|_{F''-\{A\to C\}}$={A,B}, so A→C is not redundant

$E^+|_{F''-\{E\to A\}}$={E,D}, so E→A is not redundant

$E^+|_{F''-\{E\to D\}}$={E,A}, so E→D is not redundant

$H^+|_{F''-\{H\to G\}}$={H}, so H→G is not redundant

so F''=F_{min} ={ A→B, A→C, E→A, E→D, BD→E, E→H, H→G, EI→J }

(3) U={A, B, C, D, E, G, H, I, J, K}

$R_1 = \{A, B, C, D, E\}$ so $U_1 = \{A, B, C, D, E\}$

$R_2 = \{E, G, H\}$ so $U_2 = \{E, G, H\}$

$R_3 = \{E, I, J, K\}$ so $U_3 = \{E, I, J, K\}$

A	B	C	D	E	G	H	I	J	K
a_1	a_2	a_3	a_4	a_5	b_{16}	b_{17}	b_{18}	b_{19}	b_{110}
b_{21}	b_{22}	b_{23}	b_{24}	a_5	a_6	a_7	b_{28}	b_{29}	b_{210}
b_{31}	b_{32}	b_{33}	b_{34}	a_5	b_{36}	b_{37}	a_8	a_9	a_{10}

A	B	C	D	E	G	H	I	J	K
a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}
b_{21}	b_{22}	b_{23}	b_{24}	a_5	a_6	a_7	b_{28}	b_{29}	b_{210}
b_{31}	b_{32}	b_{33}	b_{34}	a_5	b_{36}	b_{37}	a_8	a_9	a_{10}

There is a row which has all the set in U, so R_1, R_2, R_3 of R is loss-less-join.

(4) left hand side of F is X={A,E,B,D,C,H,I}

step1:

$A^+ = \{A, B, C\}$

$E^+ = \{A, B, C, D, E, H, G\}$

$B^+ = \{B\}$

$D^+ = \{D\}$

$H^+ = \{G\}$
$I^+ = \{I\}$
step2:
$EI^+ = \{A, B, C, D, E, H, G, I, J\}$
step3:
$EIK^+ = \{A, B, C, D, E, H, G, I, J, K\}$

So, super key are {EIK}, {BDIK},{EIKH},{EIKA},{EIKB}

(5) p={R1={EIK}, R2={EIJ}, R3={EAD}, R4={ADH}, R5={HG}, R6={ABC}}

A	B	C	D	E	G	H	I	J	K
				a			a		a
				a			a	a	
a			a	a					
a			a			a			
					a	a			
a	a	a							
a	a	a	a	a	a	a	a	a	a

So, this BCNF relations is lossless-join, but it cannot be dependency-preserving since there is no BD→E.

Q2:

(1) undo T1, T3 and redo T2
(2) undo T1, T3.

Q3:
（1）
Data pages: P3, P4, P8, P7, P1
Queries:
Q1: read: P3, P4, P8, P7
Q2: read: P1, P8
Buffer: 3
FIFO:
Q1:

3	4	8
7	4	8

STEP:4
Q2:

7	4	8
7	1	8

STEP:1
FIFO: TOTAL STEP:1+4=5
MRU:

3	4	8
3	4	7

STEP:4
Q2

3	4	7
3	4	1
3	4	8

STEP:2
MRU: TOTAL STEP:4+2=6
So FIFO buffer replacement policy is better than MRU buffer replacement policy.
（2）
Data pages: P3, P4, P8, P7, P6
Queries:
Q1: read: P3, P4, P8, P7
Q2: read: P7, P6
Q3: read: P4, P6
Buffer: 3
FIFO:
Q1:

3	4	8
7	4	8

STEP:4
Q2:

7	4	8
7	6	3

STEP:2
Q3:

7	6	3
4	6	3

STEP:1
FIFO: TOTAL STEP:4+2+1=7
LRU:

3	4	8
7	4	8

STEP:4
Q2

7	4	8
7	6	3

STEP:2
Q3

7	6	3
7	4	6

STEP:2

LRU: TOTAL STEP:4+2+2=8
So FIFO buffer replacement policy is better than LRU buffer replacement policy.