Q1) a) $A \rightarrow B$ is not true because $a1 \rightarrow b1$, $\rightarrow b2$ ✗

b) $B \rightarrow C$ ✓

c) $C \rightarrow A$ is not true because $c1 \rightarrow a1$, $\rightarrow a2$ ✗

d) $AB \rightarrow C$ ✓

e) $AC \rightarrow B$ is not true because $a2c1 \rightarrow b1$, $\rightarrow b3$ ✗

f) $BC \rightarrow A$ is not true because $b3c1 \rightarrow a1$, $\rightarrow a3$ ✗

violated: a, b, e, f

Q2)

a)

	A	B	C
R1	α_A	α_B	β_{1C}
R2	α_A	~~β_{2B}~~ α_B	α_C

R2 row is filled with α so it is lossless.

b)

	A	B	C
R1	α_A	α_B	β_C
R2	β_A	α_B	α_C

none of the rows are filled with α it is not lossless

Q3) a) $A \rightarrow D$
$BC \rightarrow E$
$D \rightarrow AB$

$(C)^+ \rightarrow C$ ✗
$(CA)^+ \rightarrow CADBE$ ✓
$(CB)^+ \rightarrow CBE$ ✗
$(CD)^+ \rightarrow CDABE$ ✓

candidate keys {CA, CD}

b) $(A)^+ \rightarrow ADB$ ✗ does not include all attr, not BCNF form
no need to check rest

c) Either there is no super key and right hand side does not include prime attributes so it is not in 3NF form.

Q4) a)

F	G
A → B	A → B
~~AB → C~~	A → C
D → A	D → A
D → C	D → E
D → E	E → B
A → C	

FD's can be inferred

A → B
A → C
D → A
D → E

A	B
AB	B

b) No

c) No

Q5) a)

F

A → B
A → D
~~CD → B~~
C → D
B → D

F

A → B ✓
A → D ✗
C → B ✓
C → D ✗
B → D ✓

cover A → B ✓ ~~AB~~ is B reachable? no

cover A → D

A
ABD ✓ can reach D so it is redundant

cover C → B is B reachable?

no

so it is not redundant

C
CD

cover C → D is D reachable?

yes

C
C → B → D

so C → D is redundant

cover B → D is D reachable?

no

B
B

so it is not redundant

C	D
CD → B	D

so D is redundant in CD which makes

Canonical cover = A → B
C → B
B → D

b) (3)

F

A → B

C → B

B → D

P.A

$(AC)^+ = (ACBD)$ ✓

$(AC)^+$ superkey

it is not in 3 NF brm

$R_1(A, B, D)$

$R_2(C, B)$

$R_3(B, D)$

} Has to be created for 3 NF brm