Question 1

1) No.

2) Candidate keys: ABJ and AEJ.

3) Find a minimal cover F_m for F.

   One of the possible solutions:

   $F_m = \{AB \rightarrow E, D \rightarrow H, E \rightarrow B, E \rightarrow C, C \rightarrow D, C \rightarrow I, H \rightarrow \mathrm{G}\}$.

4) Decompose into a set of 3NF relations if it is not in 3NF. Make sure your decomposition is dependency-preserving and lossless-join. Justify your answers.

   According to the algorithm provided on the lecture notes, we can get one of the possible solutions based on the F_m in 3):

   R_0 = {A, B, E}, R_1 = {D, H}, R_2 = {E, B, C}, R_3 = {C, D, I}, R_4 = {H, G}, R_5 = {A, B, J}.

Question 2

1) There are 96 super-keys can be found for R. ABJ, ABCJ, ABEJ, ABDJ and ABGJ.

2) 1NF. The FD AB → CE violates the definition of 2NF.

3) No. $D \rightarrow H$ is lost.

4) No. Final state of the table:

Decomposition	A	B	C	D	E	G	H	I	J
$R_1(A, B, C, D, E)$	a	a	a	a	a	a	a	a	b
$R_2(E, G, H)$	b	a	a	a	a	a	a	a	b
$R_3(E, I, J)$	b	a	a	a	a	a	a	a	a

   No row is entirely made up by "a" value, so the decomposition is not lossless.

5) Decompose it into a collection of BCNF relations if it is not in BCNF. Make sure your decomposition is lossless-join and briefly justify your answers. (3 marks)

   According to the algorithm provided on the lecture notes, we can get one of the possible solutions:

$F_m = \{AB \rightarrow E, D \rightarrow H, E \rightarrow B, E \rightarrow C, C \rightarrow D, C \rightarrow I, H \rightarrow \mathrm{G}\}$.

R= {A, B, C, D, E, G, H, I, J}

Consider $AB \rightarrow E$, $E \rightarrow B$: R_0 = {A, E}, R_1 = {E, B}, R'= {A, B, C, D, G, H, I, J}

Consider $D \rightarrow H$: R_2 = {D, H}, R''= {A, B, C, D, G, I, J}

Consider $C \rightarrow D$: R_3 = {C, D}, R'''= {A, B, C, G, I, J}

Consider $C \rightarrow I$: R_4 = {C, I}, R''''= {A, B, C, G, J}

Consider $AB \rightarrow C$: R_5 = {A, B, C}, R'''''= {A, B, G, J}

Consider $AB \rightarrow G$: R_6 = {A, B, G},

R_7 = {A, B, J}.

One of the possible lossless-join decompositions is： R_0~R_7