Question 1

1) No.

2) Candidate keys: ABJ and AEJ.

3) Find a minimal cover F_m for F.

   One of the possible solutions:

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

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. $D \to H$ 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:

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

Consider $AB \to E$, $E \to B$: $R_0 = \{A, E\}$, $R_1 = \{E, B\}$,

Consider $D \to H$: $R_2 = \{D, H\}$,

Consider $C \to D$: $R_3 = \{C, D\}$,

Consider $C \to I$: $R_4 = \{C, I\}$,

Consider $AB \to C$: $R_5 = \{A, B, C\}$,

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

$R_7 = \{A, B, J\}$.

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