part2

1

(a)

$A^+ = ABCDEFGH$ Because A is a superkey , $A \rightarrow CF$ does not violate BCNF

$BCG^+ = BCDG$ Because BCG is NOT a superkey , $BCG \rightarrow D$ violates BCNF

$CF^+ = ABCDEFGH$ Because CF is a superkey , $CF \rightarrow AH$ does not violate BCNF

$D^+ = DB$ Because D is NOT a superkey , $D \rightarrow B$ violates BCNF

$H^+ = BDEGH$ Because H is NOT a superkey , $H \rightarrow DEG$ violates BCNF

(b)

- Decompose R using FD $BCG \rightarrow D$. $BCG^+ = BCDG$, so this yields two relations: $R1 = BCDG$ and $R2 = ABCEFGH$.
- Project the FDs onto $R1 = BCDG$. $B^+ = B, C^+ = C, G^+ = G, D^+ = DB$, so we need to decompose further because $D \rightarrow B$ violates BCNF.
- Decompose R1 using FD $D \rightarrow B$. $D^+ = DB$, so this yields two relations: $R3 = BD, R4 = CDG$
- Project the FDs onto $R3 = BD. D \rightarrow B$, so D is a superkey. This relation satisfies BCNF.
- Project the FDs onto $R4 = CDG. C^+ = C, G^+ = G, D^+ = DB, CG^+ = CG, CD^+ = CD, DG^+ = DG$, so there is no more FDs that we can use to decompose. This relation satisfies BCNF.
- Project the FDs onto $R2 = ABCEFGH$. We know that $C^+ = C, G^+ = G, D^+ = DB, CG^+ = CG, H^+ = HBDEG$, and those FDs violates BCNF. So this yields two relations: $R5 = BEGH, R6 = ACFH$
- Project the FDs onto $R5 = BEGH$. We know that $B^+ = B, E^+ = E, G^+ = G, H^+ = BDEGH$, so H is the superkey. This satisfies BCNF.
- Project the FDs onto $R6 = ACFH$. We know $A^+ = ACFH, C^+ = C, F^+ = F, H^+ = BDEG$, A is the superkey so this FD satisfies BCNF.
- Final decomposition:
  (a) $R3 = BD$ with FD $D \rightarrow B$
  (b) $R4 = CDG$ with no FDs
  (c) $R5 = BEGH$ with FD $H \rightarrow BEG$
  (d) $R6 = ACFH$ with FD $A \rightarrow CFH$

2.

(a) $S = \{AB \rightarrow EF, B \rightarrow CEF, BCD \rightarrow AF, BCDE \rightarrow A, BCE \rightarrow D, DF \rightarrow C\}$

$AB^+ = ABCDEF$

$B^+ = ABCDEF$

$BCD^+ = ABCDEF$

$BCDE^+ = ABCDEF$

$BCE^+ = ABCDEF$

$DF^+ = CDF$

So the key is B because B is the smallest superkey (b)Set

AB $\rightarrow$ E As (1)
AB $\rightarrow$ F As (2)
B $\rightarrow$ C As (3)
B $\rightarrow$ E As (4)
B $\rightarrow$ F As (5)
BCDE $\rightarrow$ A As (6)
BCD $\rightarrow$ F As (7)
BCD $\rightarrow$ A As (8)
BCE $\rightarrow$ D As (9)
DF $\rightarrow$ C As (10)

Then we can use the FDs above to compute the closure:

$AB^{+}{}_{S-(1)} = ABE$ we can get rid of (1)

$AB^{+}{}_{S-(1)-(2)} = ABF$ we can get rid of (2)

$B^{+}{}_{S-(1)-(2)-(3)} = B$

$B^{+}{}_{S-(1)-(2)-(4)} = B$

$B^{+}{}_{S-(1)-(2)-(5)} = B$

$BCDE^{+}{}_{S-(1)-(2)-(6)} = BCDEA$ we can get rid of (6)

$BCD^{+}{}_{S-(1)-(2)-(6)-(7)} = BCDF$ we can get rid of (7)

$BCD^{+}{}_{S-(1)-(2)-(6)-(7)-(8)} = BCD$

$BCE^{+}{}_{S-(1)-(2)-(6)-(7)-(9)} = BCE$

$DF^{+}{}_{S-(1)-(2)-(6)-(7)-(10)} = DF$

As a result we have:

B $\rightarrow$ C As (3)
B $\rightarrow$ E As (4)
B $\rightarrow$ F As (5)
BCD $\rightarrow$ A As (8)
BCE $\rightarrow$ D As (9)
DF $\rightarrow$ C As (10)

We can simplify this result furthermore by reducing multiple attributes on the LHS:

We can reduce the LHS to (8) because $B^+ = ABCDEF$

$B \to A$

We can reduce the LHS to (9) because $B^+ = ABCDEF$

$B \to D$

After the change:

$B \to C$
$B \to E$
$B \to F$
$B \to A$
$B \to D$
$DF \to C$

Without $B \to C$, we can also get C by other FDs. Remove $B \to C$.
In conclusion, the minimal basis is:

$B \to E$
$B \to F$
$B \to A$
$B \to D$
$DF \to C$

(c)
Recall the revised FDs:

$B \to ADEF$
$DF \to C$

The set of relations that would result would have these attributes:

$$R1(A, B, D, E, F) \qquad R2(C, D, F)$$

So the final set of relation is

$$R1(A, B, D, E, F) \qquad R2(C, D, F)$$

(D)
We cannot find a relation that violates BCNF after doing all the full projections:

$$B^+ = ABCDEF$$

B is the key of R1

$$DF^+ = CDF$$

DF is the superkey of R2.

So this schema does not allow redundancy.