note

✓ means Yes / True option

means No / False option

since github don't support latex symbol, here have a png version.

q1

(a)

- **✓** i
- ✓ ii
- □iii
- □iv
- ✓ ∨
- ✓ vi

(b)

No.

Because only one instance here.

When saying one functional dependencies that **hold** on schema r(R), it means that in every legal instance of r(R) it satisfies the functional dependency.

q2

(a)

iv

(b)

□ii

$$leve{ } ec{ } \hspace{0.1cm} ext{iii} \hspace{0.1cm} (Q
ightarrow U \Rightarrow QS
ightarrow SU
ightarrow T)$$

$$leve{ }$$
 iv $(QS o SU o R o W)$

$$ightharpoonup \lor ((PQ o S) \land (Q o U) \Rightarrow PQ o SU o R o W)$$

□ vi

Here, "∧" means logical conjunction "and".

(c)

✓.

(d)

 \Box .

q3

(a)

First, AB o A, AB o B

$$(AB o B) \wedge (B o CD) \Rightarrow AB o BCD$$

Therefore, AB o ABCD

(b)

Let $F=\{A
ightarrow B, \; B
ightarrow CD, \; E
ightarrow F\}$

i

 $AB\cap BCD=B$ and $B o BCD\ \in F^+\Rightarrow AB\ and\ BCD$ is lossless

Furthermore, $AB \cap EF$, $BCD \cap EF = \varnothing$

🗾 ii

$$F_1=\{A
ightarrow B\}$$
, $F_2=\{A
ightarrow B\}$, $F_3=\{A
ightarrow B\}$

And thus, $F'=F_1\cup F_2\cup F_3=F$,which means, of course, $F'^+=F^+$.

(c)

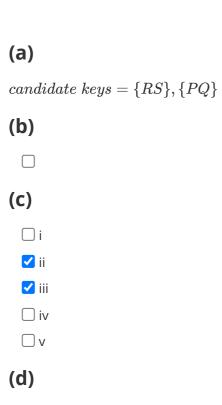
 \Box i

ii

(d)

✓ i

□ii



(e)

✓ i

✓ iii ✓ iv

✓ v

(f)

 ${\cal E}$ itself is 3NF.

(g)

R o P violates BCNF, thus we break $\, {\cal E} \,$ in two parts:

ullet $\mathcal{E}_1(RP)$, corresponding functional dependencies: $F_1=\{R o P\}$. Now, $\ \mathcal{E}_1$ is in BCNF.

ullet ${\mathcal E}_2(RQS)$, $F_2=\{S o Q\}$, F_2 violates BCNF

Break \mathcal{E}_2 into $\mathcal{E}_3(SQ)$ and $\mathcal{E}_4(SR)$

 \mathcal{E}_3 is in BCNF but \mathcal{E}_4 does not, so we continue break \mathcal{E}_4 into: $\mathcal{E}_5(S), \ \mathcal{E}_6(R)$

Finally got one decomposition: $\mathcal{E}_1(RP),~\mathcal{E}_3(SQ),~\mathcal{E}_5(S),~\mathcal{E}_6(R)$

To show this decomposition has as few tables as possible, one could see that the rest FDs which violates BCNF is $S \to Q$.

And the decomposition from $S \to Q$ leads to similar results except the difference in letters(R/S, P/Q). Thus both decomposition have the same number of tables .