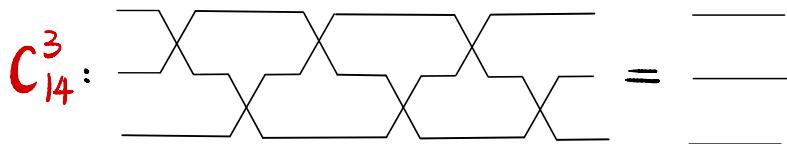
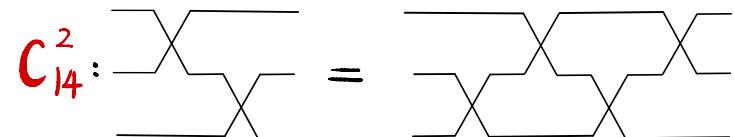
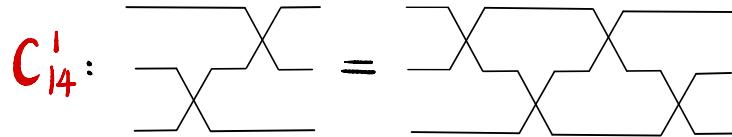
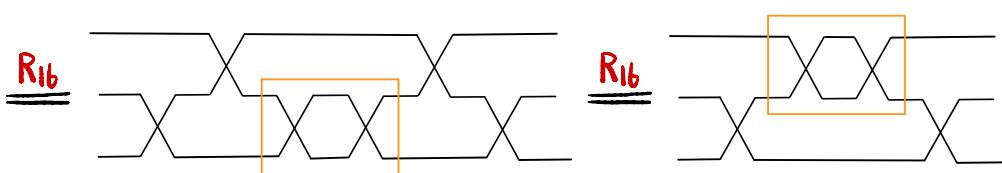
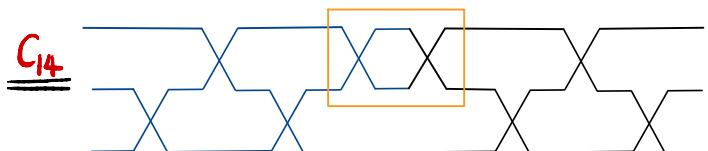
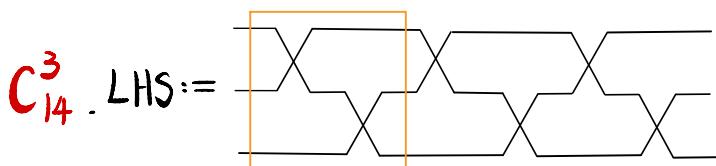
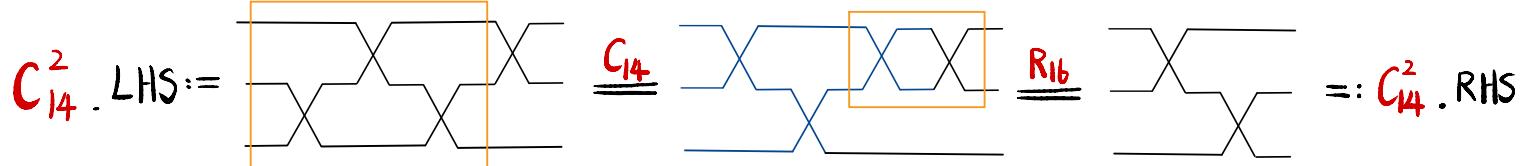
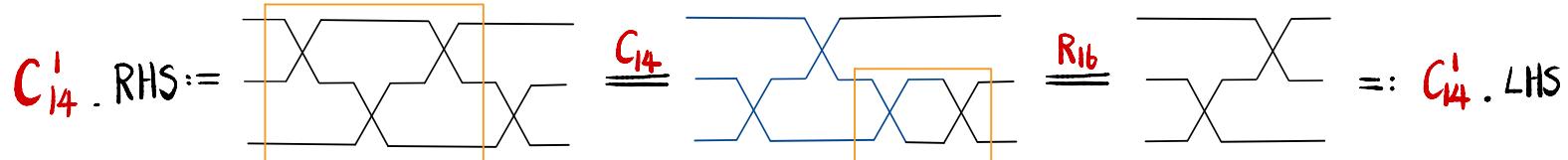


Lem A C_{14} & R_{16} imply



Proof:



$$C_{15} : \begin{array}{c} \text{Diagram of } C_{15} \\ \text{Left: } \text{Diagram of } C_{15} \\ \text{Right: } \text{Diagram of } C_{15} \end{array} = \begin{array}{c} \text{Diagram of } C_{15} \\ \text{Left: } \text{Diagram of } C_{15} \\ \text{Right: } \text{Diagram of } C_{15} \end{array}$$

Lem B R_{16} & G_5 imply

$$C_{15}^1 : \begin{array}{c} \text{Diagram of } C_{15}^1 \\ \text{Left: } \text{Diagram of } C_{15}^1 \\ \text{Right: } \text{Diagram of } C_{15}^1 \end{array} = \begin{array}{c} \text{Diagram of } C_{15}^1 \\ \text{Left: } \text{Diagram of } C_{15}^1 \\ \text{Right: } \text{Diagram of } C_{15}^1 \end{array}$$

$$\text{Proof: } C_{15}^1 \cdot LHS := \begin{array}{c} \text{Diagram of } C_{15}^1 \cdot LHS \\ \text{Left: } \text{Diagram of } C_{15}^1 \cdot LHS \\ \text{Right: } \text{Diagram of } C_{15}^1 \cdot LHS \end{array} \stackrel{\text{R}_{16}}{=} \begin{array}{c} \text{Diagram of } C_{15}^1 \cdot LHS \\ \text{Left: } \text{Diagram of } C_{15}^1 \cdot LHS \\ \text{Right: } \text{Diagram of } C_{15}^1 \cdot LHS \end{array}$$

$$\stackrel{G_5}{=} \begin{array}{c} \text{Diagram of } G_5 \\ \text{Left: } \text{Diagram of } G_5 \\ \text{Right: } \text{Diagram of } G_5 \end{array}$$

$$\stackrel{R_{16}}{=} \begin{array}{c} \text{Diagram of } R_{16} \\ \text{Left: } \text{Diagram of } R_{16} \\ \text{Right: } \text{Diagram of } R_{16} \end{array} =: C_{15}^1 \cdot LHS$$

IV

$$\text{Def 5: } \begin{array}{c} \text{Diagram A} \\ \text{Diagram B} \end{array} := \begin{array}{c} \text{Diagram C} \\ \text{Diagram D} \end{array}$$

$$C_{15}: \begin{array}{c} \text{Diagram E} \\ \text{Diagram F} \end{array} = \begin{array}{c} \text{Diagram G} \\ \text{Diagram H} \end{array}$$

$$R_{16}: \begin{array}{c} \text{Diagram I} \\ \text{Diagram J} \end{array} = \begin{array}{c} \text{Diagram K} \\ \text{Diagram L} \end{array} \quad R_{17}: \begin{array}{c} \text{Diagram M} \\ \text{Diagram N} \end{array} = \begin{array}{c} \text{Diagram O} \\ \text{Diagram P} \end{array} \quad C_{15}^1: \begin{array}{c} \text{Diagram Q} \\ \text{Diagram R} \end{array} = \begin{array}{c} \text{Diagram S} \\ \text{Diagram T} \end{array}$$

Lem C Def 5, R_{16} , R_{17} & C_5 imply

$$C_{15}^2: \begin{array}{c} \text{Diagram U} \\ \text{Diagram V} \end{array} = \begin{array}{c} \text{Diagram W} \\ \text{Diagram X} \end{array}$$

$$C_{15}^3: \begin{array}{c} \text{Diagram Y} \\ \text{Diagram Z} \end{array} = \begin{array}{c} \text{Diagram AA} \\ \text{Diagram BB} \end{array}$$

$$C_{15}^4: \begin{array}{c} \text{Diagram CC} \\ \text{Diagram DD} \end{array} = \begin{array}{c} \text{Diagram EE} \\ \text{Diagram FF} \end{array}$$

$$C_{15}^5: \begin{array}{c} \text{Diagram GG} \\ \text{Diagram HH} \end{array} = \begin{array}{c} \text{Diagram II} \\ \text{Diagram JJ} \end{array}$$

$$\text{Proof: } C_{15}^2 \cdot \text{RHS} := \begin{array}{c} \text{Diagram K} \\ \text{Diagram L} \end{array} \xrightarrow{\text{Def 5}} \begin{array}{c} \text{Diagram M} \\ \text{Diagram N} \end{array} \xrightarrow{\text{R}_{16}} \begin{array}{c} \text{Diagram O} \\ \text{Diagram P} \end{array}$$

$$\xrightarrow{\text{R}_{17}} \begin{array}{c} \text{Diagram Q} \\ \text{Diagram R} \end{array} =: C_{15}^2 \cdot \text{LHS}$$

$$C_{15}^3 \cdot \text{RHS} := \begin{array}{c} \text{Diagram S} \\ \text{Diagram T} \end{array} \xrightarrow{\text{Def 5}} \begin{array}{c} \text{Diagram U} \\ \text{Diagram V} \end{array} \xrightarrow{C_{15}^1} \begin{array}{c} \text{Diagram W} \\ \text{Diagram X} \end{array}$$

$$\xrightarrow{\text{R}_{17}} \begin{array}{c} \text{Diagram Y} \\ \text{Diagram Z} \end{array} \xrightarrow{\text{R}_{16}} \begin{array}{c} \text{Diagram AA} \\ \text{Diagram BB} \end{array} =: C_{15}^3 \cdot \text{LHS}$$

$$C_{15}^4 \cdot \text{RHS} := \begin{array}{c} \text{Diagram CC} \\ \text{Diagram DD} \end{array} \xrightarrow{\text{Def 5}} \begin{array}{c} \text{Diagram EE} \\ \text{Diagram FF} \end{array} \xrightarrow{C_{15}} \begin{array}{c} \text{Diagram GG} \\ \text{Diagram HH} \end{array}$$

$$\xrightarrow{\text{R}_{17}} \begin{array}{c} \text{Diagram II} \\ \text{Diagram JJ} \end{array} \xrightarrow{\text{R}_{16}} \begin{array}{c} \text{Diagram KK} \\ \text{Diagram LL} \end{array} =: C_{15}^4 \cdot \text{LHS}$$

$$C_{15}^5 \cdot \text{RHS} := \begin{array}{c} \text{Diagram MM} \\ \text{Diagram NN} \end{array} \xrightarrow{\text{Def 5}} \begin{array}{c} \text{Diagram OO} \\ \text{Diagram PP} \end{array} \xrightarrow{\text{R}_{16}} \begin{array}{c} \text{Diagram QQ} \\ \text{Diagram RR} \end{array} \xrightarrow{\text{R}_{17}} \begin{array}{c} \text{Diagram SS} \\ \text{Diagram TT} \end{array}$$

$$=: C_{15}^5 \cdot \text{LHS}$$

$$C_{15}: \quad \text{Diagram} = \text{Diagram} \quad C_{15}^1: \quad \text{Diagram} = \text{Diagram} \quad \text{Def 2: } \quad \text{Diagram} := \text{Diagram}$$

$$R_{19}: \quad \text{Diagram} = \text{Diagram} \quad \text{Diagram} = \text{Diagram} \quad \text{Def 4: } \quad \text{Diagram} := \text{Diagram}$$

Lem C^1 Def 2, Def 4, G_5 & R_{19} imply

$$C_{15}^6: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^7: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^8: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^9: \quad \text{Diagram} = \text{Diagram}$$

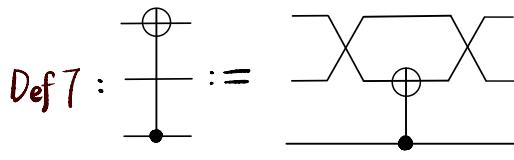
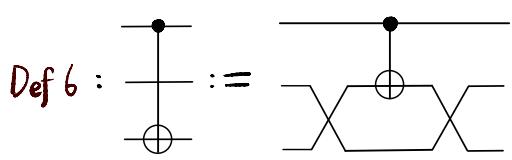
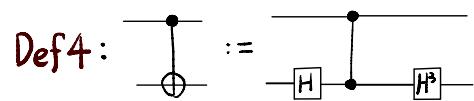
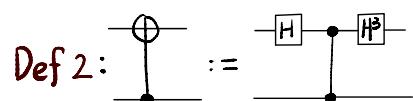
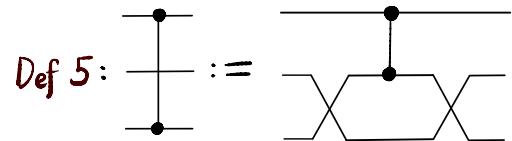
$$\text{Proof: } C_{15}^6. \text{LHS} := \text{Diagram} \quad \text{Def 4} \quad \text{Diagram} \quad R_{19} \quad \text{Diagram}$$

$$C_5 \quad \text{Diagram} \quad R_{19} \quad \text{Diagram} \quad \text{Def 4} \quad \text{Diagram} =: C_{15}^6. \text{RHS.}$$

$$C_{15}^7. \text{LHS} := \text{Diagram} \quad \text{Def 2} \quad \text{Diagram} \quad R_{19} \quad \text{Diagram}$$

$$C_5 \quad \text{Diagram} \quad R_{19} \quad \text{Diagram} \quad \text{Def 2} \quad \text{Diagram} =: C_{15}^7. \text{RHS.}$$

Reasoning analogously, we can prove C_{15}^8 & C_{15}^9 are the consequence of Def 2, Def 4, G_5 & R_{19} . □



R_{16} : =

C_{15}^2 : =

C_{15}^4 : =

R_{19} : =

R_{17} : =

Lem D Def 2, Def 4-7, G_5 , R_{16} , R_{17} & R_{19} imply

Def 6: = & Def 7: =

Proof:

R_{17} $\underline{\underline{C_5^2}}$ $\underline{\underline{R_{16}}}$ $\underline{\underline{R_{19}}}$

R_{16}

$\underline{\underline{R_{16}}}$

$\underline{\underline{Def 7}}$

$\underline{\underline{Def 2}}$

$\underline{\underline{R_{16}}}$

$\underline{\underline{R_{17}}}$ $\underline{\underline{C_5^4}}$

$\underline{\underline{R_{16}}}$

$\underline{\underline{R_{19}}}$

$\underline{\underline{R_{16}}}$

$$C_{15}^2: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^3: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^4: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^5: \quad \text{Diagram} = \text{Diagram}$$

$$\text{Def 2: } \text{Diagram} := \text{Diagram}$$

$$R_{19}: \quad \text{Diagram} = \text{Diagram}$$

$$\text{Diagram} = \text{Diagram}$$

$$\text{Def 4: } \text{Diagram} := \text{Diagram}$$

Lem E Def 2, Def 4, G5 & R19 imply

$$C_{15}^{10}: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^{11}: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^{12}: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^{13}: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^{14}: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^{15}: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^{16}: \quad \text{Diagram} = \text{Diagram}$$

$$C_{15}^{17}: \quad \text{Diagram} = \text{Diagram}$$

$$\text{Proof: } C_{15}^{10}. \text{LHS} := \text{Diagram} \quad \underline{\underline{\text{Def 4}}} \quad \text{Diagram}$$

$$\text{Diagram} \quad \underline{\underline{\text{R19}}} \quad \text{Diagram}$$

$$\underline{\underline{C_5^2}} \quad \text{Diagram} \quad \underline{\underline{\text{R19}}} \quad \text{Diagram}$$

$$\text{Diagram} \quad \underline{\underline{\text{Lem D}}} \quad \text{Diagram} =: C_{15}^{10}. \text{RHS.}$$

$$C_{15}^{11}. \text{LHS} := \text{Diagram} \quad \underline{\underline{\text{Def 2}}} \quad \text{Diagram}$$

$$\text{Diagram} \quad \underline{\underline{\text{R19}}} \quad \text{Diagram}$$

$$\underline{\underline{C_5^2}} \quad \text{Diagram} \quad \underline{\underline{\text{R19}}} \quad \text{Diagram}$$

$$\text{Diagram} \quad \underline{\underline{\text{Lem D}}} \quad \text{Diagram} =: C_{15}^{11}. \text{RHS.}$$

Reasoning analogously, we can prove $C_{15}^{12} - C_{15}^{17}$ are the consequence of Def 2, Def 4, G5 & R19.