$$\dfrac{\dfrac{\dfrac{\Gamma,\ x{:}(A{\times}B) \vdash x{:}(A{\times}B)}{\Gamma,\ x{:}(A{\times}B) \vdash (\text{fst } x){:}A} \qquad \dfrac{\Gamma,\ x{:}(A{\times}B) \vdash x{:}(A{\times}B)}{\Gamma,\ x{:}(A{\times}B) \vdash (\text{snd } x){:}B}}{\Gamma,\ x{:}(A{\times}B) \vdash \{(\text{snd } x),(\text{fst } x)\}{:}(B{\times}A)}}{\emptyset \vdash \lambda x{:}(A{\times}B).\{(\text{snd } x),(\text{fst } x)\}{:}((A{\times}B){\to}(B{\times}A))}$$

$$\dfrac{\dfrac{\Gamma,\ x{:}A,\ y{:}B \vdash x{:}A}{\Gamma,\ x{:}A \vdash \lambda y{:}B.x{:}(B{\to}A)}}{\emptyset \vdash \lambda x{:}A.\lambda y{:}B.x{:}(A{\to}(B{\to}A))}$$

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x2{:}A,\ x3{:}B \vdash x3{:}B \qquad \dfrac{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x2{:}A,\ x3{:}B \vdash x2{:}A \qquad \Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x2{:}A,\ x3{:}B \vdash x1{:}(A{\to}(B{\to}C))}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x2{:}A,\ x3{:}B \vdash (x1\ x2){:}(B{\to}C)}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x2{:}A,\ x3{:}B \vdash ((x1\ x2)\ x3){:}C}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x3{:}B \vdash \lambda x2{:}A.((x1\ x2)\ x3){:}(A{\to}C)}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)) \vdash \lambda x3{:}B.\lambda x2{:}A.((x1\ x2)\ x3){:}(B{\to}(A{\to}C))}}{\emptyset \vdash \lambda x1{:}(A{\to}(B{\to}C)).\lambda x3{:}B.\lambda x2{:}A.((x1\ x2)\ x3){:}((A{\to}(B{\to}C)){\to}(B{\to}(A{\to}C)))}$$

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(A{\times}B) \vdash x4{:}(A{\times}B)}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(A{\times}B) \vdash x4{:}(A{\times}B)}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(A{\times}B) \vdash (\text{snd } x4){:}B}\qquad \dfrac{\dfrac{\dfrac{}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(A{\times}B) \vdash x4{:}(A{\times}B)}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(A{\times}B) \vdash (\text{fst } x4){:}A}\qquad \dfrac{}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(A{\times}B) \vdash x1{:}(A{\to}(B{\to}C))}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(A{\times}B) \vdash (x1\ (\text{fst } x4)){:}(B{\to}C)}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(A{\times}B) \vdash ((x1\ (\text{fst } x4))\ (\text{snd } x4)){:}C}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)) \vdash \lambda x4{:}(A{\times}B).((x1\ (\text{fst } x4))\ (\text{snd } x4)){:}((A{\times}B){\to}C)}}{\emptyset \vdash \lambda x1{:}(A{\to}(B{\to}C)).\lambda x4{:}(A{\times}B).((x1\ (\text{fst } x4))\ (\text{snd } x4)){:}((A{\to}(B{\to}C)){\to}((A{\times}B){\to}C))}$$

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(B{\times}A) \vdash x4{:}(B{\times}A)}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(B{\times}A) \vdash x4{:}(B{\times}A)}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(B{\times}A) \vdash (\text{fst } x4){:}B}\qquad \dfrac{\dfrac{\dfrac{}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(B{\times}A) \vdash x4{:}(B{\times}A)}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(B{\times}A) \vdash (\text{snd } x4){:}A}\qquad \dfrac{}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(B{\times}A) \vdash x1{:}(A{\to}(B{\to}C))}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(B{\times}A) \vdash (x1\ (\text{snd } x4)){:}(B{\to}C)}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)),\ x4{:}(B{\times}A) \vdash ((x1\ (\text{snd } x4))\ (\text{fst } x4)){:}C}}{\Gamma,\ x1{:}(A{\to}(B{\to}C)) \vdash \lambda x4{:}(B{\times}A).((x1\ (\text{snd } x4))\ (\text{fst } x4)){:}((B{\times}A){\to}C)}}{\emptyset \vdash \lambda x1{:}(A{\to}(B{\to}C)).\lambda x4{:}(B{\times}A).((x1\ (\text{snd } x4))\ (\text{fst } x4)){:}((A{\to}(B{\to}C)){\to}((B{\times}A){\to}C))}$$

$$\dfrac{\dfrac{\dfrac{\dfrac{}{\Gamma,\ x{:}A,\ y{:}(A{\to}\bot) \vdash x{:}A}\qquad \dfrac{}{\Gamma,\ x{:}A,\ y{:}(A{\to}\bot) \vdash y{:}(A{\to}\bot)}}{\Gamma,\ x{:}A,\ y{:}(A{\to}\bot) \vdash (y\ x){:}\bot}}{\Gamma,\ x{:}A \vdash \lambda y{:}(A{\to}\bot).(y\ x){:}((A{\to}\bot){\to}\bot)}}{\emptyset \vdash \lambda x{:}A.\lambda y{:}(A{\to}\bot).(y\ x){:}(A{\to}((A{\to}\bot){\to}\bot))}$$

$$\dfrac{\dfrac{\dfrac{\dfrac{\Gamma,\ x1{:}(A{\times}(B{\times}C)) \vdash x1{:}(A{\times}(B{\times}C))}{\Gamma,\ x1{:}(A{\times}(B{\times}C)) \vdash (\text{snd } x1){:}(B{\times}C)}}{\Gamma,\ x1{:}(A{\times}(B{\times}C)) \vdash (\text{snd } (\text{snd } x1)){:}C} \quad \dfrac{\dfrac{\Gamma,\ x1{:}(A{\times}(B{\times}C)) \vdash x1{:}(A{\times}(B{\times}C))}{\Gamma,\ x1{:}(A{\times}(B{\times}C)) \vdash (\text{snd } x1){:}(B{\times}C)}}{\Gamma,\ x1{:}(A{\times}(B{\times}C)) \vdash (\text{fst } (\text{snd } x1)){:}B} \quad \dfrac{\Gamma,\ x1{:}(A{\times}(B{\times}C)) \vdash x1{:}(A{\times}(B{\times}C))}{\Gamma,\ x1{:}(A{\times}(B{\times}C)) \vdash (\text{fst } x1){:}A}}{\Gamma,\ x1{:}(A{\times}(B{\times}C)) \vdash \{(\text{fst } x1),(\text{fst } (\text{snd } x1))\}{:}(A{\times}B)}}{\Gamma,\ x1{:}(A{\times}(B{\times}C)) \vdash \{\{(\text{fst } x1),(\text{fst } (\text{snd } x1))\},(\text{snd } (\text{snd } x1))\}{:}((A{\times}B){\times}C)}}{\emptyset \vdash \lambda x1{:}(A{\times}(B{\times}C)).\{\{(\text{fst } x1),(\text{fst } (\text{snd } x1))\},(\text{snd } (\text{snd } x1))\}{:}((A{\times}(B{\times}C)){\to}((A{\times}B){\times}C))}$$