2.3

- $(x, x) \in \overset{\alpha}{=}$
- $(A, A) \in \overset{\alpha}{=}$
- $(A_1, A_2) \in \overset{\alpha}{=}$, $(A_2, A_1) \in \overset{\alpha}{=}$
- $(A_1, A_2) \in \overset{\alpha}{=}$ $(A_2, A_3) \in \overset{\alpha}{=}$, $(A_1, A_3) \in \overset{\alpha}{=}$
- $(A_1, B_1) \in \overset{\alpha}{=}$ $(A_2, B_2) \in \overset{\alpha}{=}$, $(A_1B_1, A_2B_2) \in \overset{\alpha}{=}$
- $M = \lambda_x A$, $N = \lambda_y B$. $x \notin FV(B)$ $(A, B[y \rightsquigarrow x]) \in \overset{\alpha}{=}$, $(M, N) \in \overset{\alpha}{=}$ ($\rightsquigarrow$)

2.1

(1)

.

1. $M \equiv x$. $M[x \rightsquigarrow N] \equiv N$ $M[x \hookrightarrow N] \equiv N$.
2. $M \equiv y$, $y \not\equiv x$. $M[x \rightsquigarrow N] \equiv y$ $M[x \hookrightarrow N] \equiv y$.
3. $M \equiv M_1M_2$. $M[x \rightsquigarrow N] = (M_1[x \rightsquigarrow N])(M_2[x \rightsquigarrow]N)$ $M[x \hookrightarrow N] = (M_1[x \hookrightarrow N])(M_2[x \hookrightarrow N])$. $(M_1[x \rightsquigarrow N]) \equiv (M_1[x \hookrightarrow N])$ $(M_2[x \rightsquigarrow N]) \equiv (M_2[x \hookrightarrow N])$. , . , $M[x \rightsquigarrow N] \equiv M[x \hookrightarrow N]$, , $M[x \hookrightarrow N]$.
4. $M = \lambda_x P$. $M[x \rightsquigarrow N] \equiv \lambda_x P$ $M[x \hookrightarrow N] \equiv \lambda_x P$, , $M[x \rightsquigarrow N] \equiv M[x \hookrightarrow N]$.
5. $M = \lambda_y P$ $y \not\equiv x$. , , . , , . - , $x \notin FV(P)$ $y \notin FV(N)$. , $FV(N) \cap BV(M) = \{\}$.

   BV , $y \in BV(M)$. $FV(N) \cap BV(M) = \{\}$, , $y \notin FV(N)$. , .

, $P[x \hookrightarrow N] \equiv P[x \rightsquigarrow N]$, , $[x \hookrightarrow N] \equiv [x \rightsquigarrow N]$

(2)

$M = \lambda_y \lambda_x y.$ x $y.$,
$M[x \hookrightarrow y]$ $\lambda_y \lambda_x y.$
, $BV(M) = \{x, y\}$, $FV(N) = \{y\}$ (N e y)
.

2.5

$M' \stackrel{\alpha}{=} M$, , $M'[x \rightsquigarrow N]$, $FV(N) \cap BV(M') = \{\}$. $FV(N) \cap BV(M) = \{x_1 x_2, ..., x_n\}$.
$\{z_1, z_2, ..., z_n\}$ $FV(N) \cup BV(M)$ ( ).
x_i z_i. - $M' \equiv M[x_1 \rightsquigarrow z_1][x_2 \rightsquigarrow z_2]...[x_n \rightsquigarrow z_n]$. ,
,
, $M' \stackrel{\alpha}{=} M$.

???

$c_i = \lambda_n n c_s c_0$

1. , $n \in \mathbb{N}$ e $c_i c_n \stackrel{\beta}{=} c_n$.

2. , $c_i \stackrel{\beta\eta}{=} I$?

1

$n \in \mathbb{N}$. , $c_i c_n \stackrel{\beta}{=} c_n c_s c_0 = (\lambda_f \lambda_x f^n x) c_s c_n \stackrel{\beta}{=} c_s^n c_0$.

$n = 0$, $c_i c_0 \stackrel{\beta}{==} c_0 c_s c_0 = (\lambda_f \lambda_x x) c_s c_0 \stackrel{\beta}{=} c_0$, .

$n+1$. $c_i c_{n+1} \stackrel{\beta}{=} c_{n+1} c_s c_0 = (\lambda_f \lambda_x f^{n+1} x) c_s c_0 \stackrel{\beta}{=}$ $c_s^{n+1} c_0$. n- , $c_s^{n+1} c_0 = c_s(c_s^n c_0)$. , $c_s(c_s^n c_0) \stackrel{\beta}{=} c_s(c_i c_n)$. , $c_s(c_i c_n) \stackrel{\beta}{=} c_s c_n$. c_s , $c_s c_n = c_{n+1}$. .

2

$K = \lambda_x \lambda_y x$. K c_i I. $IK \stackrel{\beta}{=} K = A_1$. $c_i K \stackrel{\beta}{=} K c_s c_0 \stackrel{\beta}{=} c_s = A_2$. c_s $c_s = \lambda_n \lambda_f \lambda_x f(nfx)$. , A_1 A_2 , a A_1 $A_1 a = K a \stackrel{\beta}{=} \lambda_y a$, , a A_2 , $A_2 a \stackrel{\beta}{=} \lambda_f \lambda_x f(afx)$. , a .