

1. **Part 1 (Lexicon)** Translate each of the following into the hyper-lambda-calculus.

	Morpheme	Type	Translation
(1)	every	$C \rightarrow \wedge D$	$\lambda P_0 \wedge \{x \mid Px\}$
(2)	some	$C \rightarrow \vee D$	$\lambda P_0 \vee \{x \mid Px\}$
(3)	no	$C \rightarrow \wedge \{S \rightarrow S \times D\}$	$\lambda P_0 \wedge \{\neg \times x \mid Px\}$
(4)	any	$C \rightarrow \exists D$	$\lambda P_0 \exists \{x \mid Px\}$
(5)	and	$(S \times S) \rightarrow S$	$\lambda PQ \{P \& Q\}$
(6)	does-not	$D_1 \rightarrow S. \rightarrow D_1 \rightarrow S$	$\lambda P_1 \lambda x_1 \sim Px$
(7)	woman	$D_0 \rightarrow S$	$\lambda x_0 \mathbf{W}x$
(8)	man	$D_0 \rightarrow S$	$\lambda x_0 \mathbf{M}x$
(9)	friend	$D_6 \rightarrow (D_0 \rightarrow S)$	$\lambda y_6 \lambda x_0 \mathbf{F}xy$
(10)	married (stative)	$D_3 \rightarrow (D_0 \rightarrow S)$	$\lambda y_3 \lambda x_0 \mathbf{M}xy$
(11)	respects	$D_2 \rightarrow (D_1 \rightarrow S)$	$\lambda y_2 \lambda x_1 \mathbf{R}xy$
(12)	likes	$D_2 \rightarrow (D_1 \rightarrow S)$	$\lambda y_2 \lambda x_1 \mathbf{L}xy$
(13)	cop-be	$C \rightarrow D_1 \rightarrow S$	$\lambda P_0 \{P_1\}$
(14)	recommends	$D_2 \rightarrow D_3 \rightarrow D_1 \rightarrow S$	$\lambda y_2 \lambda z_3 \lambda x_1 \mathbf{R}xyz$
(15)	mother(def)	$C \rightarrow D$	$\lambda x_6 \{\mathbf{m}(x)\}$
(16)	father(def)	$C \rightarrow D$	$\lambda x_6 \{\mathbf{f}(x)\}$
(17)	partner(def)	$C \rightarrow D$	$\lambda x_6 \{\mathbf{p}(x)\}$
(18)	to	$D \rightarrow D_3$	$\lambda x \{x_3\}$
(19)	of	$D \rightarrow D_6$	$\lambda x \{x_6\}$
(20)	by	$D \rightarrow D_5$	$\lambda x \{x_5\}$
(21)	's	$D \rightarrow D_6$	$\lambda x \{x_6\}$
(22)	who	$D \rightarrow S. \rightarrow C \rightarrow C$	$\lambda Q \lambda P_0 \lambda x_0 \{Px \& Qx\}$
(23)	helshelit	\emptyset	\emptyset
(24)	ed	$D_2 \rightarrow D_1 \rightarrow S. \rightarrow D_5 \rightarrow D_0 \rightarrow S$	$\lambda \{ \lambda y_2 \lambda x_1 \mathbf{R}xy \} \{ \lambda y_5 \lambda x_0 \mathbf{R}xy \}$
(25)	does	misprint	sorry!
(26)	[+ θ]	$D \rightarrow D_\theta$	$\lambda x \{x_\theta\}$
(27)	[− α]	$D \rightarrow D_{-\alpha}$	$\lambda x \{x_{-\alpha}\}$
(28)	(− α)	$D_{-\alpha} \rightarrow D$	$\lambda x_{-\alpha} \{x\}$
(29)	[mod]	$C \rightarrow C \rightarrow C$	$\lambda Q_0 \lambda P_0 \lambda x_0 \{Px \& Qx\}$

1. Every man respects some woman who does not respect him.

every	man	[+1]	[-1]	respects	[+2]	some	woman	who	[+1]	does-not	respect	(-1)	him	[+2]
$\lambda P_0 \wedge \{x \mid Px\}$	\mathbf{M}_0	$\lambda x \{x_1\}$	$\lambda x \{x_{-1}\}$					$\lambda Q \lambda P_0 \lambda x_0 \{Px \& Qx\}$	$\lambda x \{x_1\}$			$\lambda x_{-1} \{x\}$	\emptyset	$\lambda x \{x_2\}$
$\lambda P_0 \wedge \{x \mid \mathbf{M}x\}$		$\lambda x \{x_1 \times x_{-1}\}$									$\lambda y_2 \lambda x_1 \mathbf{R}xy$	$\lambda x_{-1} \{x_2\}$		
										$\lambda P_1 \lambda x_1 \sim Px$	$\lambda x_{-1} \lambda y_1 \mathbf{R}yx$			
								$\lambda Q_1 \lambda P_0 \lambda x_0 \{Px \& Qx\}$	$\lambda x_{-1} \lambda y_1 \sim \mathbf{R}yx$					
							\mathbf{W}_0	$\lambda x_{-1} \lambda P_0 \lambda y_0 \{Py \& \sim \mathbf{R}yx\}$						
						$\lambda P_0 \vee \{y \mid Py\}$	$\lambda x_{-1} \lambda y_0 \{\mathbf{W}y \& \sim \mathbf{R}yx\}$							
					$\lambda x \{x_2\}$	$\lambda x_{-1} \vee \{y \mid \mathbf{W}y \& \sim \mathbf{R}yx\}$								
				$\lambda y_2 \lambda x_1 \mathbf{R}xy$	$\lambda x_{-1} \vee \{y_2 \mid \mathbf{W}y \& \sim \mathbf{R}yx\}$									
$\lambda P_0 \wedge \{x_1 \times x_{-1} \mid \mathbf{M}x\}$		$\lambda x_{-1} \vee \{\lambda z_1 \mathbf{R}zy \mid \mathbf{W}y \& \sim \mathbf{R}yx\}$												
$\wedge \{x_1 \times \vee \{\lambda z_1 \mathbf{R}zy \mid \mathbf{W}y \& \sim \mathbf{R}yx\} \mid \mathbf{M}x\}$														
$\wedge \{\vee \{\mathbf{R}xy \mid \mathbf{W}y \& \sim \mathbf{R}yx\} \mid \mathbf{M}x\}$														
$\forall x \{\mathbf{M}x \rightarrow \exists y \{\{\mathbf{W}y \& \sim \mathbf{R}yx\} \& \mathbf{R}xy\}\}$														

2. Every friend of every man is married to some friend of his.

every	friend	of	every	man	[+1]	[-1]	is	married	to	some	friend	of	(-1)	his
			$\lambda P_0 \wedge \{ y \mid P y \}$	\mathbf{M}_0	$\lambda x \{ x_1 \}$	$\lambda x \{ x_{-1} \}$						$\lambda x \{ x_6 \}$	$\lambda x_{-1} \{ x \}$	\emptyset
		$\lambda x \{ x_6 \}$	$\wedge \{ y \mid \mathbf{M} y \}$								$\lambda y_6 \lambda x_0 \mathbf{F} x y$	$\lambda x_{-1} \{ x_6 \}$		
	$\lambda y_6 \lambda x_0 \mathbf{F} x y$		$\wedge \{ y_6 \mid \mathbf{M} y \}$							$\lambda P_0 \vee \{ z \mid P z \}$		$\lambda x_{-1} \lambda z_0 \mathbf{F} z x$		
$\lambda P_0 \wedge \{ x \mid P x \}$			$\wedge \{ \lambda x_0 \mathbf{F} x y \mid \mathbf{M} y \}$						$\lambda x \{ x_3 \}$		$\lambda x_{-1} \vee \{ z \mid \mathbf{F} z x \}$			
			$\wedge \{ \wedge \{ x \mid \mathbf{F} x y \} \mid \mathbf{M} y \}$		$\lambda x \{ x_1 \times x_{-1} \}$			$\lambda y_3 \lambda x_0 \mathbf{M} x y$			$\lambda x_{-1} \vee \{ z_3 \mid \mathbf{F} z x \}$			
							$\lambda P_0 \{ P_1 \}$				$\lambda x_{-1} \vee \{ \lambda x_0 \mathbf{M} x z \mid \mathbf{F} z x \}$			
			$\wedge \{ \wedge \{ x_1 \times x_{-1} \mid \mathbf{F} x y \} \mid \mathbf{M} y \}$								$\lambda x_{-1} \vee \{ \lambda x_1 \mathbf{M} x z \mid \mathbf{F} z x \}$			
											$\wedge \{ \wedge \{ x_1 \times \vee \{ \lambda x_1 \mathbf{M} x z \mid \mathbf{F} z x \} \mid \mathbf{F} x y \} \mid \mathbf{M} y \}$			
											$\wedge \{ \wedge \{ \vee \{ \mathbf{M} x z \mid \mathbf{F} z x \} \mid \mathbf{F} x y \} \mid \mathbf{M} y \}$			
											$\forall y \{ \mathbf{M} y \rightarrow \forall x \{ \mathbf{F} x y \rightarrow \exists z \{ \mathbf{F} z x \ \& \ \mathbf{M} x z \} \} \}$			

3. No woman likes any book recommended to her by any friend of her mother.

no woman	likes	[+2]	any	book	[mod]	recommended to her	by any friend of her mother
					(from below) $\lambda Q_0 \lambda P_0 \lambda x_0 \{ Px \& Qx \}$	(from below) $\lambda w_{-1} \lambda y_5 \lambda x_0 \mathbf{R}yxw$	(from below) $\lambda w_{-1} \Pi \{ y_5 \mid \mathbf{F}[y, \mathbf{m}(w)] \}$
						$\lambda w_{-1} \Pi \{ \lambda x_0 \mathbf{R}yxw \mid \mathbf{F}[y, \mathbf{m}(w)] \}^*$	
				\mathbf{B}_0	$\lambda w_{-1} \Pi \{ \lambda P_0 \lambda x_0 \{ Px \& \mathbf{R}yxw \} \mid \mathbf{F}[y, \mathbf{m}(w)] \}$		
			$\lambda P_0 \Pi \{ z \mid Pz \}$	$\lambda w_{-1} \Pi \{ \lambda x_0 \{ \mathbf{B}x \& \mathbf{R}yxw \} \mid \mathbf{F}[y, \mathbf{m}(w)] \}$			
		$\lambda x \{ x_2 \}$	$\lambda w_{-1} \Pi \{ \Pi \{ z \mid \mathbf{B}z \& \mathbf{R}yzw \} \mid \mathbf{F}[y, \mathbf{m}(w)] \}$				
	$\lambda z_2 \lambda x_1 \mathbf{L}xz$	$\lambda w_{-1} \Pi \{ \Pi \{ z_2 \mid \mathbf{B}z \& \mathbf{R}yzw \} \mid \mathbf{F}[y, \mathbf{m}(w)] \}$					
(from below) $\wedge \{ \neg \times x_1 \times x_{-1} \mid \mathbf{W}x \}$	$\lambda w_{-1} \Pi \{ \Pi \{ \lambda x_1 \mathbf{L}xz \mid \mathbf{B}z \& \mathbf{R}yzw \} \mid \mathbf{F}[y, \mathbf{m}(w)] \}$						
$\wedge \{ \neg \times x_1 \times \Pi \{ \Pi \{ \lambda x_1 \mathbf{L}xz \mid \mathbf{B}z \& \mathbf{R}yzx \} \mid \mathbf{F}[y, \mathbf{m}(x)] \} \mid \mathbf{W}x \}$							
$\wedge \{ \neg \times \Pi \{ \Pi \{ \mathbf{L}xz \mid \mathbf{B}z \& \mathbf{R}yzx \} \mid \mathbf{F}[y, \mathbf{m}(x)] \} \mid \mathbf{W}x \}$							
$\wedge \{ \wedge \{ \wedge \{ \sim \mathbf{L}xz \mid \mathbf{B}z \& \mathbf{R}yzx \} \mid \mathbf{F}[y, \mathbf{m}(x)] \} \mid \mathbf{W}x \}$							
$\forall x \{ \mathbf{W}x \rightarrow \forall y \{ \mathbf{F}[y, \mathbf{m}(x)] \rightarrow \forall z \{ \{ \mathbf{B}z \& \mathbf{R}yzx \} \rightarrow \sim \mathbf{L}xz \} \}$							

* This computation appeals to the type-logical principle according to which any anaphorically-marked D-phrase can be duplicated $[\delta_{-1} \vdash \delta_{-1} \times \delta_{-1}]$.

4. no woman

no	woman	[+1]	[-1]
$\lambda P_0 \wedge \{\neg \times x Px\}$	W ₀	$\lambda x \{x_1\}$	$\lambda x \{x_{-1}\}$
$\wedge \{ \neg \times x \mathbf{W}x \}$		$\lambda x \{x_1 \times x_{-1}\}$	
$\wedge \{ \neg \times x_1 \times x_{-1} \mathbf{W}x \}$			

5. recommended to her

recommend	ed	to	(-1)	her
$\lambda y_2 \lambda z_3 \lambda x_1 \mathbf{R}xyz$	**	$\lambda x \{x_3\}$	$\lambda x_{-1} \{x\}$	\emptyset
$\lambda x_3 \lambda z_5 \lambda y_0 \mathbf{R}zyx$		$\lambda w_{-1} \{w_3\}$		
$\lambda w_{-1} \lambda z_5 \lambda y_0 \mathbf{R}zyw$				

6. by any friend of her mother

by	any	friend	of	(-1)	her	[+6]	mother	
$\lambda x \{x_5\}$	$\lambda P_0 \Pi \{y Py\}$	$\lambda x_6 \lambda y_0 \mathbf{F}yx$	$\lambda x \{x_6\}$	$\lambda x_{-1} \{x\}$	\emptyset	$\lambda x \{x_6\}$	$\lambda x_6 \{m(x)\}$	
				$\lambda x_{-1} \{x_6\}$		$\lambda x_{-1} \{m(x)\}$		
				$\lambda x_{-1} \{m(x)\}$				
				$\lambda x_{-1} \{m(x)_6\}$				
				$\lambda x_{-1} \lambda y_0 \mathbf{F}[y, m(x)]$				
$\lambda x_{-1} \Pi \{ y \mathbf{F}[y, m(x)] \}$								
$\lambda x_{-1} \Pi \{ y_5 \mathbf{F}[y, m(x)] \}$								