$\underline{\ \ }$ = Free

4.1

	Formulae	Sentence
I) $\forall x (P^1_1 x \to Q^1 \underline{y})$	✓	✗
II) $\exists x \neg(\neg\neg \exists y P^1_y \wedge \neg\neg\neg\neg\neg R^2 xa)$	✓	✓
III) P^0	✓	✓
IV) $\forall x \exists y \exists z (R^3_{25} xyz)$	✓	✓
V) $\forall x \exists x Q^2_{xx}$	According to FLM it is a sentence & a formulae. According to the rule in the slides it is not.	
VI) $\neg(\neg(\exists x P^1_x \wedge \exists y Q^1_y))$	✗	✗
VII) $\forall x(\exists y(P^2_{xy} \wedge P^1_x) \vee Q^3 x \underline{y} x)$	✓	✗

4.2

I) $(\forall x \forall y (P^2_{yxy} \to (P^2_{yyx} \wedge R^2_x)))$

II) $(\forall x R^3 x x \underline{z} \wedge \exists y R^3 \underline{x}\,\underline{z}\,\underline{x})$

III) $(\neg \forall z_2 R^2 \underline{x}\,\underline{z})$

IV) $(\forall x \neg\neg((P^2 x \underline{y} \vee R^2 yx) \vee R^2 \underline{z}\,\underline{y}))$

(4.3)

I) a: London

~~B~~ P^1: ...$_1$ is Big

R^1: ...$_1$ is ugly

$P^1a \wedge R^1a$

II)

c: Culham

P^1: ... is a large village

P^1c

III)

P^1: ...$_1$ is a city

Q^1: ...$_1$ is a city hall

R^2: ...$_1$ has ...$_2$

$\forall x(P^1x \rightarrow \exists y(Q^1y \wedge R^2xy))$

IV)

P^1: ...$_1$ is a material object

Q^1: ...$_1$ is divisible

$\forall x(P^1x \rightarrow Q^1x)$

V) a: tom

P^1: ...$_1$ is a car

Q^2: ...$_1$ owns ...$_2$

$\exists x(P^1x \wedge Q^2ax)$

VI) a: tom

P^1: $\dots_1$ is a car

Q^2: $\dots_1$ owns $\dots_2$

R^2: $\dots_1$ won't sell $\dots_2$

$$\exists x (P^1 x \land Q^2 ax \land R^2 ax)$$

VII) P^1: $\dots_1$ is a man

Q^1: $\dots_1$ is a country

R^2: $\dots_1$ has visited $\dots_2$

$$\exists x (P^1 x \land \forall y (Q^1 y \to R^2 xy))$$

4.4

I) tom acts freely.

II) Either tom acts freely, or it is not the case that tom is a person.

III) Every person acts freely.

IV) Someone is a person if and only if they act freely.

V) It is not the case that there exists someone who acts freely.

4.5

I) It is not the case that there exists a set.

II) It is not the case that every set has at least one element.

III) There exists a set with no elements.

IV) There does ~~exist~~ not exist a set that contains everything.

7.2

I) P^1: ..., is a Book author

Q^1: ..., is Famous

$$\neg \forall x (P^1 x \to Q^1 x)$$

II)

P^1: ..., is a Book

Q^1: ..., is Famous

$$\exists x (P^1 x \wedge Q^1 x)$$

III)

P^1: ..., is a Book

Q^1: ..., is Famous

R^1: ..., is well written

$$\forall x (P^1 x \to (Q^1 x \leftrightarrow R^1 x))$$

III) a: tom

P^1: $_1$ is a Book author

Q^1: $_1$ is famous

R^2: $_1$ does not believe that $\ldots_2$ exists

~~$\forall x(P^1_x \rightarrow$~~

~~$\exists x(P^1 x \wedge Q^1 x$~~

a: tom

P^1: believes that not every Book author is Famous.

$\neg P^1 a$

a: tom

b: the believe that not every Book author is Famous

P^2: $_1$ Believes $\ldots_2$

$P^2 ab$

(you could make the case that b refers to just a single thing, multiple people can have the same belief)

7.3

I)
b: Ben
P^2: ...₁ despises ...₂
Q^1: ...₁ is a logician

$\forall x(Q^1 x \rightarrow P^2 bx)$ | $\exists x(Q^1 x \wedge P^2 bx)$

II)
a: Harry
b: Ron
P^2: ...₁ is a parent of ...₂
Q^2: ...₁ slanders ...₂

$Q^2 ab \wedge \forall x(P^2 xa \rightarrow Q^2 ax)$

or: $Q^2 ab \wedge \forall x(P^2 xb \rightarrow Q^2 ax)$

III)
P^1: ...₁ is a student
Q^1: ...₁ is a tutor
R^2: ...₁ is better than ...₂

$\forall x(P^1 x \rightarrow \forall y(Q^1 y \rightarrow R^2 xy))$

or: $\forall x(P^1 x \rightarrow \exists y(Q^1 y \wedge R^2 xy))$

or: $\exists x(P^1 x \wedge \forall y(Q^1 y \rightarrow R^2 xy))$

or: $\exists x(P^1 x \wedge \exists y(Q^1 y \wedge R^2 xy))$

IV)

~~Only rich Germans~~ ~~Be~~

~~Be~~ P^1: ...$_1$ is rich

Q^1: ...$_1$ is German

R^1: ...$_1$ is a ~~h~~ house

P_1^1: ...$_1$ is in Munich

~~Q_1: ...$_1$ is~~ P^2: ...$_1$ Buys ...$_2$

~~One house vs. multiple houses~~

$$\forall x\,((R^1x \wedge P_1^1x) \rightarrow \exists y\,(P^1y \wedge Q^1y \wedge P^2yx))$$

Only rich Germans Buy houses in Munich

IF a house is in munich, then there exists a rich German who ~~Be~~ Buys it.

However, it might also ~~mean~~ Be possible that the houses get Bought By nobody. so:

IF a house is in Munich, then ~~it~~ there does not exist ~~a~~ ~~rich~~ ~~German~~ someone who is not rich ~~and~~ German who Buys the house:

$$\forall x\,((R^1x \wedge P_1^1x) \rightarrow \neg\exists y\,(\neg(P^1y \wedge Q^1y) \wedge P^2yx))$$

V)

a: James

P^1: ...$_1$ is a fast car

Q^2: ...$_1$ likes ...$_2$

$\forall x (P^1 x \rightarrow Q^2 a x)$

or: $\exists x (P^1 x \land Q^2 a x)$

VI)

P^1: ...$_1$ is a mistake

Q^1: ...$_1$ is a thing that is capable of making mistakes

*

R^2: ...$_1$ made ...$_2$

$\exists x (P^1 x \land \forall y (Q^1 y \rightarrow R^2 y x))$

or: $\forall x (Q^1 x \rightarrow \exists y (P^1 y \land R^2 x y))$