

p. 225 #C

compare to different sentence

$$\neg \forall x (T(x))$$

①  $\forall x (\neg T(x))$

② m: Marzipan ← add to symb. key

$$S(m)$$

③  $\exists x (\neg S(x))$  ← compare to different sentence

④ c: chocolate ← add to symb key

$\forall y (B(c, y))$  ← could argue against this answer

⑤  $\forall x (\neg B(x, x))$

⑥  $\forall x (\text{if } x \text{ sugar-free chocolate} \rightarrow \text{Boris has never tried it})$

"if chocolate has no sugar, then Boris has not tried it"

~~a-c~~  
a-f ~ named  
s-z - variables

$$\neg S(c) \rightarrow \neg T(c)$$

C(c) ⑦ "Boris has tried m and Boris has tried c and for any candy x (if [x has marzipan and chocolate in it] then Boris has not tried x)"

$$(T(m) \wedge T(c)) \wedge \forall x ((M(x) \wedge C(x)) \rightarrow \neg T(x))$$

8)  $\forall x (C(x) \rightarrow \text{then } x \text{ is better than any candy w/o chocolate})$

$\forall x (C(x) \rightarrow \forall y (\neg C(y) \rightarrow B(x,y)))$   
 $\uparrow$   $\uparrow$   $\uparrow$   
x has choc. in it    if y does not have chocolate in it    x is better than y

OR

$\forall x \forall y (C(x) \rightarrow (\neg C(y) \rightarrow B(x,y)))$

9)  $\forall x ((C(x) \wedge M(x)) \rightarrow \forall y ((F(y) \wedge \neg M(y)) \rightarrow B(x,y)))$

Sometimes we write certain predicates in a weird order.

$\langle (5, 10) \sim$  could be a predicate  
meaning  
"5 < 10"

because it's weird to write as " $\langle (5, 10)$ ", we abuse notation & write

instead.  $5 < 10$

p.228

"Pavel owes money to everyone else"

$$\forall x (\neg(x=p) \rightarrow \theta(p, x))$$

p.230

#6)  ~~$\forall x (\neg(x=p) \rightarrow \neg\theta(x, h))$~~

← this is actually fine — contrapositive (probably equivalent to)

"if x owes money to Hikaru, then x is Pavel"

$$\forall x (\theta(x, h) \rightarrow x=p)$$

P. 230

"There exists at least two apples."

WILL NOT work:

$$(\exists x A(x)) \wedge (\exists y A(y))$$

could refer to the same apple!



MUST BE

$$\exists x \exists y ((A(x) \wedge A(y)) \wedge \neg(x=y))$$

forces the two variables x and y to not refer to same object in domain