

Logic—Sample Test D3 with Answers

NAME _____

Translate the following sentences into the language of quantifier logic using the given abbreviations. Remember that you do not need to worry about tense.

$Ax = x$ is alabaster.

$Sx = x$ is smooth.

$Mx = x$ is malachite.

$Tx = x$ is a temple.

$Dx = x$ is damaged.

$Cx = x$ is cared for.

$s =$ the statue

$f =$ the floor

1. “The alabaster floor will be damaged if it is not cared for.”

$Af \ \& \ \sim Cf \supset Df$

2. “No temples are made of malachite.”

$\sim \exists x(Tx \ \& \ Mx)$

3. “The only temple that is damaged is the alabaster one.”

$\exists x(Tx \ \& \ Dx \ \& \ Ax) \ \& \ \sim \exists x(Tx \ \& \ Dx \ \& \ \sim Ax)$

4. “Unless the statue is a malachite statue, it isn’t cared for.”

$\sim Ms \supset \sim Cs$

5. “The floor is undamaged, but everything else is damaged.”

$\sim Df \ \& \ \forall x(x \neq f \supset Dx)$

6. “The statue is made of neither alabaster nor malachite.”

$\sim (As \vee Ms)$

7. “Every alabaster thing is cared for, except possibly the statue, which is damaged.”

$\forall x((Ax \ \& \ x \neq s) \supset Cx) \ \& \ Ds$

Logic—Sample Test D3 with Answers

$Px = x$ is a person.

$Cx = x$ is a coat.

$Bxy = x$ belongs to y . (y owns x , y possesses x , y has x , etc.)

$Wxy = x$ is wearing y .

$Sxyz = x$ sold y to z .

$Fx = x$ is made of fur.

$s =$ Shawn

$l =$ Laurie

8. “Shawn sold his only coat to Laurie.”

$\exists x(Cx \ \& \ Bxs \ \& \ Ssxl \ \& \ \forall y((Cy \ \& \ x \neq y) \supset \sim Bys))$

9. “No one sold anything to Shawn.”

$\sim \exists xy(Px \ \& \ Sxys)$

10. “All Shawn’s coats are fur coats.”

$\forall x((Bxs \ \& \ Cx) \supset Fx)$

11. “Laurie has a fur coat.”

$\exists x(Cx \ \& \ Fx \ \& \ Bxl)$

12. “Someone is wearing one of Laurie’s coats.”

$\exists xy(Px \ \& \ Cy \ \& \ Byl \ \& \ Wxy)$

13. “Anyone wearing fur possesses a coat.”

$\forall x((Px \ \& \ \exists y(Fy \ \& \ Wxy)) \supset \exists z(Cz \ \& \ Bzx))$

14. “Any coat that is fur belongs to either Shawn or Laurie.”

$\forall x((Cx \ \& \ Fx) \supset (Bxs \ \vee \ Bxl))$

15. “Laurie only wears non-fur coats.”

$\forall x((Cx \ \& \ Wlx) \supset \sim Fx)$

16. “No one besides Laurie is wearing a fur coat.”

$\sim \exists xy(Px \ \& \ x \neq l \ \& \ Fy \ \& \ Cy \ \& \ Wxy)$

17. “Everyone is wearing what he or she owns.”

$\forall xy((Px \ \& \ Wxy) \supset Byx)$

Logic—Sample Test D3 with Answers

18. The relation L , where Lxy means “ x is at least as large as y .”

Reflexive? (**Reflexive** / Irreflexive / Neither)

Symmetric? (Symmetric / Anti-symmetric / **Neither**)

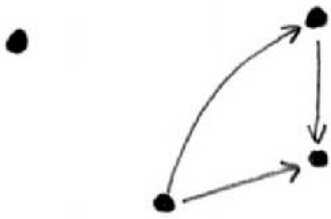
Transitive? (**Transitive** / Not-transitive)

19. The relation R , where R is defined over the universe pictured below.

Reflexive? (Reflexive / **Irreflexive** / Neither)

Symmetric? (Symmetric / **Anti-symmetric** / Neither)

Transitive? (**Transitive** / Not-transitive)

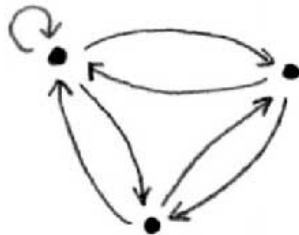


20. The relation Q , where Q is defined over the universe pictured below.

Reflexive? (Reflexive / Irreflexive / **Neither**)

Symmetric? (**Symmetric** / Anti-symmetric / Neither)

Transitive? (Transitive / **Not-transitive**)



Logic—Sample Test D3 with Answers

Use the truth tree method to determine whether the following two statements are equivalent to each other. Number all lines. Label all derived lines with the rule and the line from which they were derived. Cross out discharged sentences.

$$\{ \forall x \forall y ((Bx \& By) \supset x=y), \sim \exists x \exists y (Bx \& By \& x \neq y) \}$$

1. $\forall x \forall y ((Bx \& By) \supset x=y)$
 2. $\sim \sim \exists x \exists y (Bx \& By \& x \neq y)$
 3. $\exists x \exists y (Bx \& By \& x \neq y)$ 2, $\sim\sim$
 4. $Ba \& Bc \& a \neq c$ 3, \exists
 5. Ba 4, $\&$
 6. Bc 4, $\&$
 7. $a \neq c$ 4, $\&$
 8. $(Ba \& Bc) \supset a=c$ 1, \forall

/ \

9. $\sim(Ba \& Bc)$ $a=c$ 8, \supset
 / \ x

10. $\sim Ba$ $\sim Bc$ 9, \supset
 x x

Valid

1. $\sim \exists x \exists y (Bx \& By \& x \neq y)$
 2. $\sim \forall x \forall y ((Bx \& By) \supset x=y)$
 3. $\exists x \exists y \sim ((Bx \& By) \supset x=y)$ 2, QE
 4. $\forall x \forall y \sim (Bx \& By \& x \neq y)$ 1, QE
 5. $\sim ((Ba \& Bc) \supset a=c)$ 3, \exists
 6. $\sim (Ba \& Bc \& a \neq c)$ 4, \forall
 7. $Ba \& Bc$ 5, $\sim\supset$
 8. $a \neq c$ 5, $\sim\supset$

/ \

9. $\sim(Ba \& Bc)$ $\sim(a \neq c)$ 6, $\sim\&$
 x x

Valid

Equivalent

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Use the truth tree method to determine whether the set of sentences is consistent. Number all lines. Label all derived lines with the rule and the line from which they were derived.

21. $\{ \exists x(Px \ \& \ a=x), \ \forall xy((Py \ \& \ x=a) \supset Qxy), \ \forall x \sim Qxx \}$

1. $\exists x(Px \ \& \ a=x)$
 - ✓ 2. $\forall xy((Py \ \& \ x=a) \supset Qxy)$
 - ✓ 3. $\forall x \sim Qxx$
 4. $Pb \ \& \ a=b$ 1, \exists
 5. $(Pb \ \& \ b=a) \supset Qbb$ 2, \forall
 6. $\sim(Pb \ \& \ b=a)$ Qbb 5, \supset
 7. $\sim Qbb$ 3, \forall
- x
- Inconsistent

22. $\{ \forall x(f(x) \neq x), \ \forall x G_{f(x)x}, \ \exists y \sim Gyy \}$

- ✓ 1. $\forall x G_{f(x)x}$
 - ✓ 2. $\forall x (f(x) \neq x)$
 3. $\exists y \sim Gyy$
 4. $\sim Gaa$ 3, \exists
 5. $G_{f(a)a}$ 1, \forall
 6. $f(a) \neq a$ 2, \forall
- Consistent