

Logic—Sample Final Examination E1

NAME \_\_\_\_\_

Evaluate whether the following arguments are valid. Write a V or an I next to each argument. (1 point each)

1. Only African elephants are not gray.  
No elephant is both Indian and African.  
All elephants are either Indian or African.  
Thus, Indian elephants are gray.

2. If the tree is a mulberry tree, then the bird in the tree is a warbler.  
The bird in the tree isn't red.  
If the bird in the tree is a warbler, it's red.  
Thus, the tree isn't a mulberry tree.

3. Every crustacean has a shell.  
Thus, some crustaceans have shells.

4. Unless it's asleep, the bull moose will charge you.  
Thus, either the bull moose will charge you or it's asleep.

5. X is above Y.  
Y is not above itself.  
Z is below Y.  
Thus, X is above Z.

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Translate the following sentences into the language of quantifier logic using the given abbreviations. Remember that you do not need to worry about tense. (These problems are worth 1 point each.)

$Bx = x$  is a boy

$Gx = x$  is a girl

$Dxy = x$  is dancing with  $y$

$k =$  Keith

$j =$  Julie

6. “No boy is going to dance with Julie.”
7. “Every boy except possibly Keith is going to dance with Julie.”
8. “Unless Julie dances with a girl, Keith will not dance with any boys.”
9. “Every boy and girl who is dancing is dancing with someone of the opposite sex.”
10. “Keith is dancing with some girl other than Julie.”
11. “Every girl is dancing with a boy except perhaps for Julie.”

$F =$  Flyboy is visible.

$X =$  Dr. X-ray is visible.

$M =$  Merqueen is visible.

$S =$  Dr. X-ray can see Flyboy.

$A =$  Merqueen can stay alive out of water.

$T =$  Merqueen can team up with Dr. X-ray.

$P =$  Flyboy can team up with Dr. X-ray.

12. “Flyboy is invisible, but Dr. X-ray can see him.”
13. “Unless Merqueen can stay alive out of water, she can’t team up with Dr. X-ray.”
14. “At least two of the following are visible: Dr. X-ray, Flyboy, or Merqueen.”
15. “Merqueen can team up with Dr. X-ray if Dr. X-ray is visible.”
16. “Flyboy and Merqueen both can’t team up with Dr. X-ray.”

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$Px = x$  is a person

$Hx = x$  is a hero

$Gx = x$  is green

$Cxy = x$  can see  $y$

$Sxy = x$  succumbs to the will of  $y$

$s =$  Princess Shadow

$h =$  The Incredible Hulk

$m =$  Modok

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

17. “The Incredible Hulk can be seen, and he’s green.”
18. “Princess Shadow is invisible.”
19. “If Princess Shadow can see Modok, she will succumb to his will.”
20. “Princess Shadow isn’t the only hero who succumbs to Modok’s will.”
21. “Every hero can see some other hero.”
22. “No more than two heroes are green.”
23. “At least two heroes succumb to Modok’s will.”
24. “Every hero succumbs to the will of something.”
25. “The only heroes who possibly avoid succumbing to the will of Modok, are those that are green.”

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Label each of the following sequences of symbols with a check mark if and only if it is a legitimate statement of logic. Mark the expression with an 'X' if and only if it is not a legitimate statement. (1 point each)

- 26.  $\sim(\sim F \vee (\sim\sim E \supset \sim R)) \& \sim J$
- 27.  $\sim\sim\sim(T \& \sim\sim E) \vee E$
- 28.  $\forall x\sim\forall y(Q \supset (Kxy \vee Kyx))$
- 29.  $\exists xy(Rx \& Fxy)$
- 30.  $\forall x(U \& \sim\forall ySyy)$
- 31.  $\forall xy(Lxc = y \& Py)$
- 32.  $\exists z\forall y(Wzy \supset \sim(z = y)) \& Pa) \vee K$

Construct truth tables to test whether these arguments are valid or invalid. *In the case of an invalid argument, indicate the row or rows that show that the argument is invalid by circling at least one of them.* (These problems are worth 3 points each.)

- 33.  $\sim W \& L$   
 $\sim W \supset E$  \_\_\_\_\_  
 $L \& E$


Valid or invalid? \_\_\_\_\_  
 If it is invalid, circle any one row that proves that it is invalid.

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$$\begin{array}{l}
 34. \quad E \vee \sim D \\
 \quad \quad \underline{D \vee J} \\
 \quad \quad E \vee J
 \end{array}$$


Valid or invalid? \_\_\_\_\_  
 If it is invalid, circle any one row that proves that it is invalid.

Use the truth table method to determine whether the set of sentences is consistent. (4 points each)

$$35. \{ \text{“Pedro is not going”}, \text{“Laurie is going,”} \text{“Pedro is going if and only if Laurie is going,”} \}$$


Consistent or Inconsistent? \_\_\_\_\_  
 If it is consistent, circle any one row that proves that it is consistent.

$$36. \{ \text{“Rachel and Jennifer are camping,”} \text{“Rachel is camping unless Jennifer is,”} \}$$


Consistent or Inconsistent? \_\_\_\_\_  
 If it is consistent, circle any one row that proves that it is consistent.

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For each of the following sentences indicate whether it is a tautology, a contradiction, or a contingent sentence. Show some kind of formal proof.

37. “Unless Audrey lives in a cave, she doesn’t live in a cave.” (3 points)

38. “If Indiana is where she lives, she doesn’t live in Indiana.” (3 points)

39. “Everest is taller than everything in existence.” (4 points)

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40. Are the following sentences logically equivalent to each other? Show some kind of formal proof. (5 points)

“It’s not only people who are nice who help Jason.”

“Someone who isn’t nice is helping Jason.”

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. Answers should look just as in the book (except that you should cross out each complex sentence after you use it.)

41. {  $A \vee B$ ,  $\sim(P \supset A)$ ,  $\sim(P \& B)$  } (3 points)

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42. {  $\exists xPx \ \& \ \exists z\sim Pz, \ \forall xz((Px \ \& \ \sim Pz) \supset Lxz), \ \forall yLyy$  } (4 points)

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43. {  $\exists x((Px \ \& \ \sim(x = b)) \ \& \ \sim Fbx)$ ,  $\forall x\forall z(((Px \ \& \ Pz) \ \& \ \sim(x = z)) \supset Fxz)$ ,  $\forall y\sim Fyy$  } (4 points)

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Use the truth tree method to determine whether the argument is valid. Number all lines. Label all derived lines with the rule and the line from which they were derived. Answers should look just as in the book (except that you should cross out each complex sentence after you use it.)

44. (3 points)

$$\begin{array}{l} K \supset L \\ L \supset M \\ \hline \sim M \supset \sim K \end{array}$$

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45.  $\exists x(Px \ \& \ Bx)$   
 $\forall y(Py \supset y = b)$   
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 $Ba$

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46. What is the definition of an equivalence relation? (1 point)

47. The relation  $S$ , where  $Mxy$  means  $x$  is a mother to  $y$ .

Reflexive? ( Reflexive / Irreflexive / Neither )

Symmetric? ( Symmetric / Anti-symmetric / Neither )

Transitive? ( Transitive / Intransitive / Neither )

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

Reflexive? ( Reflexive / Irreflexive / Neither )

Symmetric? ( Symmetric / Anti-symmetric / Neither )

Transitive? ( Transitive / Intransitive / Neither )

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

Reflexive? ( Reflexive / Irreflexive / Neither )

Symmetric? ( Symmetric / Anti-symmetric / Neither )

Transitive? ( Transitive / Intransitive / Neither )

50. Why do we translate arguments like “All cats meow. Frisky is a cat. Thus, Frisky meows.” with quantifier logic, which is harder, instead of with propositional logic, which is easier? (2 points)

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51. Why could we not create a symbol in sentential logic to represent the English connective ‘because’? (2 points)

52. For each of the following sentences in the left hand column of the table below, indicate whether it is consistent with the statement  $P = \text{“Not everyone is perfect.”}$  Also indicate whether the sentence is entailed by  $P$ . (1 point each)

	Consistent with $P$ ? (Y/N)	Entailed by $P$ ? (Y/N)
“No one is perfect.”		
“Someone is perfect.”		
“No one is imperfect.”		
“Not everyone is imperfect.”		
“Someone is imperfect.”		