

Directions: Remove the last page (answersheet) from this exam and place your name and any answers you wish graded on this sheet. You may write on the exam itself, but only answers you place on the answersheet will be graded.

Your exam (exam1/exam1oA) consists of 52 questions, for a total of 100 points. Read each question carefully (note: answers may break onto the next page). For each question, choose one and only one (the best) answer (unless the question states otherwise).

1 Chapter 1

1.1 Definitions and Concepts

- (2 points) From the logician's perspective, what is an argument?
 - An argument is a series of sentences in which a certain sentence comes after another set of sentences.
 - An argument is a disagreement between two people.
 - An argument is a series of propositions in which a certain proposition (the conclusion) is represented as "following from" another set of propositions (the premises or assumptions).
 - An argument is a series of sentences (some of which express propositions) in which a certain sentence comes after another set of sentences.
- (2 points) In the context of logic, what is a proposition?
 - A proposition is a sentence of any kind.
 - A proposition is an argument.
 - A proposition is something (typically expressed by a sentence) that is capable of being true or false.
 - A proposition is an implied threat, e.g., "your money or your life."
 - A proposition is a sentence (or something that is expressed by a sentence) that is known to be true or known to be false.
- (2 points) Which of the following *are* propositions? (indicate all that apply). You should read each sentence literally.
 - The person sitting nearest to me is cheating.
 - Logic is not required for my major.
 - What is an exam?
 - Stop taking this test.
- (2 points) Which of the following is the best definition of "deductive validity"?
 - it is impossible for the premises of the argument to be true and the conclusion false.
 - it is possible for the premises of the argument to be true and the conclusion false.
 - it is impossible for the premises of the argument to be true and the conclusion true.
 - if the premises are known to be true, then the conclusion is also known to be true.
- (2 points) Which of the following best describes the *intuition test* for deductive validity.
 - Examine the argument, if you get a feeling that the argument is valid, then the argument is valid.
 - Consider each possible interpretation of the propositional letters in the argument, then use the valuation rules to determine the truth value of each proposition. Finally, check to see if under any of the interpretations, the valuation rules show the premises true and the conclusion is false.
 - Try to imagine a scenario where the premises are true and the conclusion is false. If you can imagine such a scenario, then the argument is not deductively valid. If you cannot imagine such a scenario, then the argument is deductively valid.



- D. It is an algorithm that mechanically checks each and every premise for truth, then checks the conclusion for falsity.
6. (2 points) Which of the following best describes the *imagination test* for deductive validity.
- A. Try to imagine a scenario where the premises are true and the conclusion is false. If you can imagine such a scenario, then the argument is not deductively valid. If you cannot imagine such a scenario, then the argument is deductively valid.
- B. Try to imagine a scenario where the premises are true and the conclusion is false. If you can imagine such a scenario, then the argument is deductively valid. If you cannot imagine such a scenario, then the argument is not deductively valid.
- C. You simply imagine a scenario where the argument seems right and makes sense according to everyday reasoning. If the argument “feels” right, then it is valid. If the argument “feels” wrong, then it is not valid.
- D. You imagine a scenario where the argument seems right and makes sense according to everyday reasoning and facts given to us from science, tradition, and common sense. If the argument “feels” right, then it is valid. If the argument “feels” wrong, then it is not valid.
7. (2 points) From the logician’s point of view, an argument is said to be “objectively good” if and only if it has which three traits (indicate all three):
- A. all true premises
- B. the conclusion of the argument follows from the premises
- C. the premises are relevantly related to the conclusion
- D. the conclusion positively impacts human welfare
- E. people, in general, take the argument to be persuasive

2 Chapter 2

2.1 PL: Symbols

8. (2 points) Which of the following *are* symbols of PL (indicate all that apply, using only those symbols specified in our textbook / handouts)?
- | | | | |
|---------------|----------------|--------------------|-------------|
| A. \pm | D. \uparrow | G. \subset | J. Δ |
| B. \ddagger | E. \boxtimes | H. $\not\subseteq$ | K. \neg |
| C. $\&$ | F. $\exists!$ | I. \cong | L. \vee |

2.2 Syntax

2.2.1 Wffs

Directions: Determine which of the following are well-formed formulas (wffs) in *PL*. If a formula is a wff, write “wff” on the line provided. If it is not a wff, then write “not a wff”. In determining whether a formula is a wff, you may use the *relaxed* definition of a wff, viz., the one that is determined by the formation rules for **PL** and the conventions used for simplifying formulas.

- | | |
|--|---|
| 9. (2 points) $\neg Q \ddagger B$ | 13. (2 points) $\neg\neg F$ |
| 10. (2 points) $\neg S \neg \wedge M$ | 14. (2 points) $\neg(B \rightarrow \neg Q)$ |
| 11. (2 points) $Q \rightarrow S \vee (B \wedge W)$ | 15. (2 points) $\neg A \wedge \neg B$ |
| 12. (2 points) $A \wedge B$ | 16. (2 points) $\neg\neg\neg F$ |



17. (2 points) $\neg(S \vee \neg Q)$

2.2.2 Parts, subformulas, scope, main operator

18. (2 points) List all of the proper parts of $\neg A \wedge B$

19. (2 points) List all of the subformulas of $P \rightarrow \neg Q$.

20. (2 points) Which of the following is the best definition for the main operator of a wff in **PL**?

- A. The main operator of a **PL** wff is propositional letter with the greatest scope.
- B. The main operator of a **PL** wff is always either the negation \neg or the wedge \wedge
- C. The main operator of a **PL** wff ϕ is the truth-functional operator whose scope is ϕ (the entire wff).
- D. The main operator of a **PL** wff is the operator that has the least or smallest scope.

Directions: Write the main operator of the following wffs on the line provided. Be specific!

21. (2 points) $A \vee B$

22. (2 points) $\neg((P \rightarrow Q) \vee R)$

23. (2 points) $(A \wedge Q) \vee (K \rightarrow L)$

24. (2 points) $P \vee \neg(Q \rightarrow R)$

25. (2 points) $\neg(Z \leftrightarrow \neg B) \vee C$

2.2.3 Types of Wffs

Directions: Write whether the following wff is complex, atomic, and / or a literal wff. For example, “complex” or “atomic and literal”.

26. (2 points) $A \vee \neg B$

27. (2 points) $\neg P$

Directions: Write the name of the following complex wffs on the line provided (e.g. conjunction, disjunction, conditional, biconditional, or negation)

28. (2 points) $\neg P \rightarrow Q$

29. (2 points) $\neg A \rightarrow \neg B$

30. (2 points) $A \vee \neg B$

2.3 Semantics

31. (2 points) In simple terms, what is an interpretation in **PL**?

- A. It takes combinations of symbols and says if they are true or false.
- B. It tells you if a complex formula is true or false.
- C. It takes letters $A - Z$ and says if they are true or false.

Directions: Determine the truth value for each of the following formulas given the following interpretation: $\mathcal{I}(A) = T$, $\mathcal{I}(B) = T$, $\mathcal{I}(C) = F$



32. (2 points) $B \wedge A$

35. (2 points) $C \vee A$

33. (2 points) $\neg C$

36. (2 points) $B \rightarrow C$

34. (2 points) $A \wedge A$

37. (2 points) $A \leftrightarrow C$

2.4 Translations

Directions: Translate the following English propositions into well-formed formulas (wffs) in the language of propositional logic (PL) capturing as much of the logical structure of the sentences as possible. Use the following translation key.

I = The world is indeterministic, H = Humans have free will, F = Our actions are fated. P = My life has a purpose.

38. (2 points) The world is not indeterministic.

39. (2 points) The world is indeterministic or our actions are fated

40. (2 points) It is neither the case that our actions are fated nor humans have free will.

41. (2 points) It is not both the case that humans have free will and our actions are fated.

42. (2 points) The world is indeterministic only if humans have free will.

43. (2 points) My life has purpose even if our actions are fated.

Directions: Translate the following well-formed formulas (wffs) from the language of propositional logic (PL) into English. Use the following translation key:

S = Shinji is lonely, G = Gendo is stern, M = Misato is conflicted

44. (2 points) S

48. (2 points) $S \rightarrow G$

45. (2 points) $G \wedge M$

49. (2 points) $G \rightarrow S$

46. (2 points) $S \vee G$

47. (2 points) $G \rightarrow S$

50. (2 points) $\neg(M \wedge S)$

Directions: The following questions are bonus questions. Write your answers on the back of the answersheet.

51. (2 points (bonus)) Suppose someone has been robber and *exactly one* of the following sentences is true. Identify the true sentence:

- A. Tek is the robber or Liz is the robber.
- B. Tek is the robber.
- C. Liz is the robber.
- D. Renna is the robber.

52. (1 point (bonus)) Suppose there are 13 red socks and 13 blue socks in a drawer. You begin pulling socks randomly from the drawer. What is the minimum number of socks you need to pull in order to ensure you have a pair of matching socks (a pair of matching socks is two socks of the same color.)

Congratulations! You have completed the exam. 😊

- Turn in your exam and answer sheet. 📄
- If your homework is graded, collect it from me. 🔄
- Feel free to leave. Class is complete. 🚶



1. _____
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17. _____
18. _____
19. _____
20. _____



Solutions for exam1/exam1oA

1. C
2. C
3. A, (B)
4. A
5. A
6. A
7. A, (B), (C)
8. K, (L)
9. not a wff, contains a non-PL symbol
10. not a wff, middle negation makes it a non-wff
11. not a wff, missing parentheses
12. wff
13. wff
14. wff
15. wff
16. wff
17. wff
18. $A, \neg A, B$
19. $P, Q, \neg Q, P \rightarrow \neg Q$
20. C
21. \vee
22. \neg
23. \vee
24. \vee
25. \vee
26. complex
27. complex and literal
28. conditional
29. conditional
30. disjunction
31. C
32. T
33. T
34. T
35. T
36. F
37. F
38. $\neg I$
39. $I \vee F$
40. $\neg F \wedge \neg H$ or $\neg(F \vee H)$
41. $\neg(H \wedge F)$ or $\neg H \vee \neg F$
42. $I \rightarrow H$
43. P or $P \wedge (I \vee \neg I)$
44. Shinji is lonely.
45. Gendo is stern and Misato is conflicted.
46. Shinji is lonely or Gendo is stern.
47. If Gendo is stern, then Sinji is lonely.
48. If Sinji is lonely, then Gendo is stern.
49. If Gendo is stern, then Sinji is lonely.
50. It is not both the case that Misato is conflicted and Shinji is lonely.
51. D
52. 3

