

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/exam1mA) consists of 50 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

1. (2 points) From the logician's perspective, what is an argument?
 - A. An argument is a series of sentences in which a certain sentence comes after another set of sentences.
 - B. An argument is a disagreement between two people.
 - C. 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).
 - D. An argument is a series of sentences (some of which express propositions) in which a certain sentence comes after another set of sentences.
2. (2 points) In the context of logic, what is a proposition?
 - A. A proposition is a sentence of any kind.
 - B. A proposition is an argument.
 - C. A proposition is something (typically expressed by a sentence) that is capable of being true or false.
 - D. A proposition is an implied threat, e.g., "your money or your life."
 - E. A proposition is a sentence (or something that is expressed by a sentence) that is known to be true or known to be false.
3. (2 points) Which of the following *are* propositions? (indicate all that apply). You should read each sentence literally.
 - A. Logic is a course taught at various universities.
 - B. Logic is useful for evaluating arguments.
 - C. What is logic?
 - D. Stop taking this test.
4. (2 points) When does a conclusion "follow from" the premises of an argument?
 - A. When all of the propositions in the argument are true.
 - B. When all of the sentences in the argument are relevantly related to each other.
 - C. When it is impossible for its premises to be true and its conclusion false.
 - D. When it is possible for the premises to be true and the conclusion.
5. (2 points) Which of the following best describes the *intuition test* for deductive validity.
 - A. 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.
 - 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 not deductively valid. If you cannot imagine such a scenario, then the argument is deductively valid.
 - C. Examine the argument, if you get a feeling that the argument is valid, then the argument is 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 deductively valid. If you cannot imagine such a scenario, then the argument is not deductively valid.
 - B. 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.
 - C. 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. You imagine a scenario where the argument seems right and makes sense according to everyday reasoning and facts given to us from science. If the argument “feels” right, then it is valid. If the argument “feels” wrong, then it is not valid.
7. (2 points) Suppose that it is impossible for an argument’s conclusion to be false. Is this argument valid or invalid?
- A. it will depend upon the truth of the premises; if the premises are false, then the argument is invalid; if the premises are true, then the argument is valid.
 - B. invalid
 - C. valid

2 Chapter 2

2.1 PL: Symbols

8. (2 points) Which of the following are **not** symbols in **PL** (indicate all that apply, using only those symbols specified in our textbook / handouts)?
- A. $\leftarrow$
 - B. $\downarrow$
 - C. $\neg$
 - D. $\vee$
 - E. $\rightarrow$
 - F. B

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, 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) $B \neg B$
10. (2 points) $R \neg \wedge M$



11. (2 points) $Q \leftrightarrow S \vee (B \wedge C)$
12. (2 points) $A \neg B$
13. (2 points) $\neg \neg F$
14. (2 points) $\neg(B \rightarrow \neg Q)$

2.2.2 Parts, subformulas, scope, main operator

15. (2 points) List all of the proper parts of $\neg P$.
16. (2 points) List all of the subformulas of $\neg(P \vee Q)$.
17. (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!

18. (2 points) $\neg Q$
19. (2 points) $(P \vee S) \wedge R$
20. (2 points) $\neg S \rightarrow (A \vee B)$
21. (2 points) $\neg(P \rightarrow S) \vee R$
22. (2 points) $\neg((Z \leftrightarrow Y) \wedge M)$
23. (2 points) $P \rightarrow \neg(\neg Q \vee \neg R)$
24. (2 points) $\neg \neg(L \rightarrow Q)$

Directions: Write the literal negation of the following wffs.

25. (2 points) $P \wedge Q$
26. (2 points) $\neg Z \vee \neg B$

2.2.3 Types of 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, 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.

27. (2 points) $\neg F \wedge \neg Q$
28. (2 points) $F \rightarrow \neg Q$
29. (2 points) $A \vee \neg B$
30. (2 points) $\neg P \leftrightarrow Q$



2.3 Semantics

31. (2 points) What is an interpretation in **PL**?
- A. An interpretation of **PL** is a function that takes wffs as input and assigns them a single truth value (T or F) as output.
 - B. An interpretation of **PL** specifies the meaning of a wff by telling us what ideas or images or associations it evokes in human agents.
 - C. An interpretation of **PL** is a function that takes propositional letters as input and assigns them a single truth value (T or F) as output.
 - D. An interpretation of **PL** specifies the meaning of a wff by telling us what objects in the world that the wff refers.
 - E. An interpretation of **PL** specifies the meaning of a wff by assigning a wff a truth value T for true, F for false, or I for indeterminate.
32. (2 points) What is the main difference between an interpretation in **PL** and a valuation in **PL**?
- A. An interpretation of **PL** gives meaning to parentheses while a valuation does not.
 - B. An interpretation of **PL** allows for determining the main operator of a wff while a valuation does not.
 - C. An interpretation of **PL** assigns truth values to propositional letters while a valuation assigns truth values to wffs.
 - D. An interpretation of **PL** assigns truth values to wffs while a valuation assigns truth values to propositional letters.
 - E. An interpretation of **PL** assigns truth values to conjunctions while a valuation assigns truth values to negated wffs and conditionals.

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

33. (2 points) $\neg A$
34. (2 points) $C \wedge A$
35. (2 points) $A \rightarrow C$
36. (2 points) $\neg B$
37. (2 points) $C \vee A$
38. (2 points) $B \rightarrow A$
39. (2 points) $B \leftrightarrow C$

2.4 Translations

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

40. (2 points) $\neg G$
41. (2 points) $S \wedge M$
42. (2 points) $S \vee M$
43. (2 points) $S \rightarrow G$
44. (2 points) $S \leftrightarrow G$



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.

- 45. (2 points) Our actions are not fated.
- 46. (2 points) Humans have free will or our actions are fated.
- 47. (2 points) It is neither the case that humans have free will nor our actions are fated.
- 48. (2 points) It is not both the case that humans have free will and our actions are fated.
- 49. (2 points) Humans have free will only if the world is not indeterministic.
- 50. (2 points) Humans have free will even if the world is indeterministic.

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. 🚶



Directions: Please write your **name** on the top of this page. Answer all of the questions on the answer sheet provided. If an answer will not fit on the blank provided, place your answer on one of the several blank pages.

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|-----------|-----------|
| 1. _____ | 26. _____ |
| 2. _____ | 27. _____ |
| 3. _____ | 28. _____ |
| 4. _____ | 29. _____ |
| 5. _____ | 30. _____ |
| 6. _____ | 31. _____ |
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| 8. _____ | 33. _____ |
| 9. _____ | 34. _____ |
| 10. _____ | 35. _____ |
| 11. _____ | 36. _____ |
| 12. _____ | 37. _____ |
| 13. _____ | 38. _____ |
| 14. _____ | 39. _____ |
| 15. _____ | 40. _____ |
| 16. _____ | 41. _____ |
| 17. _____ | 42. _____ |
| 18. _____ | 43. _____ |
| 19. _____ | 44. _____ |
| 20. _____ | 45. _____ |
| 21. _____ | 46. _____ |
| 22. _____ | 47. _____ |
| 23. _____ | 48. _____ |
| 24. _____ | 49. _____ |
| 25. _____ | 50. _____ |



Solutions for exam1/exam1mA

1. C
2. C
3. A, (B)
4. C
5. C
6. C
7. C
8. A, (B)
9. not a wff
10. not a wff
11. not a wff, missing parentheses
12. not a wff
13. wff
14. wff
15. P
16. $P, Q, P \vee Q, \neg(P \vee Q)$
17. C
18. $\neg$
19. $\wedge$
20. $\rightarrow$
21. $\vee$
22. $\neg$
23. $\rightarrow$
24. Leftmost $\neg$
25. $\neg(P \wedge Q)$, not $\neg P \wedge Q$
26. $\neg(\neg Z \vee \neg B)$, not $\neg\neg Z \vee \neg B$
27. conjunction
28. conditional
29. disjunction
30. biconditional
31. C
32. C
33. F
34. F
35. F
36. T
37. T
38. T
39. T
40. Gendo is not stern.
41. Shinji is lonely and Misato is conflicted.
42. Sinji is lonely or Misato is conflicted.
43. If Sinji is lonely, then Gendo is stern.
44. Sinji is lonely if and only if Gendo is stern.
45. $\neg F$
46. $H \vee F$
47. $\neg H \wedge \neg F$ or $\neg(H \vee F)$
48. $\neg(H \wedge F)$ or $\neg H \vee \neg F$
49. $H \rightarrow \neg I$
50. H or $H \wedge (I \vee \neg I)$

