

Directions: The following exam consists of 50 questions, for a total of 100 points and 0 bonus point. Read each question carefully (note: answers may break onto the next page). This exam tests your knowledge over the material from Chapter 1 and Chapter 2 of *Symbolic Logic: Syntax, Semantics, and Proof* and any additional handouts or discussion generated from this text. While you may write on the test itself, please place your name and final answers on the “answer sheet” found on the last page of this exam. You may use the back of the “answer sheet” as scrap paper.

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) In the context of logic, what is a proposition?
 - A. A proposition is a sentence that is capable of being morally right or wrong.
 - B. A proposition is a sentence of any kind.
 - C. A proposition is something (typically expressed by a sentence) that is capable of being true or false.
 - D. A proposition is a sentence (or something that is expressed by a sentence) that is known to be true or known to be false.
 - E. A proposition is an invitation to do something, e.g. a particular proposal to do x on the condition that someone does y .
2. (2 points) 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 series of propositions in which a certain proposition (the conclusion) is represented as “following from” another set of propositions (the premises or assumptions).
 - C. An argument is a series of sentences in which a certain sentence comes before another set of sentences.
 - D. An argument is a series of sentences (some of which express propositions) in which a certain sentence comes after another set of sentences.
3. (2 points) Which of the following are **not** propositions? (indicate all that apply). You should read each sentence literally.
 - A. Close the door, right now.
 - B. How many questions are on this exam?
 - C. The door to this classroom is brown.
 - D. Joe Biden is the current president of the USA.
 - E. It will rain tomorrow.
4. (2 points) Which of the following is the best explanation of when an argument is “deductively valid”
 - A. when it is impossible for the premises of the argument to be true and the conclusion false.
 - B. when it is possible for the premises of the argument to be true and the conclusion false.
 - C. when the the premises are, in fact, true and the conclusion is, in fact, true.
 - D. when the conclusion is false.
 - E. when we know the truth of the premises and know the truth of the conclusion.

5. (2 points) Which of the following best describes the **intuition test** for deductive validity.
- A. Examine the argument, if you get a feeling that the argument is valid, then the argument is valid.
 - B. 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.
 - 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.
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. 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.
 - 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.
 - E. 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.
7. (2 points) Which of the following definitions best captures what it means for an argument to be “sound”?
- A. an argument is sound if and only if it is a valid argument.
 - B. an argument is sound if and only if it has all true premises.
 - C. an argument is sound if and only if it has all true premises, is a valid argument, and is practically beneficial to human beings.
 - D. an argument is sound if and only if it has all true premises, is a valid argument, and where the conclusion does not express anything that might be viewed as controversial.
 - E. an argument is sound if and only if it has all true premises and is a valid argument.
8. (2 points) Suppose it is logically impossible for an argument’s premises to be true. That is, the argument is such that the premises are always false. Is this argument valid or invalid?
- A. invalid
 - B. valid
 - C. it will depend upon the truth of the conclusion; if the conclusion is false, then the argument is invalid; if the conclusion is true, then the argument is valid.
 - D. it will depend upon the truth of the conclusion; if the conclusion is true, then the argument is invalid; if the conclusion is false, then the argument is valid.
9. (2 points) Suppose it is impossible for an argument’s conclusion to be false. Is this argument valid or invalid?
- A. invalid

- B. valid
- C. 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.
- D. it will depend upon the truth of the premise; if the premises are true, then the argument is invalid; if the premises are false, then the argument is valid.

2 Chapter 2

2.1 PL: Symbols

10. (2 points) Which of the following are **not** symbols in **PL** (indicate all that apply)?
- A. \exists
 - B. \vee
 - C. Q
 - D. \uparrow
 - E. \leftrightarrow
 - F. \wedge
 - G. P

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.

- 11. (2 points) $S \neg W$
- 12. (2 points) $\neg M \rightarrow \neg W$
- 13. (2 points) $\neg \neg (M \wedge \neg W)$
- 14. (2 points) $(\neg P \rightarrow Q) \wedge S$
- 15. (2 points) $\neg (P \rightarrow M) \neg \vee \neg B$
- 16. (2 points) $(A \rightarrow S) \vee (B \wedge C)$

2.2.2 Parts, subformulas, scope, main operator

- 17. (2 points) Consider the following wff: $P \rightarrow \neg Q$. List all of the **proper parts** of this wff on the line provided.
- 18. (2 points) Consider the following wff: $P \wedge Q$. List all of the **subformulas** of this wff on the line provided.
- 19. (2 points) True or false. If $P \wedge Q$ is a wff, then $P \wedge Q$ is a proper part of that wff.
- 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 the furthest left and right set of parentheses.
- C. The main operator of a **PL** wff is always either the negation \neg or the wedge \wedge
- D. The main operator of a **PL** wff ϕ is the truth-functional operator whose scope is ϕ (the entire wff).
- E. 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. Some of the wffs may be written using the conventions for simplifying wffs.

- 21. (2 points) $(P \wedge S)$
- 22. (2 points) $\neg(X \rightarrow Y)$
- 23. (2 points) $(\neg(M) \wedge \neg(Z))$
- 24. (2 points) $\neg S \wedge (A \vee B)$
- 25. (2 points) $P \leftrightarrow \neg(\neg Q \vee \neg R)$

2.2.3 Literal Negation

Directions: Write the literal negation of the following wffs.

- 26. (2 points) Q
- 27. (2 points) $\neg P \leftrightarrow S$

2.2.4 Types of Wffs

- 28. (2 points) Which of the following is the best definition of an atomic wff in PL
 - A. An atomic wff in PL is a well-formed formula in PL consisting only of a single propositional letter, e.g. P, R, S, D .
 - B. An atomic wff in PL is a well-formed formula in PL consisting only of a single propositional letter, e.g. P, R, S, D , and a truth-functional operator.
 - C. An atomic wff in PL is a well-formed formula in PL consisting only of a single propositional letter, e.g. P, R, S, D , a truth-functional operator, and a set of parentheses.
 - D. An atomic wff in PL is a well-formed formula in PL consisting only of a multiple propositional letters, e.g. P, R, S, D , a truth-functional operator, and a set of parentheses.
 - E. An atomic wff in PL is any combination of symbols from PL .

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

- 29. (2 points) $P \wedge \neg Q$
- 30. (2 points) $\neg P \vee Q$
- 31. (2 points) $P \leftrightarrow \neg Q$

2.3 Semantics

32. (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** specifies the meaning of a wff by telling us what objects in the world that the wff refers.
 - D. 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.
 - E. 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.
33. (2 points) What is the main difference between an interpretation in **PL** and a valuation in **PL**?
- A. An interpretation of **PL** assigns truth values to propositional letters while a valuation assigns truth values to wffs.
 - B. An interpretation of **PL** gives meaning to parentheses while a valuation does not.
 - C. An interpretation of **PL** allows for determining the main operator of a wff while a valuation does not.
 - 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: $\mathcal{I}(Q) = T$, $\mathcal{I}(M) = T$, $\mathcal{I}(P) = F$

34. (2 points) Q
35. (2 points) $Q \wedge P$
36. (2 points) $M \wedge P$
37. (2 points) $M \vee P$
38. (2 points) $M \rightarrow P$
39. (2 points) $M \leftrightarrow P$

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:
T = Tek is tall, A = Tek is angry, H = Hikaru is tall, O = Olga is happy, R = Rei is happy, K = Tek is happy.

40. (2 points) $\neg T$
41. (2 points) $T \rightarrow H$
42. (2 points) $H \rightarrow T$

43. (2 points) $(T \wedge H) \wedge O$

44. (2 points) $T \leftrightarrow H$

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 translation key provided above.

45. (2 points) Tek is tall and Olga is happy.

46. (2 points) If Tek is tall, then Rei is happy.

47. (2 points) Tek is neither happy nor angry.

48. (2 points) Tek is not both happy and angry.

49. (2 points) Hikaru is tall only if Tek is tall.

50. (2 points) Tek is tall even if Tek is angry.

Congratulations! You did it!

- turn in your exam and answer sheet at the front of the classroom,
- check to see if your homework has been graded,
- feel free to leave.

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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