> **Directions:** The following exam consists of 50 questions, for a total of 50 points. 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 final answers on the "answer sheet" provided (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. (1 point) What is logic? (indicate the best answer)
    A. Logic is the art that aims at translating various sentences in English into a formal language.
    B. Logic is the art that aims at translating various sentences in English into a formal language, and aims to determine which formulas are well-formed.
    C. Logic is the science that provides a list of symbols, gives rules for determining whether the combination of these symbols is a well-formed formula, and then translates English sentences into these well-formed formulas.
    D. Logic is the science that provides a list of symbols, gives rules for determining whether the combination of these symbols is a well-formed formula, and then translates these well-formed formulas into English.
    E. Logic is a science that aims to identify principles for good and bad reasoning. In essence, it aims to develop criteria (rules or methods) for the identification of good and bad arguments.

2. (1 point) 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 sentences in which a certain sentence comes before another set of sentences.
    C. An argument is a series of sentences (some of which express propositions) in which a certain sentence comes after another set of sentences.
    D. 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).

3. (1 point) 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 a sentence (or something that is expressed by a sentence) that is known to be true or known to be false.
    D. A proposition is an invitation to do something, e.g. a particular proposal to do x on the condition that someone does y.
    E. A proposition is a sentence (or something that is expressed by a sentence) that is capable of being true or false.

4. (1 point) Which of the following are **not** propositions? (indicate all that apply)

A. John is five feet tall.

B. If John is in Toronto, then he is in Canada.

C. John is happy and Mary is not happy.

D. Who is at the door?

E. Is Mary a painter?

5. (1 point) Which of the following is **not** one of the stated problems of the imagination test for validity.

   A. Human beings are subject to potential biases when they evaluate arguments, e.g. they might contend that they cannot imagine a scenario when they really can.

   B. The imagination of a human being is limited and so human beings will struggle to accurately make use of the imagination test when given arguments with many premises or when the premises express complex (difficult to imagine scenarios).

   C. Human beings suffer from systematic cognitive difficulties that influence their capacity to reason (e.g. the Wason card-selection test).

   D. Human beings lack the capacity to directly see (know) the reality of things. For example, I might see a patch of red clothing but what I am really seeing are electromagnetic waves.

6. (1 point) On what condition is it the case that an argument in English is deductively valid?

   A. on the condition that it is possible for the premises of the argument to be true and the conclusion false.

   B. on the condition that the premises are, in fact, true and the conclusion is, in fact, true.

   C. on the condition that the premises and the conclusion are not both false.

   D. on the condition that we don't know the premises to be false and the conclusion to be true.

   E. on the condition that it is impossible for the premises of the argument to be true and the conclusion false.

7. (1 point) 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.

8. (1 point) 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.

9. (1 point) Suppose it is logically impossible for an argument's premises to be true. Is this argument valid or invalid?

A. invalid

B. valid

10. (1 point) Suppose it is impossible for an argument's conclusion to be false. Is this argument valid or invalid?

A. invalid

B. valid

11. (1 point) Which of the following (if any) is true of a sound argument (circle the best answer)?

A. the argument is valid and there is one false premise.

B. the argument is valid and there are two false premises.

C. the argument is invalid and all of the premises are true.

D. the argument is invalid and most (but not all) of the premises are true.

E. none of the above.

2 Chapter 2

2.1 PL: Symbols

12. (1 point) Which of the following are **not** symbols in **PL** (indicate all that apply)?

A. $\rightarrow$

B. $\leftrightarrow$

C. $\wedge$

D. $\vee$

E. P

F. (

G. ?

H. $\uparrow$

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.

13. (1 point) $M \rightarrow Q$

13. _____

14. (1 point) $\neg M \vee W$

14. _____

15. (1 point) $\neg(M \wedge \neg W)$

15. _____

16. (1 point) $(P \rightarrow Q) \rightarrow S$

16. _____

17. (1 point) $\neg\neg(R\neg \wedge M) \vee M$

17. _____

18. (1 point) $A \vee B \wedge C$

18. _____

2.2.2 Literal Negation

Directions: Write the literal negation of the following wffs.

19. (1 point) P

19. _____

20. (1 point) $\neg(P)$

20. _____

21. (1 point) $P \leftrightarrow S$

21. _____

22. (1 point) $\neg M \vee W$

22. _____

23. (1 point) $\neg(M \wedge \neg W)$

23. _____

2.2.3 Types of Wffs

24. (1 point) 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, and a truth-functional operator.

    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, a truth-functional operator, and a set of parentheses.

    C. 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.

D. An atomic wff in PL is any combination of symbols from PL.

E. 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.

25. (1 point) What type of complex wff is the following: $P \land Q$ (circle the best answer)?

    A. a conjunction

    B. a conditional

    C. a disjunction

    D. a biconditional

    E. a negated wff

26. (1 point) What type of complex wff is the following: $P \lor Q$?

    A. a disjunction

    B. a biconditional

    C. a conditional

    D. a conjunction

    E. a negated wff

27. (1 point) What type of complex wff is the following: $P \leftrightarrow Q$?

    A. a biconditional

    B. a conditional

    C. a conjunction

    D. a disjunction

    E. a negated wff

2.2.4 Subformulas, Main Operator

28. (1 point) 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 the truth-functional operator with the greatest scope.

    B. The main operator of a **PL** wff is propositional letter with the greatest scope.

    C. The main operator of a **PL** wff is the furthest left and right set of parentheses.

    D. The main operator of a **PL** wff is always either the negation $\neg$ or the wedge $\land$

    E. The main operator of a **PL** wff is the operator that has the least or smallest scope.

> **Directions:** Determine the main operator of the following wffs. Some of the wffs may be written using the conventions for simplifying wffs.

29. (1 point) $(P \rightarrow \neg(s))$

    29. _____

30. (1 point) $(\neg(X) \rightarrow Y)$

    30. _____

31. (1 point) $(\neg(M) \lor \neg(Q))$

    31. _____

32. (1 point) $\neg((A \vee B))$

32. _____

33. (1 point) $P \rightarrow \neg(\neg Q \vee \neg R)$

33. _____

2.3   Semantics

34. (1 point) What is an interpretation in **PL**?
    A. An interpretation of **PL** is a function that takes wffs as input and assigns them 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.

35. (1 point) What is one 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 wffs while a valuation assigns truth values to propositional letters.
    D. An interpretation of **PL** assigns truth values to conjunctions while a valuation assigns truth values to negated wffs and conditionals.
    E. An interpretation of **PL** assigns truth values to propositional letters while a valuation assigns truth values to wffs.

Directions: Determine the truth value for each of the following formulas.

36. (1 point) If $\mathscr{I}(M) = T$ what is truth value is given by the following valuation function: $v(M)$?

36. _____

37. (1 point) If $\mathscr{I}(M) = T$ and $\mathscr{I}(P) = F$, what is the truth value of $(M \rightarrow P)$?

37. _____

38. (1 point) If $\mathscr{I}(P) = F$, what is the truth value of $(M \wedge P)$?

38. _____

39. (1 point) If $\mathscr{I}(M) = T$, what is the truth value of $(M \vee P)$?

39. _____

40. (1 point) If $\mathscr{I}(M) = F$ and $\mathscr{I}(P) = F$, what is the truth value of $(M \leftrightarrow P)$?

40. _____

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:
J = John is criminal, B = John broke out of prison, M = Mary is a police officer, S = Mary suspects John for the crime.

41. (1 point) $\neg B$

42. (1 point) $B \rightarrow J$

43. (1 point) $B \leftrightarrow \neg J$

44. (1 point) $B \wedge \neg M$

45. (1 point) $\neg(M \wedge S)$

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.

46. (1 point) John is a criminal and John broke out of prison.

    46. _____

47. (1 point) Either John is a criminal or John is not a criminal.

    47. _____

48. (1 point) John neither broke out of prison nor is John a criminal.

    48. _____

49. (1 point) Mary suspects John for the crime only if Mary is a police officer.

    49. _____

50. (1 point) John is a criminal even if John broke out of prison.

    50. _____

Congratulations!

- turn in your answer sheet at the front of the classroom,
- check to see if your homework has been graded,
- feel free to leave. Class is complete.
- answers to the exam will be posted to CANVAS once all exams have been turned in.

1. _____

2. _____

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