

Name _____ Period _____ Logic and Computation

Logic Midterm Study Guide

Directions: For each of the following definitions by genus and difference, box the defined term, circle the genus, and underline the difference.

1. A heliostat is a device that rotates a mirror to reflect the light of the sun on a stationary target.
2. The technique of combining a pair of separate images and displaying them as a three-dimensional scene is called stereoscopy.
3. Some struggling businesses file for "Chapter 11", a section of the United States Bankruptcy code that requires a reorganization of the business to keep it alive and repay its creditors over time.
4. According to Arizona's legal code, Class 1 Misdemeanor Theft, or "petty theft", is a charge related to stealing property or services of a value less than \$1000, obtaining the same through fraud, or unauthorized control of the same.

Directions: Translate the following sentences into symbols and create a truth table for each.

5. She can have a peanut butter and jelly sandwich but not a bag of Flamin' Hot Cheetos or Takis.
6. He cannot have any rice cakes for dessert if he does not both eat his cauliflower and drink his oat milk

Directions: Create a truth table to prove the following:

7. Use the truth table method to prove the following logical equivalence: $\neg P \vee Q \equiv P \rightarrow Q$

8. Use the truth table method to prove the following logical equivalence: $\neg(P \rightarrow Q) \equiv P \wedge \neg Q$

9. Use the truth table method to prove that the following argument is valid.

$$\neg P \vee \neg Q$$

$$Q$$

$$\neg P$$

10. Use the truth table method to prove that the following argument is invalid

$$P \rightarrow Q$$

$$Q$$

$$P$$

Short Answer:

11. Define valid argument.

12. Define sound argument.

13. What are the advantages and disadvantages of using a truth table to prove an argument rather than using rules of inference?

14. Summarize the steps of proving an argument with an indirect derivation (reductio ad absurdum argument).

Directions: Distribute the negation in each problem using De Morgan's Laws:

15. $\neg(\neg X \vee Y)$

16. $\neg(X \wedge \neg Y \vee \neg Z)$

Directions: Factor out a negation in each problem using De Morgan's Laws:

17. $X \vee \neg Y$

18. $\neg W \wedge X \wedge Y \vee \neg Z$

Proofs Mixed Practice:

Prove the following with a direct proof (or a conditional derivation).

19. Premises: $(\neg(Q \rightarrow R) \rightarrow P)$, $\neg P$, Q . Conclusion: R .

20. Premises: $(P \vee Q)$, $(\neg Q \vee S)$ Conclusion: $(\neg P \rightarrow S)$

21. Premises: P , $(P \rightarrow R)$, $(P \rightarrow (R \rightarrow Q))$. Conclusion: Q .

22. Premises: $(P \rightarrow (Q \rightarrow R))$, $(\neg R \wedge P)$. Conclusion: $\neg Q$.

23. Premises: $(P \rightarrow (Q \wedge S))$, $(Q \rightarrow R)$, $(S \rightarrow T)$. Conclusion: $(P \rightarrow (R \wedge T))$.

24. Premises: $(P \rightarrow (Q \rightarrow R))$, Q . Conclusion: $(P \rightarrow R)$.

25. Premises: $(P \rightarrow (Q \rightarrow R))$, $(P \rightarrow (S \rightarrow T))$, $(Q \wedge S)$. Conclusion: $(P \rightarrow (R \wedge T))$.

26. Premises: $(P \vee Q) \wedge (\neg Q \vee \neg R)$ Conclusion: $(R \rightarrow P)$

Directions: Prove the following problems with an indirect proof. Do not use De Morgan's Laws for these.

27. Premise: $(\neg P \wedge \neg Q)$. Conclusion: $\neg(P \vee Q)$.

28. Premise: $(P \vee \neg R)$, $(Q \rightarrow \neg P)$, Conclusion: $\neg(R \wedge Q)$.

29. Premise: $(\neg P \vee \neg Q)$. Conclusion: $\neg(P \wedge Q)$.

30. **Very Challenging!** Premise: $\neg(P \wedge Q)$. Conclusion: $(\neg P \vee \neg Q)$.

Programming Bonus Questions:

Programming questions will not be a graded part of the final, but they will appear in a bonus section for a minor amount of extra credit.

1. Label each part of the following Java code with the correct term from the word bank:

```
Gibberish g = new Gibberish(7.5, true);
```

Word Bank: *class, method, object, null, char, String, int, array, double, constructor, void, exception, enum.*

a. What kind of thing is `Gibberish` ?

b. What kind of thing is `Gibberish(7.5, true)` ?

c. What kind of thing is `g` ?

d. What kind of thing is `7.5` ?

e. What kind of thing is `true` ?

2. What is the relationship between a class and an object?

3. A company sells boxes of tea that are either small, medium, or large. Each tea box has a price, a flavor name, and can be caffeinated or decaf. Write a simple class that represents a tea box. A constructor is not necessary.

4. The tea company is running a promotion where all decaf teas will be sold at a 25% discount. Write a static method called `discountPrice()` that takes a tea box as an input. It should return the normal price if the tea is caffeinated, but it should return the discounted price if the tea is decaf.

5. The customer can complete their online purchase with a shopping cart full of tea boxes. The company needs to know how much to charge them while the special discount is running. Write a static method called `totalPrice()` that takes an array of tea boxes as an input. It should find the total price of all tea boxes with discounts taken into consideration.