

Scientific Foundations of Logic

Logic · Answer Key · 25 Questions

1. Which law of classical logic states that for any proposition, either that proposition is true or its negation is true?

- A) Law of Identity
- B) Law of Non-Contradiction
- C) Law of Excluded Middle**
- D) Law of Sufficient Reason

2. In propositional logic, what is the result of a 'conjunction' (AND) operation if both inputs are false?

- A) True
- B) False**
- C) Null
- D) Undefined

3. Who is credited with developing the first formal system of deductive reasoning known as the syllogism?

- A) Aristotle**
- B) Plato
- C) Euclid
- D) Pythagoras

4. What term describes a logical argument where the conclusion necessarily follows from the premises?

- A) Inductive
- B) Abductive
- C) Valid**
- D) Heuristic

5. In Boolean algebra, which logical operator is equivalent to the 'NOR' gate if followed by a 'NOT' gate?

- A) AND
- B) OR**
- C) XOR
- D) NAND

6. Which 19th-century mathematician introduced the binary system as the foundation for modern logical algebra?

- A) Alan Turing
- B) George Boole**
- C) Charles Babbage
- D) Ada Lovelace

7. What is the name of the logical fallacy that assumes a conclusion is true simply because it has not been proven false?

- A) Ad Hominem
- B) Argumentum ad Ignorantiam**
- C) Post Hoc Ergo Propter Hoc
- D) Straw Man

8. In predicate logic, what symbol represents the 'universal quantifier'?

- A) ?
- B) ?**
- C) ?
- D) ?

9. Which theorem by Kurt Gödel proves that any consistent formal system capable of arithmetic contains unprovable statements?

- A) Incompleteness Theorem**
- B) Completeness Theorem
- C) Compactness Theorem
- D) Fixed-point Theorem

10. What type of logic allows for truth values between 0 and 1, representing degrees of truth?

- A) Binary Logic
- B) Fuzzy Logic**
- C) Propositional Logic
- D) Predicate Logic

11. Which logical connective produces a true value only if both input values are identical?

- A) XNOR**
- B) XOR
- C) NAND
- D) NOR

12. In formal logic, what is the inverse of the implication 'If P, then Q'?

- A) If Q, then P
- B) If not P, then not Q**
- C) If not Q, then not P
- D) P if and only if Q

13. Which logical principle asserts that 'A is A'?

- A) Law of Identity**
- B) Law of Non-Contradiction
- C) Law of Excluded Middle
- D) Double Negation

14. What is the logical equivalent of 'P OR Q' in terms of implication?

- A) If P, then Q
- B) If not P, then Q**
- C) If Q, then P
- D) If P, then not Q

15. Which logical operator returns true only if the inputs are different?

- A) AND
- B) OR
- C) XOR**
- D) NAND

16. In a truth table for 'If P, then Q', what is the result when P is false and Q is true?

- A) True**
- B) False
- C) Indeterminate
- D) Contradictory

17. Which mathematician and logician is known for his work on the 'Principia Mathematica'?

- A) Bertrand Russell**
- B) Gottlob Frege
- C) David Hilbert
- D) Alfred Tarski

18. What does the logical term 'tautology' refer to?

- A) A statement that is always false
- B) A statement that is always true**
- C) A circular argument
- D) A premise based on opinion

19. In classical logic, what is the 'Law of Non-Contradiction' formally defined as?

- A) Not (P and Not P)**
- B) P or Not P
- C) If P, then P
- D) P equals P

20. What is the primary difference between deductive and inductive reasoning?

- A) Deduction moves from specific to general
- B) Induction moves from general to specific
- C) Deduction guarantees truth if premises are true**
- D) Induction guarantees truth if premises are true

21. Which branch of logic deals with the properties of sets and their memberships?

- A) Propositional Logic
- B) Set Theory**
- C) Modal Logic
- D) Temporal Logic

22. In modal logic, what does the 'diamond' symbol ($\Diamond$) typically represent?

- A) Necessity
- B) Possibility**
- C) Obligation
- D) Permission

23. What is a 'contingent' proposition in logic?

- A) A statement that is always true
- B) A statement that is always false
- C) A statement that can be true or false depending on the situation**
- D) A statement that is self-contradictory

24. Which logician developed the concept of the 'Turing Machine' to model algorithmic computation?

- A) Alan Turing**
- B) John von Neumann
- C) Claude Shannon
- D) Kurt Gödel

25. What is the logical negation of the statement 'All cats are mammals'?

A) No cats are mammals

B) Some cats are not mammals

C) All mammals are cats

D) Some mammals are not cats