

Class 9 | Logical Reasoning Olympiad

Instructions: Each question has one correct answer. Choose the best option (A/B/C/D). Answer key is provided at the end. This paper is for practice only — not an official exam paper. Recommended time: **45 minutes**.

Q1. In type theory, the Curry-Howard correspondence maps proofs to:

A. algorithms

B. databases

C. programs

D. formulas

Q2. 'Lindström's theorem' characterises first-order logic as the:

A. weakest logic with a complete proof system

B. strongest logic satisfying compactness and downward Löwenheim-Skolem theorem

C. only logic in which all sets are definable

D. most expressive logic with decidable model-checking

Q3. The 'Sleeping Beauty' problem: Beauty is put to sleep and a coin is flipped. If heads, she wakes once; if tails, twice (with memory erased between). When woken, what should she assign as P(Heads)?

A. 1/2 (Halfer)

B. 2/3 (Thirder)

C. 1/3 (Thirder)

D. Undefined

Q4. 'Löwenheim-Skolem theorem' has the paradoxical implication that:

A. all first-order theories have infinite models

B. there is no uncountable model of arithmetic

C. a first-order theory with an uncountable model also has a countable model (Skolem's paradox)

D. set theory cannot be axiomatised

Q5. In knowledge representation, the 'closed-world assumption' vs 'open-world assumption' differ in:

A. how large the knowledge base can be

B. whether missing information is assumed false (CWA) or unknown (OWA)

C. how inference is performed

D. the expressivity of the logic used

Q6. What is 'epistemic modality' in linguistics and logic?

A. the logic of time

B. modality relating to the speaker's knowledge or certainty about a proposition

C. the study of speech acts

D. modal operators applied to ethics

Q7. The 'unexpected hanging paradox' is related to which modern logical topic?

A. probabilistic reasoning

B. backward induction

C. self-reference and knowledge operators

D. modal logic only

Q8. Which property distinguishes a 'computable function' from a non-computable one?

A. being expressible in C code

B. being solvable in polynomial time

C. there exists a Turing machine that computes it for all inputs in finite time

D. being definable in first-order logic

Q9. 'Paraconsistent logic' differs from classical logic in that:

A. it rejects the law of identity

B. it cannot derive any conclusion from contradictions

C. it allows some contradictions without explosion (ex contradictione quodlibet does not hold)

D. it uses fuzzy truth values

Q10. In decision theory, 'maximin' strategy means:

A. maximise the maximum possible payoff

B. maximise the minimum guaranteed payoff (choose the best worst-case outcome)

C. minimise the maximum regret

D. minimise the minimum payoff

Q11. 'Second-order logic' extends first-order logic by allowing quantification over:

A. functions only

B. constants

C. predicates and sets

D. modal operators

Q12. The 'Common Knowledge' paradox of the 'Muddy Children' is resolved when:

A. each child privately knows their own status

B. an external announcement makes it common knowledge that at least one child is muddy

C. the children compare notes

D. the number of muddy children is revealed

Q13. The 'simulation argument' (Nick Bostrom) concludes that at least one of these is likely true: (1) advanced civilisations go extinct before simulation capability; (2) advanced civilisations choose not to simulate; (3) ___

A. our universe is a virtual simulation

B. we are already living in a simulation

C. simulations are computationally impossible

D. advanced civilisations are inevitable

Q14. 'Grue' paradox (Goodman's new riddle of induction) challenges:

A. deductive reasoning

B. the notion that all green emeralds confirm 'all emeralds are green' — 'grue' objects show confirmation is not simple

C. quantum mechanics

D. mathematical induction

Q15. The 'Turing degree' of a problem measures:

A. how fast a Turing machine solves it

B. its computational complexity class

C. its computability relative to an oracle — how hard it is relative to other problems

D. the number of Turing machines that can solve it

Q16. In probability theory, what does 'exchangeability' (de Finetti) mean?

A. any two random variables can be swapped

B. a sequence where the joint probability is invariant under permutation of the variables

C. conditional independence

D. independence of all random variables

Q17. What is 'abduction' in Peirce's semiotics (not just inference)?

A. logical deduction from axioms

B. the process of generating hypotheses — a creative, pre-rational inference leading to discovery

C. generalisation from examples

D. refutation through counterexample

Q18. The 'St Petersburg game' has infinite expected value, but most people would pay very little to play. This is resolved by:

A. ignoring the tails outcomes

B. realising the game is unfair

C. using diminishing marginal utility (Bernoulli) or bounded utility functions

D. calculating expected value incorrectly

Q19. 'Hume's fork' divides all meaningful propositions into:

A. true and false

B. verifiable and unverifiable

C. relations of ideas (analytic, necessary) and matters of fact (synthetic, contingent)

D. linguistic and non-linguistic

Q20. In formal epistemology, 'epistemic akrasia' means:

A. lacking knowledge

B. holding a belief while believing it to be irrational

C. changing beliefs too quickly

D. believing in contradictions

Q21. What is 'supervenience' in philosophy of mind?

A. mental states supervening on physical states, meaning no mental change without physical change

B. physical states determining conscious experience directly

C. the primacy of mental properties over physical ones

D. the identity of mental and physical states

Q22. The 'frame problem' in logical AI is that:

A. reasoning about static worlds is NP-hard

B. formal logic cannot represent spatial frames

C. it is very hard to represent all the things that do NOT change as the result of an action

D. temporal reasoning requires exponential space

Q23. In bounded rationality (Herbert Simon), agents:

A. always maximise utility perfectly

B. are irrational in all decisions

C. use heuristics to make satisfactory rather than optimal decisions given cognitive and time limits

D. ignore information entirely

Q24. Which axiom of ZFC set theory allows the construction of power sets?

A. Axiom of Infinity

B. Axiom of Regularity

C. Axiom of Power Set

D. Axiom of Choice

Q25. 'Wittgenstein's rule-following paradox' (Philosophical Investigations) challenges:

A. logic itself

B. mathematics foundations

C. the idea that any rule determines its own application — any action can be made consistent with a rule interpretation

D. language as a private internal system

Q26. In evolutionary game theory, 'replicator dynamics' describes:

A. genetic mutation rates

B. how species replicate

C. how the frequency of strategies in a population changes based on their relative fitness

D. natural selection at the individual level

Q27. 'Coherentism' in epistemology holds that beliefs are justified:

A. by sense experience alone

B. by their coherence with other beliefs in a web of mutual support

C. by infallible a priori reasoning

D. by divine revelation

Q28. The 'Twin Earth' thought experiment (Putnam) was designed to show that:

A. exact physical duplicates must have identical mental states

B. meaning cannot be entirely in the head — extension is determined by the world

C. language is purely conventional

D. mental states are physical states

Q29. In game theory, 'backward induction' in a finite extensive game finds:

A. the minimax strategy

B. the Nash equilibrium for cooperative games

C. the subgame perfect equilibrium

D. the dominant strategy

Q30. 'Foundationalism' in epistemology holds that:

A. all beliefs must be justified by other beliefs

B. justification regresses infinitely

C. there are basic, self-justifying beliefs that ground all other beliefs

D. justification is circular

Q31. In modal logic, system S4 adds to T the axiom:

A. $\Box P \rightarrow \Box \Box P$ (what is known is known to be known)

B. $\Diamond P \rightarrow \Box \Diamond P$

C. $\neg \Diamond P \rightarrow \Box \neg P$

D. $\Box P \rightarrow \Diamond P$

Q32. What is the 'hard problem of consciousness' (Chalmers)?

A. explaining how the brain processes information

B. explaining why physical processes give rise to subjective experience (qualia)

C. measuring consciousness empirically

D. explaining unconscious cognitive processes

Q33. 'Inferentialism' (Brandom) holds that meaning is determined by:

A. reference to external objects

B. subjective mental concepts

C. inferential role — the place of a term in networks of inference and assertion

D. evolutionary function

Q34. Which is the CORRECT formalisation of 'Some cats are not black' in predicate logic?

A. $\forall x(\text{Cat}(x) \rightarrow \neg \text{Black}(x))$

B. $\neg \exists x(\text{Cat}(x) \wedge \text{Black}(x))$

C. $\exists x(\text{Cat}(x) \wedge \neg \text{Black}(x))$

D. $\forall x(\text{Cat}(x) \wedge \neg \text{Black}(x))$

Q35. 'Dual-process theory' (Kahneman's System 1 and System 2) describes:

A. two brain hemispheres with separate functions

B. two cognitive systems: fast, intuitive, automatic (S1) and slow, deliberate, analytical (S2)

C. two types of memory

D. two stages of decision-making

Q36. The 'Preface Paradox' shows that it can be rational to:

A. believe a contradiction when it is profitable

B. believe each claim in a book is true while also believing the book contains errors

C. publish without certainty

D. withhold belief in complex topics

Q37. 'Folk theorem' in repeated game theory states that:

A. cooperation is impossible in repeated games

B. any individually rational payoff can be sustained as a Nash equilibrium in an infinitely repeated game

C. the Prisoner's Dilemma is always defection

D. cooperative strategies are only stable in 2-player games

Q38. In Tarski's theory of truth, 'snow is white' is true if and only if:

A. most people believe snow is white

B. science confirms snow is white

C. snow is white

D. the sentence corresponds to a fact in a model

Q39. What is the 'decision problem' (Entscheidungsproblem) and its resolution?

A. the problem of making optimal decisions; resolved by game theory

B. the problem of deciding which axioms to use; resolved by Gödel

C. the question of whether there is an algorithm to determine truth of any mathematical statement; shown undecidable by Church and Turing

D. the problem of computational complexity; resolved by Cook

Q40. The 'argument from marginal cases' in animal ethics argues:

A. that marginal cases in nature require special protection

B. if we grant moral status to humans with low cognitive capacity, consistency requires granting moral status to animals with equal or higher capacity

C. that cognitively limited humans have fewer rights

D. that animals are morally equivalent to humans in all contexts

Answer Key

Q1: C	Q2: B	Q3: C	Q4: C	Q5: B	Q6: B	Q7: C	Q8: C	Q9: C	Q10: B
Q11: C	Q12: B	Q13: B	Q14: B	Q15: C	Q16: B	Q17: B	Q18: C	Q19: C	
Q20: B	Q21: A	Q22: C	Q23: C	Q24: C	Q25: C	Q26: C	Q27: B	Q28: B	
Q29: C	Q30: C	Q31: A	Q32: B	Q33: C	Q34: C	Q35: B	Q36: B	Q37: B	
Q38: C	Q39: C	Q40: B							

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