

**Class 8 | 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 modal logic, 'necessarily P' ( $\Box P$ ) means:

A. P is true now

B. P is probably true

C. P is true in all possible worlds

D. P is true in at least one possible world

**Q2.** The 'frame problem' in AI logic describes:

A. how to represent visual information in a frame

B. the difficulty of specifying what does NOT change when an action is performed

C. how to handle exception cases in rules

D. the problem of representing spatial relationships

**Q3.** Which of the following illustrates the 'conjunction fallacy' (Tversky & Kahneman)?

A. estimating 95% when the correct answer is 80%

B. judging  $P(A \text{ and } B) > P(A)$  because scenario  $A \wedge B$  is more representative

C. ignoring base rates in probability estimates

D. overweighting small probabilities

**Q4.** What is 'defeasible reasoning'?

A. reasoning that always leads to certain conclusions

B. reasoning that produces conclusions that can be retracted if new information contradicts them

C. reasoning based on definitions only

D. deductive proof from axioms

**Q5.** The 'resolution principle' in automated theorem proving:  $P \vee Q$  and  $\neg P \vee R$  resolve to:

A.  $P \vee R$

B.  $\neg P \wedge Q$

C.  $Q \vee R$

D.  $P \wedge \neg R$

**Q6.** In a Bayesian network, 'explaining away' occurs when:

**A.** a prior explanation is shown to be false

**B.** two parent nodes' probabilities are updated because observing one explains the effect of the other

**C.** posterior probability exceeds prior probability

**D.** all explanations are equally likely

**Q7.** The 'lottery paradox' (Kyburg) states:

**A.** it is rational to believe you will win a lottery

**B.** it is rational to believe of each ticket that it will lose, yet irrational to believe all tickets will lose

**C.** rationality prevents betting

**D.** probability cannot justify belief

**Q8.** Gödel's second incompleteness theorem states that a consistent formal system:

**A.** cannot prove its own axioms

**B.** contains undecidable statements

**C.** cannot prove its own consistency

**D.** is incomplete with respect to arithmetic

**Q9.** In game theory, a 'dominant strategy' is one that:

**A.** always leads to winning

**B.** is the best response only if the opponent plays their best

**C.** yields a better or equal payoff than any other strategy regardless of the opponent's choice

**D.** is chosen by the Nash equilibrium

**Q10.** Which of these is a PARADOX of self-reference?

**A.** All ravens are black

**B.** The set of all sets that do not contain themselves (Russell's Paradox)

**C.** The sorites paradox

**D.** Zeno's paradoxes

**Q11.** In a 'zero-sum game', if one player gains  $x$ , the other loses:

**A.** less than  $x$

**B.** more than  $x$

**C.** exactly  $x$

**D.** 0

**Q12.** The 'Sleeping Beauty Problem' debate concerns whether Beauty should assign  $P(\text{Heads}) = 1/2$  (Halfer) or  $P(\text{Heads}) = 1/3$  (Thirder). This is a puzzle about:

**A.** probability theory in casinos

**B.** self-locating belief and the relationship between observer credences and objective probabilities

**C.** Bayesian networks

**D.** game theory under uncertainty

**Q13.** In non-monotonic logic, 'closed-world assumption' means:

**A.** the world has a fixed number of facts

**B.** anything not known to be true is assumed to be false

**C.** logical deductions cannot be retracted

**D.** all facts are accessible

**Q14.** Which of the following is a Nash equilibrium in the Prisoner's Dilemma (one-shot)?

**A.** Both cooperate

**B.** One cooperates, one defects

**C.** Both defect

**D.** Random play

**Q15.** 'Occam's Razor' as a principle of reasoning states:

**A.** always assume the worst case

**B.** always assume the best case

**C.** among competing hypotheses, prefer the one with the fewest unnecessary assumptions

**D.** the first answer is usually correct

**Q16.** In formal logic, 'soundness' of an argument means:

**A.** the premises are consistent

**B.** the conclusion is interesting

**C.** the argument is valid AND all premises are true

**D.** the conclusion follows syntactically

**Q17.** The 'trolley problem' primarily illustrates the tension between:

**A.** utilitarianism (consequences) and deontological ethics (duty/rights)

**B.** egoism and altruism

**C.** virtue ethics and relativism

**D.** legal and moral norms

**Q18.** In epistemic logic, 'Kp' (agent knows P) satisfies which axiom in system S5?

**A.**  $Kp \rightarrow \neg K\neg p$

**B.**  $Kp \rightarrow p$  (T axiom: knowledge implies truth)

**C.**  $Kp \rightarrow KKp$  only

**D.**  $\neg Kp \rightarrow K\neg p$

**Q19.** What is the 'Raven Paradox' (Hempel)?

**A.** all ravens are paradoxically unpredictable

**B.** observing a non-black non-raven (e.g. a green apple) constitutes evidence that 'all ravens are black'

**C.** ravens are a special case in evolutionary logic

**D.** the statement 'all ravens are black' is unfalsifiable

**Q20.** 'Bayesian updating' changes the prior probability to a posterior based on:

**A.** intuition

**B.** frequency of past events

**C.** the likelihood of new evidence given the hypothesis

**D.** the number of competing hypotheses

**Q21.** In probability, the 'St Petersburg Paradox' reveals that expected value alone:

**A.** is always a reliable decision criterion

**B.** predicts rational gambling behaviour exactly

**C.** can fail as a decision criterion when outcomes involve infinite values

**D.** works only for finite games

**Q22.** The 'No-No Paradox' involves two sentences: A says 'B is false', B says 'A is false'. Neither is provably true or false. This illustrates:

**A.** circular reasoning

**B.** bivalence in classical logic

**C.** that classical logic may not handle self-referential sentences without truth gaps

**D.** that all self-referential statements are true

**Q23.** In temporal logic, 'G P' (globally P) means:

**A.** P was true in the past

**B.** P is sometimes true

**C.** P holds at all future time points

**D.** P eventually becomes true

**Q24.** In a 'common knowledge' scenario (mutual knowledge of k-th order), what distinguishes common knowledge from merely mutual knowledge?

**A.** common knowledge requires everyone to know P

**B.** common knowledge requires everyone to know P, everyone knows everyone knows P, and so on infinitely

**C.** mutual knowledge is stronger than common knowledge

**D.** common knowledge requires written acknowledgement

**Q25.** The 'Sorites Paradox' (heap paradox) challenges:

**A.** the existence of heaps

**B.** classical bivalent logic by showing vague predicates create borderline cases

**C.** inductive reasoning in mathematics

**D.** the law of non-contradiction

**Q26.** In the P vs NP problem, 'P' and 'NP' refer to:

**A.** polynomial and non-polynomial time algorithms

**B.** problems solvable in polynomial time vs. problems verifiable in polynomial time

**C.** prime and non-prime number problems

**D.** parallel and non-parallel algorithms

**Q27.** 'Goodhart's Law' states:

**A.** good outcomes always follow from good intentions

**B.** when a measure becomes a target, it ceases to be a good measure

**C.** every problem has an optimal solution

**D.** markets are always efficient

**Q28.** The 'no miracles argument' for scientific realism states:

**A.** science cannot explain miracles

**B.** the predictive success of science would be a miracle if scientific theories were not approximately true

**C.** science has replaced religion

**D.** scientific models are merely useful fictions

**Q29.** Which of these is an example of the 'fallacy of composition'?

**A.** The team is the best; therefore each player is the best

**B.** Each player is the best; therefore the team is the best

**C.** Most players are good; therefore the team is good

**D.** The team won; therefore each player played well

**Q30.** In logic programming (Prolog), the execution uses:

**A.** forward chaining only

**B.** neither backward nor forward chaining

**C.** backward chaining (SLD resolution)

**D.** truth tables

**Q31.** What is 'naive set theory's' problem, resolved by ZFC?

**A.** it cannot define infinite sets

**B.** Russell's Paradox — the set of all sets leads to contradiction

**C.** it cannot prove the axiom of choice

**D.** it lacks a notion of empty set

**Q32.** The 'Allais paradox' demonstrates that people violate:

**A.** Bayes' theorem

**B.** Nash equilibrium

**C.** expected utility theory

**D.** Occam's Razor

**Q33.** 'Reflective equilibrium' (Rawls) in moral epistemology involves:

**A.** reflecting on past moral decisions

**B.** reaching equilibrium between moral intuitions and theoretical principles through mutual adjustment

**C.** a purely theoretical derivation of moral principles

**D.** reaching consensus through democratic vote

**Q34.** In game theory, the 'trembling hand perfect equilibrium' refines Nash equilibria by:

**A.** assuming players always cooperate

**B.** allowing only dominant strategies

**C.** requiring equilibria to be robust to small random errors ('trembles') in strategy execution

**D.** eliminating dominated strategies

**Q35.** What does 'completeness' of a logic mean?

**A.** all true statements can be derived (every semantic consequence is provable)

**B.** there are no contradictions in the system

**C.** every statement has a proof or disproof

**D.** only valid arguments are accepted

**Q36.** The 'Ellsberg paradox' shows that people prefer:

**A.** risk over uncertainty

**B.** uncertainty over risk

**C.** known probabilities over unknown ones (ambiguity aversion), violating expected utility

**D.** both equally

**Q37.** 'Occam's Razor' in Bayesian terms corresponds to:

**A.** choosing the hypothesis with the highest likelihood

**B.** assigning lower prior probability to more complex hypotheses

**C.** maximising the posterior probability

**D.** minimising the number of data points

**Q38.** In intuitionistic logic, the 'law of excluded middle' ( $P \vee \neg P$ ):

**A.** is a theorem

**B.** is provable from P

**C.** is NOT a theorem — truth requires constructive proof

**D.** is an axiom in all logical systems

**Q39.** 'Representativeness heuristic' leads to:

**A.** more accurate probability estimates

**B.** slower but more accurate reasoning

**C.** judging probability by how much something resembles a prototype, ignoring base rates

**D.** anchoring on the first piece of information

**Q40.** What is 'dialetheism' in philosophy of logic?

**A.** the view that all logic is dialectical

**B.** the view that some contradictions are true (true contradictions, 'dialetheia')

**C.** the study of dialogue in logic

**D.** a form of paraconsistent epistemology

**Answer Key**

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

---

Free practice paper from [syllabax.com](https://syllabax.com) · Take the free live challenge at [syllabax.com/olympiad/class/8](https://syllabax.com/olympiad/class/8) · Not affiliated with SOF or any official olympiad body.