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இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2026
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2026
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තර්ක ශාස්ත්‍රය හා විද්‍යාත්මක ක්‍රමය I அளவையியலும் விஞ்ஞானமுறையும் I **Logic and Scientific Method I**	**24 E I**	පැය දෙකයි இரண்டு மணித்தியாலம் ***Two hours***

Instructions:

* *Answer **all** questions.*
* *Write your **Index Number** in the space provided in the answer sheet.*
* *Instructions are given on the back of the answer sheet. Follow them carefully.*
* *In each of the questions **1** to **50**, pick one of the alternatives from (1), (2), (3), (4), (5) which is **correct** or **most appropriate** and **mark your response on the answer sheet with a cross** (×) on the number of the correct option in accordance with the instructions given on the back of the answer sheet.*

N.B.

* The symbols for the logical constants and operations used in this paper are only as follows. In answering this paper the symbols should be used accordingly.

In the sentential and predicate calculi:

Negation : $\sim$, Implication : $\rightarrow$, Conjunction : $\wedge$, Disjunction : $\vee$, Biconditional : $\leftrightarrow$,
Universal quantifier : $\wedge$, Existential quantifier : $\vee$

In class logic:

The class union of A and B: $A \cup B$, class intersection: $A \cap B$ or AB, the complement of A: $\overline{A}$, universe class: U, null class: ϕ

In Boolean algebra:

sum: +, product: $\cdot$, the complement of X: $\overline{X}$, values: 1 and 0

In Logic gates:

The AND, OR, NOT, XOR gates for the inputs A and B will be respectively shown by $A \cdot B$, $A + B$, $\overline{A}$, $A \oplus B$

1. What is logic?
(1) search for true conclusions.
(2) study of methods which distinguish between truth and falsity.
(3) study of the laws of thought.
(4) study of our processes of thinking.
(5) study of methods and rules in the arguments distinguishing between correct and incorrect arguments.

2. The English translation of the title of Isaac Newton's 'Principia' published in 1687 is "Mathematical Principles of Natural.....".
Which of the following terms correctly fills in the blank above?
(1) Physics (2) Science (3) Philosophy (4) Metaphysics (5) Cosmology

3. All men are immortal.
All kings are men.
Therefore all kings are immortal.
The above argument is
(1) valid and true.
(2) invalid and sound.
(3) violates the rules of the categorical syllogism.
(4) valid but unsound.
(5) neither valid nor sound.

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4. The chemical formula H_2O of water means
   (1) one atom of water consists of two molecules of Hydrogen and one molecule of Oxygen.
   (2) one molecule of water consists of two molecules Hydrogen and one molecule of Oxygen.
   (3) one molecule of water consists of two atoms of Hydrogen and one atom of Oxygen.
   (4) one gram of water consists of 2/3 gram of Hydrogen and 1/3 gram of Oxygen.
   (5) the volume of Hydrogen and oxygen of a fixed amount of water are equal.

5. What are the two types of quality of traditional categorical propositions?
   (1) Universal, particular
   (2) Analytic, synthetic
   (3) Affirmative, negative
   (4) Simple, Complex
   (5) a priori, a posteriori

6. Science is built on Conservation Laws. Which of the following Conservation Laws are considered absolute and invariant in contemporary physical science?
   (1) Conservation of Mass
   (2) Conservation of Energy.
   (3) Conservation of Matter.
   (4) Conservation of Mass-Energy.
   (5) Conservation of Mechanical Energy.

7. Given that, if a relative is a reflective transitive relation between two or more people and if A is a relative of B and B is a relative of C, which of the following statements is **incorrect**?
   (1) B is a relative of A.
   (2) A is a relative of A.
   (3) C is a relative of B.
   (4) C is a relative of A.
   (5) A is a relative of both B and C.

8. A diabetic patient conducts a random check of her blood sugar. She pricks her finger tip with a needle and then gets the oozing drop of blood blotted on the sugar testing strip which has it's other end pushed into a small machine which displays a number giving the blood sugar level. Assuming that the sugar testing strip has some chemicals which reacts with blood, this test is best considered as
   (1) an experiment
   (2) an observation
   (3) a crucial experiment
   (4) an observation using instruments
   (5) a controlled group test

9. Which of the following statements about the square of opposition is correct?
   (1) In the contrary opposition of the A proposition is true then the corresponding E proposition is also true.
   (2) In opposition of sub-contrariety, if the I propositions is false, then the corresponding O proposition is also false.
   (3) In the opposition of sub-alterneity, if the E proposition is true then the corresponding O proposition also true.
   (4) In the opposition of contradiction, if the A proposition is true then the corresponding O proposition is also true.
   (5) In the opposition of contradiction, if the I proposition is false then the corresponding E proposition is also false.

10. Kepler's Law 'All planets move in elliptic orbits around the Sun' is a
   (1) A particular generalization.
   (2) A statistical generalization.
   (3) A generalization of generalizations.
   (4) A particular empirical generalization.
   (5) A particular empirical observation.

11. In the logical study of 'division', which of the following is an example of a division by dichotomy?
   (1) Liquids and gases
   (2) Asian and non-Asian
   (3) Roots and branches
   (4) High intelligence and low-intelligence
   (5) Rich class and poor class

12. All dogs are animals. Therefore some animals are dogs. This inference is best considered to be a
   (1) obversion.
   (2) contraposition.
   (3) inversion.
   (4) conversion.
   (5) conversion by limitation.

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13. Louis Pasteur devised his 'swan-neck flask' instrument to
(1) prevent the transmission of the hydrophobia virus by the shape of the 'Swan-neck'.
(2) test the Theory of Spontaneous Generation, first by boiling the yeast solution, then preventing the microbes from contacting the yeast by the shape of the neck but still allowing contact of the microbes outside with yeast by turning the neck.
(3) test the theory of spontaneous generation of microbes by making a culture of microbes in the bulb.
(4) discover the different microbes in atmosphere and make cultures of them.
(5) make a culture of the hydrophobic a virus in the bulb and using the swan neck to put in the required measure of virus in the skull of the dog.

14. All judges are lawyers.
Some lawyers are university graduates.
Therefore, some judges are university graduates.
The above syllogism
(1) is valid.
(2) commits fallacy of illicit major.
(3) commits fallacy of illicit minor.
(4) commits fallacy of undistributed middle.
(5) commits fallacy of four terms.

15. Let A be set of numbers 0, 1, 2, 3, 4, 5
Let B be set of numbers 0, -1, -2, -3, -4, -5
Then A and B are,
(1) Contradictory sets.
(2) Partially overlapping sets.
(3) Completely Disjunctive sets.
(4) Mutually exclusive sets.
(5) Such that their intersection gives the null set.

16. In whose honour is the micro particles 'Boson' named?
(1) Amar Bose
(2) Jagdish Chandra Bose
(3) Subas Chandra Bose
(4) Einstein
(5) Satyendra Nath Bose

17. What is the converse of the following proposition?
'Some recently imported cars are overpriced and heavily taxed vehicles'
(1) Some heavily taxed cars are recently imported and overpriced.
(2) Some overpriced and heavily taxed vehicles are not recently imported cars.
(3) Some overpriced and heavily taxed vehicles are recently imported cars.
(4) Overpriced and heavily taxed vehicles are recently imported cars.
(5) No overpriced and heavily taxed vehicles are recently imported.

18. When you test your vehicle tyre pressure by normal gauge, does it use an absolute zero or a relative zero?
(1) Uses a non-absolute zero. The zero pressure indicates the pressure at sea level.
(2) Uses a non-absolute zero. The zero-pressure indicates that the pressure inside the tyre is equivalent to the atmosphere pressure of the place where the vehicle is.
(3) Use a non-absolute zero. The zero pressure indicates that there is no gas inside the tyre.
(4) Uses an absolute zero.
(5) Uses a non-absolute zero. The zero pressure indicates the pressure level generally accepted and used by the manufacturers.

19. If Dutugemunu married Kalu Etana, then Saliya is Kalu Etana's son. But Dutugemunu did not marry Kalu Etana. Therefore, Saliya is not Kalu Etana's son.
The above hypothetical syllogism.
(1) Commits the fallacy of affirming the consequent.
(2) Commits the fallacy of denying the antecedent.
(3) is valid
(4) does not commit a formal fallacy.
(5) commit an informal fallacy.

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20. Development of Medical Radiology begins with
(1) Michael Faraday's discovery of Electro-magnetic induction.
(2) Ernest Rutherford's discovery of alpha rays.
(3) Heinrich Hertz's discovery of radio waves.
(4) Wilhelm Roentgen's discovery of X-rays.
(5) Paul Villard's discovery of gamma-rays.

21. Not all royal princes become kings.
In the above proposition
(1) the subject is distributed but the predicate is not distributed.
(2) the subject is not distributed but the predicate is distributed.
(3) both the subject and predicate are distributed.
(4) both the subject and the predicate are undistributed.
(5) It is not possible to determine whether the subject or the predicate is distributed or not.

22. The meaning of Karl Popper's method of 'Conjectures and Refutations' can be taken as
(1) Science progresses through collecting observations and then proving generalization through induction.
(2) Science advances not by establishing generalizations as final truths but by eliminating errors through criticism and testing.
(3) Inductive inference is possible in science.
(4) Some scientific theories are not testable.
(5) Science is built on paradigms which give the axioms of that science.

23. No man is taller than 8 feet in height.
Friday is a man.
Therefore, Friday is not taller than 8 feet in height.
Which option states the moods and the figure of the above syllogism correctly?
(1) *EAE*, 3 (2) *EIE*, 4 (3) *EAE*, 1 (4) *EAE*, 2 (5) *EIE*, 3

24. Can today's science conduct experiments on celestial bodies?
(1) No, observations only can be done.
(2) Yes, Eddington's test during a solar eclipse to see whether Einstein's prediction from the General Relativity is an experiment.
(3) Yes, Discovery of various elements in the sky and sky bodies by observations of various wave lengths and colours is experiment.
(4) Yes, Analysis of rocks and other materials brought by trips to the Moon are done through experiment.
(5) No, we cannot control sky bodies and phenomena.

25. If the proposition, 'No man is wise' is false, which option gives the truth values of the corresponding A, I, O proposition in that order?
(1) False, True, False (2) Indeterminate, True, Indeterminate
(3) True, True, Indeterminate (4) True, True, True
(5) False, Indeterminate, True

26. Which of the following is generally **not** used in social scientific investigations?
(1) Field survey (2) Observation (3) Experiment
(4) Case study (5) Models

27. Which of the following symbolic expressions is **not** a theorem?
(1) $(P \rightarrow Q) \vee (Q \rightarrow R)$ (2) $(\sim P \wedge \sim Q) \rightarrow (P \leftrightarrow Q)$
(3) $(P \rightarrow Q) \wedge ((\sim P \rightarrow R) \wedge (\sim Q \rightarrow \sim R)) \rightarrow P$ (4) $(\sim P \wedge Q) \rightarrow \sim (P \leftrightarrow Q)$
(5) $(P \rightarrow Q) \leftrightarrow ((P \wedge Q) \leftrightarrow P)$

28. What is the mean and mean deviation respectively of the following quantities?
1, 2.5, 3.5, 5, 6, 7.5, 9.5
(1) 4, 2 (2) 5, 1.5 (3) 5.5, $1\frac{1}{4}$ (4) 6, 3 (5) 5, $2\frac{1}{7}$

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29. X is the class of all classes which are not members of themselves. Is X a member of itself? The answers to this question ultimately leads one to,
(1) necessary truth. (2) necessary falsity. (3) paradox.
(4) contradiction. (5) dilemma.

30. What is artificial intelligence?
(1) Developing techniques of improving intelligence in human beings.
(2) A branch of computer science focussed on building systems capable of performing tasks that usually require human intelligence.
(3) Study of methods by which human intelligence could be made more creative.
(4) Study of the intelligence which superseding normal human intelligence.
(5) The study of distinguishing between the intelligent activity of machine from those of humans using the Turing tests.

31. A, B, C are classes such that, $A\overline{B}\overline{C} = \phi$, $AB \neq \phi$, $x \in BC\overline{A}$
Which of the following is true?
(1) $C\overline{A}\overline{B} \neq \phi$ (2) $A = \phi$ (3) $CB \neq \phi$ (4) $\overline{A}\overline{B}\overline{C} = \phi$ (5) $AB\overline{C} \neq \phi$

32. How many different nine letter words could be formed from the letters of the word 'Malleable'?
(1) 4 306 (2) 7 460 (3) 9 600 (4) 10 460 (5) 10 800

33. Which of the following indirect truth-table lines properly shows the invalidity of the following symbolic argument?
$(((P \leftrightarrow Q) \rightarrow R) \wedge \sim R) \rightarrow \sim (P \rightarrow Q)$
(1) F F T T F T T F F F F T T
(2) T F F T F T T F F F T T F
(3) T F F T F T T F F T T F F
(4) T F T T F T T F F T T F T
(5) F F F T F T T F F F T F F

34. The fit of observation with reality is more in natural science than in social science. Why? Because
(1) natural scientific observations express their data using less statistical analysis than the social sciences.
(2) The questions put to nature to see what is happening are highly theoryladen in the social sciences, whereas the natural sciences use 'observation' language to express them.
(3) The social science depends on response of subjects for their observations and these tend to be not all that stable as the observations in the natural science.
(4) The prediction in social science is much less reliable than the prediction in natural science.
(5) There are no paradigms in social science as there are in natural science.

35. In the Boolean algebra, with the usual notation, which of the following is **incorrect**?
(1) $-1 = 0$ (2) $-0 = 1$ (3) $x+1 = 1$ (4) $x + \bar{x} = 0$ (5) $x(y+z) = xy + xz$

36. What is a Cancer?
(1) It is a group of diseases caused by microbes.
(2) A disease caused by a virus.
(3) A psycho-pathological disease caused by nerve damage.
(4) It is a group of diseases which have a nature of uncontrolled growth and spread of abnormal cells development.
(5) A disease caused by vitamin deficiency in the body.

37. Which of the following symbolic expressions give the correct output, indicated by the K-map given below?

C \ AB	00	01	11	10
0	1			
1		1	1	1

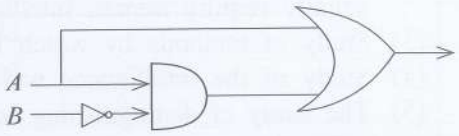
(1) $AC + BC + \overline{A}\overline{B}$ (2) $A\overline{C} + AC + B\overline{C}$ (3) $BC + \overline{A}\overline{B} + \overline{A}C$
(4) $\overline{A}\overline{C} + BC + AB$ (5) $\overline{A}C + \overline{B}\overline{C} + A\overline{B}$

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38. A problem outside the normal science (in Kuhn's sense) is
(1) discrepancy between the expectation going by the current paradigm and observed situation.
(2) a few details that has to be filled up to 'complete' the present conception.
(3) questions like 'what is the atomic weight of the newly discovered chemical element?'.
(4) working in the paradigm of classical physics, the question like, Is time an absolute thing, could it not be considered as relative to space.
(5) questions like the problems and techniques in the split of the atom.

39. What is the output of the following logic gate?
(1) $(A+B)$ (2) $(A\cdot\bar{B})+A$
(3) A (4) $\overline{(A+B)}$
(5) B



40. "The empirical nature of a theory shines when it is shown to be false." Who would you think makes the statement like the above?
(1) Carl Hempel (2) Ernest Nagel (3) Karl Popper
(4) Paul Feyerbend (5) Thomas Kuhn

41. What is the correct truth-tree of the symbolic argument?
$(P \wedge Q) \rightarrow \sim R \cdot (P \rightarrow S) \therefore (Q \rightarrow (\sim R \vee S))$

(1)
$(P\wedge Q)\rightarrow \sim R$
$(P\rightarrow S)$
$\sim(Q \rightarrow (\sim R \vee S))$
Q
$\sim(\sim R \vee S)$
R
$\sim S$
$\sim P \quad \sim S$
$\sim(P\wedge Q) \quad R\times$
$\sim P$
$Q\times$

(2)
$(P\wedge Q)\rightarrow \sim R$
$(P\rightarrow S)$
$\sim(Q \rightarrow (\sim R \vee S))$
Q
$\sim(\sim R \vee S)$
R
$\sim S$
$\sim P \quad S\times$
$\sim(P\wedge Q) \quad \sim R\times$
$\sim P \quad \sim Q$

(3)
$(P\wedge Q)\rightarrow \sim R$
$(P\rightarrow S)$
$\sim(Q \rightarrow (\sim R \vee S)$
Q
$(\sim R \vee S)$
R
$\sim S$
$\sim P \quad \sim S$
$\sim(P\wedge Q) \quad \sim R$
$\sim P\times$
$\sim Q$

(4)
$(P\wedge Q)\rightarrow \sim R$
$(P\rightarrow S)$
$\sim(Q \rightarrow (\sim R \vee S))$
Q
$\sim(\sim R \vee S)$
R
$\sim S$
$\sim P \quad \sim S$
$\sim(P\wedge Q) \quad \sim R$
$P\times$
$\sim Q$

(5)
$(P\wedge Q)\rightarrow \sim R$
$(P\rightarrow S)$
$(Q \rightarrow (\sim R \vee S))$
Q
$\sim(\sim R \vee S)$
R
$\sim S$
$\sim P \quad \sim S$
$\sim(P\wedge Q) \quad \sim R$
$\sim P \quad Q$

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42. Rejecting all non-observable and non-empirical concepts and emphasizing on conducting "experiments" by the Behaviourists in Psychology and introducing quantitative concepts and analysis as far as possible by Economists could be taken as major efforts by the practitioners of those social sciences to make their field more

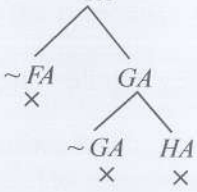
(1) Popular
(2) Modern
(3) Scientific on the lines of natural science
(4) Mathematical
(5) Technological

43. What is the correct truth tree of the following symbolic argument?

$\Lambda x\ (Fx \rightarrow Gx) \cdot \Lambda x\ (Gx \rightarrow Hx) \cdot \sim \mathrm{HA}\ \therefore \sim \mathrm{FA}$

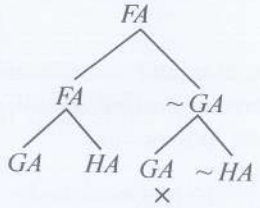
(1)

$\Lambda x\ (Fx \rightarrow Gx)$
$\Lambda x\ (Gx \rightarrow Hx)$
$\sim HA$
$\therefore \sim FA$
$\Lambda x\ (Fx \rightarrow Gx)$
$\Lambda x\ (Gx \rightarrow Hx)$
$\sim HA$
FA
$(FA \rightarrow GA)$
$(GA \rightarrow HA)$
$\sim HA$
FA



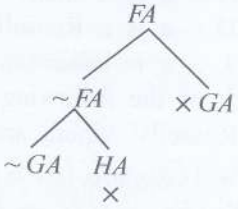
(2)

$\Lambda x\ (Fx \rightarrow Gx)$
$\Lambda x\ (Gx \rightarrow Hx)$
$\sim HA$
$\therefore \sim FA$
$\Lambda x\ (Fx \rightarrow Gx)$
$\Lambda x\ (Gx \rightarrow Hx)$
$\sim HA$
FA
$(FA \rightarrow GA)$
$(GA \rightarrow HA)$
$\sim HA$
FA



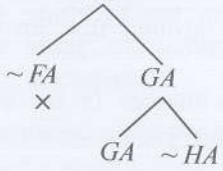
(3)

$\Lambda x\ (Fx \rightarrow Gx)$
$\Lambda x\ (Gx \rightarrow Hx)$
$\sim HA$
$\therefore \sim FA$
$\Lambda x\ (Fx \rightarrow Gx)$
$\Lambda x\ (Gx \rightarrow Hx)$
$\sim HA$
$\sim FA$
$(FA \rightarrow GA)$
$(GA \rightarrow HA)$
$\sim HA$
FA



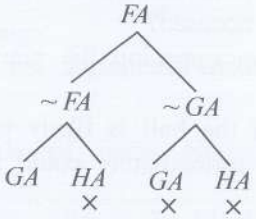
(4)

$\Lambda x\ (Fx \rightarrow Gx)$
$\Lambda x\ (Gx \rightarrow Hx)$
$\sim HA$
$\therefore \sim FA$
$\Lambda x\ (Fx \rightarrow Gx)$
$\Lambda x\ (Gx \rightarrow Hx)$
$\sim HA$
FA
$(FA \rightarrow GA)$
$(GA \rightarrow HA)$
$\sim HA$
FA



(5)

$\Lambda x\ (Fx \rightarrow Gx)$
$\Lambda x\ (Gx \rightarrow Hx)$
$\sim HA$
$\therefore \sim FA$
$\Lambda x\ (Fx \rightarrow Gx)$
$\Lambda x\ (Gx \rightarrow Hx)$
$\sim HA$
FA
$(FA \rightarrow GA)$
$(GA \rightarrow HA)$
$\sim HA$
FA



44. What does Paul Feyeraband mean when he speaks of 'anarchism' is the methodology of science as the best policy?

(1) Inductive and deductive methodologies have to be rejected.
(2) After relativist attacks on traditional methodologies, no satisfactory new methodology has emerged.
(3) As the records of eminent scientists like Copernicus, Galileo and others show, scientists adopt various methods in their work and only criterion is that of success. Thus any methods that work are admissible.
(4) There is a correct method for sciences.
(5) Sciences and scientists should be controlled by the scientific community.

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45. In which of the following explanations is the effect occurring prior to cause?
(1) Functional explanation (2) Teleological explanation
(3) Statistical explanation (4) Causal explanation
(5) Probabilistic explanation

46. 'No man is a man.' The above statement is
(1) a true preposition. (2) a dilemma.
(3) a contradiction. (4) a paradox.
(5) contingently false.

47. One conceivable shortcoming in the Methodology of scientific research programmes of Imre Lakatos is
(1) its extremely rational outlook.
(2) its inability to state clearly when a regressive programme has to be given up.
(3) making a theory a research programme makes the theory instrumentalist.
(4) structuring the theory into hardcore and protective belt and working only with the protective belt seems to alienate the hard core and make it dormant.
(5) there is little room for inter theory interaction.

48. On the basis of the scheme of abbreviation.
F : a is a reptile
G : a is a snake
H : a is a Russells viper
J : a is killer
Which of the following is the correct symbolization of the sentence 'Among reptiles only snakes and Russells' vipers are deadly on poisonous.
(1) $\wedge x\ (Fx \rightarrow ((Jx \rightarrow (Gx \vee Hx))$
(2) $Vx\ (Fx \rightarrow ((Jx \rightarrow Gx) \wedge (Jx \rightarrow Hx))$
(3) $\wedge x\ (Fx \rightarrow ((Jx \rightarrow (Gx \wedge Hx))$
(4) $\wedge x\ (Jx \rightarrow ((Gx \wedge Hx) \rightarrow Fx))$
(5) $\wedge x\ ((Fx \rightarrow Jx) \rightarrow (Gx \vee Hx))$

49. Max Plank in his autobiography wrote a 'a new scientific truth' does not triumph by convincing its opponents and making them see the light but rather because its opponents eventually die and new generation grows up that is familiar with it. What Planck states as 'a new scientific truth' would be in Kuhn's terms a scientific
(1) theory. (2) revolution. (3) paradigm. (4) law. (5) truth.

50. Which of the following reasons would **not** be considered as basis which a court will take into consideration in giving bail to an accused?
(1) The police and the prosecution opposing the grant of bail on the ground that investigation are not completed.
(2) The relevant accused received the bail is likely to influence the witnesses in the case.
(3) The grant of bail to accused immediately could lead to unavoidable public commotion and unrest.
(4) The accused is a well known businessman in the country.
(5) The accused has a record of violating bail terms.

* * *

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AL/2026/24/E-II

සියලු ම හිමිකම් ඇවිරිණි/முழுப் பதிப்புரிமையுடையது/All Rights Reserved]

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2026
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2026
General Certificate of Education (Adv. Level) Examination, 2026

තර්ක ශාස්ත්‍රය හා විද්‍යාත්මක ක්‍රමය II
அளவையியலும் விஞ்ஞானமுறையும் II
Logic and Scientific Method II

24 E II

පැය තුනයි
மூன்று மணித்தியாலம்
Three hours

අමතර කියවීම් කාලය - මිනිත්තු 10 යි
மேலதிக வாசிப்பு நேரம் - 10 நிமிடங்கள்
Additional Reading Time - 10 minutes

Use additional reading time to go through the question paper, select the questions you will answer and decide which of them you will prioritise.

Instructions:

* *The Number of questions that should be answered is six.*
* *The question in the* ***Part*** **I** *is compulsory.*
* *In addition answer* ***five*** *questions selecting* ***at least two*** *questions from each of the* ***Parts*** **II** *and* **III**.

N.B.

* The symbols for the logical constants and operations are as given below. In answering this paper, the symbols should be used accordingly.

In the sentential and predicate calculi:

Negation: $\sim$, Implication: $\rightarrow$, Conjunction: $\wedge$, Disjunction: $\vee$, Biconditional: $\leftrightarrow$,
Universal quantifier: $\wedge$, Existential quantifier: $\vee$

In class logic:

The class union of classes A and B: $A \cup B$, class intersection: $A \cap B$ or AB, the complement of A: $\overline{A}$, universe class: U, null class: ϕ

In Boolean algebra:

sum: $+$, product: $\cdot$, the complement of X: $\overline{X}$, values : 1 and 0

In Logic gates:

The AND, OR, NOT, XOR gates for inputs A and B will be respectively shown by $A \cdot B$, $A + B$, $\overline{A}$, $A \oplus B$

* The candidates are advised **not** to use any other symbols for logical constants.
* The candidate should **not** use theorems (e.g. De Morgan theorem)in derivations except when the theorem itself has been proved by the candidate.

Part I

1. (i) Write down the subject and predicate, in that order, of the following sentence.

All candidates for the General Manager post of that bank are candidates with a doctorate in Banking with ten years experience.

(ii) Name the twentieth century Russian scientist who advocated, Lamarckism as against the Darwinian and other views.

(iii) Write down the Aristotelian categorical A proposition, which is considered logically equivalent to the hypothetical sentence, if one is a Sri Lankan then he can come back to Sri Lanka at any time.

(iv) What is the most appropriate term to fill in the blank of the following statement?

"Emile Rue discovered that..... secreted by a bacteria brings about the death by diphtheria."

(v) If $((P \rightarrow Q) \wedge \sim P)$ is false, what could be the truth value of Q?

(vi) In Boolean algebra, what is equivalent to $(x+y)\cdot(x+\overline{y})$?

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(vii) What is Karl Marx's 'Theory of Value'?

(viii) If A, B are classes and $A = \phi$ and B is not null, then what is $A \cdot \overline{B}$ equivalent to?

(ix) Symbolize the sentence, "All that glitters is not gold" using the scheme of abbreviation
F : a glitters.
G : a is gold.

(x) Three colours are seen prominently in pictures of the ladies (leaving ornaments) of the Sigiriya frescos. Name the three colours.

(02 × 10 = 20 marks)

Part II

2. (*a*) (i) What is a categorical proposition? *(02 marks)*

(ii) A person could call the same characteristics differently as in Bertrand Russell's of following jocular example
I am firm
You are obstinate
He is a pig-headed fool
Which of the three forms; usages of language literal, emotive and command is used in the above example? *(03 marks)*

(iii) "This man is mortal." to which of the following categories does this proposition fall in Aristotelian Logic.
(1) Universal proposition
(2) Particular proposition
(3) Singular proposition *(02 marks)*

(*b*) (i) Distinguish between immediate inference and mediate inference. *(03 marks)*

(ii) When you infer from the proposition "All crows are black," the proposition that "some non-black things are not crows", what is the type of immediate inference that is made? *(02 marks)*

(iii) Write short essay on 'Ordinary Language and Logic'. *(04 marks)*

3. (*a*) Explain the followings.
(i) Connotation and denotation
(ii) Analytic and synthetic truth
(iii) Synonymy
(iv) Ostensive definition *(02 × 4 = 08 marks)*

(*b*) (i) Is it necessary to have all the five limbs of the *Pancāvayava Anumāna*? Discuss. *(04 marks)*

(ii) Explain **two** of the followings,
(1) *Chala*
(2) *Prasanga*
(3) *Udaharana* *(02 × 2 = 04 marks)*

4. (*a*) Determine the validity or invalidity of the following syllogisms using the Rules for the Validity of a Syllogism. When the syllogism is invalid, state the rules that are violated and the fallacy that is committed.

(i) Some parrots are not green.
All parrots are pets.
Therefore all pets are not green.

(ii) Some diamonds are not precious stones.
Some Sri Lankan gems are diamonds.
Therefore some precious stones are Sri Lankan gems. *(04 × 2 = 08 marks)*

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(*b*) (i) Symbolize the following argument in terms of classes, giving your scheme of abbreviation and determine its validity using Venn diagrams.

All women-cricket teams play fifty over cricket.

Some women-cricket teams also play twenty over cricket.

Therefore some women cricket teams playing twenty over cricket play fifty over cricket. *(04 marks)*

(ii) Explain the following concepts.

(1) Universe class

(2) Null class *(02 × 2 = 04 marks)*

5. (*a*) Prove the following theorems.

(i) $(P \rightarrow Q) \wedge (P \rightarrow \sim Q) \rightarrow \sim P$

(ii) $(P \rightarrow Q) \vee (Q \rightarrow R)$ *(02 × 2 = 04 marks)*

(*b*) Symbolize the following argument giving your scheme of abbreviation and test its validity by the **indirect** method of truth table.

Raja will come if he gets the message, on the condition that he is still interested. He did not come but he is still interested.

Therefore, Raja did not get the message. *(02 marks)*

(*c*) Symbolize the following argument giving your scheme of abbreviation and show its validity by the method of derivation.

If the blue litmus paper turns red, then the solution is acid. Therefore if the blue litmus paper turns red, then either the solution is acid or some impurity has entered the solution. *(02 marks)*

(*d*) Symbolize the following argument giving your scheme of abbreviation and examine its validity by derivation.

All comedians are fun loving men.

No fun loving men are rich.

Therefore no comedian is rich. *(02 marks)*

(*e*) Symbolize the following argument giving your scheme of abbreviation and show its validity by **truth trees**.

Everyone who have either a sense of humour or a sense of beauty love children. Anyone who loves children is happy. Therefore any one who has a sense of humour is happy. *(02 marks)*

(*f*) (i) Draw the K-map for the following Boolean expression in

$\bar{A}BC + A\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C} + A\bar{B}C + ABC$

(ii) Using disjunction draw a logic gate for the symbolic expression $(\sim A \leftrightarrow \sim B)$. *(02 × 2 = 04 marks)*

6. (*a*) Identify the fallacies in the following arguments and explain how each fallacy occurs.

(i) Nobody has been able to prove that there are no ghosts. Therefore there must be ghosts.

(ii) (The following is from Mark Antony's funeral speech in Shakespeare's Julies Caesar)

Friends, Romans, Countrymen, lend me your ears. I come to bury Caesar, not to praise him. The good is oft interred with their bones, so be it with Caesar. Here is the will, and under Caesar's seal, to every Roman citizen he gives, Seventy-five drachmas. (The aroused crowd rushes to get Ceaser's killers. Antony says to himself "I had moved them".)

(iii) After seven days of *pooja* at the temples of deities in the *Vanni*, praying for rain, heavy rain fell in the *Vanni* and the floods started. Therefore the *poojas* to the deities brought the rain. *(03 × 3 = 09 marks)*

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(*b*) (i) What are the attributes of evidence in a court of law? *(04 marks)*

(ii) "Eyewitness testimony carries more weight in a court of law." Briefly explain. *(03 marks)*

Part III

7. (*a*) "Charles Darwin was a supreme practitioner of inductive methodology in science." Substantiate, using his activities during the *Beagle* expedition and after. *(04 marks)*

(*b*) "Mathematization of physics and astronomy and development of deductive method in science go hand in hand." Illustrate this statement from the work of Galileo, Kepler and Newton. *(06 marks)*

(*c*) Francis Bacon said his inductive method leads to 'true' and 'certain knowledge', which thinkers of the time like Descartes were also aiming at. On the other hand, what David Hume showed was that there is no rational basis for inductive method." Discuss. *(06 marks)*

8. (*a*) "Devising experiments and at times even observations to get the required data is one of the common but sometimes extremely difficult and creative, complicated activities of the scientist". Substantiate this, using at least **two** examples from the history of science. *(10 marks)*

(*b*) "Natural and social sciences and even artificial intelligence are today heavy use of statistical methods." Examine. *(06 marks)*

9. (*a*) (i) What is an empirical generalization? Explain, using Boyle's law. *(03 marks)*

(ii) Explain what is meant by saying that Newton's Theory of Gravitation is a theoretical generalization. *(03 marks)*

(iii) What is meant by saying that "the social sciences do not explain but bring about understanding?" *(04 marks)*

(*b*) Analogy and models play an indispensable role in the creative activity of science. Discoveries of structures are discoveries of models. As statements like,"What were ducks earlier have now become rabbits", show, even paradigm changes are mostly model changes. Discuss. *(06 marks)*

10. (*a*) State and explain the salient features of a Scientific Revolution in Kuhn's account. *(10 marks)*

(*b*) "Poppers falsifiability has more or less continued in Feyerabend and Lakatos" Do you agree? *(06 marks)*

11. Write notes on **four** of the following

(i) The age of Artificial Intelligence and its problems

(ii) Comparison of Lakatos' scientific research programmes and paradigms of Kuhn

(iii) Environment and health issues

(iv) Space research and travel - where could it lead us?

(v) Spreading fake news is a crime

(vi) Ethical problems of genetic engineering *(04 × 4 = 16 marks)*

* * *

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