නව නිර්දේශය/புதிய பாடத்திட்டம்/*New Syllabus*

NEW

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

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2019 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2019 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2019

තර්ක ශාස්ත්‍රය හා විද්‍යාත්මක ක්‍රමය	I
அளவையியலும் விஞ்ஞானமுறையும்	I
Logic and Scientific Method	**I**

24 **E** **I**

07.08.2019 / 1300 – 1500

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.
* Each question carries **01** marks making a total of **50** marks.

N.B.

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

In the sentential and predicate calculi

Negation : ~, Implication : →, Conjunction : ∧, Disjunction : ∨, Biconditional : ↔

Universal quantifier : Λ , Existential quantifier : V

In class logic:

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

In Boolean algebra:

sum: +, product: ·, the complement of x: $\bar{x}$, values 1 and 0.

In Logic gates:

The AND, OR, NOT, XOR gates will be respectively shown by $A \cdot B, A + B, \bar{A}, A \oplus B$.

1. Two of the factors in the Aristotelian analysis of a proposition are
   (1) premises and conclusions.
   (2) truth and validity.
   (3) particular and singular.
   (4) subject and predicate.
   (5) function and argument.

2. The deviations from a circular orbit of the observed positions recorded by Tycho de Brahae of the motion of one of the following planets guided Kepler to the discovery that planetary orbits are elliptic. That planet was
   (1) Jupiter. (2) Venus. (3) Mars. (4) Mercury. (5) Uranus.

3. A sound deductive argument is
   (1) a valid argument.
   (2) an invalid argument with a true conclusion.
   (3) a valid argument with false premises.
   (4) an invalid argument with true premises.
   (5) a valid argument with true premises.

4. In scientific methodology, an empirical test is
   (1) an observation.   (2) an experiment.
   (3) an observation or an experiment.   (4) an experiment with measurement.
   (5) an observation followed up with experiment.

[see page two

5. Of the sentences given below, what could be considered a simple categorical proposition in traditional Logic?
   (1) He is a Sri Lankan or an Indian.
   (2) If anyone is a Sri Lankan, then he can come.
   (3) No Sri Lankan was the Secretary General of the United Nations Organization.
   (4) Did Socrates drink the poison?
   (5) Jack and Jill went up the hill.

6. Which of the following could be considered a natural observation?
   (1) Kepler's observation that the orbit of a planet around the Sun was elliptic.
   (2) Lavoisier's observation that the weight of an object after combustion increases.
   (3) Galileo's observation through his telescope that the surface of the Moon is uneven.
   (4) John Dalton's observation that elements combine in small ratios by weight to form compounds.
   (5) John Waston's seeing the X-ray diffraction pattern of DNA molecule produced by Rosalind Franklin as that of a 'double helix'.

7. The obverse of the sentence, 'All shrimps are non obtainable today' is
   (1) Some shrimps are not obtainable today.
   (2) All non-obtainable things today are shrimps.
   (3) No shrimps are obtainable today.
   (4) Some non-obtainable things today are shrimps.
   (5) Some shrimps are obtainable today.

8. Which of the following measurements could or does use a ratio scale?
   (1) Testing a person's knowledge of French
   (2) The Intelligence Quotient (IQ) of a person
   (3) Length
   (4) Temperature in °C or °F
   (5) Term test assessment of a student's marks in the class

9. The syllogism "All Sri Lankans are Aryans. Some Indians are Aryans. Therefore some Sri Lankans are Indians."
   (1) is a valid argument.
   (2) commits the fallacy of the illicit major.
   (3) commits the fallacy of the illicit minor.
   (4) is a sound argument.
   (5) commits the fallacy of the undistributed middle.

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10. The colours in the rainbow, X-rays, infra-red rays, ultra-violet rays and gamma rays are all
    (1) white light.   (2) gravitational waves.   (3) invisible light.
    (4) electromagnetic radiation. (5) radio waves.

11. Which of the following pairs of propositions in the traditional square of opposition has a **non-symmetric** relation between its two members?
    (1) A and E   (2) A and O   (3) A and I   (4) E and I   (5) O and I

12. The binomial nomenclature using two names to classify organisms based on genus and species was a major contribution to taxonomy by
    (1) Jean-Baptiste Lamarck.   (2) Charles Darwin.
    (3) Carolus Linnaeus   (4) Alfred Wallace.
    (5) Antoine Van Leeuwenhoek.

13. Which of the following statements about 'conversion' is true?
    (1) The converse of an I proposition is an O proposition.
    (2) The converse of an A proposition is an A proposition.
    (3) The converse of an O proposition is an A proposition.
    (4) The converse of an I proposition is an I proposition.
    (5) The converse of an E proposition is an A proposition.

14. In a complete induction by enumeration if the premises are true then the conclusion is
    (1) true.   (2) probable.   (3) invalid.   (4) uncertain.   (5) possibly true.

15. The sentence,
'It is false that if it rains the Mahaveli overflows.' and
The sentence,
'It rains and the Mahaveli does not overflow.' are
    (1) contradictory.   (2) not logically related.
    (3) logically equivalent.   (4) contrary.   (5) neither equivalent nor contrary.

16. Nanometre and the light year can be, respectively, best used for giving the measures of
    (1) size of bacteria and dinosaurs.
    (2) wave lengths of audible sound and the speed of a car.
    (3) atomic distances and intergalactic distances.
    (4) sizes of micro-organisms and velocity of sound.
    (5) speed of rotation of Earth about its axis and distances of Saturn from Earth as both orbit the Sun.

17. If A, B are non-empty classes and $A\bar{B} = \phi$, then
    (1) $\bar{A}\bar{B} \neq \phi$ (2) $\bar{A}B \neq \phi$ (3) $\bar{A}\bar{B} = \phi$ (4) $AB \neq \phi$ (5) $AB = \phi$

18. How many different sets of three cards can be dealt from a pack of 52 cards?
    (1) 17850   (2) 20658   (3) 22100   (4) 126000   (5) 221225

19. Which of the following is the correct truth-tree for the argument $(P \vee \sim Q) \cdot (P \to R) \; \therefore \; (Q \to R)$?

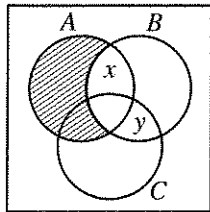   (1)   (2)   (3)   (4)   (5)

20. X's household needs 1 kg of sugar, 5 coconuts, 5 kg of rice, 2 kg of dhal and $3\,l$ (litres) of milk for the week. The prices of these items during two successive weeks were as follows.

		Price: 1st week (Rs.)	Price: 2nd week (Rs.)
Sugar	1 kg	100	110
Coconut		50	45
Rice	1 kg	90	100
Dhal	1 kg	150	160
Milk	1 l	200	220

If only these factors are counted in the calculation of the cost of living index, the ratio by which the cost of living index has changed in the second week to two decimal places is
    (1) 0.95   (2) 1.07   (3) 1.10   (4) 1.16   (5) 1.19

21. In the sentence, 'A few men were non-smokers.'
    (1) the subject is distributed
    (2) no term is distributed.
    (3) only the predicate is distributed.
    (4) both subject and predicate are distributed.
   (5) the distribution of the terms cannot be determined.

22. Who, among the following scientists, was the outstanding scientist that used innovative, instructive and lasting methods to provide solutions to the immediate problems of life and occupation, which his society in general, was facing?
    (1) Isaac Newton   (2) Charles Darwin
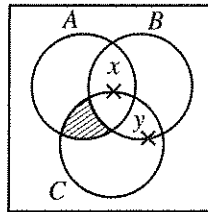   (3) Alexander Fleming   (4) J.C. Bose
    (5) Louis Pasteur

23. If A, B, C are classes and x, y are class members and $AB \neq \phi, AC = \phi, \bar{B}C \neq \phi, x \in A$ and $y \in B$, then Venn diagram which represents these correctly is
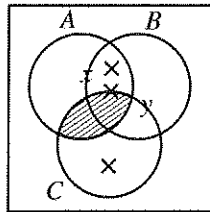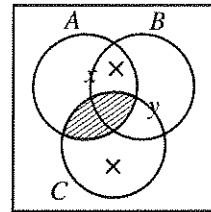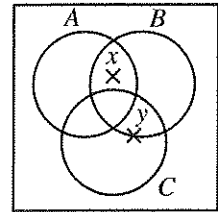

| (1) | (2) | (3) | (4) | (5) |

24. The methodologists of science who had been influenced by B.L. Whorf's idea that language has an effect on the world view of a community were
    (1) Inductivists.   (2) Empiricists.   (3) Deductivists.
    (4) Relativists.   (5) Positivists.

25. Which set of the following characteristics properly apply to the syllogism, "All Pakistanese speak Urdu. All Sinhalese do not speak Urdu. Therefore, no Sinhalese are Pakistanese"?
    (1) Figure 1, AAE, valid   (2) Figure 2, AEE, valid
    (3) Figure 3, AOE, invalid   (4) Figure 4, AOE, valid
    (5) Figure 2, AOE, invalid

26. Hooke's law says that (within certain limits) the extension of a spring or wire is directly proportional to the force applied. When a graph of the force applied against the extension is plotted, which of the following would the graph appear to be?
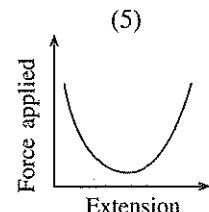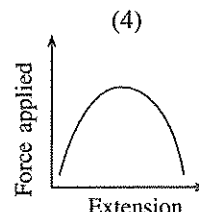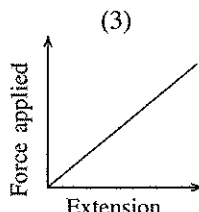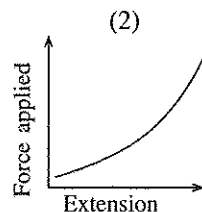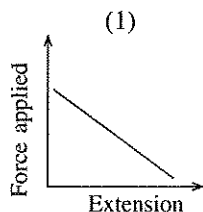
27. The three classes A, B, C shown in the diagram are such that
    (1) some of them are null.
    (2) none of them are null.
    (3) together, they do not exhaust the universe of discourse.
    (4) whether the classes are null or not null is indeterminable.
    (5) all of them are null.
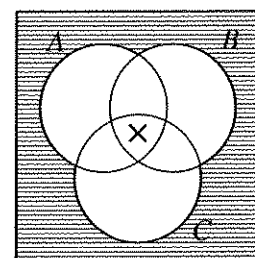
28. Galileo's Law is an empirical generalization but Newton's Law of Gravitation is a theoretical generalization because,
    (1) Newton's Law is more accurate than Galileo's.
    (2) Newton's Law is more general than Galileo's.
    (3) Galileo's Law is more simple than Newton's.
    (4) Newton's Law has non-observational concepts while Galileo's Law hasn't.
    (5) Newton's Law goes beyond Galileo's law.

29. Out of the given list, which of the following rules of inference is used in the proof of the theorem $(P \lor \sim P)$?
    (1) Double negation   (2) Addition   (3) Adjunction
    (3) Modus ponens   (5) Modus tollens

30. The three stages in evolution of human knowledge that August Comte saw were
    (1) Thesis – Anti thesis – Synthesis
    (2) Aesthetic – Moral – Religious
    (3) Theological – Metaphysical – Positivist
    (4) Oral – Anal – Genital
    (5) Sense – Reason – Understanding

31. Which of the following fallacies is **not** considered a fallacy of irrelevance?
   (1) Appeal to pity   (2) Appeal to force
    (3) Argument from ignorance   (4) Petitio principii
    (5) Appeal to authority

32. When compared with the research in the Natural Sciences, a limitation in the research in the Social Sciences, in general is, that it does **not** engage in
    (1) empirical research.   (2) scientific research.
    (3) experimental research.   (4) theoretical research.
    (5) objective research.

33. What is the symbolization of the sentence,
"Those who are graduates only wear the cloak." using the scheme of abbreviation
F: *a* is a graduate,   G: *a* wears the clock?
    (1) $\lor x (Fx \land Gx)$ (2) $\Lambda x (Gx \rightarrow Fx)$ (3) $\Lambda x (Fx \rightarrow Ga)$
    (4) $\Lambda x (Fx \rightarrow Gx)$ (5) $\Lambda x (\sim Gx \rightarrow \sim Fx)$

34. The deductive methodologies outline how a scientific generalization is
    (1) discovered.   (2) tested.   (3) verified.   (4) falsified.   (5) analysed.

35. What is logically equivalent to the symbolic sentence $(P \leftrightarrow Q)$?
    (1) $(P \rightarrow Q) \land (\sim Q \rightarrow P)$ (2) $(P \lor Q) \land (Q \rightarrow P)$
    (3) $(P \land Q) \rightarrow (\sim P \land \sim Q)$ (4) $(P \rightarrow Q) \land (Q \rightarrow \sim P)$
    (5) $(P \land Q) \lor (\sim P \land \sim Q)$

36. Which of the following gives the proper sequence of situations outlined in Thomas Kuhn's account of the process of any science?
    (1) pre-science, crisis, paradigm, anomalies, normal science, revolution
    (2) revolution, crisis, normal science, anomalies, paradigm, pre-science
    (3) pre-science, revolution, normal science, crisis, anomalies, paradigm
    (4) paradigm, pre-science, normal science, revolution, crisis, anomalies
    (5) pre-science, paradigm, normal science, anomalies, crisis, revolution

37.   (a) 2, 3, 3, 4, 4, 5, 5, 4, 6, 6, 7, 5, 5, 8, 5
    (b) 3, 5, 7, 9, 1, 11, 18, 22
    (c) 2, 3, 3, 4, 3, 6, 7, 8, 8, 9, 3
What are the modes of the three arrays of data given above?
    (1) (a) 5 (b) none (c) 3.   (2) (a) 4 and 5 (b) 8 (c) 3 and 8.
    (3) (a) 4 and 5 (b) none (c) 5.   (4) (a) 5 (b) none (c) 3 and 8.
    (5) (a) 5 (b) 5 (c) 8.

38. Which is the correct truth table line for the argument $(P \lor Q) \cdot (R \rightarrow \sim Q) \cdot Q \therefore P$, when the indirect truth table method is used to test its validity?
    (1) F T T T   F T F T T T   F F
    (2) T T F T   F T T T T F   T F
    (3) T T F T   F T T T T F   F F
    (4) T T F T   F T T T T F   F T
    (5) T T F T   F T T F T F   F F

39. Carl Hempel states that the Covering Law Model of Explanation (Deductive Nomological Explanation) gives the structure of explanation in social sciences as well but that the explanations given in the social sciences is mostly,
    (1) teleological.   (2) functional.
    (3) probabilistic-statistical.   (4) Ideological.
    (5) causal.

40.
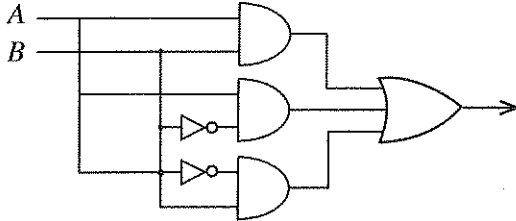
The simplified form of the Boolean expression corresponding to the above logic gate is
    (1) $(A + \bar{B})$ (2) $(\bar{A} . \bar{B})$ (3) $(\overline{A+B})$ (4) $(A + B)$ (5) $(\bar{A} + \bar{B})$

41. What the discovery of Neptune confirmed was that the initial conditions used in the derivation of the orbit of Uranus
    (1) were not all true.
    (2) had used some false data.
    (3) were not exhaustive of the relevant data.
    (4) were irrelevant.
    (5) were not accompanied by a sufficient number of auxiliary hypotheses.

42. What is equivalent to $\overline{x.y}$ in Boolean algebra?
    (1) $\bar{x}.\bar{y}$ (2) $\bar{x}+\bar{y}$ (3) $x+y$ (4) $x.(y+\bar{y})$ (5) $\overline{x+y}$

43. About 70 years back, a leading Newspaper Office conducted a last minute opinion poll by telephone to predict the result of a Presidential Election in a powerful country. The poll was conducted by recording the preferences of voters using the telephone. The poll predicted a win for the more conservative candidate but at the elections the predicted candidate lost. It was realized later that the prediction went wrong due to a methodological error. What was it?
    (1) The pollster did not take into account that in an advanced country the more progressive candidate would be favoured by the voter.
    (2) the questionnaire of the pollster was not properly designed.
    (3) The sample of the population selected for interviews using telephone subscribers was liable to be not fair.
    (4) The poll did not take into account that the winning candidate was already the incumbent President seeking a second term and hence was in an advantageous position.
    (5) The pollster had not been properly trained.

44. A candidate sitting for the G.C.E.(A/L) examination paper in Logic and Scientific Method some years back tried to show that the argument.

    Vx Fx ∴ ∧x Fx

    is valid by the following derivation.

    1. ~~Show~~ ∧x Fx

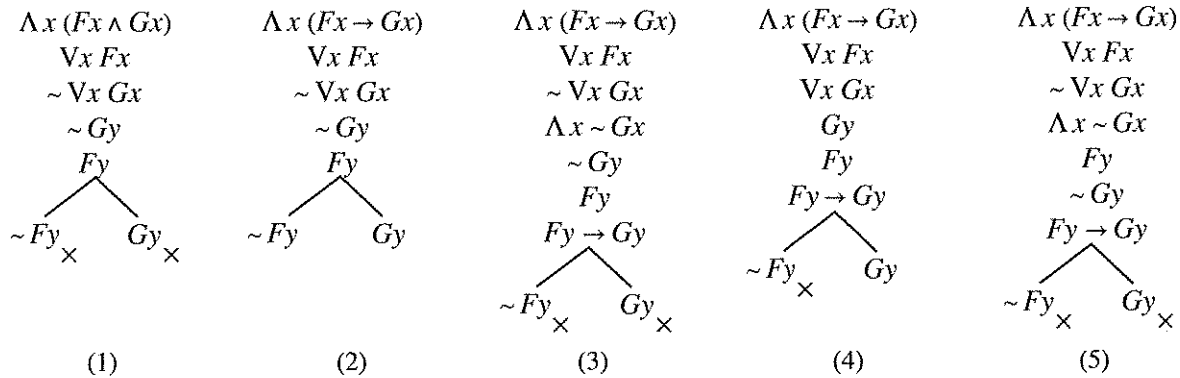 | 2. Vx Fx | Premise |
    | 3. Fy | 2, EI |
    | 4. ~~Show~~ ∧y Fy | |
    | 5. Fy | 3, R |
    | 6. Fx | 4, UI |

    In which line did the candidate make the first false move?
    (1) 2   (2) 3   (3) 4   (4) 5   (5) 6

45. Which of the following is the correct truth tree for the argument, "All men are unicorns. Some men exist. Therefore some unicorns exist.", given that *F*: *a* is a man and *G*: *a* is a unicorn?

(1)	(2)	(3)	(4)	(5)

(1)
$\Lambda x\,(Fx \wedge Gx)$
$Vx\,Fx$
$\sim Vx\,Gx$
$\sim Gy$
Fy
$\sim Fy \times \quad Gy \times$

(2)
$\Lambda x\,(Fx \rightarrow Gx)$
$Vx\,Fx$
$\sim Vx\,Gx$
$\sim Gy$
Fy
$\sim Fy \quad Gy$

(3)
$\Lambda x\,(Fx \rightarrow Gx)$
$Vx\,Fx$
$\sim Vx\,Gx$
$\Lambda x \sim Gx$
$\sim Gy$
Fy
$Fy \rightarrow Gy$
$\sim Fy \times \quad Gy \times$

(4)
$\Lambda x\,(Fx \rightarrow Gx)$
$Vx\,Fx$
$Vx\,Gx$
Gy
Fy
$Fy \rightarrow Gy$
$\sim Fy \times \quad Gy$

(5)
$\Lambda x\,(Fx \rightarrow Gx)$
$Vx\,Fx$
$\sim Vx\,Gx$
$\Lambda x \sim Gx$
Fy
$\sim Gy$
$Fy \rightarrow Gy$
$\sim Fy \times \quad Gy \times$

46. Which of the following positions is subscribed to by relativist thinkers in the methodology of science?

(1) Linear growth of scientific knowledge
(2) Successive paradigms in science are consistent
(3) Theoryladenness of observation language
(4) When theory succession takes place the preceding paradigm could be reduced to the succeeding paradigm.
(5) The possibility of crucial tests between successive theories

47. Which of the following is an analytic sentence?

(1) The evening star is the morning star.
(2) Some bachelors are married.
(3) The Sun rises every morning.
(4) Earth is a sphere.
(5) Man is mortal.

48. The theory of punishment which the quote, "An eye for an eye and a tooth for a tooth." exemplifies is

(1) Restorative justice.
(2) Rehabilitative justice.
(3) Pragmatic justice.
(4) Retributive justice.
(5) Reformative justice.

49. If you are given that

"None but a fool would commit suicide" and you know that this particular person Somapala committed suicide,

which of the following conclusions can you reach?

(1) All are fools.
(2) Either you are not a fool or you commit suicide.
(3) There are some fools.
(4) One's being a fool and one's committing suicide are equivalent.
(5) There are no fools who do not commit suicide.

50. The civilization built in the dry zone lowlands of Sri Lanka is universally acknowledged to be a technologically highly sophisticated rare quality example in the ancient world of

(1) an arid zone civilization.
(2) an agricultural civilization.
(3) a paddy cultivating civilization.
(4) a hydraulic civilization.
(5) a mechanical civilization.

* * *

(නව නිර්දේශය /புதிய பாடத்திட்டம் /*New Syllabus*)

NEW

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka

Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2019 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2019 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2019

තර්ක ශාස්ත්‍රය හා විධිඥාත්මක ක්‍රමය	**II**
අளவையியலும் விஞ்ஞானமுறையும்	**II**
Logic and Scientific Method	**II**

24 E II

09.08.2019 / 1400 – 1710

පැය තුනයි	අමතර කියවීම් කාලය - මිනිත්තු 10 යි
மூன்று மணித்தியாலம்	மேலதிக வாசிப்பு நேரம் - 10 நிமிடங்கள்
Three hours	**Additional Reading Time - 10 minutes**

Use **additional reading time** to go through the question paper, select the questions and decide on the questions that you give priority in answering.

Instructions:

* The question in first Part 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 used in this paper are as following. In answering this paper, the symbols should be used accordingly.

In the sentential and predicate calculi,

Negation : ~, Implication: →, Conjunction: ∧, Disjunction: ∨, Biconditional: ↔

Universal quantifier: ∧, Existential quantifier: ∨

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 or 0.

In Logic gates:
The AND, OR, NOT, XOR gates will be respectively shown by $A \cdot B, A + B, \overline{A}, A \oplus B$.

* The candidate is advised **not** to use any other symbols for logical constants or operations.
* 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) Of what do truth and validity, in that order, become values or characteristics?

   (ii) In Popperian terms, what is the defining characteristic of scientific knowledge?

   (iii) When is a deductive system consistent?

   (iv) Name the **two** fundamental physical dimensions in terms of which speed expressed.

   (v) How does the middle term occur in the premises in the third figure of the Aristotelian categorical syllogism?

   (vi) Given that F: a glitters, G: a is gold, symbolize the sentence 'All that glitters is not gold.', interpreting it suitably and using only the universal quantifier and the symbol of implication.

   (vii) Natural scientific theory provided explanation but what, according to some dominant groups of social scientific methodologists, does social scientific theory provide in place of explanation?

(viii) What is a Boolean expression?

(ix) "Religion is the sigh of the oppressed creature, the heart of the heartless world and the soul of a soulless condition. It is the opium of the masses."

Who made the above statement?

(x) Francis Crick, the co-discoverer of the structure of the DNA molecule, wrote in his book, 'Of Molecules and Men',

"The ultimate aim of the modern movement in biology is in fact to explain all biology in terms of physics and chemistry."

What is the term that is usually used to refer to this aim and approach mentioned by Crick?   *(10 × 02 = 20 marks)*

Part II

2. (*a*) (i) What is the immediate inference of 'conversion'?

(ii) Which of the Aristotelian categorical propositions have conversions without restrictions? Give example.

(iii) Explain, giving an example, conversion by limitation.   *(08 marks)*

(*b*) Determine the validity/invalidity of the following syllogisms. When the syllogism is invalid state the rule/rules it violates and name the fallacy/fallacies that results.

(i) Men are hot-tempered.
Sri Lankans are men.
Therefore Sri Lankans are hot-tempered

(ii) No astronauts are over fifty years of age.
Anyone over fifty years of age is mature.
Therefore no astronaut is mature.

(iii) Some terrorists strike.
Those who strike are hit back.
Therefore terrorists are hit back.   *(08 marks)*

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3. (*a*) Symbolize the following argument giving your scheme of abbreviation and test it for validity by the indirect method of truth tables.

Although Nimalee and Madusha are clever, either of them is not of good behaviour. Nimalee will not get the job unless her behaviour is good. If Nimalee does not get the job then she goes abroad with Madusha. Therefore, Madusha goes abroad.   *(05 marks)*

(*b*) Symbolize the following argument stating your scheme of abbreviation using P, Q, R, ... to symbolize the simple sentences in the order of occurrence of them in the argument and show it to be valid by derivation.

If and only if Mahadanamutta was wise he was clever. He was clever but he broke the wall of the house and got into Gamarala's house on the elephant. He got the goat's neck cut and ordered breaking the pot and finally he got the goat's head out! The fact that he broke the wall of the house and got the goat's neck cut implies that he is a fool. If he is a fool then he is not wise. Therefore, we live in a mad world.   *(06 marks)*

(*c*) Using quantification symbolize the following argument giving your scheme of abbreviation and show it to be valid by the method of derivation.

All men are ambitious. Some men are businessmen. Therefore, some who are ambitious are businessmen.   *(05 marks)*

4. (a) (i) Simplify the Boolean expression $f = \bar{A} \cdot \bar{B} \cdot \bar{C} + \bar{A} \cdot B \cdot \bar{C}$ using the Karnaugh map. *(02 marks)*

   (ii) Simplify the above expression using the rules of Boolean algebra and check the result that you get in (i). *(02 marks)*

   (iii) Draw the logic gate for the full expression $f = \bar{A} \cdot \bar{B} \cdot \bar{C} + \bar{A} \cdot B \cdot \bar{C}$ without simplifying it. *(02 marks)*

   (iv) Draw the reduced logic gate for the expression given in (iii) above using the simplified equivalent obtained in (i) and (ii) above. *(02 marks)*

   (b) Symbolize the following arguments giving your schemes of abbreviation and determine their validity/invalidity using the method of truth-trees.

   (i) If Sherlock Holmes overslept or Watson was indecisive than the criminal escapes to South America. The criminal did not escape to South America. Therefore, Sherlock Holmes did not oversleep. *(04 marks)*

   (ii) Every elephant is not a Tusker.
   A tusker is highly-priced.
   Therefore, every elephant is not highly priced.
   (You may take 'every A is not B' as equivalent to the particular negative, 'some A is not B'.) *(04 marks)*

5. (a) Symbolize the following arguments in terms of classes giving your scheme of abbreviation and determine their validity using Venn diagrams.

   (i) No vehicles are unregistered.
   No marriages are unregistered.
   Therefore, some marriages are vehicles.

   (ii) All children are lovable.
   Some children are naughty.
   Therefore, some naughty ones are lovable. *(02 × 2 marks)*

   (b) Identify and explain the fallacy in each of the following.

   (i) Birds outnumber men.
   This parrot is a bird.
   Therefore, this parrot outnumbers men.

   (ii) X says that Y is ruining our vegetation by cutting the valuable timber in our forests. But that must be a lie, for I saw X himself selling his jack tree near the house to be cut.

   (iii) All of us cannot be famous because all of us cannot be so well-known.

   (iv) The President's counsel, addressing the judge said, "My lord, when I asked the accused, Have you stopped beating your wife?" he said, "Yes". So he admits that he was a wife-beater and he must be punished. *(03 × 4 marks)*

6. (a) Write short notes on the following.
   (i) Law and ethics
   (ii) Logic used in the legal processes
   (iii) Crime and society *(02 × 3 marks)*

   (b) Discuss briefly the relationship between the following.
   (i) Logic and language
   (ii) Logic and mathematics.
   (iii) Logic and computer science. *(02 × 3 marks)*

   (c) (i) Discuss the logical nature of the statement, 'The barren woman was at the theatre with her son.'

   (ii) What is the meaning of 'is' in
   Two plus two is four? *(02 × 2 marks)*

Part III

7. (a) State Popper's demarcation criterion between scientific and non-scientific statements clarifying the conditions that a statement should satisfy for it to be scientific. *(04 marks)*

   (b) "Social sciences are not falsifiable in the Popperion sense." Discuss this statement taking into consideration questions of meaning, prediction and test in the social scientific research. *(06 marks)*

   (c) Discuss the distinction between pure science and applied science. Could empirical investigations of social problems like suicide done in Sri Lanka be considered both pure science and applied science? *(06 marks)*

8. (a) Discuss, in fair detail, the role of instruments in scientific research. *(06 marks)*

   (b) "Although science is ultimately resting on our sense perceptions it is the theoretical knowledge which builds and pushes scientific knowledge forward." Make your observations. *(06 marks)*

   (c) Discuss the role of models in science. *(04 marks)*

9. (a) (i) What do scientific theories explain? *(04 marks)*

   (ii) What is teleological explanation? *(04 marks)*

   (b) "Social scientific theories do not explain. In any case, deductive explanation is usually not possible there." Discuss. *(08 marks)*

10. (a) "High level scientific theory change is based on a gestalt switch or conversion." Show how, statements of relativists like Kuhn and Feyeraband like 'There is no rationality in theory change', 'no verifiability or falsifiability of paradigms is possible', 'no communication is possible between successive theories', lead to such a conclusion. *(12 marks)*

    (b) The position and arguments of relativists demolished an established view of science and method. What are the defining features of the position that they attacked? *(04 marks)*

11. (a) "Value free rational and empirical science envisaged by the methodologies of Bacon and Descartes is no longer operative. Multinational companies and global political power control current science directly or indirectly. Science today needs more meaningful control in view of the threat to life on the planet." Discuss. *(06 marks)*

    (b) "Finest steel in the ancient world was produced in Sri Lanka." Substantiate this statement indicating,

    (i) the centres of iron-smelting for steel production,

    (ii) techniques and fuels used for heating furnaces,

    (iii) sources of evidence which establish the industry in ancient Sri Lanka. *(06 marks)*

    (c) **Either**

    "Until the 15th century of the Christian era, China had better science than the West." Would you agree?

    Or

    "Ayurveda and acupuncture are alternate systems and techniques of medicine different from current Western medicine." Substantiate. *(04 marks)*

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