අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2021(2022)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2021(2022)
General Certificate of Education (Adv. Level) Examination, 2021(2022)

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

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

Universal quantifier : Λ, Existential quantifier : V

In class logic:

The class union of A 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 for the inputs A and B will be respectively shown by $A \cdot B, A + B, \bar{A}, A \oplus B$.

1. In the Aristotelian analysis the term 'Greek' in the proposition 'Socrates was not a Greek' is

(1) true. (2) distributed. (3) false.
(4) undistributed. (5) singular.

2. Which of the following pioneered the introduction of the positivist methodology of the natural sciences to social sciences.

(1) August Comte (2) Jorgen Habermas (3) Karl Marx
(4) Sigmund Freud (5) Francis Bacon

3. All men are over ten feet in height. All those over ten feet in height are wild elephants. Therefore men are wild elephants.
The above argument is

(1) invalid. (2) valid but not sound.
(3) not a syllogism. (4) sound.
(5) in mood Barbara in figure II

[see page two

4. A scientist examines microbes using the magnifying optical arrangements of a microscope. The scientist
(1) is doing an experiment.
(2) is making the microbes larger.
(3) is making a natural observation.
(4) gets a distorted picture.
(5) is making a mal-observation.

5. The middle term of a syllogism occurs only as a predicate. What is the figure of the syllogism?
(1) Figure I (2) Figure II
(3) Figure III (4) Figure IV
(5) The given facts are insufficient to determine the figure.

6. Which of the following is true of viruses?
(1) They are bacteria
(2) consist of DNA or RNA
(3) can be grown in any artificial culture, with or without living cells
(4) exist anywhere as highly active particles
(5) are usually a particles of over 1000 nano-meters in diameter

7. When an E proposition is false, what are the truth values of the corresponding A, I and O propositions respectively?
(1) False, True, Indeterminate
(2) Indeterminate, False, True
(3) Indeterminate, True, Indeterminate
(4) True, True, False
(5) Indeterminate, Indeterminate, False

8. Which of the following fields uses a Principle of Uncertainty as a key foundation?
(1) Newtonian mechanics (2) Space technology
(3) Quantum mechanics (4) Molecular Biology
(5) Gestalt psychology

9. The conversion by limitation of the proposition 'All mammals are elephants' is
(1) No mammals are non-elephants. (2) Some elephants are mammals.
(3) Some elephants are non-mammals. (4) All elephants are mammals.
(5) This elephant is a mammal.

10. Measurement showed that Kamala is taller than Wimala but shorter than Mala. Mala is shorter than Seela who is shorter than Leela. When arranging these five in the order of their heights we are using
(1) a ratio scale (2) an interval scale (3) an ordinal scale
(4) a nominal scale (5) no standard scale

11. All Veddahs descend from Vijaya's children.
Some who descend from Vijaya's children are Sinhalese.
Therefore all Veddahs are Sinhalese.
The above argument
(1) commits the fallacy of Illicit major.
(2) commits the fallacy of Illicit minor.
(3) commits the fallacy of Undistributed middle.
(4) is valid.
(5) is sound.

12. Two dice are thrown. What is the probability of getting a score of 6?
(1) $\frac{1}{6}$ (2) $\frac{5}{36}$ (3) $\frac{1}{18}$ (4) $\frac{7}{36}$ (5) $\frac{1}{4}$

[see page three

13. If you are given the statements: 'only if it rains the ground gets wet' and 'it has rained' which of the following conclusions could you reach?

(1) It will rain tomorrow.
(2) The ground is wet.
(3) The ground has absorbed the water.
(4) The ground is not wet.
(5) None of the above conclusions follow.

14. What is the logical problem in using the principle of Uniformity of Nature in meeting Hume's criticism of induction and causality?

(1) It is not an a priori truth.
(2) Nature exhibits unlimited variety.
(3) The method justification of this Principle faces the same logical problem that Hume raised against induction and causality.
(4) Uniformity of nature restricts human freedom.
(5) The logical problem raised here is only imaginary.

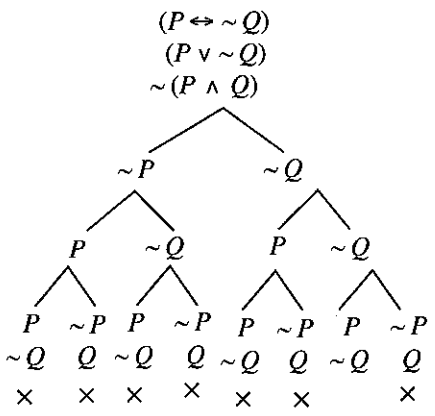
15. If A, B, C are classes and $\overline{A}\overline{B}\overline{C} \neq \phi$ then,

(1) $\overline{A} = \phi$ (2) $A \neq \phi$ (3) $AB = \phi$ (4) $ABC \neq \phi$ (5) $\overline{A}\overline{B} \neq \phi$

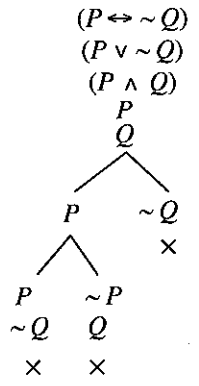
16. A cube of side of 2 units in length floats in water with $\frac{1}{4}$ of it immersed. The cube is made of wood of density $\frac{1}{2}$ when the density of water is 1. What is the size of the cavity in units inside the cube, going by the Archimedes' principle which states that "any object fully or partially immersed in a fluid gets an upward buoyant force equal to the weight of the fluid displaced by the object"?

(1) 1 (2) 2 (3) 4 (4) $\frac{1}{2}$ (5) $\frac{1}{6}$

17. Which of the following is the correct truth tree of the argument $(P \leftrightarrow \sim Q) \cdot (P \vee \sim Q) \therefore \sim(P \wedge Q)$?



(1)



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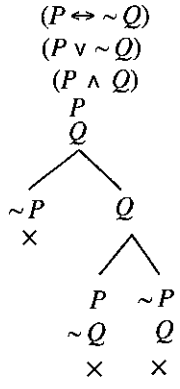

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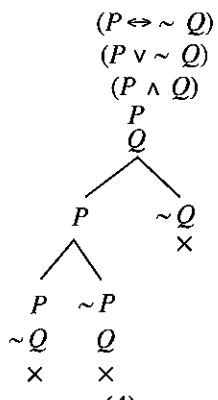

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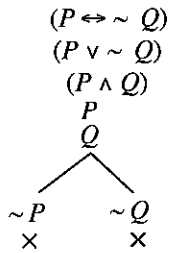

(5)

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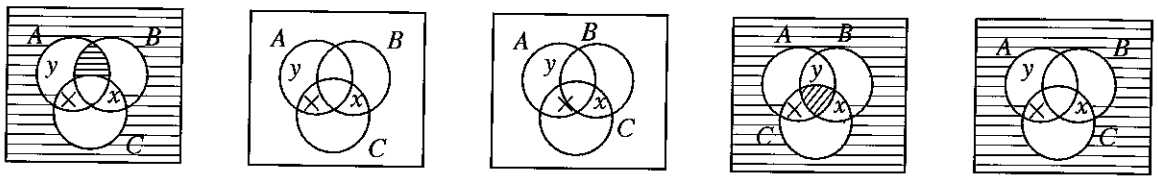
18. What is the range of the following numbers of Covid-19 cases reported during a week?
75, 400, 1300, 800, 3900, 3950, 3800
(1) 2500 (2) 3150 (3) 3750 (4) 3875 (5) 3900

19. In the sentence 'Florence Nightingale is an angel.'
(1) The subject is undistributed.
(2) The predicate is distributed.
(3) Both the subject and the predicate are distributed.
(4) The subject is distributed.
(5) Distribution of terms cannot be determined.

20. In how many ways could couples be selected from a group of 25 people?
(1) 130 (2) 240 (3) 250 (4) 300 (5) 360

21. If A, B, C are classes and x, y are members of classes, which of the following diagrams satisfies the conditions $ABC = \phi$, $\bar{A}\bar{B}\bar{C} = \phi$, $AC \neq \phi$, $x \in BC$ and $y \in AB$?

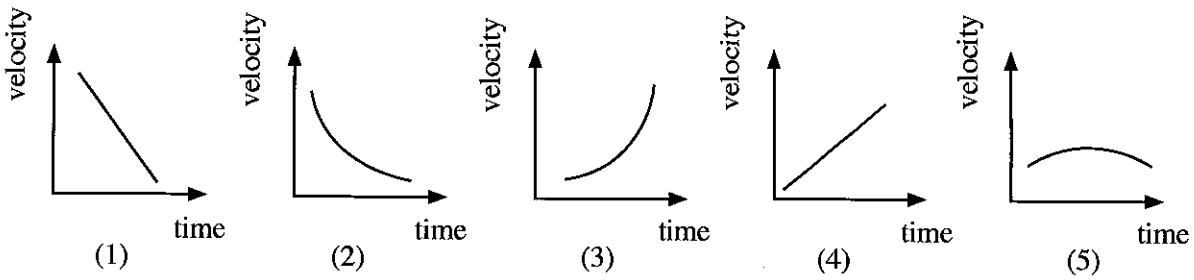


(1) (2) (3) (4) (5)

22. After Joseph Black showed that Carbon Dioxide (fixed air) was always separable from normal air, interests in the investigation of gases increased. Together with these developments more precise measurement of weight led to a discovery by a Frenchman in the seventeen seventies which led to a well known revolution in science. What was this discovery?
(1) Discovery of hydrogen
(2) All matter consists of atoms
(3) Combustion is caused by oxidation
(4) Air consists of many gases
(5) Air has nitrogen

23. All men are greedy.
Some men are not honest.
Therefore some greedy are not honest.
The above syllogism is
(1) a valid syllogism in the third figure and mood AII.
(2) an invalid syllogism in the second figure.
(3) a valid syllogism in the forth figure and mood AII.
(4) an invalid syllogism in third figure.
(5) a valid syllogism in the third figure and mood OAO.

24. Galileo's Law is that 'the acceleration of a freely falling body near the surface of the Earth is constant'. What is the shape of the figure you get when the velocity of fall of a such a body is plotted against time ?



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

[see page five

25. What is/are the rule/ rules of inference (if any) used in showing that $(P \vee \sim P)$
(1) Assumption for Indirect derivation, Repetition
(2) Assumption for Indirect derivation, Addition
(3) Contradiction, Addition
(4) Contradiction, Repetition
(5) Addition, Repetition

26. Which of following is an observational statement
(1) Sun is at the centre of the solar system.
(2) Electrons move around the nucleus of the atom.
(3) The traffic light which I now see is red.
(4) 5+3=8
(5) All crows are black.

27. 'All Sri Lankans are not scientists'. If we symbolize Sri Lankans by F and Scientists by G which symbolization is logically equivalent to the above statement?
(1) $\Lambda x\,(Fx \rightarrow \sim Gx)$ (2) $\mathrm{V}\,x\,(Fx \wedge \sim \rightarrow Gx)$ (3) $\Lambda x \sim\, (Fx \wedge Gx)$
(4) $\mathrm{V}x \sim\, (Fx \rightarrow Gx)$ (5) $\sim \mathrm{V}\,x\,(Fx \wedge \sim Gx)$

28. Soon after the doctor examined the patient the patient went unconscious. Therefore the patient going unconscious was due to the doctor examining him. What is the fallacy in the above argument?
(1) amphiboly (2) appeal to ignorance (3) petitio principii
(4) ad hominem (5) post hoc, ergo propter hoc

29. Pioneering scientists who advance science to a new level seem to have often used these experiments. Thus e.g. Galileo used them, Newton used them and Einstein used them. These experiments are
(1) introspective tests.
(2) public demonstrations.
(3) experiments using self made instruments.
(4) experiments dealing with the mind.
(5) Gedanken or thought experiments.

30. Which of the following is the correct row of values you get when, the validity of the argument $[(R \rightarrow Q) \vee R\ ) \wedge (P \wedge Q)] \therefore (P \rightarrow R)]$ is tested by the indirect truth table method?
(1) T T F T F T T F FF T F F (2) T T T T F T T T FF T F F
(3) F T T T F T T T T F TF F (4) F T F T F T T T T F TF F
(5) T T F T F T T T T F TF F

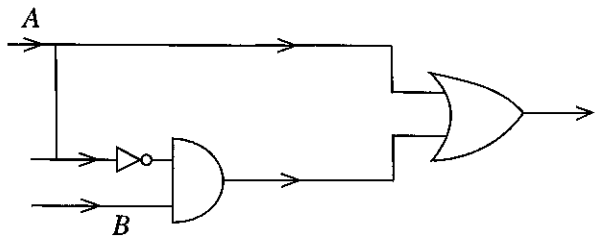
31. Who is the archaeologist who with his outstanding research and interpretations maintained that the Mahāvamsa statement about "a king that built on a particular rock a fine palace worthy to behold like another Alakamanda and dwelt there like the god Kuvera" was more or less literary true?
(1) Hocart (2) Paranavithana (3) Codrington
(4) Sir John Marshall (5) Deraniyagala

32. In Boolean algebra the values of $(x+x)$ and $(x \cdot x)$ respectively would be
(1) $2x$ and x^2 (2) x and x^2 (3) $2x$ and x (4) 1 and x^2 (5) x and x

33. What is meant by a 'Novel prediction'?
(1) A prediction which states a fact which is already known.
(2) A prediction which was empirically verified.
(3) A prediction which gets falsified by empirical test.
(4) A prediction which leads to the discovery of a fact which had not been known so far.
(5) A prediction which goes against the empirical facts already known.

[see page six

34.



Which of the following Boolean expressions gives the simplified equivalent for the expression drawn in the above gate?

(1) $(A.B)$ (2) $(\overline{A}+\overline{B})$ (3) $(A+B)$ (4) $(A \oplus B)$ (5) $(\overline{A\,.\,B})$

35. The structure of deductive nomological explanation, also called the covering law model of explanation as presented by Carl Hempel is such that

(1) there can be only one general law or explanans.
(2) all deductive explanation could be brought under causal explanation.
(3) the explanation of empirical generalizations by theories cannot come under it.
(4) causal explanations can be brought under deductive explanations.
(5) empirical generalizations like Keplers Laws cannot be the explanans i.e., the generalizations that explain.

36. When is the deductive system consistent?

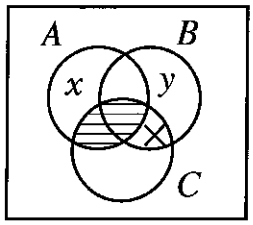
(1) When its terms and operations are properly defined.
(2) When, out of any two contradictory sentences in the system one could be proved.
(3) When the axioms of the system are outlined clearly.
(4) When contradictory sentences cannot be expressed in the system.
(5) When it can translate sentences in a natural language.

37. A library records in the back of its books the date each book is borrowed. It wishes to determine the average number of times a book is borrowed a year. For this every tenth book found in the shelves was taken out and its number of withdrawals in the last 12 months was counted. What should be the observation about this sampling?

(1) This will give a reasonable estimate of the required assessment.
(2) It would have been better to have taken a structured sample based on subjects.
(3) The sample is not large enough.
(4) The books left in the shelves would be the less borrowed and the sample thus would not be fair.
(5) The sample is too large as the library will have thousands of books.

38. If A, B, C in the diagram are classes and x, y are members of classes, then in the given diagram

(1) The class BC is empty.
(2) The universe outside A, B, C has nothing.
(3) No members belong to both B and C.
(4) The class ABC is non empty.
(5) None of the classes A, B or C is empty.



39. Karl Popper's methodology bases itself on

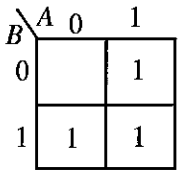
(1) falsified conjectures.
(2) falsifiability of conjectures by empirical test.
(3) ad hoc hypotheses.
(4) working with a multiple of simultaneously competing hypotheses in the same field.
(5) verified conjectures.

[see page seven

40. "Killing a human being is a culpable homicide not amounting to murder" in the legal eyes when
(1) the killer did not use a weapon.
(2) when the killer surrendered to the police soon after the killing and confessed the killing.
(3) when the killer did not meddle with the body of the victim after the killing.
(4) when the victim did not die on the spot.
(5) when the killer did not have maliciously intended to kill the victim prior to the killing.

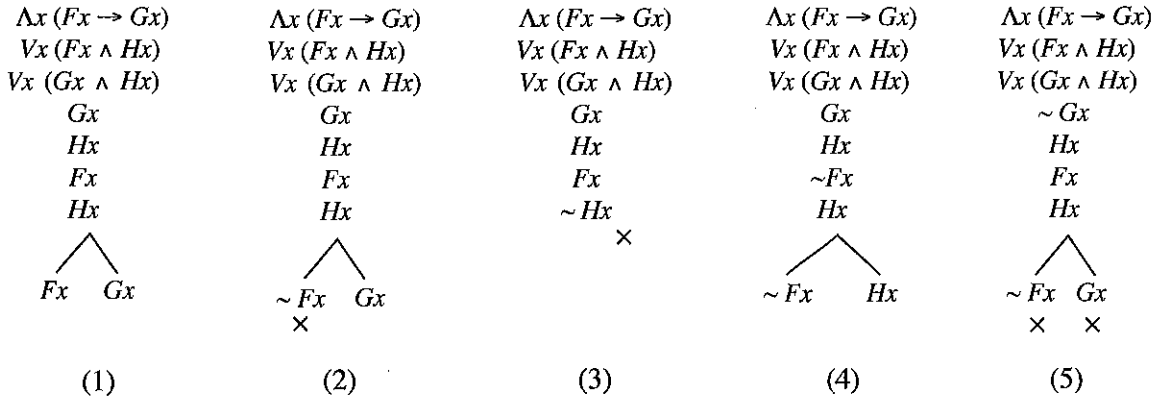
41. Thomas Kuhn, in his 'The Structure of Scientific Revolution' says, "... emergence of new theories is generally proceeded by a period of pronounced professional insecurity" and illustrates this situation when he discusses the cases of emergence of three major theories or revolutions. What are these three theories?
(1) Theory of Evolution, Freudian Theory, Newtonian theory
(2) Newtonian theory, Faraday's electromagnetic theory, Galilean physics
(3) Copernican revolution, Lavoisier's Oxidation theory, Einstein's Relativity theory
(4) Copernican revolution, Newtonian theory, Atomic theory
(5) Copernican revolution, Lavoisier's Oxidation theory, Atomic theory

42. What is the primary Boolean expression corresponding to the K Map shown?
(1) $(\bar{A}B+B)$
(2) $(B+A)$
(3) $(\bar{A}+B)$
(4) $(A+\bar{B})$
(5) $(\bar{A}+\bar{B})$



43. In 1895, a Professor of Physics at Wurzburg, Germany was testing whether cathode rays could pass through glass. He was shocked to discover that although the cathode tube was covered with heavy black paper and lead in front of the discharge tube blocked the rays, his own flesh was glowing around his bones on the fluorescent screen behind his hand. The Professor was awarded the first Nobel Prize for Physics in 1901 for the discovery that he made due to this observation. The above is a part of the story of the accidental discovery of
(1) electrons (2) gamma rays (3) X-rays
(4) radium (5) the quantum emission

44. Symbolize the following argument using predicate calculus.
'Rivers are sacred things. Some rivers are in Sri Lanka. Therefore it is not true that some sacred things are in Sri Lanka.'
Which of the following is its correct truth tree when determining its validity?



[see page eight

45. "... results... suggest abolishing the distinction between a context of discovery and a contest of justification and disregarding the related distinction between observational terms and theoretical terms. Neither distinction plays a role in scientific practice. Attempts to enforce them would have disastrous consequences." The above assertions are made as a sectional title in his view of the history of science by

(1) Carl Hempel
(2) Russell Hanson
(3) Thomas Kuhn
(4) Imre Lakatos
(5) Paul Feyeraband

46. Which is the self contradictory sentence in the following set?

(1) $\sim \sim \sim (P \rightarrow \sim P)$
(2) Winston Churchill is identical with Winston Churchill.
(3) $\sim (P \wedge \sim P)$
(4) All brothers are non-sisters.
(5) Some bachelors are married.

47. A function of the negative heuristic in the Methodology of scientific research programmes of Imre Lakatos is to

(1) promote the development of auxiliary hypotheses.
(2) refrain from actions which are not in line with the hardcore of the programme.
(3) modify the protective belt.
(4) develop ad hoc hypotheses.
(5) forget the unsolvable anomalies.

48. Which of the following is a theorem?

(1) $((P \rightarrow Q) \rightarrow R)$
(2) $(\forall x Fx \leftrightarrow \sim \Lambda x \sim Fx)$
(3) $(P \rightarrow Q) \leftrightarrow (\sim P \wedge Q)$
(4) $(\forall x Fx \rightarrow \Lambda z Fz)$
(5) $((P \vee Q) \rightarrow P)$

49. What is Bisokotuva?

(1) The inner chamber of a king's palace which the queens occupied.
(2) The bathing spot-reserved for the queens in the lake.
(3) The gate which controls the inner pressure of the water of a tank and guides the distribution of water from the tank.
(4) The spot where the crowning of the king (abhisekha) took place.
(5) The structure built by laying stones in the tank bund to prevent erosion of the bund.

50. Of the following which should be the dominant basis of the obligation of the person and the society to actively engage in the control of a global pandemic?

(1) legal aspect
(2) scientific aspect
(3) ethical aspect
(4) religious aspect
(5) experience from ancient times

* * *

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2021(2022)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2021(2022)
General Certificate of Education (Adv. Level) Examination, 2021(2022)

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:

* *Number of questions that should be answered – 06*
* *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 used in this paper are as following. 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 will be for inputs A and B are 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) What is the obverse of the proposition 'Some S is P' ?

(ii) In the standard notation of traditional logic, name the relationship of the
(a) Proposition O to proposition I
(b) Proposition I to proposition O
in the square of opposition.

(iii) In the following, what is the term appropriate for the blank?
A valid symbolic sentence with no premises is called a .....

(iv) Which of the following is the definition of the null class?
(a) The class with no members
(b) The class of classes with no members

[see page two

(v) In Boolean algebra what are the following expressions equivalent to?

(a) $x + 1$

(b) $\overline{0}$

(vi) Who is the Nobel prize winning Economist of Indian birth whose studies of welfare economics and causes of famine encouraged policy makers to maintain stable prices of food?

(vii) What (type of) sampling would you choose in a study using a population which has unevenly distributed heterogenous groups?

(viii) How is factorial 7 expressed as a product?

(ix) To which aspect of science does Paul Feyarabend's use of terms 'anything goes' and 'anarchism' apply?

(x) According to Karl Popper scientists should come out with bold conjectures. Bold conjectures are more testable and hence more falsifiable. Therefore does Popper want theories with greater and greater falsifiability? (Your answer should just be the one of 'yes' or 'no'.)

(02 × 10 = 20 marks)

Part II

2. (*a*) Distinguish between

(i) Immediate inference and mediate inference.

(ii) Validity and truth

(02 × 2 = 4 marks)

(*b*) Explain the three elements and the sign of quantity that is seen in each of the traditional propositions *A*, *E*, *I*, *O*. *(04 marks)*

(*c*) (i) What is the converse, if any, of 'all landowners are capitalists'?

(ii) What is the contrapositive of 'All Veddahs are Sri Lankans'? *(02 × 2 = 4 marks)*

(*d*) (i) What is the logical relationship between the propositions placed diagonally opposite each other in the square of opposition?

(ii) If 'All men are mortal' is false what could be said about the truth value of 'No man is mortal'? *(02 × 2 = 4 marks)*

3. (*a*) Determine whether the following syllogisms are valid or invalid. When the syllogism is invalid state the rule/rules violated and the resulting fallacy/fallacies.

(i) All logicians are philosophers. All mathematicians are logicians. Therefore, all philosophers are mathematicians.

(ii) Only flowers are beautiful. All girls are beautiful. Therefore all girls are flowers.

(03 × 2 = 6 marks)

(*b*) What are the **four** figures of the syllogism? *(04 marks)*

(*c*) Symbolize the following arguments in terms of classes and determine their validity using Venn diagrams.

(i) Only onions are expensive. Some expensive things are imported. Therefore some imported things are onions.

(ii) A few graduates are teachers. No teachers are wealthy. Therefore there are no wealthy graduates. *(03 × 2 = 6 marks)*

[*see page three*

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

(i) $((P \wedge Q) \rightarrow R) \leftrightarrow (P \rightarrow (Q \rightarrow R))$

(ii) $(\sim P \rightarrow Q) \leftrightarrow (\sim Q \rightarrow P)$ *(02 × 2 = 4 marks)*

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

He will go to England or Australia but not both. Only if he goes to Australia he marries Alice. He did not marry Alice. Therefore he did not go to Australia but went to England. *(04 marks)*

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

If Alfred shouts then Agnes cries. If she cries she will fall sick. If she falls sick then she will be taken to the hospital and she will be cured. Therefore if Alfred shouts Agnes will be cured. *(04 marks)*

(*d*) Symbolize the following argument in terms of the predicate calculus giving your scheme of abbreviation and show its validity by derivation.

All journalists are graduates and all teachers are clever.

Some journalists are teachers.

Therefore some graduates are clever. *(04 marks)*

5. (*a*) Symbolize the following arguments giving your schemes of abbreviation and determine their validity by the method of truth trees.

(i) If the war ceases then there is peace. War has ceased but there is no peace. Therefore I bought some land on the Moon.

(ii) Some metals shine. All metals are heavy. Therefore some shining things are heavy. *(04 × 2 = 08 marks)*

(*b*) (i) Using Boolean algebra simplify the Boolean expression.

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

(ii) Draw the K-map for the expression in (i). *(02 × 2 = 04 marks)*

(*c*) Draw the logic gates for the following expressions, where A, B, C stand for sentences.

(i) $(A \rightarrow B) \vee (\sim B \vee C)$

(ii) $(A \leftrightarrow B) \wedge (B \wedge C)$ *(02 × 2 = 04 marks)*

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

(i) Each atom is of negligible weight. Therefore this piece of rock which is composed of atoms is of negligible weight.

(ii) Soon after the pandemic set the rains started. Therefore the rains started because of the pandemic.

(iii) His friends of the club drink heavily. Therefore his speech in parliament on the bad effects of alcohol was meaningless. *(03 × 3 = 09 marks)*

(*b*) (i) State and explain the theory of punishment expressed in the statement 'An eye for an eye and a tooth for a tooth'. *(04 marks)*

(ii) Explain what counts as circumstantial evidence in a court of law. *(03 marks)*

[*see page four*

Part III

7. (*a*) (i) Distinguish between empirical science and non-empirical sciences giving examples. *(04 marks)*

(ii) How does Karl Popper characterise an empirical science? *(02 marks)*

(iii) Distinguish between inductive and deductive methodologies of science. *(04 marks)*

(iv) Galileo is supposed have dropped metal balls from the leaning tower of Pisa to demonstrate that the weights of bodies do not affect the speed of the free fall of bodies. Is the test he did a natural observation or an experiment? Why? *(04 marks)*

(v) Is Psychology a natural science or a social science? *(02 marks)*

8. (*a*) Discuss the role of the microscope and the telescope in the development of physical and life sciences to illustrate the significance of the use of instruments in scientific test. *(08 marks)*

(*b*) Explain the following distinctions in the methodology of science giving examples.

(i) Description and explanation of data

(ii) Quantitative and qualitative data

(iii) Universal and statistical generalization

(iv) Actual experiment and thought experiment *(02 × 4 = 08 marks)*

9. (*a*) "Quantitative data and quantitative analysis increasingly characterise social scientific study". Discuss, illustrating your answer with examples. *(08 marks)*

(*b*) Why is general agreement or objectivity lacking in social science? Discuss. *(08 marks)*

10. (*a*) "The views of relativists like Kuhn and Feyarabend have brought the methodologies of natural sciences and social sciences closer." Do you agree? Explain your answer. *(08 marks)*

(*b*) Explain following

(i) Teleological explanation

(ii) Functional explanation *(02 × 2 = 04 marks)*

(*c*) "Social scientific data are not stable". Make your observations. *(04 marks)*

11. (*a*) "The role of social media in promoting social development" Discuss. *(04 marks)*

(*b*) "Avoiding food wastage is a primary responsibility of the contemporary man." Discuss. *(06 marks)*

(*c*) Examine the significance of the utilization of indigenous medical knowledge for a healthy life. *(06 marks)*

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