

## නව නිර්දේශය/புதிய பாடத்திட்டம்/New Syllabus

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

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2020  
 கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2020  
 General Certificate of Education (Adv. Level) Examination, 2020

කර්ක 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 (x) 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 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 :  $\Lambda$ , 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:  $\phi$

## In Boolean algebra:

sum:  $+$ , product:  $\cdot$ , 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

$A \cdot B, A + B, \bar{A}, A \oplus B$ .

- In the Aristotelian analysis the proposition 'A particular person  $X$  was not subjected to quarantine' is
  - (1) a universal affirmative.
  - (2) a particular negative.
  - (3) a universal negative.
  - (4) a singular negative.
  - (5) a singular affirmative.
- A star which had been observed by quite a number of European astronomers for about a century from 1690 was observed by William Herschel one night in 1781 using a much improved telescope of his own make. But a problem which he noticed in the appearance of the star made him postpone his decision as to what that object was. The object is planet Uranus. What was the problem that Herschel noticed?
  - (1) The weakness of the light emitted by the star
  - (2) The star had a square shape
  - (3) It appeared to have a disc size unsuitable for a star
  - (4) The star did not shine
  - (5) The star appeared close to Earth

3. Which of the following gives the necessary and sufficient conditions for a sound argument?
- (1) The argument being valid
  - (2) All the premises being true
  - (3) The argument being valid and not more than one premise being false
  - (4) The argument being valid and all the premises being true
  - (5) All premises and the conclusion being true
4. The decision whether a scientific test is an experiment or observation depends on
- (1) the instruments used in the test.
  - (2) whether the result of the test is a discovery or an invention.
  - (3) whether the object undergoing test has been subjected to any change by the test.
  - (4) whether the scientist doing the test has made plans and preparations for the test.
  - (5) whether the test process happened accidentally.
5. The necessary condition for a major term of an Aristotelian syllogism is that it should
- (1) be the subject of a proposition.
  - (2) be the predicate of a proposition.
  - (3) be distributed at least once.
  - (4) not be a subject.
  - (5) be undistributed.
6. To which of the following results do the Convex and Concave lenses in an instrument respectively subject light?
- (1) become colourful and dark
  - (2) Diverge and converge
  - (3) Reflect and diffract
  - (4) Converge and diverge
  - (5) Diffract and reflect
7. As seen by the square of oppositions, when an A proposition is false, which of the following options gives the correct sequence of the truth values of the corresponding E, I, O propositions?
- (1) False, Indeterminate, True
  - (2) Indeterminate, Indeterminate, True
  - (3) Indeterminate, False, True
  - (4) Indeterminate, Indeterminate, False
  - (5) True, Indeterminate, True
8. The basis of the sequence of elements in Mendeleev's first Periodic Table was
- (1) the temporal sequence of the discovery of each element.
  - (2) the ability of the neighbouring elements in the Periodic Table to form chemical compounds.
  - (3) the ascending order of the atomic weight of the elements.
  - (4) the atomic number of the elements.
  - (5) the number of electrons in an atom of each element.
9. The obverse of the proposition 'certain students do not drive vehicles' is
- (1) some drive vehicles.
  - (2) all are non-drivers of vehicles.
  - (3) some students are non-drivers of vehicles.
  - (4) some students do not drive vehicles.
  - (5) some who drive vehicles are students.
10. A certain psychiatrist wants to evaluate how far effective a new drug is for neurosia. He uses the following classification in noting down his observations.

Turned very bad	Turned fairly bad	No change	Turned fairly good	Turned very good
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What is the scale that this researcher used?

- (1) Nominal scale
- (2) Interval scale
- (3) Ordinal scale
- (4) Ratio scale
- (5) No scale has been used

11. Some Sri Lankans are British citizens.  
All Sri Lankans are Sri Lankan citizens.  
Therefore some Sri Lankan citizens are British citizens.  
The above syllogism  
(1) is an unsound argument. (2) is a sound argument.  
(3) commits the fallacy of four terms. (4) commits the fallacy of illicit major.  
(5) is self contradictory.
12. Who was the person who could get by intuition unknown theorems of pure mathematics and was the first Indian to be a fellow of the British Royal Society?  
(1) Sir J.C. Bose (2) Abdul Kalam Azad (3) Sir C.V. Raman  
(4) Abdus Salam (5) Ramanujan
13. Which of the following conclusions could you reach if you are given the statements:  
'if it rains then the ground gets wet' and 'if it does not rain then the ground gets wet'?  
(1) It rains (2) The ground is in a wet zone  
(3) The ground gets wet (4) It does not rain  
(5) No conclusion can be reached
14. The essence of David Hume's argument against induction is  
(1) There is, in general no limit to induction by enumeration.  
(2) The argument for the justification of induction commits the fallacy of circularity.  
(3) Science should be based on deductive reasoning.  
(4) It is wrong for science to come to conclusions based on empirical facts.  
(5) It is wrong to conclude that the hypothesis is true just because the prediction is true.
15. If  $A, B, C$  are classes and  $ABC \neq \phi$  then,  
(1)  $ABC \neq \phi$  (2)  $AB \neq \phi$  (3)  $AC \neq \phi$  (4)  $\bar{A}\bar{B}\bar{C} \neq \phi$  (5)  $\bar{A}\bar{B} \neq \phi$
16. Two dice are thrown. What is the probability of number '1' coming up on both dice?  
(1)  $\frac{23}{36}$  (2)  $\frac{5}{9}$  (3)  $\frac{4}{9}$  (4)  $\frac{1}{18}$  (5)  $\frac{1}{36}$
17. Which of the following is the correct truth tree of the argument  $(P \leftrightarrow Q) \cdot (P \vee Q) \therefore (P \wedge Q)$ ?
- (1)

(2)

(3)

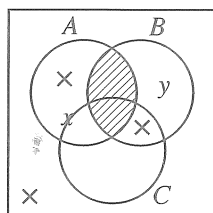
(4)

(5)
18. What is the standard deviation of the values 3, 4, 5, 6, 7 ?  
(1) 1.3 (2) 1.4 (3) 1.5 (4) 2.0 (5) 2.1
19. In the sentence 'Certain girls magnetize the mind.'  
(1) The subject is distributed.  
(2) The distribution of the terms is indeterminable.  
(3) Both the subject and the predicate are undistributed.  
(4) All terms are distributed.  
(5) Only the subject is undistributed.

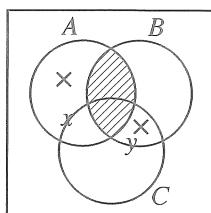
20. If the number combinations of 3 students in a class of 12 students is  $C$  and the number of permutations of these students taken three at a time is  $P$ , how are  $C$  and  $P$  related?

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

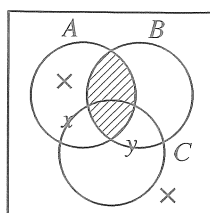
21. If  $A, B, C$  are classes which together do not exhaust the universe and  $x, y$  are members of classes then which of the following diagrams represent all these conditions and further that  $AB = \phi$ ,  $A\bar{C} \neq \phi$ ,  $BC \neq \phi$ ,  $x \in A$  and  $y \in C$ ?



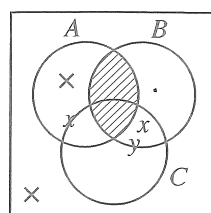
(1)



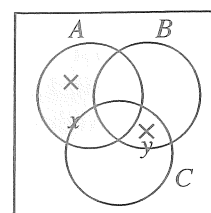
(2)



(3)



(4)



(5)

22. Who is the distinguished British biochemist who won the applause of the world by his study of the history of science of an Eastern nation and also had relationships with Sri Lanka?

- (1) Sir Julian Huxley      (2) H.G. Wells  
(3) J.B.S. Haldane      (4) Joseph Needham  
(5) Cyril Ponnampereuma

23. The syllogism

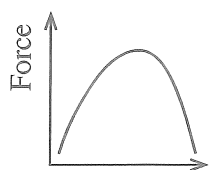
All film stars are popular.

Some film stars are playful.

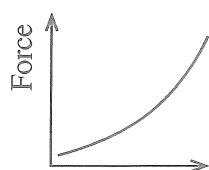
Therefore some playful ones are popular.

is

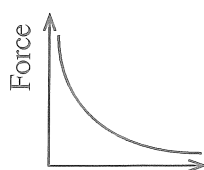
- (1) a valid syllogism in the second figure and the second mood.  
(2) a valid syllogism in the fourth figure in the AAI mood.  
(3) a valid syllogism in the third figure in the AII mood.  
(4) an invalid syllogism in second figure in AII mood.  
(5) an invalid syllogism in third figure in the AII mood.
24. If the force applied to a body is increased by uniform values then according to Newton's Second Law of Motion which of the following diagrams show the way in which the body's acceleration changes?



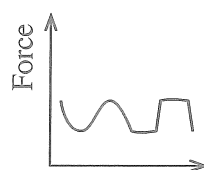
(1)



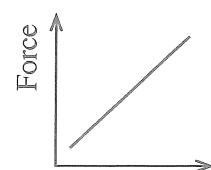
(2)



(3)



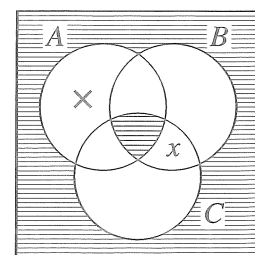
(4)



(5)

25. If  $A, B, C$  in the diagram are classes and if  $x$  is a member of a class then

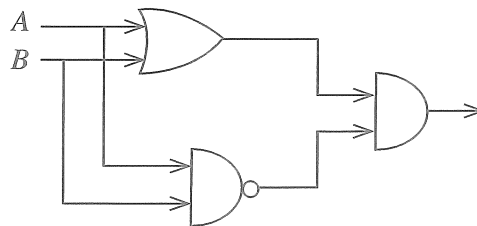
- (1) all these classes are empty.  
(2) the classes are such that the three of them don't have anything in common or anything outside them when they are taken together.  
(3) it is false that each of these classes has members.  
(4) the only non-empty class is  $A$ .  
(5)  $AB$  is empty.



26. Who was the outstanding Economist who brought about a revolution in Economics with a book which he published in 1936 which advocated that government should step in with more expenditure, lower taxes, welfare work etc., to pull the economy out from depression and unemployment instead of following traditional laissez faire economics of government non-interference?
- (1) Gunnar Myrdal
  - (2) John Neville Keynes
  - (3) John Maynard Keynes
  - (4) Jaan Tinbergen
  - (5) Amartya Sen
27. What rule/rules of inference in the system that we use in the proof of the theorem  $\sim(P \wedge \sim P)$ ?
- (1) Double negation
  - (2) Simplification and Adjunction
  - (3) Adjunction
  - (4) Simplification
  - (5) Repetition and addition
28. Which of the following is theoretical?
- (1) Acid turns blue litmus red
  - (2) A loaf of bread weighs less than 400 grams
  - (3) Neptune
  - (4) Electrons
  - (5) The atmospheric pressure on the peak of Pidurutalagala mountain
29. "There is no evidence that any one has seen him after the bush fire. Therefore he is not among the living."
- The fallacy in the above argument is
- (1) amphiboly.
  - (2) fallacy of post hoc ergo propter hoc.
  - (3) appeal to ignorance.
  - (4) ad hominem.
  - (5) petitio principii.
30. It is generally considered that Carl Jung moved away from the psycho analytical research that he was doing with Freud due to
- (1) Freud's not using behaviouristic methods.
  - (2) Jung's decision that there is no unconscious.
  - (3) Jung's non-acceptance of Freud's view that a main factor which leads to neurosis is sex repression in childhood.
  - (4) The necessity for Jung to come up with the concept of the collective unconscious.
  - (5) Jung's realization that psycho-analytical methodology is not sufficient for curing mental disease.
31. In which of the following ways could one symbolize the sentence 'None other than a Sri Lankan is eligible to vote' using the scheme of abbreviation
- $F$ : a is a Sri Lankan,  
 $G$ : a is eligible to vote
- (1)  $\Delta x (Fx \rightarrow Gx)$
  - (2)  $\Delta x (Gx \rightarrow Fx)$
  - (3)  $\sim \Delta x (Fx \rightarrow Gx)$
  - (4)  $\forall x (Fx \wedge Gx)$
  - (5)  $\forall x (\sim Fx \wedge \sim Gx)$
32. In a certain tropical island in the Pacific Ocean with a multi-ethnic population, 80% of the people live in the villages and 20% in the cities. At a general election A and B were the main parties and the higher percentage of the village population preferred party A while a higher percentage of the city population party B. A newspaper held a pre-election poll by interviewing the random sample of the electorate by mobile phone (and at that time almost all voters in the island had mobile phones) and predicted the outcome of the election but the prediction went wrong. What would you consider was the major mistake in the conduct of the poll?
- (1) Method of selection of the random sample.
  - (2) Not training interviewers sufficiently for the proper conduct of the survey.
  - (3) There were over forty parties other than A and B contesting in the election.
  - (4) The random sample was too small.
  - (5) Not using a stratified sample.

33. The three sentences  
 $(P \vee (P \wedge Q)), (P \wedge (P \vee Q)), P$   
 are such that
- (1) the first two sentences are logically equivalent and the third one is contradictory to each of the first two.
  - (2) the last two sentences are logically equivalent and the first one is contradictory to them.
  - (3) the three sentences are contradictory of each other.
  - (4) the first and the third one are logically equivalent sentences but the second one is contradictory to either of them.
  - (5) the three sentences are logically equivalent to each other.
34. What Karl Popper means by the term 'corroborated' in connection with a scientific theory is that
- (1) the theory is confirmed.
  - (2) the theory is true.
  - (3) the theory has not been falsified by the tests conducted so far.
  - (4) there is a probability for the theory being true.
  - (5) now the theory could be accepted.
35. Which of the following is the correct row of values for testing the validity/invalidity of the argument  $((P \rightarrow Q) \wedge (\sim P \rightarrow R)) \wedge (Q \vee \sim R) \therefore (R \vee \sim Q)$  by the indirect truth table method.
- (1) TTTT    TFTFT    TTTFF    FFFT
  - (2) TTTT    FTTFT    TTTFF    FFFT
  - (3) TTFT    FTTFT    TTTFF    FTFF
  - (4) TTFT    FTTFT    TTFFF    FFFT
  - (5) TTTT    FTTTF    TTFTF    FFTF
36. Black holes are areas where light can neither enter or get out. But applying the indeterminacy principle of quantum mechanics to the General Theory of Relativity a certain scientist showed in the 1970s that a black hole emits radiation. Who is that scientist?
- (1) P.A.M. Dirac
  - (2) Werner Heisenberg
  - (3) Wolfgang Pauli
  - (4) Stephen Hawking
  - (5) John Wheeler

37.



The simplified form of the Boolean expression corresponding to the above logical gate is

- (1)  $(A \cdot B)$
  - (2)  $(A + B)$
  - (3)  $(A \oplus B)$
  - (4)  $(\bar{A} + \bar{B})$
  - (5)  $(\overline{A + B})$
38. In Thomas Kuhn's view a scientist/scientists gives up one paradigm and accept/accepts a new paradigm because
- (1) it is not possible to avoid a hard logical conclusion.
  - (2) the new paradigm solves all the anomalies that had gathered.
  - (3) he/they get converted to follow the new paradigm.
  - (4) the old paradigm will never raise its head anymore.
  - (5) the new paradigm is more simple.

39. 1. Show  $\Lambda x (Fx \rightarrow Gx) \rightarrow (\Lambda x Fx \rightarrow \Lambda x Gx)$   
 2.  $\Lambda x (Fx \rightarrow Gx)$   $A^n$  - for CD  
 3. Show  $(\Lambda x Fx \rightarrow \Lambda x Gx)$   
 4.  $\Lambda x Fx$   $A^n$  for CD  
 5.  $Fx$  4, U.I.  
 6. Show  $(\Lambda x Gx)$   
 7.  $Fx$  5, R  
 8.  $(Fx \rightarrow Gx)$  2, U.I.  
 9.  $Gx$  7, 8, M.P.

The error committed in the above derivation could be corrected by cutting off an unnecessary line. What is the present number of that line?

(NB - of course, once the line is cut off line numbers in the derivation change and the and notation to another line has to be changed. Ignore that.)

- (1) 2                      (2) 5                      (3) 6                      (4) 7                      (5) 8

40. You are entrusted with conducting an investigation to collect facts for the preparation of a report which would portray the problems that the businesses run by Sri Lankans face after the Corona pandemic. What would be the structure of the sample of subjects that you would interview for this purpose?

- (1) A non-stratified random sample of Sri Lankans.
- (2) An stratified sample based on provincial representation.
- (3) An stratified sample based on the levels of education.
- (4) An stratified sample based on ethnic groups.
- (5) An stratified sample based on the representation of different types of businesses of Sri Lankans.

41. Going by the laws of Boolean algebra the equivalent of  $\overline{(x+y)}$  is

- (1)  $(\bar{x} + \bar{y})$                       (2)  $(x + \bar{y})$                       (3)  $(\bar{x} \cdot \bar{y})$                       (4)  $(x \cdot y)$                       (5)  $(x + \bar{x}) \cdot y$

42. In Lakatos' methodology the way in which the hardcore of the research programme could be protected is by

- (1) making novel discoveries.
- (2) avoiding experiments which give results that contradict the hardcore.
- (3) revising the protective belt.
- (4) accepting the anarchistic nature of methodology.
- (5) accepting the theoryladenness of observational statements.

43. When the singular sentence "Raja is mortal" is given, which of the following conclusions could be logically reached according to modern logic?

- (1) Some men are mortal.
- (2) Raja is a man.
- (3) There are mortal things.
- (4) There is one man.
- (5) No conclusion can be obtained.

44. In his book 'Aganist Method', Feyerabend states that

- (1) Galileo did not follow scientific method because he wrote in his mother tongue.
- (2) Galileo moved away from scientific method as he used psychological tactics to convert his readers.
- (3) The fact that Galileo did not use ad hoc hypotheses was a feature of a good scientific method.
- (4) Galileo turned out to be an unsuccessful scientist by removing the hard rational nature from his methodology.
- (5) Galileo was a progressive scientist who used various methods and strategies.

45. In which of the following sentences is it necessary to use synonyms to show its analyticity?
- (1)  $(P \wedge (P \rightarrow Q)) \rightarrow Q$
  - (2) All brothers are males
  - (3) Queen Elizabeth II is identical Queen Elizabeth II
  - (4)  $(P \wedge \sim P)$
  - (5) All men are men
46. Karl Popper, rejecting induction and outlining his methodology of falsifiability in his book "Logic of scientific Discovery" wrote, "The basis of my proposal is an logical asymmetry that exists between verification and falsifiability; that arises from the logical nature of a universal proposition". How did he present this logical asymmetry?
- (1) Although a universal statement is relevant to all the objects in a field, it does not assert an existence.
  - (2) It is not possible to logically derive a universal statement from singular propositions. But a universal statement might be contradicted by a singular statement.
  - (3) A universal statement can be metaphysical. But a metaphysical statement cannot be scientific.
  - (4) The number of implications that could be derived from a universal statement are infinite. But infinity is not a definite concept.
  - (5) A universal statement takes a hypothetical form. But the observational sentences are categorical.
47. Giving capital punishment for a person found guilty of murder is best considered justifiable as
- (1) deterrent and retributive punishment.
  - (2) deterrent and rehabilitative punishment.
  - (3) rehabilitative and retributive punishment.
  - (4) reformatory and deterrent punishment.
  - (5) reformatory and rehabilitative punishment.
48. Which of the following is a theorem?
- (1)  $((P \wedge Q) \leftrightarrow P)$
  - (2)  $((P \rightarrow Q) \rightarrow Q)$
  - (3)  $\Lambda x (Fx \rightarrow Gx) \rightarrow (\forall x Fx \rightarrow \forall x Gx)$
  - (4)  $(\forall x Fx \rightarrow \Lambda y Fy)$
  - (5)  $(\sim P \vee Q) \rightarrow (P \rightarrow \sim Q)$
49. Which of the following is the correct truth-tree to test the validity of the argument "Rabbits have horns. Those which have horns fly. Therefore rabbits fly."?
- |  |  |  |  |  |
|--|--|--|--|--|
| $\forall x (Fx \wedge Gx)$<br>$\forall x (Gx \wedge Hy)$<br>$\sim \forall x (Fx \wedge Hx)$<br>$\Lambda x \sim (Fx \rightarrow Hx)$<br>$Fy$<br>$\sim Hy$<br>$Gy$<br>$Hy$<br>$\times$ | $\Lambda x (Fx \rightarrow Gx)$<br>$\Lambda x (Gx \rightarrow Hx)$<br>$\sim \Lambda x (Fx \rightarrow Hx)$<br>$\forall x \sim (Fx \rightarrow Hx)$<br>$Fy$<br>$\sim Hy$<br>$\swarrow \quad \searrow$<br>$\sim Gy \quad Hy$<br>$\swarrow \quad \searrow$<br>$\sim Fy \quad Gy$<br>$\times \quad \times$ | $\forall x (Fx \wedge Gx)$<br>$\Lambda x (Gx \rightarrow Hx)$<br>$\sim \Lambda x (Fx \rightarrow Hx)$<br>$\forall x \sim (Fx \rightarrow Hx)$<br>$Fy$<br>$Hy$<br>$Fy$<br>$Gy$<br>$\swarrow \quad \searrow$<br>$\sim Gy \quad Hy$<br>$\swarrow \quad \searrow$<br>$\sim Fy \quad Gy$<br>$\times \quad \times$ | $\Lambda x (Fx \rightarrow Gx)$<br>$\Lambda x (Gx \rightarrow Hx)$<br>$\sim \Lambda x (Fx \rightarrow Hx)$<br>$\forall x \sim (Fx \rightarrow Hx)$<br>$Fy$<br>$\sim Hy$<br>$\swarrow \quad \searrow$<br>$\sim Gy \quad Hy$<br>$\swarrow \quad \searrow$<br>$\sim Fy \quad Gy$<br>$\times \quad \times$ | $\Lambda x (Fx \rightarrow Gx)$<br>$\forall x (Fx \wedge Gx)$<br>$\sim \Lambda x (Fx \rightarrow Hx)$<br>$\forall x \sim (Fx \rightarrow Hx)$<br>$Fy$<br>$\sim Hy$<br>$Fy$<br>$Gy$<br>$\swarrow \quad \searrow$<br>$\sim Fy \quad Gy$<br>$\times \quad \times$ |
| (1)  | (2)  | (3)  | (4)  | (5)  |
50. By what following term are the people who spread in Sri Lanka from about 40,000 BC known?
- (1) Dravidians
  - (2) Aryans
  - (3) Balangoda man
  - (4) Yakkhas
  - (5) Veddas