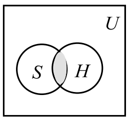
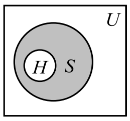
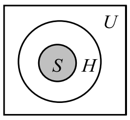
14.MATHEMATICAL REASONING

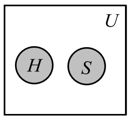
Single Correct Answer Type

1. H:Set of holiday, S: Set of Sunday and U:Set of day's
   Then, the Venn diagram of statement, 'Every Sunday implies holiday' is

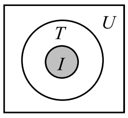
   a) 

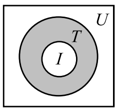
   b) 

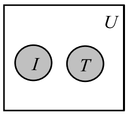
   c) 

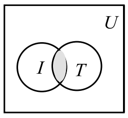
   d) 

2. Simplify $(p \vee q) \wedge (p \vee {\sim}q)$
   a) p b) T c) F d) q
3. The statement $p \Rightarrow p \vee q$ is
   a) A tautology
   b) A contradiction
   c) Both a tautology and contradiction
   d) Neither a tautology nor a contradiction
4. $p \rightarrow q$ is logically equivalent to
   a) $p \wedge \sim q$ b) $\sim p \rightarrow \sim q$ c) $\sim q \rightarrow \sim p$ d) None of these
5. Which of the following is logically equivalent to $p \wedge q$?
   a) $p \rightarrow \sim q$ b) $\sim p \vee \sim q$ c) $\sim (p \rightarrow \sim q)$ d) $\sim (\sim p \wedge \sim q)$
6. Some triangles are not isosceles. Identify the Venn diagram

   a) 

   b) 

   c) 

   d) 

7. Which of the following is contingency?
   a) $p \vee \sim p$ b) $p \wedge q \Rightarrow p \vee q$ c) $p \wedge \sim q$ d) None of these
8. $\sim (p \vee q) \vee (\sim p \wedge q)$ is logically equivalent to
   a) $\sim p$ b) p c) q d) $\sim q$
9. A compound sentence formed by two simple statements p and q using connective 'or' is called
   a) Conjunction b) Disjunction c) Implication d) None of these
10. If p and q are two statements, then $p \vee \sim (p \Rightarrow \sim q)$ is equivalent to
    a) $p \wedge \sim q$ b) p c) q d) $\sim p \wedge q$
11. Let $p \wedge (q \vee r) = (p \wedge q) \vee (p \wedge r)$. Then, this law is known as
    a) Commutative law b) Associative law c) De-Morgan's law d) Distributive law
12. If p and q are two statements, then statement $p \Rightarrow q \wedge \sim q$ is
    a) Tautology b) Contradiction
    c) Neither tautology not contradiction d) None of the above
13. Which of the following is logically equivalent to ${\sim}({\sim}p \rightarrow q)$?
    a) $p \wedge q$ b) $p \wedge \sim q$ c) $\sim p \wedge q$ d) $\sim p \wedge \sim q$
14. The statement $(p \Rightarrow q) \Leftrightarrow (\sim p \wedge q)$ is a
    a) Tautology b) Contradiction c) Neither (a) nor (b) d) None of these
15. A compound sentence formed by two simple statements p and q using connective 'and' is called
    a) Conjunction b) Disjunction c) Implication d) None of these
16. Let p: is not greater than and q: Pairs is in France Be two statements. Then, ${\sim}(p \vee q)$ is the statement
    a) 7 is greater than or Pairs is not in France
    b) 7 is not greater than 4 and Pairs is not in France
    c) 7 is greater than 4 and Pairs is in France
    d) 7 is greater than 4 and Pairs is not in France
17. If p and q are two simple propositions, then $p \leftrightarrow {\sim}q$ is true when

a) p and q both are true
b) Both p and q are false
c) p is false and q is true
d) None of these

18. Negation of "Pairs is in France and Londan is in England" is
a) Pairs is in England and Londan is in France
b) Pairs is not in France or Londan is not in England
c) Pairs is in England or Londan is in France
d) None of the above

19. If truth value of $p \vee q$ is true, then truth value of $\sim p \wedge q$ is
a) False if p is true b) True if p is true c) False if q is true d) True if q is true

20. The logically equivalent proposition of $p \Leftrightarrow q$ is
a) $(p \wedge q) \vee (p \wedge q)$ b) $(p \Rightarrow q) \wedge (q \Rightarrow p)$ c) $(p \wedge q) \vee (q \Rightarrow p)$ d) $(p \wedge q) \Rightarrow (p \vee q)$

21. Which of the following connectives satisfy commutative law?
a) $\wedge$ b) $\vee$ c) $\Leftrightarrow$ d) All the above

22. Which of the following propositions is a contradiction?
a) $(\sim p \vee \sim q) \vee (p \vee \sim q)$ b) $(p \rightarrow q) \vee (p \wedge \sim q)$ c) $(\sim p \wedge q) \wedge (\sim q)$ d) $(\sim p \wedge q) \vee (\sim q)$

23. Let p be the proposition Mathematics is interesting and let q be the proposition that Mathematics is difficult, then the symbol $p \wedge q$ means
a) Mathematics is interesting implies that Mathematics is difficult
b) Mathematics is interesting implies and is implied by Mathematics is difficult
c) Mathematics is intersecting and Mathematics is difficult
d) Mathematics is intersecting or Mathematics is difficult

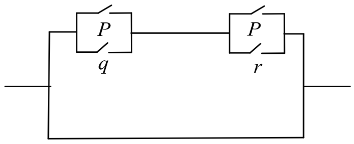
24. If $(p \wedge \sim r) \rightarrow (\sim p \vee q)$ is false, then the truth values of p, q and $r$are respectively
a) T, F and F b) F, F and T c) F, T and T d) T, F and T

25. If statements p and r are false and q is true, then truth value of $\sim p \Rightarrow (q \wedge r) \vee r$ is
a) T b) F c) Either T or F d) Neither T nor F

26. Let p and q be two statements, then $(p \vee q) \vee \sim p$ is
a) Tautology b) Contradiction c) Both (a) and (b) d) None of these

27. the contrapositive of "If two triangles are identical, then these are similar" is
a) If two triangles are not similar, then these are not identical
b) If two triangles are not identical, then these are not similar
c) If two triangles are not identical, then these are similar
d) if two triangles are not similar, then these are identical

28. Simplify the following circuit and find the boolean polynomial.



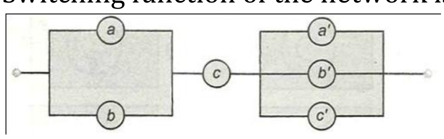
a) $p \vee (q \wedge r)$ b) $p \wedge (q \vee r)$ c) $p \vee (q \vee r)$ d) $p \wedge (q \wedge r)$

29. Which of the following statement is a tautology
a) $(\sim q \wedge p) \wedge q$ b) $(\sim q \wedge p) \wedge (p \wedge \sim p)$ c) $(\sim q \wedge p) \vee (p \wedge \sim p)$ d) $(p \wedge q) \wedge (\sim (p \wedge q))$

30. The negation of the proposition "If 2 is prime, then 3 is odd" is
a) If 2 is not prime, then 3 is not odd b) 2 is prime and 3 is not odd
c) 2 is not prime and 3 is odd d) If 2 is not prime, then 3 is odd

31. If p, q, and r are simple propositions with truth values T,F,T, then the truth value of $(\sim p \vee q) \wedge\wedge \sim q \rightarrow p$ is
a) True b) False c) True, if r is false d) None of these

32. Switching function of the network is



a) $(a \wedge b) \vee c \vee (a' \wedge b' \wedge c')$ b) $(a \wedge b) \vee c \vee (a' \wedge b' \wedge c)$
c) $(a \vee b) \wedge c \wedge (a' \vee b' \vee c')$ d) None of the above

33. The negation of the proposition $q \vee \sim (p \wedge r)$ is
a) $\sim q \vee (p \wedge r)$ b) $\sim q \wedge (p \wedge r)$ c) $\sim p \vee \sim q \vee \sim r$ d) None of these
34. Which of the following pairs are logically equivalent?
a) Conditional, Contrapositive
b) Conditional, Inverse
c) Contrapositive, Converse
d) Inverse, Contrapositive
35. The statement $(\sim p \wedge q) \vee \sim q$ is
a) $p \vee q$ b) $p \wedge q$ c) $\sim (p \vee q)$ d) $\sim (p \wedge q)$
36. $\sim[(p \wedge q) \rightarrow (\sim p \vee q)]$ is
a) Tautology b) Contradiction c) neither (a) nor (b) d) either (a) or (b)
37. If $p \rightarrow (q \vee r)$ is false, then the truth values of p, q, r are respectively
a) F, T, T b) T, T, F c) T, F, F d) F, F, F
38. Let R be the set of real numbers and $x \in R$. Then, $x + 3 = 8$ is
a) Open statement b) A true statement c) False statement d) None of these
39. Which of the following not a statement in logic?
1. Earth is planet.
2. Plants are living objects.
3. $\sqrt{-3}$ is a rational number.
4. $x^2 - 5x + 6 < 0$, when $x \in -R$.
a) 1 b) 3 c) 2 d) 4
40. Dual of $(x \wedge y) \vee (x \wedge 1) = x \wedge x \vee y \wedge y$ is
a) $(x \vee y) \wedge (x \vee 0) = x \vee (x \wedge y) \vee y$ b) $(x \wedge y) \wedge (x \vee 1) = x \vee (x \wedge y) \vee y$
c) $(x \vee y) \vee (x \vee 0) = x \vee (x \wedge y) \vee y$ d) None of the above
41. The contrapositive of $(\sim p \wedge q) \rightarrow \sim r$ is
a) $(p \wedge q) \rightarrow r$ b) $(p \vee q) \rightarrow r$ c) $r \rightarrow (p \vee \sim q)$ d) None of these
42. $\sim p \wedge q$ is logically equivalent to
a) $p \rightarrow q$ b) $q \rightarrow p$ c) $\sim(p \rightarrow q)$ d) $\sim(q \rightarrow p)$
43. $p \wedge (q \wedge r)$ is logically equivalent to
a) $p \vee (q \wedge r)$ b) $(p \wedge q) \wedge r$ c) $(p \vee q) \vee r$ d) $p \rightarrow (q \wedge r)$
44. If $p =$ He is intelligent
$q =$He is strong
Then, symbolic form of statement
"It is wrong that he is intelligent or strong," is
a) $\sim p \vee \sim p$ b) $\sim (p \wedge q)$ c) $\sim (p \vee q)$ d) $p \vee \sim q$
45. Which of the following is a contradiction?
a) $(p \wedge q) \wedge (\sim (p \vee q))$ b) $p \vee (\sim p \wedge q)$ c) $(p \rightarrow q) \rightarrow p$ d) None of these
46. The statement $p \vee q$ is
a) A tautology b) A contradiction c) Contingency d) None of these
47. When does the value of the statement $p(\wedge r) \Leftrightarrow (r \wedge q)$ become false?
a) p is T, q is F b) p is, r is F c) p is F, q is $F$and r is F d) None of these
48. $(p \wedge \sim q) \wedge (\sim p \wedge q)$ is
a) a tautology b) a contradiction c) tautology and contradiction d) neither a tautology not a contradiction
49. If p always speaks against q, then $p \Rightarrow p \vee \sim q$ is
a) A tautology b) Contradiction c) Contingency d) None of these
50. If p, q, r have truth values T, F, T respectively, which of the following is true?
a) $(p \rightarrow q) \wedge r$ b) $(p \rightarrow q) \wedge \sim r$ c) $(p \wedge q) \wedge (p \vee r)$ d) $q \rightarrow (p \wedge r)$

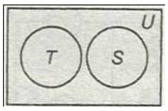
51. Dual of $(x' \vee y')' = x \wedge y$ is
a) $(x' \vee y') = x \vee y$ b) $(x' \wedge y')' = x \vee y$ c) $(x' \wedge y')' = x \wedge y$ d) None of the above
52. $p \vee q$ is true when
a) Both p and q are true b) p is true and q is false c) p is false and q is true d) All of these
53. Which of the following propositions is a tautology?
a) $(\sim p \vee \sim q) \vee (p \vee \sim q)$
b) $(\sim p \vee \sim q) \wedge (p \vee \sim q)$
c) $\sim p \wedge (\sim p \vee \sim q)$
d) $\sim q \wedge (\sim p \vee \sim q)$
54. For any two statements p and q, $\sim(p \vee q) \vee (\sim p \wedge q)$is logically equivalent to
a) p b) $\sim p$ c) q d) $\sim q$
55. Identify the false statement
a) $\sim[p \vee (\sim q)] \equiv (\sim p) \wedge q$ b) $[p \vee q] \vee (\sim p)$ is a tautology
c) $[p \wedge q] \wedge (\sim p)$ is a contradiction d) $\sim(p \vee q) \equiv (\sim p) \vee (\sim q)$
56. $\sim[p \leftrightarrow q]$ is
a) Tautology b) Contradiction c) neither (a) nor (b) d) either (a) or (b)
57. Let truth values of p be F and q be T. Then, truth value of $\sim(\sim p \vee q)$ is
a) T b) F c) Either T or F d) Neither T nor F
58. Which of the following statements is a tautology?
a) $(\sim q \wedge p) \wedge q$ b) $(\sim q \wedge p) \wedge (p \wedge \sim p)$ c) $(\sim q \wedge p) \vee (p \vee \sim p)$ d) $(p \wedge q) \wedge (\sim(p \wedge q))$
59. Consider the proposition : "If we control population growth, we prosper". Negative of this proposition is
a) If we do not control population growth, we prosper
b) If we control population, we do not prosper
c) We control population but we do not prosper
d) We do not control population but we prosper
60. Which of the following is not a proposition?
a) 3 is prime b) $\sqrt{2}$ is irrational
c) Mathematics is interesting d) 5 is an even integer
61. If p and q are two statements, then $(p \Rightarrow q) \Leftrightarrow (\sim q \Rightarrow \sim p)$ is a
a) Contradiction b) Tautology c) Neither (a) nor (b) d) None of these
62. The logically equivalent proposition of $p \rightarrow q$ is
a) $(p \rightarrow q) \vee (q \rightarrow p)$ b) $(p \vee q) \rightarrow (p \vee q)$ c) $(p \wedge q) \wedge (p \vee q)$ d) $(p \rightarrow q) \wedge (q \rightarrow p)$
63. If p and q are statements, then $\sim(p \wedge q) \vee \sim(q \Leftrightarrow p)$ is
a) Tautology b) Contradiction
c) Neither tautology nor contradiction d) Either tautology or contradiction
64. Consider the proposition : " If the pressure increases, the volume decreases:. The negation of this proposition is
a) If the pressure does not increase the volume does not decrease
b) If the volume increases, the pressure decreases
c) If the volume does not decreases, the pressure does not increase
d) If the volume decreases, then the pressure does not increase
65. The dual of the statement $[p \vee (\sim q)] \wedge (\sim p)$ is
a) $p \vee (\sim q) \vee \sim p$ b) $(p \wedge \sim q) \vee \sim p$ c) $p \wedge \sim(q \vee \sim p)$ d) None of these
66. Which of the following is logically equivalent to $(p \wedge q)$?
a) $p \rightarrow q$ b) $\sim p \wedge \sim q$ c) $p \wedge \sim q$ d) $\sim(p \rightarrow \sim q)$
67. The proposition $p \rightarrow \sim(p \wedge \sim q)$ is
a) A contradiction
b) A tautology
c) Either a tautology or a contradiction
d) Neither a tautology nor a contradiction

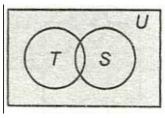
68. Which of the following statement has the truth value 'F'?
a) A quadratic equation has always a real root
b) The number of ways of seating 2 persons in two chairs out of n persons is $P(n, 2)$
c) The cube roots of unity are in GP
d) None of the above

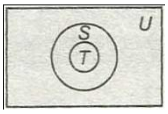
69. The negative of the proposition : “If a number is divisible by 15, then it is divisible by 5 or 3”
a) If a number is divisible by 15, then it is not divisible by 5 and 3
b) A number is divisible by 15 and it is not divisible by 5 and 3
c) A number is divisible by 15 and it is not divisible by 5 or 3
d) A number is not divisible by 15 or it is not divisible by 5 and 3

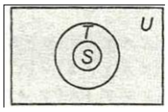
70. $p \wedge q \rightarrow p$ is
a) A tautology
b) A contradiction
c) Neither a tautology n or a contradiction
d) None of these

71. All teachers are scholar, Identify the Venn diagram

a) 

b) 

c) 

d) 

72. the negation of the statement "he is rich and happy" is given by
a) he is not rich and not happy
b) he is not rich or not happy
c) he is rich and happy
d) he is not rich and happy

73. The property $\sim (p \wedge q) \equiv \sim p \vee \sim q$ is called
a) Associative law
b) De morgan’s law
c) Commutative law
d) Idempotent law

74. The negation of the compound proposition $p \vee (\sim p \vee q)$ is
a) $(p \wedge \sim q) \wedge \sim p$
b) $(p \wedge \sim q) \vee \sim p$
c) $(p \wedge \sim q) \vee \sim p$
d) None of these

75. The negation of $q \vee \sim (p \wedge r)$ is
a) $\sim q \vee \sim (p \wedge r)$
b) $\sim q \vee (p \wedge r)$
c) $\sim q \wedge (p \wedge r)$
d) $\sim q \wedge \sim (p \wedge r)$

76. $\sim(\sim p) \leftrightarrow p$ is
a) A tautology
b) A contradiction
c) Neither a contradiction nor a tautology
d) None of these

77. The contrapositive of $2x + 3 = 9 \Rightarrow x \neq 4$ is
a) $x = 4 \Rightarrow 2x + 3 \neq 9$
b) $x = 4 \Rightarrow 2x + 3 = 9$
c) $x \neq 4 \Rightarrow 2x + 3 \neq 9$
d) $x \neq 4 \Rightarrow 2x + 3 = 9$

78. Negation of the conditional, "If it rains, I shall go to school" is
a) It rains and I shall go to school
b) It rains and I shall not go to school
c) It does not rains and I shall go to school
d) None of the above

79. If a compound statement r is contradiction, then the truth value of $(p \Rightarrow q) \wedge r \wedge p[p \Rightarrow \sim r]$ is
a) TM
b) F
c) T or F
d) None of these

80. The statement $p \vee \sim p$ is
a) Tautology
b) Contradiction
c) Neither a tautology nor a contradiction
d) None of the above

81. If $p \rightarrow (q \vee r)$ is false, then the truth values of p, q, r are respectively
a) T, T, T
b) F, T, T
c) F, F, F
d) T, F, F

82. If p: Ram is smart
q: Ram is intelligent
Then, the symbolic form Ram is smart and intelligent, is
a) $(p \wedge q)$
b) $(p \vee q)$
c) $(p \wedge \sim q)$
d) $(p \vee \sim q)$

83. Which of the following is not a proposition?
a) $\sqrt{3}$ is a prime
b) $\sqrt{2}$ is irrational

c) Mathematics is interesting d) 5 is an even integer

84. $\sim [\sim p \wedge (p \Leftrightarrow q)] \equiv$
a) $p \vee q$ b) $q \wedge p$ c) T d) F

85. Which of the following is equivalent to $p \Rightarrow q$?
a) $p \Rightarrow q$ b) $q \Rightarrow p$ c) $(p \Rightarrow q) \wedge (q \Rightarrow p)$ d) None of these

86. Let p and q be two propositions. Then the inverse of the implication $p \rightarrow q$ is
a) $q \rightarrow p$ b) $\sim p \rightarrow \sim q$ c) $p \rightarrow q$ d) $\sim q \rightarrow \sim p$

87. Let p and q be two properties. Then, the contrapositive of the implication $p \rightarrow q$ is
a) $\sim q \rightarrow \sim p$ b) $p \rightarrow \sim q$ c) $q \rightarrow p$ d) $p \leftrightarrow q$

88. If p and q are two propositions, then $\sim (p \leftrightarrow q)$ is
a) $\sim p \wedge \sim q$ b) $\sim p \vee \sim q$ c) $(p \wedge \sim q) \vee (\sim p \wedge q)$ d) None of these

89. Which of the following is logically equivalent to $\sim (\sim p \rightarrow q)$?
a) $p \wedge q$ b) $p \wedge \sim q$ c) $\sim p \wedge q$ d) $\sim p \wedge \sim q$

90. The contrapositive of $p \Rightarrow \sim q$ is
a) $\sim p \Rightarrow q$ b) $\sim q \Rightarrow p$ c) $q \Rightarrow \sim p$ d) None of these

91. In which of the following cases, $p \Rightarrow q$ is true?
a) p is true, q is true b) p is false, q is true c) p is true, q is false d) None of these

92. Which of the following propositions is a tautology?
a) $\sim (p \rightarrow q) \vee (p \wedge \sim q)$ b) $(p \rightarrow q) \rightarrow (p \wedge \sim q)$ c) $(p \rightarrow q) \vee (p \wedge \sim q)$ d) $(p \rightarrow q) \wedge (p \wedge \sim q)$

93. If p:A man is happy
q:A man is rich
Then, the statement, "If a man is not happy, then he is not rich" is written as
a) $\sim p \rightarrow \sim q$ b) $\sim q \rightarrow p$ c) $\sim q \rightarrow \sim p$ d) $q \rightarrow \sim p$

94. Which of the following is false?
a) $p \vee \sim p$ is a tautology
b) $\sim (\sim) \leftrightarrow p$ is a tautology
c) $(p \wedge (p \rightarrow)) \rightarrow$ is a contradiction
d) $p \wedge \sim p$ is a contradiction

95. Let p and q be two statements. Then, $(\sim p \vee q) \wedge (\sim p \wedge \sim q)$ is a
a) Tautology b) Contradiction
c) Neither tautology nor contradiction d) Both tautology and contradiction

96. Logical equivalent proposition to the proposition $\sim(p \vee q)$
a) $\sim p \wedge \sim q$ b) $\sim p \vee \sim q$ c) $\sim p \rightarrow \sim q$ d) $\sim p \leftrightarrow \sim q$

97. What are the truth values of $(\sim p \Rightarrow \sim q)$ and $\sim (\sim p \Rightarrow q)$ respectively, when p and q always speak true in any argument?
a) T, T b) F, F c) T, F d) F, T

98. Which of the following is a proposition?
a) I am a lion
b) A half open door is half closed
c) A triangle is a circle and 10 is a prime number
d) Logic is an interesting subject

99. Which of the following is the inverse of the proposition : "If a number is a prime, then it is odd"?
a) If a number is not a prime, then it is odd b) If a number is not a prime, then it is not odd
c) If a number is not odd, then it is not a prime d) If a number is odd, then it is a prime

100. Let p be the statement 'Ravi races' and let q be the statement 'Ravi wins'. Then, the verbal translation of $\sim(p \vee (\sim q))$ is
a) Ravi does not race and Ravi does not win
b) It is not true that Ravi races and that Ravi does not win
c) Ravi does not race and Ravi wins
d) It is not true that Ravi races or that Ravi does not win

101. The contrapositive of $(p \vee q) \rightarrow r$ is

a) $\sim r \rightarrow (p \vee q)$ b) $r \rightarrow (p \vee q)$ c) $\sim r \rightarrow (\sim p \wedge \sim q)$ d) $p \rightarrow (q \vee r)$

102. Which is not a statement?
a) $3 > 4$ b) $4 > 3$
c) Raju is an intelligent boy d) He lives in Agra

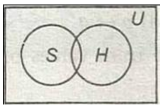
103. If $p = \Delta\, ABC$ is equilateral and q =each angle is 60°. Then, symbolic form of statement
a) $p \vee p$ b) $p \wedge q$ c) $p \Rightarrow q$ d) $p \Leftrightarrow q$

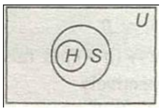
104. Consider the following statements :
p : I shall pass, q : I study
The symbolic representation of the proposition "I shall pass iff I study" is
a) $p \rightarrow q$ b) $q \rightarrow p$ c) $p \rightarrow \sim q$ d) $p \leftrightarrow q$

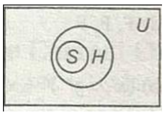
105. The false statement in the following is
a) $p \wedge (\sim p)$ is a contradiction b) $(p \Rightarrow q) \Leftrightarrow (\sim q \Rightarrow \sim p)$ is a contradiction
c) $\sim (\sim p) \Leftrightarrow p$ is a tautology d) $p \vee (\sim p)$ is a tautology

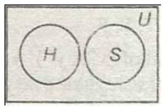
106. The negation of $p \wedge (q \rightarrow \sim r)$ is
a) $\sim p \wedge (q \wedge r)$ b) $p \vee (q \vee r)$ c) $p \vee (q \wedge r)$ d) $\sim p \vee (q \wedge r)$

107. H: Set of holidays
S: Set of Sundays
U:Set of day's
Then, the Venn diagram of statement, "Every Sunday implies holiday" is

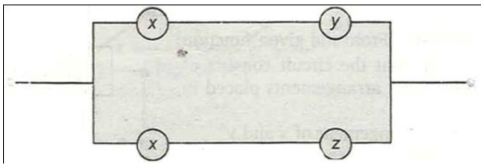
a) 

b) 

c) 

d) 

108. The switching function for switching work is



a) $x \wedge y \wedge z$ b) $x \vee y \wedge x \vee z$ c) $x \wedge y \wedge x \vee z$ d) None of these

109. If p and q are two simple propositions, then $p \leftrightarrow q$ is false when
a) p and q both are true b) p is false and q is true c) p is fale and q is true d) None of these

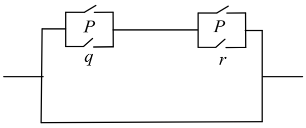
110. Let S be a non-empty subset of R. Consider the following statement
P: There is a rational number $x \in S$ such that $x > 0$.
Which of the following statements is the negation of the statement P?
a) There is a rational number $x \in S$ such that $x \leq 0$
b) There is no rational number $x \in S$ such that $x \leq 0$
c) Every rational number $x \in S$ satisfies $x \leq 0$
d) $x \in S$ and $x \leq 0 \Rightarrow x$ is not rational

111. $\sim(p \vee q) \vee (\sim p \wedge q)$ is logically equivalent to
a) $\sim p$ b) p c) q d) $\sim q$

112. Let p and q be two statements. Then, $p \vee q$ is false, if
a) p is false and q is true b) Both p and q are false c) Both p and q are true d) None of these

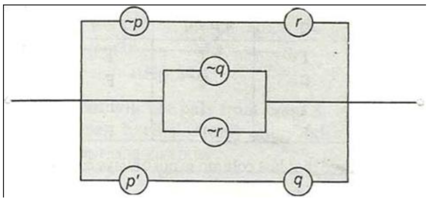
113. The statement $\sim(p \rightarrow q)$ is equivalent to
a) $p \wedge (\sim q)$ b) $\sim p \wedge q$ c) $p \wedge q$ d) $\sim p \wedge \sim q$

114. For the circuit shown below, the Boolean polynomial is



a) $(\sim p \vee q) \vee (p \vee \sim q)$ b) $(\sim p \wedge q) \wedge (p \wedge q)$ c) $(\sim p \wedge \sim q) \wedge (q \wedge p)$ d) $(\sim p \wedge q) \vee (p \vee \sim q)$

115. The switching function of network is



a) $\sim p \vee r \wedge (\sim q \wedge \sim r) \wedge p' \vee q$ b) $(\sim p \wedge r) \wedge (\sim q \vee \sim r) \wedge p' \vee q$
c) $(\sim p \wedge r) \wedge (\sim q \vee \sim r) \wedge p' \vee q$ d) None of the above

116. The proposition $(p \rightarrow \sim p) \wedge (\sim p \rightarrow p)$ is a
a) Tautology
b) Contradiction
c) Neither a tautology nor a contradiction
d) Tautology and contradiction

117. If $p \Rightarrow (\sim p \vee q)$ is false, the truth value of p and q are respectively
a) F, T b) F, F c) T, T d) T, F

118. Which of the following is a contradiction?
a) $p \vee q$ b) $p \wedge q$ c) $p \vee \sim p$ d) $p \wedge \sim p$

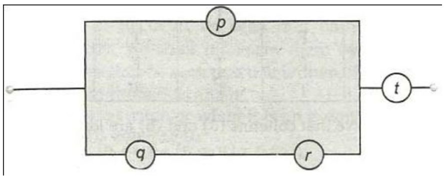
119. $\sim(\sim p \rightarrow q) \equiv$
a) $p \wedge \sim q$ b) $\sim p \wedge q$ c) $\sim p \wedge \sim q$ d) $\sim p \vee \sim q$

120. The converse of the contrapositive of the conditional $p \rightarrow \sim q$ is
a) $p \rightarrow q$ b) $\sim p \rightarrow \sim q$ c) $\sim q \rightarrow p$ d) $\sim p \rightarrow q$

121. A proposition is called a tautology, if it is
a) Always T b) Always F
c) Sometimes T, sometimes F d) None of the above

122. If p: 4 an even prime number q: 6 is a divisor of 12 and r:the HCF of 4 and 6 is 2, then which one of the following is true?
a) $(p \vee q)$ b) $(p \vee q) \wedge \sim r$ c) $\sim(q \wedge r) \vee p$ d) $\sim p \vee (q \wedge r)$

123. The switching function for the following network is



a) $(p \wedge q \vee r) \wedge t$ b) $(p \wedge q \vee r) \vee t$ c) $p \vee r \wedge q \vee t$ d) None of these

124. Which of the following is logically equivalent to $\sim (p \leftrightarrow q)$?
a) $(p \wedge \sim q) \wedge (q \wedge \sim p)$ b) $p \vee q$ c) $(p \wedge \sim q) \vee (q \wedge \sim p)$ d) None of these

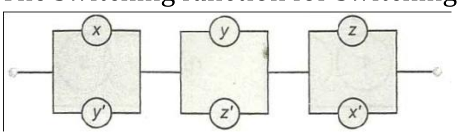
125. The inverse of the proposition $(p \wedge \sim q) \rightarrow r$ is
a) $\sim r \rightarrow \sim p \vee q$ b) $\sim p \vee q \rightarrow \sim r$ c) $r \rightarrow p \wedge \sim q$ d) None of these

126. Which is a statement?
a) $x + 1 = 6$ b) $5 \in N$ c) $x + y < 12$ d) None of these

127. Let inputs of p and q be 1 and 0 respectively in electric circuit. Then, output of $p \wedge q$ is
a) 1 b) 0 c) Both 1 and 0 d) Neither 1 nor 0

128. When does the inverse of the statement $\sim p \Rightarrow q$ results in T?
a) p and q both are true
b) p is true and q is false
c) p is false and q is false
d) Both (b) and (c)

129. The switching function for switching network is



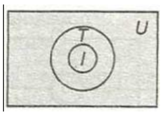
a) $(x \wedge y') \vee (y \wedge z') \vee (z \wedge x')$ b) $(x \wedge y \wedge z) \vee (x' \wedge y' \wedge z')$

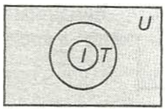
c) $(x \vee y') \wedge (y \vee z') \wedge (z \vee x')$ d) None of the above

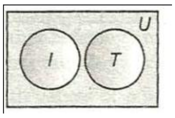
130. If $S(p, q, r) = (\sim P) \vee [\sim(q \wedge r)]$ is a compound statement, then $S(\sim p, \sim q, \sim r)$ is

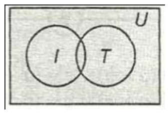
a) $\sim S(p, q, r)$ b) $S(p, q, r)$ c) $p \vee (q \wedge r)$ d) $p \vee (q \vee r)$

131. Some triangles are not isosceles. Identify the Venn diagram

a) 

b) 

c) 

d) 

132. The negation of $p \wedge\sim (q \wedge r)$ is

a) $\sim p \vee (q \wedge r)$ b) $\sim p \vee (\sim q \vee\sim r)$ c) $p \vee (q \wedge r)$ d) $\sim p \wedge (q \vee r)$

133. Dual of $x \wedge (yx) = x$ is

a) $x \vee (y \wedge x) = x$ b) $x \vee (y \vee x) = x$ c) $(x \wedge y) \vee (x \wedge x) = x$ d) None of these

134. Which of the following sentences is a statements?

a) AArushi is a pretty girl
b) What are you doing?
c) Oh! It is amazing
d) 2 is the smallest prime number

135. The contrapositive of the statement $\sim p \Rightarrow (p \wedge\sim q)$ is

a) $p \Rightarrow (\sim p \vee q)$ b) $p \Rightarrow (p \wedge q)$ c) $p \Rightarrow (\sim p \wedge q)$ d) $\sim p \vee q \Rightarrow p$

136. The statement $p \rightarrow (q \rightarrow p)$ is equivalent to

a) $p \rightarrow (p \leftrightarrow q)$ b) $p \rightarrow (p \rightarrow q)$ c) $p \rightarrow (p \vee q)$ d) $p \rightarrow (p \wedge q)$

137. Dual of $(x' \wedge y')' = x \vee y$ is

a) $(x' \wedge y') = x \wedge y$ b) $(x' \vee y')' = x \wedge y$ c) $(x' \vee y')' = xy$ d) None of these

138. If p: A man is happy
q: A man is rich
Then, the statement, ""If a man is not happy, then he is not rich" is written as

a) $\sim p \rightarrow\sim q$ b) $\sim q \rightarrow p$ c) $\sim q \rightarrow\sim p$ d) $q \rightarrow\sim p$

139. Which of the following is a tautology?

a) $p \wedge q$ b) $p \vee q$ c) $p \vee\sim p$ d) $p \wedge\sim p$

140. Let p and q be two statement, then $(p \vee q) \vee \sim p$ is

a) Tautology b) Contradiction c) Both (a) and (b) d) None of these

141. For any three propositions p, q and r, the proposition $(p \wedge q) \wedge (q \wedge r)$

a) p, q, r are all false
b) p, q, r are all true
c) p, q are true and r is false
d) p is true and q and r are false

142. Given that water freezes below zero degree Celsius. Consider the following statements :
p: Water froze this morning, q: This morning temperature was below 0°C
Which of the following is the correct?

a) p and q are logically equivalent
b) p is the inverse of q
c) p is the converse of q
d) p is the contrapositive of q

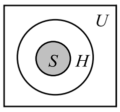
: ANSWER KEY :

1)	c	2)	a	3)	a	4)	c
5)	c	6)	b	7)	c	8)	a
9)	b	10)	b	11)	d	12)	c
13)	d	14)	a	15)	a	16)	d
17)	c	18)	b	19)	a	20)	b
21)	d	22)	c	23)	c	24)	a
25)	b	26)	a	27)	a	28)	a
29)	c	30)	b	31)	a	32)	a
33)	b	34)	a	35)	d	36)	b
37)	c	38)	a	39)	c	40)	a
41)	c	42)	d	43)	b	44)	c
45)	a	46)	c	47)	d	48)	b
49)	a	50)	d	51)	b	52)	d
53)	a	54)	b	55)	d	56)	c
57)	b	58)	c	59)	c	60)	c
61)	b	62)	d	63)	c	64)	c
65)	b	66)	d	67)	d	68)	a
69)	b	70)	a	71)	c	72)	b
73)	b	74)	a	75)	c	76)	a
77)	a	78)	b	79)	b	80)	a
81)	d	82)	a	83)	c	84)	a
85)	c	86)	b	87)	a	88)	c
89)	d	90)	c	91)	a	92)	c
93)	a	94)	c	95)	c	96)	a
97)	c	98)	c	99)	b	100)	c
101)	c	102)	c	103)	d	104)	d
105)	b	106)	d	107)	c	108)	b
109)	c	110)	c	111)	a	112)	b
113)	a	114)	d	115)	a	116)	b
117)	d	118)	d	119)	c	120)	d
121)	a	122)	d	123)	b	124)	c
125)	b	126)	b	127)	a	128)	d
129)	a	130)	d	131)	b	132)	a
133)	a	134)	d	135)	d	136)	c
137)	b	138)	a	139)	c	140)	a
141)	b	142)	a				

: HINTS AND SOLUTIONS :

1 **(c)**

The required Venn diagram of given statement is given below



2 **(a)**

$(p \vee q) \wedge (p \vee \sim q)$

$= p \vee (q \wedge \sim q)$ (distributive law)

$= p \vee 0$ (complement law)

$= p$ (0 is identify for v)

4 **(c)**

We have

$p \rightarrow q \cong \sim p \vee q$

and, $\sim q \rightarrow \sim p \cong \sim (\sim q) \vee \sim p \cong q \vee \sim p \cong \sim p \vee q$

$\cong p \rightarrow q$

5 **(c)**

We have,

$p \rightarrow q \cong \sim p \vee q$

$\therefore p \rightarrow \sim q \cong \sim p \vee \sim q \cong \sim (p \wedge q)$

So, option (a) is not correct

$\sim p \vee \sim q = \sim (p \wedge q)$

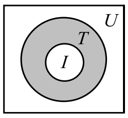
So, option (b) is not correct

$\sim (p \rightarrow \sim q) = \sim (\sim p \vee \sim q) = p \wedge q$

So, option (c) is incorrect

6 **(b)**

Some triangles are not isosceles.



8 **(a)**

$\sim (p \vee q) \vee (\sim p \wedge q)$

$\cong (\sim p \wedge \sim q) \vee (\sim p \wedge q)$

$\cong \sim p \wedge (\sim q \vee q) \cong \sim p \vee t \cong \sim p$

9 **(b)**

A compound sentence formed by two simple statements p and q using connective 'or' is called disjunction

12 **(c)**

By truth table

p	q	$\sim q$	$q \wedge \sim q$	$p \Rightarrow q \wedge \sim q$
T	T	F	F	F
T	F	T	F	F
F	T	F	F	T
F	F	T	F	T

Hence, it is neither a tautology nor contradiction

13 **(d)**

We have,

$p \rightarrow q \cong \sim p \vee q$

$\therefore \sim (\sim p \rightarrow q) \cong \sim (p \vee q) \cong \sim p \wedge \sim q$

16 **(d)**

$\sim (p \vee q) \equiv \sim p \wedge \sim q$

$\therefore$ 7 is greater than 4 and Paris is not in France.

17 **(c)**

From the truth table of $p \leftrightarrow q$ it is evident that $p \leftrightarrow q$ is true when p and q both are true or both are false

$\therefore p \leftrightarrow \sim q$ is true when p is false and $\sim q$ is false

i. e. p is false and q is true

18 **(b)**

Let p:Pairs is in France and q: London is in England

Given, $p \wedge q$

Its negation is $\sim (p \wedge q) \equiv \sim p \vee \sim q$

Hence, paris is not in France or London is not in England.

20 **(b)**

$(p \Rightarrow q) \wedge (q \Rightarrow p)$ means $p \Leftrightarrow q$

22 **(c)**

$(\sim p \wedge q) \wedge \sim q = \sim p \wedge (q \wedge \sim q) = \sim p \wedge c = c$

23 **(c)**

$p \wedge q$ means Mathematics is interesting and Mathematics is difficult

24 **(a)**

Truth Table

p	q	r	$\sim p$	$\sim r$	$p \wedge \sim r$	$(\sim p \vee q)$	$(p \wedge \sim r) \rightarrow (\sim p \vee q)$
T	T	T	F	F	F	T	T
T	T	F	F	T	T	T	T
T	F	T	F	F	F	F	T
T	F	F	F	T	T	F	F
F	T	T	T	F	F	T	T
F	T	F	T	T	F	T	T
F	F	T	T	F	F	T	T
F	F	F	T	T	F	T	T

Hence, $(p \wedge \sim r) \rightarrow (\sim p \vee q)$ is F.

When $p = \mathrm{T}, q = \mathrm{F}, r = \mathrm{F}$

26 **(a)**

By truth table

p	q	$p \vee q$	$\sim p$	$(p \vee q) \vee \sim p$
T	T	T	F	T
T	F	T	F	T

F	T	T	T	T
F	F	F	T	T

It is clear that $(p \vee q) \vee \sim p$ is a tautology

27 **(a)**

Let p: Two triangles are identical

q: Two triangles are similar

Clearly, the given statement in symbolic form is $p \rightarrow q$.

$\therefore$ Its contrapositive is given by $\sim q \rightarrow \sim p$.

ie, If two triangles are not similar, then these are not identical.

28 **(a)**

$(p \vee q) \wedge (p \vee r) = p \vee (q \wedge r)$

29 **(c)**

Truth table

p	q	$\sim p$	$\sim q$	$\sim q \wedge p$	$(\sim q \wedge p) \wedge q$	$(p \wedge \sim p)$	$(\sim q \wedge p) \vee (p \wedge \sim p)$	$(\sim q \wedge p) \vee (p \wedge \sim p)$
T	T	F	F	F	F	T	F	T
T	F	F	T	T	F	T	F	T
F	T	T	F	F	F	T	F	T
F	F	T	T	F	F	T	F	T

It is clear from the table that last column have all true values. Hence option (c) is correct

30 **(b)**

Let $p = 2$ is prime

and $q = 3$ is odd

Given, $p \rightarrow q$

Negation of $p \rightarrow q$ is $\sim (p \rightarrow q)$

$\Rightarrow \quad p \wedge \sim q$

$\Rightarrow$ 2 is prime and 3 is not odd.

31 **(a)**

p	q	r	$\sim p$	$\sim q$	$\sim p \vee q$	$(\sim p \vee q) \wedge \sim q$	$(\sim p \vee q) \wedge \sim q \rightarrow p$
T	F	T	F	T	F	F	T

32 **(a)**

Since, switches a and b and a', b' and c' are parallel which is denoted by $a \wedge b$ and $a' \wedge b' \wedge c'$ respectively

Now, $(a \wedge b), c$ and $(a' \wedge b' \wedge c')$ are connected in series, then switching function of complete network is

$(a \wedge b) \vee c \vee (a' \wedge b' \wedge c')$

33 **(b)**

The negation of $q \vee \sim (p \wedge r)$ is given by

$\sim \{q \vee \sim (p \wedge r)\} \cong \sim q \wedge (p \wedge r)$

35 **(d)**

$(\sim p \wedge q) \vee \sim q \equiv \sim q \vee (\sim p \wedge q)$ (By Commutative law)

$\equiv \sim q \vee (q \wedge q \sim p)$ (By Commutative law)

$\equiv \sim q \vee q(\sim q \vee \sim p)$ (By Distributive law)

$\equiv \sim (q \wedge p)$

$\equiv \sim (p \wedge q)$

36 **(b)**

p	q	$p \wedge q$	$\sim p$	$\sim p \vee q$	$(p \wedge q) \rightarrow (\sim p \vee q)$	$\sim[(p \wedge q) \rightarrow (\sim p \vee q)]$
T	T	T	F	T	T	F
T	F	F	F	F	T	F
F	T	F	T	T	T	F
F	F	F	T	T	T	F

It is clear from the table that

$\sim[(p \wedge q) \rightarrow (\sim p \vee q)]$

is a contradiction.

39 **(c)**

Plants are living objects is not a statement.

41 **(c)**

We know that the contrapositive of $p \rightarrow q$ is $\sim q \rightarrow \sim p$. Therefore, contrapositive of

$(\sim p \wedge q) \rightarrow \sim r$ is

$r \rightarrow \sim (\sim p \wedge q)$ or, $r \rightarrow p \vee \sim q$

42 **(d)**

p	q	$\sim p$	$\sim p \wedge q$	$q \rightarrow p$	$\sim(q \rightarrow p)$
T	T	F	F	T	F
T	F	F	F	T	F
F	T	T	T	F	T
F	F	T	F	T	F

From the table

$\sim p \wedge q \equiv \sim(q \rightarrow p)$

43 **(b)**

Clearly, $(p \wedge q) \wedge r \cong p \wedge (q \wedge r)$

44 **(c)**

The symbolic form of given statement is $\sim (p \vee q)$

45 **(a)**

$(p \wedge q) \wedge (\sim (p \vee q))$

$\cong (p \wedge q) \wedge (\sim p \wedge \sim q)$

$\cong q \wedge (p \wedge \sim p) \wedge \sim q$

$\cong q \wedge c \wedge \sim \cong c$

So, statement in option (a) is a contradiction

48 **(b)**

p	q	$\sim p$	$\sim q$	$p \wedge \sim q$	$\sim p \wedge q$	$(p \wedge \sim q) \wedge (\sim p \wedge q)$

T	T	F	F	F	F	F
T	F	F	T	T	F	F
F	T	T	F	F	T	F
F	F	T	T	F	F	F

It is clear from, the table that $(p \wedge \sim q) \wedge (\sim p \wedge q)$is a contradiction.

50 **(d)**

Since p is true and q is false

$\therefore p \to q$ has truth value F

Statement r has truth value T

$\therefore (p \to q) \wedge r$ has truth value F. Also,

$(p \to q) \wedge \sim r$ has truth value F

$p \wedge q$ has truth value F and $p \vee r$ has truth value T

$\therefore (p \wedge q) \wedge (p \vee r)$ has truth value F

As $p \wedge r$ has truth value T. Therefore, $q \to (p \wedge r)$ has truth value T

51 **(b)**

Dual of $(x' \vee y')' = x \wedge y$ is $(x' \wedge y') = x \vee y$

53 **(a)**

We have,

$(\sim p \vee \sim q) \vee (p \vee \sim q) = \sim p \vee (\sim q \vee (p \vee \sim q))$

$= \sim p \vee (p \vee \sim q) = (\sim p \vee p) \vee \sim q = t \vee \sim q = t$

54 **(b)**

$\sim (p \vee q) \vee (\sim p \wedge q)$

$\equiv (\sim p \wedge \sim q) \vee (\sim p \wedge q)$

$\equiv \sim p \wedge (\sim q \vee q)$

$\equiv \sim p$

55 **(d)**

p	q	$\sim p$	$\sim q$	$p \vee (\sim q)$	$(\sim p) \wedge q$	$p \vee q$	$\sim (p \vee q)$	$(\sim p) \vee (\sim q)$	$(p \vee q) \vee (\sim p)$
T	T	F	F	T	F	T	F	F	T
F	T	T	F	F	T	T	F	T	T
T	F	F	T	T	F	T	F	T	T
F	F	T	T	T	F	F	T	T	T

It is clear from the table that columns 8 and 9 are not equal, ie, $\sim (p \vee q)$ is not equivalent to $(\sim p) \vee (\sim q)$. Hence, option (e) is false statement.

56 **(c)**

p	q	$p \leftrightarrow q$	$\sim[p \leftrightarrow q]$
T	T	T	F
T	F	F	T
F	T	F	T
F	F	T	F

It is clear from the table that, it is neither tautology nor contradiction.

58 **(c)**

Truth Table

p	q	$\sim p$	$\sim q$	$\sim q \wedge p$	$(\sim q \wedge p) \wedge q$	$p \vee \sim p$	$(p \wedge q) \wedge (\sim (p \wedge q))$	$(\sim q \wedge p) \vee (p \vee \sim p)$
T	T	F	F	F	F	T	F	T
T	F	F	T	T	F	T	F	T
F	T	T	F	F	F	T	F	T
F	F	T	T	F	F	T	F	T

It is clear from the table that the last column has all true values.

59 **(c)**

Consider the following statements:

p : We control the population growth

q : We become prosper

The given statement is $p \to q$ and its negation is $p \wedge \sim q$

i.e. We control population but we donot become prosper

60 **(c)**

Mathematics is interestring is not a proposition.

63 **(c)**

By the truth table

p	q	$(p \wedge q)$	$\sim (p \wedge q)$	$q \Leftrightarrow p$	$\sim (q \Leftrightarrow p)$	$\sim (p \wedge q) \vee \sim (q \Leftrightarrow p)$
T	T	T	F	T	F	F
T	F	F	T	T	F	T
F	T	F	T	F	T	T

F	F	F	T	F	T	T

It is clear that it is neither tautology nor contradiction

64 **(c)**
We know that $p \to q \cong \sim q \to \sim p$
So, the given statement is equivalent to:
If the volume does not decrease, the pressure does not increase

65 **(b)**
The dual of the given statement is $(p \wedge \sim q) \vee \sim p$.

66 **(d)**
We have,
$\sim (p \to \sim q) \cong \sim (\sim p \vee \sim q) \cong p \wedge q$

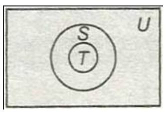
67 **(d)**
$p \to \sim (p \wedge \sim q)$
$\cong \sim p \vee \sim (p \wedge \sim q) \cong \sim p \vee (\sim p \vee q) \cong \sim p \vee q$
Clearly, it is neither a tautology nor a contradiction

68 **(a)**
The root of the quadric equation can be imaginary.

69 **(b)**
Consider the following statements:
$p =$ Number is divisible by 15
$q =$ Number is divisible by 5 or 3
We have,
$p \to q \cong \sim p \vee q$
$\therefore \sim (p \to q) \cong \sim (\sim p \vee q) \cong p \wedge \sim q$
Clearly, $p \wedge \sim q$ is equivalent to:
A number is divisible by 15 and it is not divisible by 5 and 3

70 **(a)**
Clearly, $p \wedge q \to p$ is always true. So, it is a tautology
ALITER We know that $p \to q \cong \sim p \vee q$
$\therefore p \wedge q \to p \cong \sim (p \wedge q) \vee p \cong (\sim p \vee \sim q) \vee p$
$\cong (\sim p \vee p) \vee \sim q \cong t \vee q \cong t$

71 **(c)**
All teachers are scholars



72 **(b)**
The negation of the given statement is "he is not rich or not happy".

74 **(a)**
We have,
$\sim \{p \vee (\sim p \vee q)\}$
$\cong \sim \{(p \vee \sim p) \vee q\} \cong \sim (t \vee q) \cong \sim t \cong c$
Also,
$(p \wedge \sim q) \wedge \sim p \cong (p \wedge \sim p \wedge \sim q) \cong c \wedge \sim q \cong c$
So, option (a) is correct

75 **(c)**
$\sim \{q \vee \sim (p \wedge r)\} = \sim q \wedge (p \wedge r)$

76 **(a)**
We have,
$\sim (\sim p) = p$
$\therefore \sim (\sim p) \leftrightarrow p \cong p \leftrightarrow p$
Hence, $\sim (\sim p) \leftrightarrow p$ is a tautology

77 **(a)**
The contrapositive of $p \to q$ is $\sim q \to \sim p$
So, the contrapositive of $2x + 3 = 2 \to x \neq 4$ is $x = 4 \to 2x + 3 \neq 9$

78 **(b)**
Let p: It rains, q: I shall go to school
Thus, we have $p \to q$
Its negation is $\sim (p \to q) ie, p \wedge \sim q$
ie,It rains and I shall not go to school.

81 **(d)**
We know that $p \to q$ is false when p is true and q is false. So, $p \to (q \vee r)$ is false when p is true and $q \vee r$ is false. But, $q \vee r$ is false when q and r both are false
Hence, $p \to (q \vee r)$ is false when p is true and q and r both are false

82 **(a)**
Given that
p: Ram is smart
q:Ram is intelligent
The symbolic form of "Ram is smart and intelligent." is $(p \wedge q)$

83 **(c)**
Mathematics is interesting is not a logical sentence. It may be intersecting for some persons and may not be interesting for others
$\therefore$ This is not a proposition

86 **(b)**
By definition, the inverse of implication $p \to q$ is $\sim p \to \sim q$

88 **(c)**
We know that
$p \to q \cong \sim p \vee q$ and $q \to p \cong \sim q \vee p$
$\therefore p \leftrightarrow q \cong (\sim p \vee q) \wedge (\sim q \vee p)$
$\sim (p \leftrightarrow q) \cong \sim (\sim p \vee q) \vee \sim (\sim q \vee p)$
$\sim (p \leftrightarrow q) \cong (p \wedge \sim q) \vee (q \wedge \sim p))$

89 **(d)**
$\sim (\sim p \to q) \cong \sim (p \vee q) \cong \sim p \wedge \sim q$

92 **(c)**
We have,
$p \leftrightarrow q \cong \sim p \vee q$
$\therefore (p \leftrightarrow q) \vee (p \wedge \sim q)$
$= (\sim p \vee q) \vee (p \wedge \sim q)$

$= \{(\sim p \vee q) \vee p\} \wedge \{(\sim p \vee q) \vee \sim q)\}$
$= \{(\sim p \vee p) \vee q\} \wedge \{\sim p \vee (q \vee \sim q)\}$
$= (t \vee q) \wedge (\sim p \vee t)$
$= t \wedge t = t$

93 **(a)**
'If a man is not happy, then he is not rich' is written as $\sim p \rightarrow \sim q$.

94 **(c)**
Clearly,
$p \vee \sim p$ is always true. So, it is a tautology
We have,
$\sim (\sim p) \leftrightarrow p \cong p \leftrightarrow p$
So, $\sim (\sim p) \leftrightarrow p$ is always true. So, it is a tautology
We know that $p \rightarrow q \cong \sim p \vee q$
$\therefore p \wedge (p \rightarrow q) \cong p \wedge (\sim p \vee q) \cong (p \wedge \sim p) \vee (p \wedge q)$
$\cong c \vee (p \wedge q) \cong p \wedge q$
$\therefore p \wedge (p \rightarrow q) \rightarrow p \cong p \wedge q \rightarrow p$ which is a tautology
So, option (c) is false

96 **(a)**
By De'Morgan's law, we have
$\sim (p \vee q) = \sim p \wedge \sim q$

98 **(c)**
Clearly, statement in option (c) is false. So, it has definite truth value. Hence, it is a proposition

99 **(b)**
Let p: A number is a prime
q: It is odd
Given proposition is $p \rightarrow q$ its inverse is $\sim q \rightarrow \sim q$.
ie, If a number is not prime, then it is not odd.

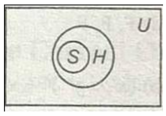
100 **(c)**
Given, p:Ravi races, q: Ravi wins
$\therefore$The statement of given proposition $\sim (p \vee (\sim q))$
Which is equivalent to $\sim p \wedge q$.
"It is not true that Ravi races or that Ravi does not win."

101 **(c)**
Contrapositive of $(p \vee q) \rightarrow r$
is $\sim r \rightarrow \sim (p \vee q) \equiv \sim r \rightarrow (\sim p \wedge \sim q)$

103 **(d)**
The symbolic form of given statement is $p \Leftrightarrow q$

105 **(b)**
$p \Rightarrow q$ is logically equivalent to $\sim q \Rightarrow \sim p$
$\therefore (p \Rightarrow q) \Leftrightarrow (\sim q \Rightarrow \sim p)$
Is a tautology but not a contradiction

106 **(d)**
$\sim \big(p \wedge (q \longrightarrow \sim r)\big) = \sim p \vee \sim (q \longrightarrow \sim r)$
$= \sim p \vee (q \wedge \sim (\sim r))$
$= \sim p \vee (q \wedge r)$

107 **(c)**
The required venn diagram of given statement is


109 **(c)**
The truth table that of $p \rightarrow q$ is as follows:

p	q	$p \rightarrow q$
T	T	T
F	T	T
T	F	F
F	F	T

110 **(c)**
P : There is rational number $x \in S$ such that $x > 0$
$\sim P$: Every rational number $x \in S$ satisfies $x \leq 0$

111 **(a)**
$\sim (p \vee q) \vee (\sim p \wedge q) \equiv (\sim p \wedge \sim q) \vee (\sim p \wedge q)$
$\equiv \sim p \wedge (\sim q \vee q) \equiv \sim p \wedge t \equiv \sim p$

113 **(a)**

p	q	$p \rightarrow q$	$\sim(p \rightarrow q)$	$\sim q$	$p \wedge (\sim q)$
T	T	T	F	F	F
T	F	F	T	T	T
F	T	T	F	F	F
F	F	T	F	T	F

From the table $\sim(p \rightarrow q) \equiv p \wedge (\sim q)$
$\therefore$ All the values are same.

114 **(d)**
For the given circuit, Boolean polynomial is $(\sim p \wedge q) \vee (p \vee \sim q)$.

116 **(b)**
We have,
$p \rightarrow \sim p \cong \sim p \vee \sim p \cong \sim p$ and $\sim p \rightarrow p \cong p \vee p \cong p$
$\therefore (p \rightarrow \sim p) \wedge (\sim p \rightarrow p) \cong \sim p \wedge p \cong c$

117 **(d)**
$p \Rightarrow (\sim p \vee q)$ is false means p is true and $\sim p \vee q$ is false
$\Rightarrow p$ is true and both $\sim p$ and q are false
$\Rightarrow p$ is true and q is false

119 **(c)**
$\sim (\sim p \longrightarrow q) \equiv \sim p \wedge \sim q$

120 **(d)**
The contrapositive of $p \rightarrow \sim q$ is
$\sim (\sim q) \rightarrow \sim p$ or $q \rightarrow \sim p$
Also, converse of $q \rightarrow \sim p$ is $\sim p \rightarrow q$.

122 **(d)**
$\therefore p$: 4 is an even prime number.
q: 6 is a divisor of 12
And r: the HCF of 4 and 6 is 2
$\therefore \sim p \vee (q \wedge r)$ is true.

123 **(b)**

The switching function for the given network is

$(p \wedge q \vee r) \vee t$

124 **(c)**

We have,

$p \leftrightarrow q \cong (p \rightarrow q) \wedge (q \rightarrow p)$

$\cong (\sim p \vee q) \wedge (\sim q \vee p)$

$\therefore \sim (p \leftrightarrow q) \cong \sim (\sim p \vee q) \vee \sim (\sim q \vee p)$

$\cong (p \wedge \sim q) \vee (q \wedge \sim p)$

125 **(b)**

The inverse of $(p \wedge \sim q) \rightarrow r$ is

$\sim (p \wedge \sim q) \rightarrow \sim r$

$\Rightarrow (\sim p \vee q) \rightarrow \sim r$

129 **(a)**

$\because$ Switches x and y' are connected parallel which is denoted by $(x \wedge y')$

Similarly, y and $z'$and z and x' are also connected parallel

Which are denoted by $(y \wedge z')$ and $(z \wedge x')$ respectively

Now, $x \wedge y', y \wedge z'$ and $z \wedge x'$ are connected in series. So, switching function of given network is

$(x \wedge y') \vee (y \wedge z') \vee (z \wedge x')$

130 **(d)**

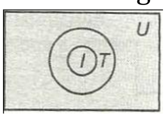
$S(p,q,r) = (\sim p) \vee [\sim (q \wedge r)]$

$= (\sim p) \vee [\sim q \vee \sim r]$

$\Rightarrow S(\sim p, \sim q, \sim r) = p \vee (q \vee r)$

131 **(b)**

Some triangles are not isosceles



136 **(c)**

q	p	$q \rightarrow p$	$p \rightarrow (q \rightarrow p)$	$p \vee q$	$p \rightarrow (p \vee q)$
T	T	T	T	T	T
T	F	F	T	T	T
F	T	T	T	T	T
F	F	T	T	F	T

$\therefore$ Statement $p \rightarrow (q \rightarrow p)$ is equivalent to $p \rightarrow (p \vee q)$.

138 **(a)**

$\because p$: A man is happy

and q: A man is rich

'If a man is not happy, then he is not rich' is written as $\sim p \rightarrow \sim q$

140 **(a)**

p	q	$p \vee q$	$\sim p$	$(p \vee q) \vee \sim p$
T	T	T	F	T
T	F	T	F	T
F	T	T	T	T
F	F	F	T	T

It is clear that $(p \vee q) \vee \sim p$ is a tautology.

141 **(b)**

$(p \wedge q) \wedge (q \wedge r)$ is true

$\Rightarrow p \wedge q$ and $q \wedge r$ are true

$\Rightarrow$ (p and q are true) and (q and r are true)

$\Rightarrow p, q$ and r are true

142 **(a)**

Clearly, $p \leftrightarrow q$