Answer all questions. Write answers in a separate booklet.

When you have eliminated the impossible, whatever remains, however improbable must be the truth. *The Sign of Four.*

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[30] Answer the following question while choosing the appropriate option mentioned below. Each Question carries 2 Marks. Multiple answers are possible. There is no negative marking.

1. A proposition or statement is a sentence which is either true or false. If a proposition is true, then we say its truth value is true, and if a proposition is false, we say its truth value is false. *Which of the following are considered to be propositions?*
   
   A. The sun is shining.
   B. Lucknow is the capital of Uttar Pradesh.
   C. The sum of two prime numbers is even.
   D. 7 + 5 = 12
   E. Dirty Cockroach!!
   F. Is it raining?
   G. Come to class!

2. The correct parenthesis of a given well formed formula $p \rightarrow q \land \neg r \iff s \lor t$ is:
   
   A. $[(p \rightarrow q) \land \neg r)] \iff (s \lor t)]$
   B. $[(p \rightarrow (q \land \neg r)) \iff (s \lor t)]$
   C. $[(p \rightarrow q) \land \neg r) \iff s) \lor t)]$
   D. $[(p \rightarrow (q \land \neg r)) \iff s) \lor t)]$
   E. None of the above

3. Which of the following propositions is tautology?
   
   A. $(p \lor q) \iff q$
   B. $p \land (q \rightarrow p)$
   C. $p \rightarrow (q \rightarrow p)$
   D. $p \lor (p \rightarrow q)$
   E. None of the above
4. Which of the proposition is $p \land (\neg p \lor q)$ is
   A. tautology
   B. A contradiction
   C. Logically equivalent to $p \land q$
   D. All of above
   E. None of the above

5. Which of the the following well formed formulas are valid?
   A. $[p \land (p \rightarrow \neg q)] \rightarrow q$
   B. $p \rightarrow q, r \rightarrow q \vdash (p \lor r) \rightarrow q$
   C. $p \rightarrow (q \land r), \neg r \vdash \neg p$
   D. $(p \leftrightarrow (q \rightarrow r)) \leftrightarrow ((p \leftrightarrow q) \leftrightarrow r)$

6. Which of the following pairs are logically equivalent? Confirm your answer using truth tables or Semantic tableaux method:
   A. $\neg (\phi \rightarrow \psi)$ and $\phi \land \neg \psi$
   B. $\neg (\phi \leftrightarrow \psi)$ and $\neg \phi \leftrightarrow \neg \psi$
   C. $\neg (\phi \leftrightarrow \psi)$ and $\neg \phi \leftrightarrow \psi$
   D. None of the above

7. What can be inferred from the following statements: No interesting poems are unpopular among people of real taste. No modern poetry is free from affectation. All your poems are on the subject of soap-bubbles. No affected poetry is popular among people of real taste. No ancient poem is on the subject of soap bubbles.
   A. your poems are interesting
   B. your poems are uninteresting.
   C. Your poems are not popular among the people of real taste.
   D. Your poems are not affected.
   E. none of the above

8. Four Machines, A B, C, D, are connected on a computer network. It is feared that a serious computer virus may have affected the network. Your Security team makes the following statements:
   If D is infected then so is A.
   If C is infected, then so is A.
   If D is clean, then B is clean but C is infected.
   If A is infected, then either B is infected or C is clean.

   Assuming that these statements are all true, what can you conclude?
   A. $\neg A \land D \land \neg C \land B$
   B. $\neg A \land \neg D \land \neg C \land B$
9. In an Iceland three are inhabitants, A, B and C, each of whom is a knight or a knave. Two people are said to be of the same type if they are both knights or both knaves. A and B make the following statements: A: B is a knave. B: A and C are of the same type.

What is C?

A. A is knight B is knave and C is Knight.
B. A is knight B is knave and C is Knave.
C. A is knave B is knave and C is Knight.
D. It cannot be determined.

10. The king of a far away land decided on the perfect way to try his prisoners. The prisoner would have to choose between two rooms, one of which contains a great banquet and the other of which contains a tiger. If he chooses the former, he gets to dine at the banquet, and is let free; if he chooses the latter, the tiger gets to dine on him! The king designed this ordeal as a test. The king put signs on the doors of the rooms, but the signs posed a puzzle. If the prisoner reasoned logically, he could figure out which room to choose, saving his life, and giving him a great banquet, too! If you were the prisoner, which door would you open (assuming, of course, that you prefer eating to being eaten)?

The king brought the first prisoner to the two doors and said said One of these signs is true, but the other is false.

1. Door 1: This room has the banquet, and the other room has the tiger.
2. Door 2: One of these two rooms has the banquet, and the other room has the tiger.

Which of the following door contains banquet?

A. Door 1
B. Door 2
C. Both the doors
D. None of the above