Mathematical Reasoning

1. **Statement-1 :** ~ $(p \leftrightarrow \sim q)$ is equivalent to $p \leftrightarrow q$.

   Statement-2 : ~ $(p \leftrightarrow \sim q)$ is a tautology. **[AIEEE-2009]**

   (1) Statement-1 is true, Statement-2 is true; Statement-2 is ***not*** a correct explanation for Statement-1

   (2) Statement-1 is true, Statement-2 is false

   (3) Statement-1 is false, Statement-2 is true

   (4) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1

2. 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? **[AIEEE-2010]**

   (1) There is a rational number $x \in S$ such that $x \leq 0$

   (2) There is no rational number $x \in S$ such that $x \leq 0$

   (3) Every rational number $x \in S$ satisfies $x \leq 0$

   (4) $x \in S$ and $x \leq 0 \Rightarrow x$ is not rational

3. The only statement among the followings that is a tautology is **[AIEEE-2011]**

   (1) $[A \wedge (A \rightarrow B)] \rightarrow B$

   (2) $B \rightarrow [A \wedge (A \rightarrow B)]$

   (3) $A \wedge (A \vee B)$

   (4) $A \vee (A \wedge B)$

4. The negation of the statement

   "If I become a teacher, then I will open a school", is **[AIEEE-2012]**

   (1) Either I will not become a teacher or I will not open a school

   (2) Neither I will become a teacher nor I will open a school

   (3) I will not become a teacher or I will open a school

   (4) I will become a teacher and I will not open a school

5. Consider :

   Statement - I : $(p \wedge \sim q) \wedge (\sim p \wedge q)$ is a fallacy.

   Statement - II : $(p \rightarrow q) \leftrightarrow (\sim q \rightarrow \sim p)$ is a tautology. **[JEE (Main)-2013]**

   (1) Statement - I is true; Statement-II is true; Statement - II is a correct explanation for Statement - I.

   (2) Statement - I is true; Statement - II is true; Statement-II is **not** a correct explanation for Statement-I.

   (3) Statement-I is true; Statement - II is false.

   (4) Statement - I is false; Statement - II is true.

6. The statement ~$(p \leftrightarrow \sim q)$ is **[JEE (Main)-2014]**

   (1) A tautology

   (2) A fallacy

   (3) Equivalent to $p \leftrightarrow q$

   (4) Equivalent to ~ $p \leftrightarrow q$

7. The negation of ~ $s \vee (\sim r \wedge s)$ is equivalent to **[JEE (Main)-2015]**

   (1) $s \wedge \sim r$ (2) $s \wedge (r \wedge \sim s)$

   (3) $s \vee (r \vee \sim s)$ (4) $s \wedge r$

8. The Boolean expression $(p \wedge \sim q) \vee q \vee (\sim p \wedge q)$ is equivalent to : **[JEE (Main)-2016]**

   (1) $p \wedge q$ (2) $p \vee q$

   (3) $p \vee \sim q$ (4) $\sim p \wedge q$

9. The following statement $(p \rightarrow q) \rightarrow [(\sim p \rightarrow q) \rightarrow q]$ is **[JEE (Main)-2017]**

   (1) Equivalent to ~ $p \rightarrow q$

   (2) Equivalent to $p \rightarrow \sim q$

   (3) A fallacy

   (4) A tautology

10. The Boolean expression $\sim(p \vee q) \vee (\sim p \wedge q)$ is equivalent to **[JEE (Main)-2018]**

(1) ~p (2) p

(3) q (4) $\sim q$

11. If the Boolean expression

$(p \oplus q) \wedge (\sim p \odot q)$ is equivalent to

$p \wedge q$, where $\oplus$, $\odot \in \{\wedge, \vee\}$, then the ordered pair $(\oplus, \odot)$ is **[JEE (Main)-2019]**

(1) $(\vee, \wedge)$ (2) $(\vee, \vee)$

(3) $(\wedge, \wedge)$ (4) $(\wedge, \vee)$

12. The logical statement

$[\sim (\sim p \vee q) \vee (p \wedge r)] \wedge (\sim q \wedge r)$ is equivalent to **[JEE (Main)-2019]**

(1) $(p \wedge r) \wedge \sim q$ (2) $(p \wedge \sim q) \vee r$

(3) $(\sim p \wedge \sim q) \wedge r$ (4) $\sim p \vee r$

13. Consider the following three statements

P : 5 is a prime number.

Q : 7 is a factor of 192.

R : L.C.M. of 5 and 7 is 35.

Then the truth value of which one of the following statements is true? **[JEE (Main)-2019]**

(1) $(\sim P) \wedge (\sim Q \wedge R)$

(2) $(\sim P) \vee (Q \wedge R)$

(3) $P \vee (\sim Q \wedge R)$

(4) $(P \wedge Q) \vee (\sim R)$

14. If q is false and $p \wedge q \leftrightarrow r$ is true, then which one of the following statements is a tautology? **[JEE (Main)-2019]**

(1) $p \vee r$ (2) $(p \wedge r) \rightarrow (p \vee r)$

(3) $(p \vee r) \rightarrow (p \wedge r)$ (4) p ∧ r

15. Contrapositive of the statement

"If two numbers are not equal, then their squares are not equal." is **[JEE (Main)-2019]**

(1) If the squares of two numbers are equal, then the numbers are equal

(2) If the squares of two numbers are not equal, then the numbers are equal

(3) If the squares of two numbers are equal, then the numbers are not equal

(4) If the squares of two numbers are not equal, then the numbers are not equal

16. The Boolean expression $((p \wedge q) \vee (p \vee \sim q)) \wedge (\sim p \wedge \sim q)$ is equivalent to **[JEE (Main)-2019]**

(1) $p \wedge q$ (2) $(\sim p) \wedge (\sim q)$

(3) $p \wedge (\sim q)$ (4) $p \vee (\sim q)$

17. The expression $\sim(\sim p \rightarrow q)$ is logically equivalent to **[JEE (Main)-2019]**

(1) $p \wedge q$ (2) $p \wedge \sim q$

(3) $\sim p \wedge \sim q$ (4) $\sim p \wedge q$

18. The contrapositive of the statement "If you are born in India, then you are a citizen of India", is:

[JEE (Main)-2019]

(1) If you are born in India, then you are not a citizen of India.

(2) If you are not born in India, then you are not a citizen of India.

(3) If you are a citizen of India, then you are born in India.

(4) If you are not a citizen of India, then you are not born in India.

19. Which one of the following statements is not a tautology? **[JEE (Main)-2019]**

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

(2) $(p \wedge q) \rightarrow p$

(3) $(p \vee q) \rightarrow (p \vee (\sim q))$

(4) $p \rightarrow (p \vee q)$

20. For any two statements p and q, the negation of the expression $p \vee (\sim p \wedge q)$ is **[JEE (Main)-2019]**

(1) $\sim p \wedge \sim q$ (2) $\sim p \vee \sim q$

(3) $p \wedge q$ (4) $p \leftrightarrow q$

21. If $p \Rightarrow (q \vee r)$ is false, then truth values of p, q, r are respectively **[JEE (Main)-2019]**

(1) T, F, F (2) F, F, F

(3) T, T, F (4) F, T, T

22. Which one of the following Boolean expressions is a tautology? **[JEE (Main)-2019]**

(1) $(p \vee q) \vee (p \vee \sim q)$ (2) $(p \wedge q) \vee (p \wedge \sim q)$

(3) $(p \vee q) \wedge (p \vee \sim q)$ (4) $(p \vee q) \wedge (\sim p \vee \sim q)$

23. The negation of the Boolean expression $\sim s \vee (\sim r \wedge s)$ is equivalent to **[JEE (Main)-2019]**

(1) $s \wedge r$ (2) r

(3) $\sim s \wedge \sim r$ (4) s ∨ r

24. If the truth value of the statement $p \to (\sim q \vee r)$ is false (F), then the truth values of the statements p, q, r are respectively **[JEE (Main)-2019]**

(1) F, T, T (2) T, T, F

(3) T, F, F (4) T, F, T

25. The Boolean expression $\sim(p \Rightarrow (\sim q))$ is equivalent to **[JEE (Main)-2019]**

(1) $(\sim p) \Rightarrow q$ (2) $p \vee q$

(3) $p \wedge q$ (4) $q \Rightarrow \sim p$

26. The logical statement $(p \Rightarrow q) \wedge (q \Rightarrow \sim p)$ is equivalent to **[JEE (Main)-2020]**

(1) $\sim q$ (2) p

(3) q (4) $\sim p$

27. Which one of the following is a tautology?

(1) $Q \to (P \wedge (P \to Q))$ **[JEE (Main)-2020]**

(2) $P \vee (P \wedge Q)$

(3) $P \wedge (P \vee Q)$

(4) $(P \wedge (P \to Q)) \to Q$

28. Which of the following statements is a tautology? **[JEE (Main)-2020]**

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

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

(3) $\sim(p \vee \sim q) \to p \vee q$

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

29. Negation of the statement :

'$\sqrt{5}$ is an integer or 5 is irrational' is **[JEE (Main)-2020]**

(1) $\sqrt{5}$ is not an integer and 5 is not irrational

(2) $\sqrt{5}$ is an integer and 5 is irrational

(3) $\sqrt{5}$ is not an integer or 5 is not irrational

(4) $\sqrt{5}$ is irrational or 5 is an integer

30. If $p \to (p \wedge \sim q)$ is false, then the truth values of p and q are respectively **[JEE (Main)-2020]**

(1) T, T (2) F, F

(3) T, F (4) F, T

31. The contrapositive of the statement "If *I* reach the station in time, then *I* will catch the train" is **[JEE (Main)-2020]**

(1) If *I* will catch the train, then *I* reach the station in time

(2) If *I* do not reach the station in time, then *I* will catch the train

(3) If *I* do not reach the station in time, then *I* will not catch the train

(4) If *I* will not catch the train, then *I* do not reach the station in time

32. Which of the following is a tautology? **[JEE (Main)-2020]**

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

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

(3) $(p \to q) \wedge (q \to p)$

(4) $(q \to p) \vee \sim(p \to q)$

33. The proposition $p \to \sim(p \wedge \sim q)$ is equivalent to **[JEE (Main)-2020]**

(1) q (2) $(\sim p) \wedge q$

(3) $(\sim p) \vee (\sim q)$ (4) $(\sim p) \vee q$

34. Let p, q, r be three statements such that the truth value of $(p \wedge q) \to (\sim q \vee r)$ is F. Then the truth values of p, q, r are respectively **[JEE (Main)-2020]**

(1) T, F, T (2) F, T, F

(3) T, T, T (4) T, T, F

35. Given the following two statements **[JEE (Main)-2020]**

(S_1) : $(q \vee p) \to (p \leftrightarrow \sim q)$ is a tautology :

(S_2) : $\sim q \wedge (\sim p \leftrightarrow q)$ is a fallacy. Then :

(1) only (S_1) is correct.

(2) both (S_1) and (S_2) are correct.

(3) only (S_2) is correct.

(4) both (S_1) and (S_2) are not correct.

36. Contrapositive of the statement **[JEE (Main)-2020]**

'If a function *f* is differentiable at *a*, then it is also continuous at *a*', is

(1) If a function *f* is continuous at *a*, then it is differentiable at *a*.

(2) If a function *f* is not continuous at *a*, then it is not differentiable at *a*.

(3) If a function *f* is not continuous at *a*, then it is differentiable at *a*.

(4) If a function *f* is continuous at *a*, then it is not differentiable at *a*.

37. The negation of the Boolean expression $x \leftrightarrow \sim y$ is equivalent to **[JEE (Main)-2020]**

(1) $(x \wedge \sim y) \vee (\sim x \wedge y)$

(2) $(x \wedge y) \vee (\sim x \wedge \sim y)$

(3) $(x \wedge y) \wedge (\sim x \vee \sim y)$

(4) $(\sim x \wedge y) \vee (\sim x \wedge \sim y)$

38. The statement $(p \rightarrow (q \rightarrow p)) \rightarrow (p \rightarrow (p \vee q))$ is **[JEE (Main)-2020]**

(1) A tautology

(2) Equivalent to $(p \vee q) \wedge (\sim p)$

(3) A contradiction

(4) Equivalent to $(p \wedge q) \vee (\sim q)$

39. The negation of the Boolean expression $p \vee (\sim p \wedge q)$ is equivalent to **[JEE (Main)-2020]**

(1) $\sim p \vee q$ (2) $p \wedge \sim q$

(3) $\sim p \vee \sim q$ (4) $\sim p \wedge \sim q$

40. Consider the statement : ''For an integer n, if $n^3 - 1$ is even, then n is odd.'' The contrapositive statement of this statement is **[JEE (Main)-2020]**

(1) For an integer n, if n is odd, then $n^3 - 1$ is even

(2) For an integer n, if n is even, then $n^3 - 1$ is even.

(3) For an integer n, if n is even, then $n^3 - 1$ is odd.

(4) For an integer n, if $n^3 - 1$ is not even, then n is not odd.

❑ ❑ ❑