



8. The contrapositive of the statement "If you are born in India, then you are a citizen of India", is :
- (1) If you are born in India, then you are not a citizen of India.  
 (2) If you are not a citizen of India, then you are not born in India.  
 (3) If you are a citizen of India, then you are born in India.  
 (4) If you are not born in India, then you are not a citizen of India.
9. Which one of the following statements is not a tautology ?
- (1)  $(p \wedge q) \rightarrow p$   
 (2)  $(p \wedge q) \rightarrow (\sim p) \vee q$   
 (3)  $p \rightarrow (p \vee q)$   
 (4)  $(p \vee q) \rightarrow (p \vee (\sim q))$
10. For any two statements p and q, the negation of the expression  $p \vee (\sim p \wedge q)$  is
- (1)  $p \wedge q$                       (2)  $p \leftrightarrow q$   
 (3)  $\sim p \vee \sim q$                 (4)  $\sim p \wedge \sim q$
11. If  $P \Rightarrow (q \vee r)$  is false, then the truth values of p, q, r are respectively :-
- (1) F, T, T                      (2) T, F, F  
 (3) T, T, F                      (4) F, F, F
12. Which one of the following Boolean expressions is a tautology ?
- (1)  $(P \vee q) \wedge (\sim p \vee \sim q)$   
 (2)  $(P \wedge q) \vee (p \wedge \sim q)$   
 (3)  $(P \vee q) \wedge (p \vee \sim q)$   
 (4)  $(P \vee q) \vee (p \vee \sim q)$
13. The negation of the boolean expression  $\sim s \vee (\sim r \wedge s)$  is equivalent to :
- (1) r                                (2)  $s \wedge r$   
 (3)  $s \vee r$                       (4)  $\sim s \wedge \sim r$
14. If the truth value of the statement  $P \rightarrow (\sim p \vee r)$  is false(F), then the truth values of the statements p, q, r are respectively :
- (1) F, T, T  
 (2) T, F, F  
 (3) T, T, F  
 (4) T, F, T
15. The Boolean expression  $\sim(p \Rightarrow (\sim q))$  is equivalent to :
- (1)  $(\sim p) \Rightarrow q$                 (2)  $p \vee q$   
 (3)  $q \Rightarrow \sim p$                     (4)  $p \wedge q$

SOLUTION

1. **Ans. (1)**

$$(p \oplus q) \wedge (\sim p \odot q) \equiv p \wedge q \text{ (given)}$$

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

from truth table  $(\oplus, \odot) = (\wedge, \vee)$

2. **Ans. (1)**

$$s[\sim(\sim p \vee q) \wedge (p \wedge r)] \wedge (\sim q \wedge r)$$

$$\equiv [(p \wedge \sim q) \vee (p \wedge r)] \wedge (\sim q \wedge r)$$

$$\equiv [p \wedge (\sim q \vee r)] \wedge (\sim q \wedge r)$$

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

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

3. **Ans. (4)**

It is obvious

$\therefore$  Option (4)

4. **Ans. (4)**

Given q is F and  $(p \wedge q) \leftrightarrow r$  is T

$\Rightarrow p \wedge q$  is F which implies that r is F

$\Rightarrow q$  is F and r is F

$\Rightarrow (p \wedge r)$  is always F

$\Rightarrow (p \wedge r) \rightarrow (p \vee r)$  is tautology.

5. **Ans. (1)**

Contrapositive of  $p \rightarrow q$  is  $\sim q \rightarrow \sim p$

6. **Ans. (3)**

7. **Ans. (1)**

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

8. **Official Ans. by NTA (2)**

**Sol.** The contrapositive of statement

$$p \rightarrow q \text{ is } \sim q \rightarrow \sim p$$

Here, p : you are born in India.

q : you are citizen of India.

So, contrapositive of above statement is

"If you are not a citizen of India, then you are not born in India".

9. **Official Ans. by NTA (4)**

**Sol.** Tautology

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

Tautology

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

Tautology

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

Tautology

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

**10. Official Ans. by NTA (4)**

$$\begin{aligned}
 \text{Sol. } & \sim(p \vee (\sim p \wedge q)) \\
 & = \sim p \wedge \sim(\sim p \wedge q) \\
 & = \sim p \wedge (p \vee \sim q) \\
 & = (\sim p \wedge p) \vee (\sim p \wedge \sim q) \\
 & = c \vee (\sim p \wedge \sim q) \\
 & = (\sim p \wedge \sim q)
 \end{aligned}$$

**11. Official Ans. by NTA (2)**

$$\begin{aligned}
 \text{Sol. } & P \Rightarrow (q \vee r) : F \\
 & P : T \quad q \vee r : F \\
 & P : T : q : F : r : F
 \end{aligned}$$

**12. Official Ans. by NTA (4)**

$$\begin{aligned}
 \text{Sol. } & (1) (p \vee q) \wedge (\sim p \vee \sim q) \equiv (p \vee q) \wedge \sim(p \wedge q) \\
 & \rightarrow \text{Not tautology (Take both } p \text{ and } q \text{ as T)} \\
 & (2) (p \wedge q) \vee (p \wedge \sim q) \equiv p \wedge (q \vee \sim q) \equiv p \wedge t \equiv p \\
 & (3) (p \vee q) \wedge (p \vee \sim q) \equiv p \vee (q \wedge \sim q) \equiv p \vee c \equiv p \\
 & (4) (p \vee q) \vee (p \vee \sim q) \equiv p \vee (q \vee \sim q) \equiv p \vee t \equiv t
 \end{aligned}$$

**13. Official Ans. by NTA (2)**

$$\begin{aligned}
 \text{Sol. } & \sim(\sim s \vee (\sim r \wedge s)) \\
 & s \wedge (r \vee \sim s) \\
 & (s \wedge r) \vee (s \wedge \sim s) \\
 & (s \wedge r) \vee (c) \\
 & (s \wedge r)
 \end{aligned}$$

**14. Official Ans. by NTA (3)**

$$\begin{aligned}
 \text{Sol. } & P \rightarrow (\sim q \vee r) \\
 & \sim p \vee (\sim q \vee r) \\
 & \left. \begin{array}{l} \sim p \rightarrow F \\ \sim q \rightarrow F \\ r \rightarrow F \end{array} \right\} \Rightarrow \left. \begin{array}{l} p \rightarrow T \\ q \rightarrow T \\ r \rightarrow F \end{array} \right\}
 \end{aligned}$$

**15. Official Ans. by NTA (4)**

$$\begin{aligned}
 \text{Sol. } & \sim(p \rightarrow (\sim q)) \equiv \sim(\sim p \vee \sim q) \\
 & = p \wedge q
 \end{aligned}$$