Logic **Marks: 60**

ANSWER KEY

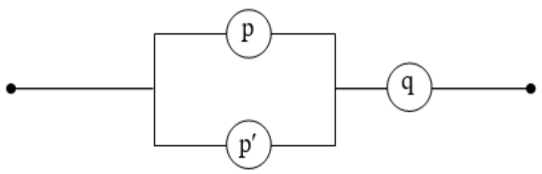
Maths

Q.1 B	Q.2 A	Q.3 A	Q.4 B	Q.5 B	Q.6 A	Q.7 A	Q.8 B
Q.9 B	Q.10 C	Q.11 C	Q.12 D	Q.13 A	Q.14 B	Q.15 B	Q.16 B
Q.17 D	Q.18 A	Q.19 B	Q.20 A	Q.21 B	Q.22 B	Q.23 C	Q.24 A
Q.25 A	Q.26 A	Q.27 B	Q.28 D	Q.29 B	Q.30 B		

SOLUTION

Maths

Q.1 Simplified logical expression for the following switching circuit is



Correct option: (B)

The symbolic form of the given circuit is

(p ∨ ~p) ∧ q ≡ T ∧ q …[Complement law]

≡ q …[Identity law]

Q.2 Let p : Boys are playing
q : Boys are happy
the equivalent form of compound statement ~ p ∨ q is

Correct option: (A)

~ p : Boys are not playing

~p ∨ q : Boys are not playing or they are happy.

Q.3 If (p ∧ ~ q) → (~ p ∨ r) is a false statement, then respective truth values of p, q and r are

Correct option: (A)

Since (p ∧ ~ q) → (~ p ∨ r) ≡ F

⇒ p ∧ ~ q ≡ T and ~ p ∨ r ≡ F

⇒ p ≡ T, ~ q ≡ T and ~ p ≡ F, r ≡ F

⇒ p ≡ T, q ≡ F, r ≡ F

∴ The truth values of p, q and r are T, F, F respectively.

Q.4 Negation of the statement 'A is rich but silly' is

Correct option: (B)

Let p : A is rich, q : A is silly

∴ ~(p ∧ q) ≡ ~p ∨ ~q

Q.5 Negation of (~p → q) is

Correct option: (B)

Since ~(p → q) ≡ p ∧ ~q,

~(~p → q) ≡ ~p ∧ ~q

Q.6 The logical statement (p → q) ∧ (q → ~p) is equivalent to

Correct option: (A)

(p → q) ∧ (q → ~p)

≡ (~p ∨ q) ∧ (~q ∨ ~p) …[Conditional law]

≡ (~p) ∨ (q ∧ ~q) …[Distributive law]

≡ (~p) ∨ F …[Complement law]

≡ ~p …[Identity law]

Q.7 Using quantifier the open sentence '$x^2 > 0$' defined on N is converted into true statement as

Correct option: (A)

Option [A] is the true statement, since square of every natural number is positive.

Q.8 The statement "If x^2 is not even then x is not even", is the converse of the statement

Correct option: (B)

Let p : x^2 is not even,

q : x is not even

Converse of p → q is q → p

i.e., If x is not even then x^2 is not even

Q.9 The dual of the statement pattern, "Tirupati is not in Andhra Pradesh and $\sqrt{2}$ is not a rational number" is _______

Correct option: (B)

The dual of the statement is obtained by interchanging "and" with "or" and "or" with "and".

The dual of the given statement is as follows:

Tirupati is not in Andhra Pradesh or $\sqrt{2}$ is not a rational number.

Q.10 Negation of the statement : 3 + 6 > 8 and 2 + 3 < 6

Correct option: (C)

Let p : 3 + 6 > 8,

q : 2 + 3 < 6

The symbolic form of given statement is p ∧ q.

∴ ~(p ∧ q) ≡ ~p ∨ ~q

i.e., 3 + 6 ≤ 8 or 2 + 3 ≥ 6

Q.11 Contrapositive of the statement 'If two numbers are not equal, then their squares are not equal', is

Correct option: (C)

Let p : two numbers are not equal.

q : squares of two numbers are not equal.

Given statement is p → q.

∴ Contrapositive is ~q → ~p.

i.e., If squares of two numbers are equal, then the numbers are equal.

Q.12 The logical expression [p ∧ (q ∨ r)] ∨ [~r ∧ ~q ∧ p] is equivalent to

Correct option: (D)

[p ∧ (q ∨ r)] ∨ [~r ∧ ~q ∧ p]

≡ [p ∧ (q ∨ r)] ∨ [p ∧ (~q ∧ ~r)] …[Associative law]

≡ [p ∧ (q ∨ r)] ∨ [p ∧ ~(q ∨ r)] …[De Morgan's law]

≡ p ∧ [(q ∨ r) ∨ ~(q ∨ r)] …[Distributive law]

≡ p ∧ T …[Complement law]

≡ p …[Identity law]

Q.13 The converse of 'If *x* is zero, then we cannot divide by *x*' is

Correct option: (A)

Let p : *x* is zero and

q : We cannot divide by *x*

Symbolic form is p → q

The converse of p → q is q → p

i.e., If we cannot divide by *x*, then *x* is zero.

Q.14 The negation of the statement: "Getting above 95% marks is necessary condition for Hema to get admission in good college" is

Correct option: (B)

p: Hema gets admission in good college.

q: Hema gets above 95% marks.

∴ Statement is p → q

~ (p → q) ≡ p ∧ ~ q

Q.15 If p : Seema is fat.
q : She is happy,
then the logical equivalent statement of 'If Seema is fat, then she is happy' is

Correct option: (B)

Given statement is p → q

We know that p → q ≡ ~p ∨ q

∴ Required equivalent statement is "Seema is not fat or she is happy"

Q.16 The statement pattern p ∧ (~ p ∧ q) is

Correct option: (B)

p ∧ (~ p ∧ q)

≡ (p ∧ ~ p) ∧ q …[Associative law]

≡ F ∧ q …[Complement law]

≡ F …[Identity law]

∴ p ∧ (~p ∧ q) is a contradiction.

Q.17 The statement pattern (p ∧ q) ∧ [~r ∨ (p ∧ q)] ∨ (~p ∧ q) is equivalent to

Correct option: (D)

{(p ∧ q) ∧ [~r ∨ (p ∧ q)]} ∨ (~p ∧ q)

≡ (p ∧ q) ∨ (~p ∧ q) …[Absorbtion law]

≡ (p ∨ ~p) ∧ q …[Distributive law]

≡ T ∧ q …[Complement law]

≡ q …[Identity law]

Q.18 ~ (p ↔ q) is equivalent to

Correct option: (A)

We know that,

p ↔ q ≡ (p → q) ∧ (q → p)

∴ ~ (p ↔ q) ≡ ~ [(p → q) ∧ (q → p)]

≡ ~ (p → q) ∨ ~ (q → p) …[By Demorgan's Law]

≡ (p ∧ ~q) ∨ (q ∧ ~p) …[∵ ~ (p → q) ≡ p ∧ ~q]

Q.19 The inverse of the proposition (p ∧ ~q) → r is

Correct option: (B)

The inverse of p → q is ~p → ~q

∴ The inverse of (p ∧ ~q) → r is ~(p ∧ ~q) → ~r

≡ [~p ∨ ~(~q)] → ~r

≡ (~p ∨ q) → ~r

Q.20 The negation of p ∨ (~ q ∧ ~ p) is

Correct option: (A)

~ [p ∨ (~ q ∧ ~ p)]

≡ ~ p ∧ ~ (~ q ∧ ~ p) …[De Morgan's law]

≡ ~ p ∧ [~ (~ q) ∨ ~ (~ p)]

≡ ~ p ∧ (q ∨ p)

≡ (~ p ∧ q) ∨ (~ p ∧ p) …[Distributive law]

≡ (~ p ∧ q) ∨ F …[Complement law]

≡ ~ p ∧ q …[Identity law]

Q.21 The only quantified statement among the following which is false, is _______

Correct option: (B)

The statement "For every prime number x, $\sqrt{x}$ is rational number" is false because square root of every prime number is irrational.

Q.22 Which of the following is an incorrect statement in logic ?

Correct option: (B)

‘Incorrect statement’ means a statement in logic with truth value false.
Options [A] and [C] are not statements in logic.
Option [D] has truth value True.
Option [B] is a statement in logic with truth value false.

Q.23 Assuming the first part of each statement as p, second as q and the third as r, the statement ‘If A, B, C are three distinct points, then either they are collinear or they form a triangle’ in symbolic form is

Correct option: (C)

p: A, B,C, are distinct points
q: Points are collinear
r: Points form a triangle
$\therefore$ p implies (q or r), i.e., $p \to (q \vee r)$

Q.24 Let a : $\sim(p \wedge \sim r) \vee (\sim q \vee s)$ and b : $(p \vee s) \leftrightarrow (q \wedge r)$.
If the truth values of p and q are true and that of r and s are false, then the truth values of a and b are respectively.

Correct option: (A)

a : $\sim(p \wedge \sim r) \vee (\sim q \vee s)$	b : $(p \vee s) \leftrightarrow (q \wedge r)$
$\equiv \sim(T \wedge \sim F) \vee (\sim T \vee F)$	$\equiv (T \vee F) \leftrightarrow (T \wedge F)$
$\equiv \sim(T \wedge T) \vee (F \vee F)$	$\equiv T \leftrightarrow F$
$\equiv \sim T \vee F$	$\equiv F$
$\equiv F \vee F$	
$\equiv F$	

Q.25 The expression $[(p \wedge \sim q) \vee q] \vee (\sim p \wedge q)$ is equivalent to

Correct option: (A)

$[(p \wedge \sim q) \vee q] \vee (\sim p \wedge q)$
$\equiv [(p \vee q) \wedge (\sim q \vee q) \vee (\sim p \wedge q)$ …[Distributive law]
$\equiv [(p \vee q) \wedge T] \vee (\sim p \wedge q)$ …[Complement law]
$\equiv (p \vee q) \vee (\sim p \wedge q)$ …[Identity law]
$\equiv [p \vee (\sim p \wedge q)] \vee [q \vee (\sim p \wedge q)]$ …[Distributive law]
$\equiv [(p \vee \sim p) \wedge (p \vee q)] \vee [q \vee (q \wedge \sim p)]$ …[Distributive law]
$\equiv (p \vee q) \vee (q)$ …[Absorption law]
$\equiv p \vee q$ …[Idempotent law]

Q.26 Truth values of $p \to r$ is F and $p \leftrightarrow q$ is F.
Then the truth values of $(\sim p \vee q) \to (p \vee \sim q)$ and $(p \wedge \sim q) \to (\sim p \wedge q)$ are respectively

Correct option: (A)

Truth values of $p \to r$ is F and $p \leftrightarrow q$ is F
$\therefore$ $p \equiv T, q \equiv F, r \equiv F$
$(\sim p \vee q) \to (p \vee \sim q)$
$\equiv (\sim T \vee F) \to (T \vee \sim F)$
$\equiv (F \vee F) \to (T \vee T)$
$\equiv F \to T$
$\equiv T$
$(p \wedge \sim q) \to (\sim p \wedge q)$
$\equiv (T \wedge \sim F) \to (\sim T \wedge F)$
$\equiv (T \wedge T) \to (F \wedge F)$
$\equiv T \to F$
$\equiv F$

Q.27 The proposition $(p \to \sim p) \wedge (\sim p \to p)$ is a

Correct option: (B)

$(p \to \sim p) \wedge (\sim p \to p)$
$\equiv (\sim p \vee \sim p) \wedge [\sim(\sim p) \vee p]$ …[$\because p \to q \equiv \sim p \vee q$]
$\equiv (\sim p \vee \sim p) \wedge (p \vee p)$ …[$\because \sim(\sim p) \equiv p$]
$\equiv \sim p \wedge p$ …[Idempotent law]
$\equiv F$ …[Complement law]
$\therefore$ $(p \to \sim p) \wedge (\sim p \to p)$ is a contradiction.

Q.28 The negation of ‘For every natural number *x*, *x* + 5 > 4’ is

Correct option: (D)

Given statement is ‘$\forall x \in N, x + 5 > 4$’

$\therefore \sim [\forall x \in N, x + 5 > 4]$

$\equiv \exists x \in N$, such that $x + 5 \le 4$

i.e., there exists a natural number *x*, for which $x + 5 \le 4$

Q.29 The negation of the statement: “Getting above 95% marks is necessary condition for Hema to get admission in good college” is

Correct option: (B)

p: Hema gets admission in good college.
q: Hema gets above 95% marks.

∴ Statement is $p \rightarrow q$

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

Q.30 The Boolean Expression $(p \wedge \sim q) \vee q \vee (\sim p \wedge q)$ is equivalent to:

Correct option: (B)

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

$\equiv [(p \vee q) \wedge (\sim q \vee q)] \vee (\sim p \wedge q)$ …[Distributive law]

$\equiv [(p \vee q) \wedge T] \vee (\sim p \wedge q)]$ …[Complement law]

$\equiv (p \vee q) \vee (\sim p \wedge q)$ …[Identity law]

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

$\equiv (T \vee q) \wedge (p \vee q)$ …[Idempotent law]

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

$\equiv p \vee q$